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The 8th International Conference on Knowledge Management in Organizations

Social and Big Data Computing for Knowledge Management

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Preface

Knowledge is increasingly recognised as the most important resource in organizations and a key differentiating factor in business today. It is increasingly being acknowledged that Knowledge Management (KM) can bring about the much needed innovation and improved business performance in organizations. The service sector now dominates the economies of the developed world. Knowledge management plays a crucial role in the development of sustainable competitive advantage through innovation in services. In recent years, social computing and big data are also becoming popular topics that extend the research to knowledge management. One of the goals of knowledge management is the ability to integrate information from multiple perspectives to provide the insights required for valid decision-making. Big data provides unique challenges and opportunities for achieving that goal.

The eighth KMO conference brings together researchers and developers from industry and the academic world to report on the latest scientific and technical advances on knowledge management in organizations. It aims to provide an international forum for authors to present and discuss research focused on the role of knowledge management for innovative services in industries, to shed light on recent advances in social and big data computing for KM as well as to identify future directions for researching the role of knowledge management in service innovation and how cloud computing can be used to address many of the issues currently facing KM in academia and industrial sectors.

The KMO proceedings consist of 50 papers covering different aspects of Knowledge Management including:

C1: Service and Innovation
C2: KM Practice and Case Study
C3: Information Technology and KM
C4: KM and Social Network
C5: KM in Business and Organization
C6: Knowledge Transfer, Sharing and Creation

Authors of the papers come from many different countries such as Australia, Austria, Brazil, Chile, China, Colombia, Finland, Hong Kong, Israel, Japan, Malaysia, Netherland, Oman, Singapore, Slovakia, Slovenia, South Africa, Spain, Taiwan, United Arab Emirates, UK and Vietnam.

We would like to thank our authors, reviewers and programme committee for their contributions and the National University of Kaohsiung for hosting the conference.

Without their efforts, there would be no conference or proceedings.

Kaohsiung, Taiwan, September 2013

Lorna Uden
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Service and Innovation

Chapter 1
Servitization of Business: An Exploratory Case Study of Customer Perspective

Zahir Ahamed, Akira Kamoshida and Takehiro Inohara

Abstract The concept of servitization 'adding value by adding services to products' was first introduced by Vandermerwe and Rada in 1988, which in later became a popular topic for researchers in the academia, business and government. Today, it is widely recognized as an increasingly relevant business strategy for manufacturing firms to improve their competitive advantage in the market. In many cases, the necessity or application of servitization concept explained by researchers from organization perspective, especially for developed economy, but they were less attentive to discuss the issue from customer viewpoint in developing economy. Therefore, this paper aims to examine the needs of servitization from customer perspectives, particularly the IT industry of emerging market 'Bangladesh'. The data was collected by the interviews of suppliers and customers in the IT industry of Bangladesh. The survey results showed that the current suppliers cannot satisfy the customer needs at this moment, because customers are not happy anymore with the IT goods only; they also require solutions, knowledge and reliability as well.

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1.1 Introduction

Servitization is defined as the strategic innovation of organization's capabilities and processes to shift from selling products to selling an integrated product and service offering that delivers value in use [1, 2]. The term 'servitization' has been explained in various forms by many authors such as 'service encapsulation' [3]; 'product-service systems' [4]; 'integrated solutions' [5]; product– service package' [6], and so on. They range from products with services as an "add-on", to services with tangible goods. They tend to be delivered using customer-centric strategies in order to provide "desired outcomes for the customer. According to Oliva and Kallenberg [7], customer orientation consists of two distinctive elements; first, a shift of the service offering from product-oriented service to "user's process oriented services", i.e., a shift from a focus on ensuring the proper functioning and/or customer's use of the product to pursuing efficiency and effectiveness of end-user's processes related to the product. Second, a shift of the nature of the customer interaction from transaction-based to relationship-based, i.e., a shift from selling products to establishing and maintaining a relationship with the customer. In other words, both a transfer from the old transaction-based mode of service to continuous connection with the customer and a shift towards process-oriented services for end-users in- stead of physical goods efficacy is required.

Servitization frequently occurs as a response to the financial difficulties, new customer demands and strategic product differentiation [7–9]. The concept of servitization very often discussed from organization viewpoint particularly for developed economies, where market is too competitive and companies can not gain their desired profit by selling goods only. But, there are not any significant discussions about this concept 'servitization as a value additions required by customers' in the developing economies' some industries, like as Information Technology (IT). In this article, we discussed the necessity of implementing servitization concept from customer perspective in Bangladesh IT market. In Bangladesh, the IT sector has started growing, particularly in the late 1990s, as a result of some favorable policies of the government, such as 100 % duty free of IT goods and services, tax exemption and financial support to the new entrepreneur, and so on. However, the big development of this sector has been observed since 2008 when the new government was elected and envisioned to create a "Digital Bangladesh" by 2021. Since then, the government rapidly increases the implementation of IT in various sectors, including e-governance. In line with the government vision, the private limited organizations, such as telecom, banking, garments, and so on have been implemented many large-scale automation projects, which increases IT Enabled Services (ITES) in the industry. In this context, services related to the hardware and non-hardware, i.e., service-ware realized very importance from customer perspective of Bangladesh IT industry. Thus, the objective of this study is to examine the current level of services provided by suppliers or/and sellers in the IT industry. It will also identify the necessity of servitization, i.e., services as a solution from customer perspective in Bangladesh IT market.

The paper is organized as follows. After the introduction, the servitization concept is explained from organization versus customer perspective in Sect. 2, followed by methodology used in this paper in Sect. 3. The background of the Bangladesh IT sector is provided in Sect. 4 with the analysis of current supply chain of goods and problems observed in this system. Section 5 discusses the existing level of services and desired customer needs. Discussion of the research out put is presented in Sect. 6. Finally, Sect. 7 concludes the paper with further research questions.

1.2 Servitization: Organization Versus Customer Perspective

1.2.1 Organization Perspective

Services are essential for the growth and competitiveness of manufacturing firms, as they can contribute to the increased demand and complement the sale or lease of tangible products [8]. Traditionally, competition between manufacturing firms has tended to focus on the goods themselves. A company gained customers or increased its sales because its goods were better than those of its competitors. But, today the competition is shifting to another level, i.e., the product-service-systems (PSS). Now the question may arise why manufacturers are going to transform it's business from not only producing goods to offering an integrated package of goods and services? It is observed that the manufacturing firms, especially high-tech industries are under massive pressure and realize the difficulties to achieve their desired profit from only selling goods, which forces them to respond by moving up value chain, seeking to innovate and create more sophisticated products and services so that they do not have to compete on the basis of cost alone [10]. Consequently, there are five key sets of factors that drive companies to pursue a servitization strategy; namely, financial, strategic, economic, marketing and environments.

- Financial Benefits: Services retain potentially higher margins than products [6, 11, 12], and generate substantial revenue from an installed base of products with a long life cycle [13, 14]. However it secures the company for regular income and balances the effects of mature markets and unfavorable economic cycles [15, 16].
- Strategic Advantages: Service addition helps the firm differentiate from competitors, aids the consolidation and protection of the core product businesses, and establishes intimate relationships with clients. Since services are more labor dependent and less visible rendering, and then more difficult to imitate, and hence a source of sustainable competitive advantage [7, 9, 17].
- Economic Pressure: Service roles in manufacturing sector are growing rapidly, as increased the share of services activities are necessary to produce goods

[18, 19]. Also, the de-industrialization and increasing international division of labor between manufacturing and services led to the declining shares of manufacturing in developed economies.
- Marketing Opportunities: Service component has great influence on purchasing decision and tend to induce repeat-sales, and by intensifying contact opportunities with the customer, can put the supplier in the right position to offer other products or services [16, 20].
- Environmental Rationale: Services make sure the use of resources more rationally and proper way [21].

Thus, by offering services, companies can gain insight into their customers' needs and are able to develop more tailored offerings which in long-run creates values for organizations.

1.2.2 Customer Perspective

Nowadays customers simply demand more and more services related to the products. They do not simply want to buy a computer or server; they also want solutions and guarantee that it works. They want ease of use, maintenance, repair, support, and knowledge how it works better. This section mainly discusses the necessity of these services from customers' perspective in the IT industry of Bangladesh. It is observed by the interview results that most of the customers just want more service and are no longer satisfied with the products alone. They want service that goes along with it, i.e., the service that addresses the underlying needs. More specifically, the customer's needs observed in this market are pre-sales services, such as consulting or/and configuration of systems, after sales services, i.e., maintenance and technical assessment, and knowledge or training for getting better performance, and finally quick response in any emergency case, like as systems fall. After interview and discussions with customers, it is clear that customers are not getting these services along with products that realize very importance for Bangladesh IT market. In this context, the application of servitization concept 'integration of goods and services offering from one space' can be one of the key strategic choices for product suppliers that can satisfy the current level of customers requirements and meet on demand market needs of Bangladesh IT industry. The following keys values can be derive by the implementation of servitization strategy in Bangladesh IT market that we identified from customer perspectives after analyzing market condition.

- Simplicity of the transaction and cost effective, which is the main concern of the customers' in Bangladesh market.
- Reducing transaction time and easy to get the desired services from one space.
- Increasing the reliability of goods and services and quick response in any emergency case.

Hence, the implementation of servitization strategy or increasing the level of product-service operations (PSS) is just on-demand market needs to satisfy the customers in Bangladesh IT industry.

1.3 Methodology

The methodology used in this paper was interviews and discussion with end users and suppliers of Bangladesh IT market. We conducted a total of 17 in-depth interviews, separated into two distinct phases. Each of the interviews lasted between 90 and 120 min, and was recorded and subsequently transcribed verbatim. The initial exploratory stage commenced in August 2012. This was composed of 7 semi-structured interviews across the selected IT goods suppliers and service engineers or/and systems integrators (SIer) in Bangladesh. The questions were asked to the respondents about the current process of supplying goods, services offering, difficulties face in supply chain system, and customer satisfaction or interaction level between suppliers and end users. The survey result shows that product suppliers or sellers cannot meet the customer needs due to the current business model or process, market condition, and infrastructure as well. The second phase of the research was composed of a further 10 semi-structured interviews carried out in December 2012. The interviewees in this phase included vice president of project management, IT engineers, IT administrators, systems engineers, and general infrastructure managers. The questions focused on the respondents' career background, current systems and services they use, problems they often face, and their desired level of services and solutions to the providers. The feedback from the interviewees' reveals that customers are not happy anymore with products only, they also want related services, such as consulting, maintenance and support, and training and knowledge services.

1.4 Bangladesh IT Market

Bangladesh is one of the next 11 emerging countries in the world, just after the BRICS [22]. The country has more than 160 million populations with GDP growth rate approximately 6.6 %, i.e., world's 5th position in fiscal year 2012 [23].

During the late 1990s, Bangladesh has seen an increasing growth of the IT industry. Initially, the favorable tax policy of the government of Bangladesh in 1998 accompanied by the global affordability of personal computers have had tremendous impact on the usage of computer. The favorable import tax policy on computers and computer accessories during that time was one of the timely steps taken by the government of Bangladesh. From then on, in accordance with the global trends, both private and public sectors in Bangladesh caught up with effective utilization of information technology. However, the big revolution of IT industry in Bangladesh has been observed in 2008 when the new government was

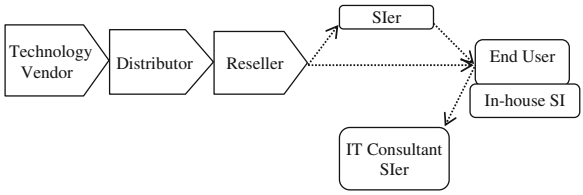

Fig. 1.1 Product supply chain system in Bangladesh IT market

elected and envisioned to create a "Digital Bangladesh" by 2021. In this context, with government IT supportive policies, many automation projects such as e-governance projects are implementing continuously that increases the demand for IT services in Bangladesh. Consequently, many large-scale automation projects have been implemented in telecom, banking, and garment/textile sectors and domestic demand for software and IT Enabled Services (ITES) increased rapidly. As a result, today the size of the IT market in Bangladesh, excluding telecom, is estimated to be around $3.2 billion [24–26], in which 61 % comprises by hardware, 29 % by software, and 10 % by ITES [27–29].

1.4.1 Current Supply Chain of IT Products

The IT industries of Bangladesh comprises distributors, dealers, resellers of computer and allied products, locally assembled computer vendors, software developers and exporters, internet service providers, ICT based educational institutions and training houses, ICT embedded services providers, and so on. In this section, we analyzed the current value chain of supplying goods in the IT industry of Bangladesh that we portrayed in Fig. 1.1 based on interview results of suppliers.

In Fig. 1.1, it is observed that the current products supply chain process takes many steps to reach the products on end user's hand, which shows many disadvantages and low values from customer perspective. For example, in the current supply chain system, the lead-time is very high, margin on margin in every step, and less reliability of goods and services. In addition to these, customers cannot get any other services related to the products except warranty in this process. Thus, customers want to reduce the transaction time and expect more valued goods and services from one space, such as consulting, training, maintenance services and so on. The next section, we identified the current level of services and customer needs in Bangladesh IT market based on the interview result of end users.

1.5 Identifying Service Level and Customer Needs

The level of services in Bangladesh IT market is observed very poor. The suppliers cannot provide any additional services along with products except warranty; even that does not work properly very often. An IT administrator comments that "when

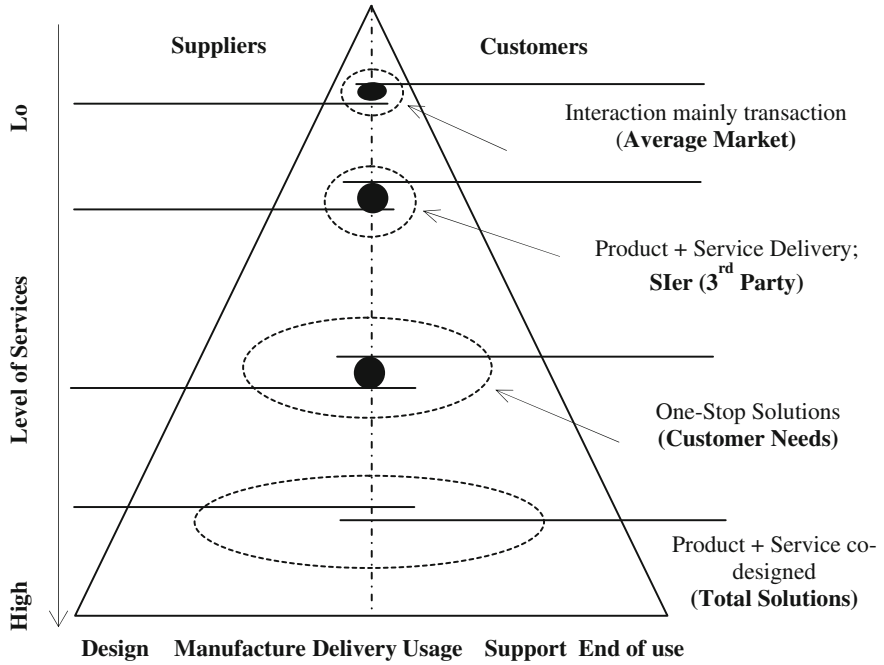

Fig. 1.2 Current level of services in Bangladesh IT market

we claim for any replacement of product, the supplier usually takes long time as it consists many parties in whole supply chain system, and sometimes they excuse as there is no availability of that model or goods anymore in the market". So, the customers are bound to buy the new one, which makes them dissatisfied. It is basically happened for the reason of poor commitment, lengthy process, and many doors that customers have to go to fulfill their desired needs, such as consulting, system integration, maintenance and so on. The following Fig. 1.2 represents the current level of services and customer needs of Bangladesh IT market.

In Fig. 1.2, it is observed that average level of services in Bangladesh IT market is still very low and need to move more advance level. In order to get the customers' desired services, they need to go to system integrators, i.e., 3rd party service providers, which incurred high cost and time. In this context, the majority of customers want these services with products from one-stop door. More specifically, the key customer needs are identified in the following based on interview and discussion with IT users.

- Consulting services, i.e., pre-sales services. For example, if a customer decided to buy a server, they require the configuration of the server or pre-verified template before the final buying of the products.

- Support and maintenance services, i.e., after sales services. Customers want the guarantee of the products that it works better and quick replacement or recovery in case of any problems during the warrantee period.
- Technical assessment, i.e., periodical check. Customers want periodical assessment of their systems or products that it performs appropriately. They also want training and/or knowledge about the products or handling the systems to gain better performance.

Thus, it is observed that the necessity of implementation of servitization concept, i.e., product-service operation in Bangladesh IT market is crucial. The execution of this concept will create value for both customers and suppliers in long-run business perspective.

1.6 Discussion

Servitization or product-service operation is crucial in hi-tech industries, such as information technology (IT). The necessity of services in this industry is realized very important in Bangladesh market. This paper is tried to seek the customer needs, i.e., desired services in this particular market through field survey. The key customer needs identified in this market are solution services. Here, the ethical meaning of 'solution' is to solve the customer problems that can be software or services such as consulting, support and maintenance, technical assessment, knowledge, training, and so on. The paper also identified the problems existing in the current IT market in Bangladesh. These problems are lengthy process of supply chain, high transaction cost, and less reliability of goods, and lack of services. Thus, the significance of servitization or value proposition of existing goods through services offering in this market is crucial.

The real value of this article is presented for both organization and customer perspectives. For existing organizations or new entrepreneurs who do see the provision of services as a key to their future business in Bangladesh IT market, it is very informative and helpful to understand the current market condition and customer needs as well. On the other hand, customers will be benefited to understand and perceived the values of implementing servitization strategy in Bangladesh IT market. It will reduce the cost of goods, minimize transaction time, and increase the reliability of goods and services, which makes the customers more satisfied.

1.7 Conclusion

Servitization is the innovation of an organization's capabilities and processes, to better create value through a shift from selling product to selling product-service systems (PSS). The concept basically recognized as one of the relevant business strategies for developed economy or western countries [30]. But, in this article, we

show that the servitization concept cannot frame by any specific economic condition, i.e., developed economy or western countries. The importance of this concept or implementation should be consider based on customer needs in every individual market or/and industry perspectives.

This paper's purpose is to identify the necessity of servitization from customer perspective in Bangladesh IT market, which is growing rapidly. We discussed the current level of services provided by suppliers in Bangladesh IT market. The survey result revealed that suppliers or/and sellers are not provided any additional services with product except warranty, even that is not working properly in some circumstances. We also identified customers' needs and expectations, which are not provided by suppliers yet. The most important needs realized by customers are consulting, maintenance, and training and knowledge services. These services denoted as the process of value creation of existing products, i.e., servitization of business [2]. Thus, the necessity of implementing servitization strategy in Bangladesh IT market is very important, which in long-term perspective crucial for organization and customers as well.

The research result can be used to design services with existing products required by customers, and help companies to mitigate the customer needs in Bangladesh IT market. The expected benefits from this research are to help enterprise managers and decision makers to response the current market needs properly and achieving the objective of implementing servitization strategy both organization and customer perspective

Since our empirical study analyzed data collected from 1 industry, i.e., IT in Bangladesh market, it would be interesting and valuable to conduct similar surveys in other regions for comparative studies. Furthermore, we may extend our study in the future by increasing the number of sampled industries, such as telecommunication, electronics, automobiles, and so on. In the future is important to make further research on service design and processes to meet the specific needs of Bangladesh IT customers. What kind of challenges associated with the implementation of servitization strategy in Bangladesh IT market?

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Chapter 2
A Service Field Concept for Service Value Creation

Michitaka Kosaka, Minh Chau Doan, Kunio Shirahada and Jing Wang

Abstract Service sector is growing up during the trend of service in economic activities. There have been many researches in order to increase service value. However, there is no mathematical model to identify and measure the service value for maximizing it effectively. This paper proposes a concept of service field for creating service value. Then the concept is applied to service matching in service mediators and information value creation in information business. This mathematical model seems to be effective for analyzing service value theoretically.

2.1 Introduction

Recently, the importance of service innovation has been discussed in various areas. This is attributed to the increasing of the ratio of service industry in GDP due to the expansion of information industry or knowledge industry [1]. Under such circumstances, new concepts related to service science such as Service Dominant Logic (SDL) [2], Persona marketing [3] or Service as a theater [4] have been proposed. In such new concepts, the "value in use" concept is very important, that is, how service receivers feel the value of provided services is an essential issue. Such service value creation is the common issue for every service business, and should be investigated more.

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Previous researches related to service value creation are followings. Service quality is one of measure on service value. Hatakeyama [5] proposed that service quality depends on the difference between the pre-expectation of a service and the after evaluation of provided service. If the after evaluation is better than the pre-expectation, then the customer feels satisfaction and the service quality is high. However, the pre-expectation and the after evaluation depend on human's feeling and it is difficult to formulate this relationship theoretically. Context-aware service [6] is one of services which are aiming at higher service value by considering the situation (time, place, people, cost, and so on).

Generally, the value of provided service is different according to the situation (human's characteristics, place, time, cost, etc.). Even if the same service is provided, the service value is different due to human's characteristics or the situation [7, 8]. The "value in use" concept in SDL depends on the situation. Also, context-aware service considers the relationship between the service value and the situation. However, there are no previous researches which give the theoretical framework for service value creation, which considers the situation-dependent characteristics of service value. Also, there is no mathematical model for service value.

In this paper, a new mathematical model for service value based on a concept of service field is proposed. This service field concept is an analogy of the electro-magnetic field in physics, where the electro-magnetic power is determined by the relation between the charge of electron and the electro-magnetic field. According to this concept, the service value is determined by the inner product of a customers' requirement vector and a provided service vector.

First, a service field concept is shown and a service value is determined by the relationship between service itself and the service field which is the situation of provided services. Next, a mathematical model for service value based on service field is discussed for enhancing service value. Moreover, this concept is applied to service matching in service mediators and information value creation in information business.

2.2 A Service Field Concept

In SDL proposed by Vargo, service value is determined by the customer on the basis of "value in use". Many service science researchers are looking at this concept to maximize human satisfaction in service system. This corresponds to the concept of 'value in use'. SDL gives a new viewpoint to service, and goods are some of factors in provided services to customers from the point of SDL. This concept is very suitable for explaining the twenty first century's global business.

The 'value in use' concept in SDL greatly depends on the contextual situation. Generally, the value of a provided service is different according to the situation (human's characteristics, place, time, cost, etc.). Even if the same service is provided, the service value is different due to human's characteristics or its situation.

A concept of service field, which is related to "value in use", is analogous to the field theory in physics, where the electro-magnetic power is determined by the relation between the charge of the electron and the electro-magnetic field. According to this analogy, the service value is determined based on the relation between the provided service and the situation in question.

In the electro-magnetic field theory, the electro-magnetic power $\boldsymbol{F}$ is given by the Eq. (2.1):

$$F = q(E + v \times B) \tag{2.1}$$

where

$\boldsymbol{F}$ electro-magnetic power, $\boldsymbol{q}$ charge in electron,

$\boldsymbol{E}$ electronic field, $\boldsymbol{B}$ magnetic field, $\boldsymbol{v}$ velocity

In the electro-magnetic theory, even if the charge $\boldsymbol{q}$ is large, there is no electro-magnetic power when there is no electro-magnetic field. This relationship can be applied to creation of service value. Even if the service quality is high, there is no service value if the service is not required by customers, that is, there is no service field. The service value is determined by the relationship between a service and its service field, which shows how customers need service.

The service field model can be specified as

$$(\text{Service value}) = (\text{Service}) \times (\text{Service field}) \tag{2.2}$$

where $\times$ denotes the relationship between service and service field. The concept of service field is shown in Fig. 2.1. Here, a high service value is generated when services are provided based on high potential values in the service field. A high potential means that the demand for provided service is high. Otherwise, provided services cannot create high service value. Consequently, in order to maximize service value, its service field should be identified, and suitable services should be provided depending on customers' characteristics or requirements in a given situation.

2.3 Service Value in Service Field Concept

If we consider the potential of service field, there are some similarities between the classical field theory and the proposed service field. The following discussion presents the analogy between a new service field and the traditional field theory in physics. The variables are relative but different in two diverse fields. Table 2.1 shows the comparison of variables, which is discussed by Wang et al. [9].

From the analogy of the traditional field theory, we can calculate the potential value $\boldsymbol{A_G}$ as following formulation

$$A_G = -\frac{Gm_1m_2}{r} \tag{2.3}$$

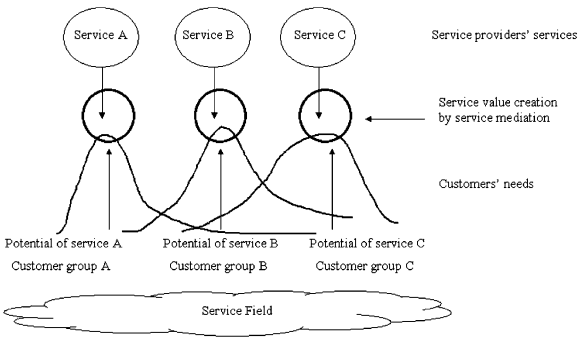

Fig. 2.1 Service field concept [7]

In this equation, $\boldsymbol{G}$ is the service index constant. The potential value $\boldsymbol{A_G}$ depends on the distance $\boldsymbol{r}$. In order to evaluate $\boldsymbol{r}$, we introduce two vectors which represent the provided service attribute vector $\boldsymbol{s}$ and the customer requirement attribute vector $\boldsymbol{a}$.

i-th provided service attribute vector $= \boldsymbol{s}_{\mathrm{i}}$ (s_{1i}, s_{2i}, s_{3i}, ……., s_{ni})

j-th customer requirement attribute vector $= \boldsymbol{a}_{\mathrm{j}}$ (a_{1j}, a_{2j}, a_{3j}, ……., a_{nj})

For example, let's consider 8Ps in service marketing to understand the service attribute vector and the potential of service field. We stimulate 8Ps (Product, Pricing, Productivity and Quality, Place, Physical evidevce, Promotion, Process, People) as service attributes in general services. Here, let's assign 8Ps to components $\{s_{ki},\ k = 1,\ 2,\ ,\ \mathrm{n}\}$ of service attribute vector $\boldsymbol{s}_{\mathrm{i}}$. With each attribute, customers and providers have different perspective and expectation. The relationship between provided service attribute vectors and requirement attribute vectors is shown in Fig. 2.2 geometrically. The smaller the distance $\boldsymbol{r}_{ij}$ is, the more preferable for $\boldsymbol{a}_{\mathrm{j}}$ the provided service $\boldsymbol{s}_{\mathrm{i}}$ is. In Fig. 2.2, $\boldsymbol{s}_2$ is preferable for $\boldsymbol{a}_1$ and $\boldsymbol{s}_1$ is preferable for $\boldsymbol{a}_2$

In reality, there are many service offerings and many requirements from customers. However, matching them perfectly is a concern of both firms and customers. The gap $\boldsymbol{r}$ between services $\boldsymbol{s}$ and customers' requirement $\boldsymbol{a}$ is the issue for the matching. When gap $\boldsymbol{r}$ is small, there is more potential that service is delivered to suitable requirement. Therefore, $\boldsymbol{r}$ in Eq. (2.3) can be defined by the distance between $\boldsymbol{a}$ (requirement attribute vector) and $\boldsymbol{s}$ (provided service attribute vector). To optimize the service value, $\boldsymbol{r}$ (the gap between these two vectors) should be minimized:

$$r = |s - a|,\ r^2 = \sum (s_n - a_n)^2 \tag{2.4}$$

To maximize the service potential, $\boldsymbol{r}$ needs to be minimized as much as possible. Therefore, this leads to the Hypothesis 1.

Hypothesis 1: Service offering should be closed to customers' needs. The closer they are to each other, the more the service value co-created to satisfy customers is.

From the Eq. (2.4), the following relationship can be obtained,

Table 2.1 Variable comparison

Traditional field theory	New service field
Attraction	Attractiveness
m' (statistic objects)	*s* (service providers)
m (kinetic objects)	*a* (customers/targets demand)
Position (of objects)	*Demand* (of services)
r (distance between m' and m)	*r* (gap between the services and the customers demand)
A_G (work of attraction)	A_G value of services

$$r^2 = |s - a|^2 = |s|^2 + |a|^2 - 2(s \cdot a) \tag{2.5}$$

The distance $\boldsymbol{r}$ is deeply related to the inner product $(\boldsymbol{s} \cdot \boldsymbol{a})$ of the provided service attribute vector $\boldsymbol{s}$ and the customer requirement attribute vector $\boldsymbol{a}$.

$$(s \cdot a) = |s||a| \cos(\alpha) \tag{2.6}$$

Therefore, the potential of service field can be determined by $|s|$, $|a|$, and cos (α). In order to maximize the service value, the distance $\boldsymbol{r}$ must be minimized. This means that the inner product of $(\boldsymbol{s} \cdot \boldsymbol{a})$ must be maximized. Based on these considerations, there should be three strategies to get high value services:

Strategy 1: $|\boldsymbol{a}|$ is as big as possible;
Strategy 2: $|\boldsymbol{s}|$ is as big as possible;
Strategy 3: Cos (α) is as max as possible => (α) is as min as possible.

From the three strategies, we have the following hypotheses:

Hypothesis 2 : If the requirements of customers are large, it is possible to match services with customers' needs because the gap between them will be small.

This hypothesis is based on **strategy 1**. If $\boldsymbol{a}$ is big, the gap $\boldsymbol{r}$ will be small, therefore, there will be a greater chance for matching services and customers's requirements.

Hypothesis 3 : If services offering is good and have large value, it is possible to match good services with customers' needs to create high service value.

This hypothesis is based on **strategy 2**. If $\boldsymbol{s}$ is big, the gap $\boldsymbol{r}$ will be small, therefore, customers will easily accept and match with good service provisions.

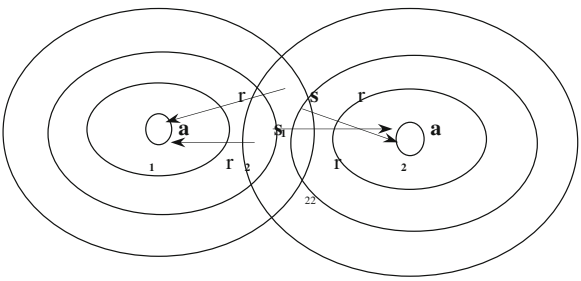

Fig. 2.2 Attractiveness of services to customers' requirement

Hypothesis 4 : Service offering should be closer to customers' demand. The more they are close, the less the gap between them. Thus, the service value co-created is optimal to satisfy customers.

This hypothesis is based on **strategy 3** and similar to **Hypothesis 1**. If $\boldsymbol{s}$ and $\boldsymbol{a}$ are close to each other, the angle α will be small in order to minimize the gap $\boldsymbol{r}$. Thus, optimal service value is co-created by both firms and customers through good collaboration without any gaps.

2.4 Service Matching in Service Mediators

Service mediator is a neutral mediator which engages two business parties that have service requirements of themselves. Mediator companies provide services through their own resources to assist their business partners and customers exchange services and satisfy their requirements. From perspective of S-D logic, they satisfy both of their customers by acting as intermediaries to bridge the demand and supply of business partners and users, therefore support for the co-creating process.

Above sections proposed a service value model to indentify and measure value of services. From the hypotheses, we affirm the importance of service matching, and based on suitable matching, service offering and customers' demand can be harmonized and extract the optimal value. However, how to classify service and customers' demand and deliver them to right target are issues of service exchange. In fact firms and customers do not have effective system and mechanism to match their services. Therefore, mediator firm is needed to assist matching process thus enhance service value.

Generally, in real services which have a lot of service offerings for requirements of customers, we can evaluate service values $\{V_{ij}\}$ by calculating the inner products of the provided services $\{\mathbf{s}_j\}$ and customers' demand $\{\mathbf{a}_i\}$ as shown in Fig. 2.3.

The biggest value of V_{ij} shows the best matching between the provided service $\boldsymbol{s}_j$ (j = 1,2,3…., m) and the requirement $\boldsymbol{a_i}$ (i = 1,2,3…., l). This evaluation of service values illustrates the possibility of applying service value model to real business such as service mediators.

Mediator firm works as a bridge to seek the necessary information from both individual parties and attempt to come to a resolved agreement on both parties' behalf. They have a good brand to attract business partners and users exchange service under their umbrallas. Huge database and powerful IT infrastructure support matching service and requirements. When vector **s** and **a** are matched with same varibales, the service value will be biggest and bring completed satisfaction to both firms and users.

From proposing new model for service value, this paper also considers the role of service mediator in enhancing service value. A detailed study of mediator case will be conducted in further research to verify and justify the competence of mediator in bringing satisfaction to both firms and customers.

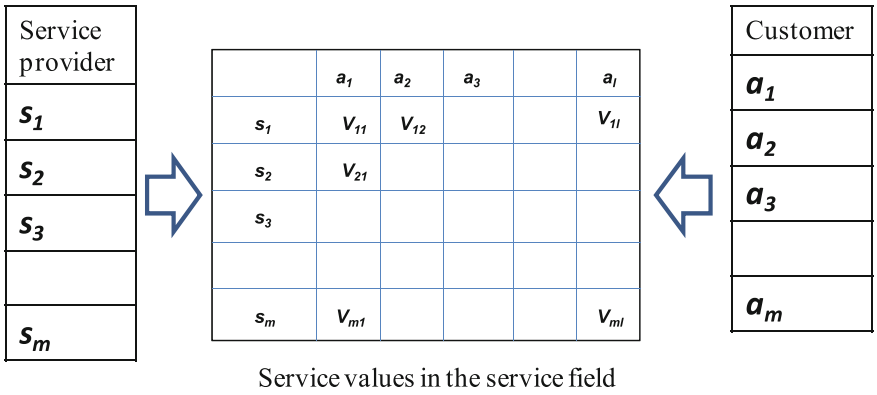

Fig. 2.3 Service values according to service and customers' demand

2.5 Relationship between Information Value and Service Value

The service field concept can be applied to information value generated by an information system. Figure 2.4 shows the relationship between information and a decision maker. The decision maker has clear objectives for which they utilize information provided by an information system. Both service and information are supporting activities for people or organizations to achieve their objectives. Therefore, the concept of service value creation can be applied to the value creation using information. If the provided information considers decision makers' objectives or situations, then suitable information is given to the decision maker for creating value with information effectively, otherwise the value creation with information cannot be expected.

Figure 2.4 shows the structure of decision making with information. The information provider (S) provides information (It) to the decision maker (I) in order to maximize the objective function Q(Ct, Ot). The value of the objective function Q is dependent on both controllable parameters (Ct) in the situation for the decision maker and uncontrollable parameters (Ot) such as the external environment. The decision maker decides the action (At) for maximizing the objective function Q based on the provided information (It). The provided information (It) should consider the situation (Ct, Ot) and the most suitable action (At*) is determined based on the provided information. Thus both service activities and information offerings have similar characteristics which are situation dependent and supporting activities.

In Fig. 2.4, the provided information (It) is required to maximize the probability of making the most suitable decision (At*). Usually the probability P(At*|It) of deciding At* based on the provided information (It) is larger than the probability of deciding At* with no information. If the decision maker uses the effective information, then the probability of maximizing Q based on At* becomes higher.

The most effective information can generate the highest probability of making decision At* which maximizes the objective function Q. The above relationship can be explained by using the mathematical equations as follows.

If Q (Ct, Ot | It) is defined as the objective function Q with provided information It, then generally the following relationship is clear.

$$Q(Ct(At), Ot|It) \geqq Q(Ct,Ot) \tag{2.7}$$

If the probability of decision At based on It is defined as P(At|It), then the expectation value of the objective function Qe is;

$$Qe(Ct, Ot|It) = \int Q(Ct(At), Ot|It)P(At|ItdAt) \tag{2.8}$$

If Q0 is defined as the expectation value of Q with no information and the provided information is effective, then

$$Qe(Ct,\ Ot\ |It) \geqq Q0 \tag{2.9}$$

If the effective information is provided, then the expectation value of the objective function increases as follows;

$$dQe(Ct,\ Ot|It)\ =\ Qe(Ct, Ot|It)\ -\ Q0(Ct,\ Ot) \tag{2.10}$$

This dQe is the effect of information (It) and is considered as the information power of (It). The Eq. (2.10) means that the information power depends on the objective function (Q), the situation (Ct, Ot), and the provided information (It). The information power is generated by the relationship between the provided information itself (It) and its situation ((Ct, Ot), Q). This relationship is similar to the service field theory, where the service value is determined by the provided service ***e*** and the service field. Here, the situation in which information is provided is defined as the information field, similar to the service field.

(Information power) = (Information) x (Situation: Information field).

This relationship is similar as the discussion of the service field and the concept of the service field can be applied for enhancing information service.

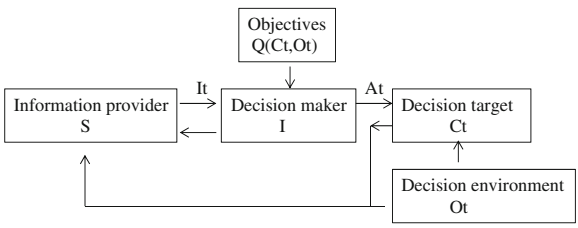

Fig. 2.4 Structure of decision making

2.6 Implications on Information Business Based on the Service Field

The concept of the information field provides important implications to information system business. From the above discussion, information business is similar to service business. Therefore, we can apply the Service Dominant Logic (SDL) view and the Good Dominant Logic (GDL) view to information business.

If information business is considered as a product business or a system business from the viewpoint of GDL, then it is important for providers to supply the information system satisfying specifications determined by the customer. The system should have good performance from a GDL viewpoint. But this does not guarantee the effectiveness of an information system for customers' business success. In order to do good business using an information system, the provided information should consider the situation and be effective for customers' objectives or problem solving. As the business environments of companies are constantly changing, the information system which was very effective in the past is not necessarily effective in a current business situation. Therefore, the information value provided by the same information system is changing dependent on the business situation.

From a SDL viewpoint, the "value in use" concept is very important, and this should be applied to information system businesses or information service businesses. The values of information systems or information services are determined based on the information power generated by the provided information. This information power is similar to the "value in use" concept. The effectiveness of investment in information systems or services is dependent on the relationship between the provided information and the situation. Therefore, service science which aims at service value creation seems to be a suitable approach for discussing the effectiveness of information systems or information services.

Characteristics of information business should be discussed from the viewpoint of value creation in SDL. From this discussion, we can summarize the relationship between service and information business as follows.

(1) Information system businesses or information service businesses are service itself.
(2) Both value creation using information and service value creation are dependent on customers' objectives and situations. Therefore, the concept of service field or the concept of information field is important for considering a mechanism of value creation.
(3) Customers have knowledge or information related to the information field or the service field. On the other hand, providers have knowledge of information technologies related to information service. In order to create high value service, collaboration between customers and providers is an effective methodology.

Therefore, the KIKI model [10] shown in Fig. 2.5, which is the service value co-creation methodology by identifying the service field, can be applied to information business.

The KIKI model consists of the following four steps;

Step.1 (*K1*). *Knowledge sharing in collaboration*. The collaborators in the service value co-creation process understand and share the objectives of the collaboration and its service field. Therefore, the collaborators share knowledge and information related to their purpose.

Step.2 (*I1*). *Identification of the service field*. The service field is identified using various technologies such as data mining and questionnaire analysis or collaborations between providers and recipients of the service. The kind of service support needed for the recipients is investigated and the services or products required to be together are clarified.

Step.3 (*K2*). *Knowledge creation for the new service idea*. The knowledge creation for the identified service of the service field in Step 2 is done and suitable service behaviors are designed after understanding the service field. Through collaboration of the participants in the service value co-creation process, new knowledge for service is created by combining various service ideas and technologies.

Step.4 (*I4*). *Implementation of the new service idea.* The created new service idea in Step 3 is implemented by considering business model, pricing of services or required information systems. Collaborators in service value co-creation process evaluate the results of knowledge creation step for the required service and take them into account in the following process for enhancing services.

The service that results from this service value creation process can be further enhanced by repeating these four steps of service value co-creation in a spiral of development. As the value co-creation process is repeated, collaborators come to understand the service field much more fully.

In the value creation process based on the KIKI model shown in Fig. 2.5, IT vendors are required to have up-to-date technologies such as "Could computing technology" or "Big data technology", various information resources related to global information business and integration abilities using Joint sessions or KJ methodology for the proceeding four steps in the KIKI model. Also, IT vendors should have various experiences such as international business experience in information system business, and make use of their experiences in collaboration with customers.

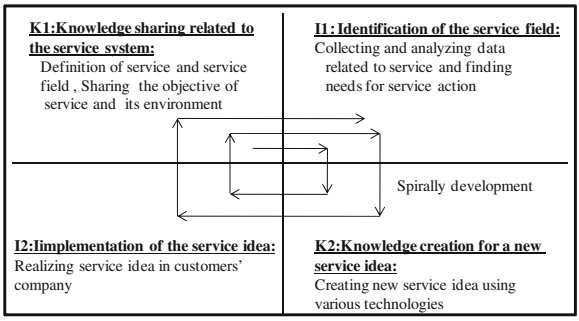

Fig. 2.5 KIKI model [10]

2.7 Conclusion

According to service trend, perspectives about service value is changed from creation to co-creation. Both firms and customers take responsibility to build the value which benefit for all. Firms do not offer values to customers in one way but need the collaboration and agreement with customers. Therefore, matching service itself and requirements from customers are the most important parts in service exchange.

This paper proposes a new mathematical framework that can identify and measure the service value. It is hoped to provide a mechanism for firms and customers to be able to realize each others' needs and match thoses sources smoothly. When suitable service can reach to suitable customers, it is easy to get agreement and satisfaction. Moreover, because both sides fulfill each others' needs by exchanging services, the service value is optimized and largest. Also, it is proposed that information value in information business is enhanced by using KIKI model which is a service value co-creation model based on the service field.

In fact this model is a conceptual proposal. Actual data and real case studies should be collected and conducted in future research to verify and justify the effectiness of the model.

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Chapter 3
Development of Future Center: A Case Study

Timo Rossi, Lorna Uden and Marja Naaranoja

Abstract Innovation is vital if companies are to survive. This is particularly so when it comes to energy innovation. Companies and government as well as universities are actively seeking to develop and adopt of renewable energy technologies. Effective innovation requires collaboration between different types of companies (big companies, small and medium-sized companies, start-ups, customers, suppliers, consultants, manufacturers, service providers etc.) and other organizations (universities, research institutes, think tanks, public sector etc.) as well as consumers. To provide collaboration among the different stakeholders, the Future Center project is created to promote energy technology innovation in Vaasa. Future Center can be described a collaboration-based, future-oriented, creative and sustainable innovation environment for the companies and other organizations in Vaasa region's energy technology cluster. This paper describes the development of the future center through the co creation of value and the lessons learned. It especially focuses on explaining the challenges and opportunities using knowledge management, value creation theories.

3.1 Introduction

Climate change and the need to manage diminishing fossil fuel reserves are, two of the biggest challenges facing us today [1]. Energy relies still heavily on fossil fuels and nuclear power to generate its electricity. This approach lacks diversity and security, threatens the health of our citizens, jeopardizes the stability of Earth's climate, and robs future generations of clean air, clean water, and energy

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independence. Energy resources, such as oil and gas are becoming scarce and also depleted while demand has been increased due to increase in population. The prices of energies are going to be going up because of the scarcity of supply. It is important that research should seek to find alternative means of energy [2].

Renewable energy sources help to reduce the dependency on non-renewable supplies, such as fossil fuels. It will help produce sustainable energy options for generations to come. Active research is going on in developed countries to innovate renewable energy to overcome the resources depletion, public concerns over climate change and environmental hazards to health and life [2]. Finland as a small country needs to involve in energy innovation in order to survive. However, the needed innovation requires collaboration between different companies, customers, stakeholders, suppliers, manufacturers and service providers as well as universities, research institutes and government agencies. There is also a need to have new ways to innovate. The use of future centre is a potential way of helping with energy innovation. The future center project was funded by EAKR(EU) to facilitate energy innovation.

Although future center projects have been successful used to promote innovation, currently there is no research to investigate how one can set up such center. It is our belief that to implement an effective future centre, it is important that we adopt a co-creation approach for the development of future center for the energy innovation in Finland. This paper describes the Vaasa future center development and how we co-create value with the different stakeholders involved for the development of the energy innovation future centre. Using this approach we were able to identify the problems and needs of the partners involved in the co-creation of value among the different stakeholders. The paper begins with a brief review of future center followed by the co creation of value. Subsequent section describes the case study, follow by the development of Vaasa energy innovation future center. It then discusses the problems identified and the lessons learned. The paper concludes with suggestions for further research.

3.2 Future Centres

Owing to the rising costs of technology development and the shortening product life cycles, it is hard for companies today to justify innovation investment. Through open innovation, companies can leverage on external R&D resources to save time and money and attack the revenue side by licensing out internal technologies. Chesbrough and Crowther [3] defined open innovation as ‘the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation, respectively. In open innovation, innovations emerge increasingly as a result of inter-organizational cooperation. Future centres can be used as places for promoting open innovation and applying open innovation approach in practice.

Future Centres are innovation environments where learning and insights from the past and future as well as from diverse participant perspectives are used to solve real world problems in the future, Kune [4] argues that they are innovation engines to help people and organizations collaboratively, systematically and continuously explore, anticipate, prepare for and actively design the future—and then return to the present to realize it. This author further argues that future centres are user-centric, people centred working environments purposely designed to enable users to collaborate in thinking about, questioning, designing and prototyping the future. Future centres also allow organizations to create innovative solutions by prototyping new policy, products, services and work relationships that matter to them. They provide dedicated working environments, tools, facilitation, methods, and the appropriate context for furthering technological, organizational, social and societal innovation [4].

Future centres first originated from Europe in the mid-1990s. They have been used in many areas such as government, business and civil society. Future centres have also been used for many purposes, dealing with specific questions and issues in many different sectors such as insurance, taxation, banking, energy, water and coastal management, pensions, education and stimulating entrepreneurial economy [5]. The first future centre was developed at the Swedish Skandia Assurance Group in 1995.

The European Commission project, Open Futures (2006–2008) has inspired the development of future centres in Europe. The Future Centre Alliance was developed to promote future centre thinking and concepts in 2010. Its aim is to support members to develop new approaches and share learning across the worldwide future centre community. In Japan, future centres are perceived as arena of knowledge management for the future that creates innovation and change through dialogue.

We concur with Stilger [5] that future centres should be a place where people can develop relationships with each other to listen and learn, brainstorm, think critically, develop and test new ideas. It should also be an environment where participants can set aside their own fears, judgements and suspicions, and begin a new dialogue with those present. Sessions at future centres can be used to: identify problems, find resources, build teams, solve problems, think logically, make decisions and create strategic vision. It is important during the sessions at the future centres to allow participants to share tacit knowledge. We concur with Kune [4], that the main purpose of future centres is creating and facilitating new ways of working with people on issues that are important to them and their organizations.

There are many uses for future centres such as for business collaborations, community design, social design, open government and business innovation. How do we create a future centre that will enable the different interested partners to collaborate? We believe that the design of this should be based on the co-creation of value.

3.3 Co-Creation of Value

A business paradigm known as Value co-creation has emerged describing how customers and end users could be involved as active participants in the design and development of personalized products, services, and experiences [6, 7]. The active participation of customers and end users is enabled through multiple interaction channels, very often by means of specifically designed technological platforms through the Internet [8, 9].

Co-creation of value is also influenced by the emerging marketing logic known as service dominant logic (SDL) proposed by Vargo and Lusch [10]. This new paradigm entails : (i) a shift from thinking about consumers to thinking about co-creators of value; (ii) a shift from thinking about value chains to thinking about value networks; (iii) a shift from thinking about product value to thinking about network value; (iv) a shift from thinking about simple co-operation or competition to thinking about complex co-opetition; and (v) a shift from thinking about individual firm strategy to thinking about strategy in relation to the entire value ecosystem [11]. This shift of paradigm challenges us to think of innovation in a new way. Innovation from the SDL perspective is now being viewed as truly user driven in value co-creation activities between customers and firms. This means user driven innovation [12]. Instead of competition, the innovation should now be the co-opetitive (from co-opetition) nature of the interactions between the different stakeholders, including the customers and end users, participating in the value co-creation process.

According to Tanev and others [13], before competing and negotiating to capture value, the different players in a value co-creation network need to compete and negotiate in order to be able to participate and to contribute value. Seppa and Tanev [9] argue that co creation of value can be viewed from two main perspectives: (i) general management perspective; (ii) new product development and innovation; (iii) virtual customer environments; (iv) service science and service-dominant logic (SDL) of marketing; and (v) international markets and entrepreneurship.

Co-creation platforms are increasingly being recognized as a promising innovation strategy together with change of innovation [14]. Because of this, Thomsen and Tanev [10] argue that there is a need for participatory platforms and co-creation practices to further enhance user innovation, in particular when they are enabled by a broader and more systematic positioning of customers and end users across the entire innovation lifecycle. They also point out that concretion here can be described as a market-driven approach within an open innovation business philosophy.

We are interested how to effectively design co-creation to promote innovation at the early stage of the future center development. It is our belief that integration of customers in the early front end development of future center in the concretion stage influences the innovation.

3.4 Case Study

Many policy-makers believe that strong university–industry relationships and high technology clusters are the keys to innovation. The future center was created as a collaboration-based, future-oriented, creative and sustainable innovation environment for companies and other organizations in Vaasa region's energy technology cluster. It includes prototyping (hands-on approach), system-thinking, interdisciplinary collaboration, human-centric approach, education and knowledge creation and sharing of idea environment for the cluster in energy innovation.

Future centre prestudy was funded by EAKR. The project explores new ways to support the development of Vaasa region's energy technology cluster. This cluster is the biggest in its field in North Europe. It consists more than 120 companies and several of them are global market leaders in their field. Together these companies are generating annual turnover of approximately 4 billion Euros. Export rate of cluster is over 70 %, which means some 30 % of Finland's total export in energy technology. Presently the cluster employs about 10,000 people and number of employees is expected to increase to more than 20,000 in 2020. (http://www.energyvaasa.fi 9.8.2012).

Using the future centre workshop initiative, leaders from different organisations from the cluster can share a platform to communicative their needs, generate ideas and seek out opportunities to collaborate with likeminded people to focus on energy innovation. Through these workshops, the different organisations have access to cutting edge expertise and leadership.

Project is divided into three stages as follows (1) studying and analysing the present situation and the future development needs related to innovation processes of the companies and other organizations in Vaasa region's energy cluster; (2) planning and organizing two workshops based on the needs found in the interviews (3) developing and testing the Future Center concept based on background research and workshops.

The duration of the project was from April 2012–February 2013. Only the first two phases of the project will be discussed. Interviews were done between May–July 2012 with focused interview methodology [15, 16]. Interview framework was standardized with ready-made questions for each studied areas. All areas were covered with each respondent during the interview. However, interviews were defined relatively free formed so that respondents could tell things freely with their own words. All interviews were made face-to-face. Duration of each interview was approximately two hours. The purpose of the focused interview was to find out the present situation and development needs of the front-end of innovation (see Fig. 3.1) related topics in the companies and public organizations relating Vaasa Energy cluster. During the interviews we collected also proposals and ideas for possible themes for the Future Center seminars and Future Center concept development.

The interviewees were selected to represent different kind of organisations: organizations from both private and public sectors; energy sector versatile fields;

different types of companies: big international companies, SMEs and small companies, start-ups, customers and suppliers; both educational and other public organizations. We also defined that all interviewed persons represented the top-management and they were familiar with strategic level innovation processes, for especially, front-end activities of their organizations.

In total 40 persons were interviewed from 38 organizations, of which 29 were companies representing all industry sectors of energy cluster and nine public organizations representing both educational and other public sides. Research sample included big international companies, SMEs and small companies as well as start-ups. Several interviewed companies are in customers-supplier relationships with each other.

All interviewees represented the top management of their organizations. 22 of interviewees were from general management, 10 from R&D or technology management and the rest eight from other functions. Some examples of the positions of interviewees were CEO, General Manager, Global Product Group Manager, CTO, Innovation Manager, Vice President (R&D), Marketing Director, Dean and Development Director.

3.5 Results

Interviewees had a possibility to vote the most interesting topics that they would like to be considered in first and second workshops. They could choose from five pre-selected suggestions (foresight, creativity, open innovation, ecological and sustainable design or Energy self-sufficiency of Vaasa) or propose their own

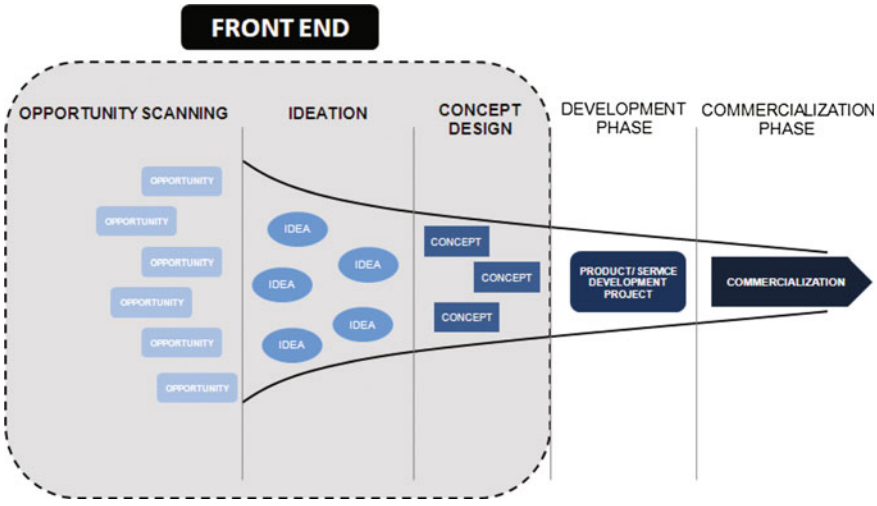


Fig. 3.1 Front-end of innovation

topics. Based on the interview results open innovation was voted quite overwhelmingly as the most interesting topic and foresight and energy self-sufficiency of Vaasa evenly as the second most interesting ones (see Fig. 3.2). The contents of the three most interesting themes are explained next.

Open Innovation approach combines the use of external and internal ideas as sources of innovations in organizations. In addition, it inspires companies also to use internal and external routes to markets. Practically, it means that companies can work together, for example, with customers, suppliers, small start-ups, universities and other research institutes for getting new ideas for innovation. Besides, they can try to find new paths to market through technology licensing and start-up or venture capitalist collaboration. From Vaasa energy technology industry point of view an open innovation workshop would concentrate on discussing possibilities and ways to pilot this approach in the cluster.

Foresight workshop would, firstly, focus on presenting the general idea of foresight and tools and ways of thinking and working relating it. Secondly, discussing how these ideas and tools could be applied in Vaasa energy technology cluster, and thirdly, applying them together with different companies and other organizations in practice for identifying and creating future opportunities.

Energy self-sufficiency of Vaasa workshop would target on ideating possibilities to design and perhaps also to build a kind of pilot area where companies could prototype their co-developed solutions (products, services and systems) in real-life in Vaasa.

As a result of this voting an Open Innovation workshop was organized in Vaasa on 18th of October 2012 and later a workshop focusing on Foresight was held in Vaasa on 14th of February 2013.

Is Future Center Concept Interesting*?*

The feedback for Future Center concept was mostly positive. According to interview results over 90 % of the organizations were interested in the concept (see Fig. 3.3). Interviewees argued that this new way of thinking and working is needed for improving innovation front-end activities and innovation collaboration between different types of companies and other organizations. They were also happy about the future-oriented approach of the concept.

> This is what we need for responding to the future needs and getting different parties (smaller and big companies, universities etc.) to work together.

> We will definitely need this kind of platform. Especially, small companies should collaborate with others to achieve new opportunities and 'by combining efforts.

Only one organization out of 38 thought that Future Center was not needed and two organizations were partially interested. These respondents said that Future Center concept would not help their organizations in creating new innovations.

> Big Companies are so strong that Future Center maybe not be important to them but it would be important to smaller companies.

> Getting people together is a good idea, but it will not help with innovating…

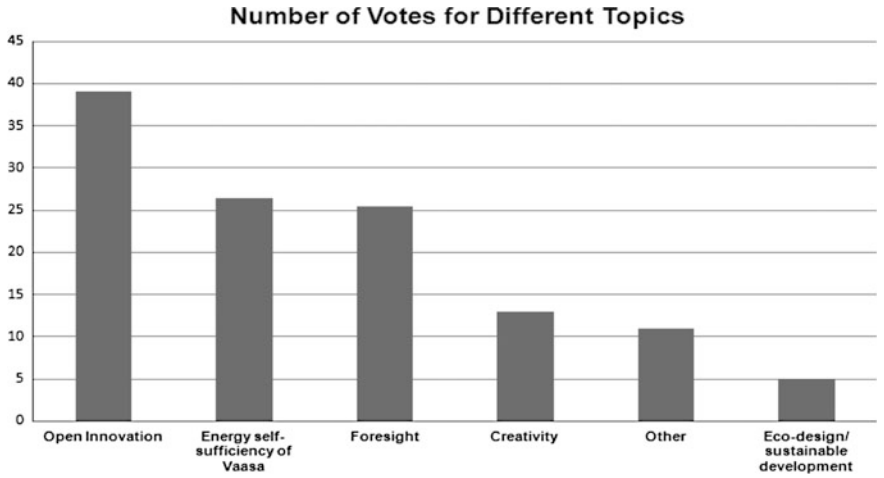
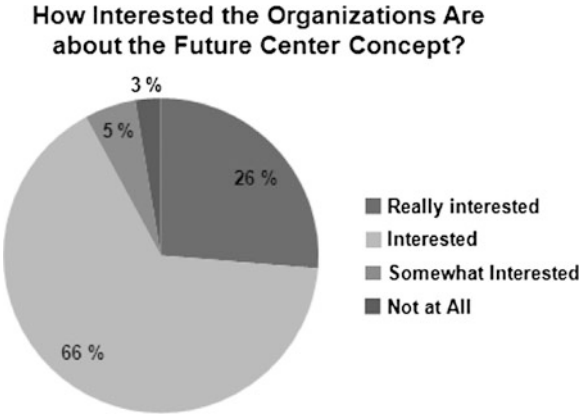


Fig. 3.2 Number of votes for different topics

As a conclusion, based on the interviews there seems to be a real-life need for Future Center concept in Vaasa region's energy technology cluster.

The respondents raised some general challenges of future center concept (Fig. 3.4). There was a need for concrete outcomes and practical pilots created. The interviewees raised a question: "How Future Center is positioned in relation to other similar organisations of the region?". Another challenge expressed was related to competitor conflicts and confidentiality issues in Future Center. The question "How to get companies interested in the Future Center concept" was also raised. Other commonly occurred themes were IPR issues, financing of the concept and concerns about bureaucracy:

Fig. 3.3 How interested the organizations are about the future center concept?



I think there could be a need but I'm afraid that it is going to high level and too far from practice. It should be in practical concept rather than simply a university theory.

Biggest risk would be if companies are not interested and they do not have resources for Future Center work. We have to show concrete results and case examples to companies.

How do we handle IPR issues?

How the Future Center can be agile and fast enough and avoid bureaucracy?

How big and small companies can work together on equal base?

Energy industry is really conservative.

The comments, ideas and concerns presented above were taken into account in Future Center concept development and when organizing workshops and seminars.

Workshop 1: The Future of Vaasa Region's Energy Cluster and Open Innovation

The first workshop "The Future of Vaasa Regions Energy Cluster and Open Innovation" was organized at University of Vaasa on 18th of October 2012. This workshop focused on promoting the Open Innovation approach in Vaasa region and discussed the opportunities and challenges related to it, and ideation of concrete proposals and how they could be applied in practice. In total 66 participants from 30 organizations participated in the workshop. Program of the workshop was divided into introduction of the topic by expert presentations (theoretical and real-life cases) and into facilitated ideation sessions in smaller groups around the topic.

After the introduction presentations the participants were divided into four small groups and one bigger group for discussing the opportunities and challenges

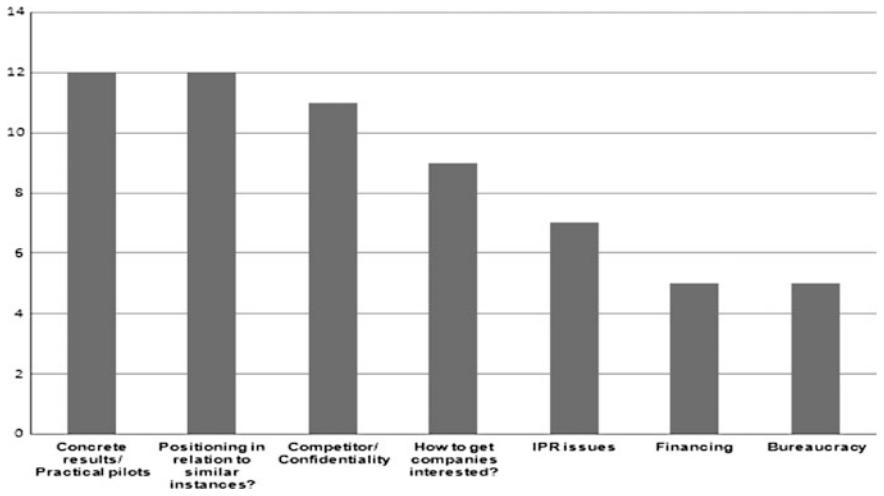


Fig. 3.4 Main challenges of future center

related to Open Innovation approach and ideation of concrete proposals how it could be applied in practice in Vaasa region. Bigger group had 25 participants. The discussion centred on the benefits and risks of Open Innovation approach in the context of Vaasa region's energy technology cluster. As an outcome of discussions the '*joy to innovate'* was found as the greatest benefit of Open Innovation and the largest risk identified was that '*we do not openly share the information'*.

The four smaller groups had in total 18 participants from 14 organizations. The first group t focused on Intellectual property rights related to problems of Open Innovation. The second group discussed the topic "How to create Together?" The third group covered Open Innovation approach from marketing point of view and discussed widely about the challenges, fears, understanding the customer, commitment of customers, internationalization and how to create commitment in Open Innovation. The last group targeted in creating practical concrete ideas for facilitating Open Innovation thinking in Vaasa region. Group talked about experiences of Open Innovation and ideated what could be done for starting with Open Innovation in practice.

The following concrete ideas were created for promoting Open Innovation for Vaasa region's energy technology cluster from the group discussions:

1. **Creating an "Innovation Pool"** that consists of persons with different backgrounds and capabilities and that have personal interest in innovating new things and solving problems. Innovation Pool could be also a forum where organizations could share their left over ideas that other companies could develop further.
2. **Creating an "Innovation Management Club"** for learning and exchanging the best innovation related practices between different organizations. Club should include participants from different organizations and different organization levels and it should be acting according to commonly agreed rules.
3. **Creating a map that includes all existing actors** that are supporting innovation related activities in Vaasa region. This would clarify who to contact in different innovation related issues.
4. **Creating ready-made, easy-to-use contract drafts** for Open Innovation related collaboration.
5. **Creating a university course** that targets to learning by solving real-life company cases.

In addition, a group of companies made a preliminary plan for starting a real-life pilot project together with city of Vaasa and Merinova for developing new energy solutions in some residential area of Vaasa. Finally, a preliminary model of Future Center concept was developed based on the interviews and results of the workshops.

Lessons learned

The collaborative actions for co creation of value in future center need to be practical that allow value creation for all the stakeholders. Open innovation is an ideal co-creation of value method. However, the method must be practical to use.

If only academics are involved in the future center workshop, SMEs would not be able to see the value of the use of future center.

3.6 Conclusions

Co-creation of value can be used in future center workshop to meet the needs of different stakeholders as well as getting their commitments. Initial commitments by stakeholder were continuously reviewed and evaluated by stakeholders. If stakeholders could see concrete evidences of benefits to them, they would be likely to collaborate. We recommend the following co-creation process:

(1) analysing the current practices, (2) develop stakeholder proposals, (3) creating a way of working with the stakeholders.

The co-creation activities in our case study shows the benefits and challenges of the use of a future center. The value co-creation process needs to be fully understood by the stakeholders. The co-creation of value needs to be planned as a continuous activity. In order to attract the interest of stakeholders the co-creation activities need to be beneficial to the all of them. Companies need to know that time spent in using the future center would reap benefits for them.

The ideal Future Center model involves a multi-staged approach to insight generation/opportunity shaping, ideation, validation and refinement. Although we have developed the co creation of value for the setting up of a future center, further empirical evaluation of this approach is needed to validate its effectiveness.

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Chapter 4
Cocreation Value Platform Based on User's Behaviour to Increase the User Engagement

Aravind Kumaresan

Abstract There are many content websites rely on both the paid subscriptions and advertisement revenue model. Although they are making more profits now, to sustain in their business they need to co-create the value along with their users rather than focusing only on the content quality and the usability of the websites. The existing studies and techniques on user engagement provides platform to understand the users behaviour on the website. But, to drive the user engagement it's still a real struggle. Many companies have started to focus on gamifications of their websites in order to drive in more user engagement. The innovative solutions provided by Badgeville for gamifications of websites are proving to be a real game changer in terms of driving user engagement. Most of the leading UK newspaper companies, who have pioneered in revolutionizing the paid content subscription model is also lacking behind in terms of user engagement. Although their website users share the popular articles in social platform the sharing metrics are not very high. The article commenting system doesn't drive high number of comments in comparison to news feeds on social networking platform like Facebook etc. The purpose of this study is aimed at creating a co-creation value platform based on user's behaviour to increase the user engagement on the news websites.

Keywords Co-creation value · Gamifications · User engagement · Value points

4.1 Introduction

Today most of the online content providers are running their business based on the shared business model of users subscription and advertisement. For the users to subscribe to the content it should provide them the utmost value and also the

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content provider should make this content available to the user in an easily available format. Also, the advertisement revenue is based on the quality and the number of readership of the content.

The real value of the content to the users cannot be easily measured until the content provider provides the users with appropriate tools to easily measure its value. In the user generated content world i.e., the Facebook, Twitter etc. [1]. The value of the content could be possibly measured based on user's engagement with the content in terms of likes, sharing of the content with other users. These social media platform acts as a medium for delivering the content and because of their easy to use tools to engage with the content, the valuable content reaches the appropriate users. Although the companies that rely on the subscriptions and the advertisement based revenue models are running successfully at the moment. Can they sustain by ignoring the user engagement of the content? To increase the user engagement the companies should setup a co creation value platform. This study demonstrates a new co-creation value platform based on gamifications of the websites to improve the user engagement. For the purpose of this study, a light-weight prototype system called value points was implemented on a financial news website to improve the comments and sharing features on articles.

4.2 Studies on User Engagement

User engagement is defined as an attribute of user experience with a specific technology, and is a suitable concept for investigating interactions with online content. User engagement intents to provide a broader framework that takes into account the characteristics of user interaction with the system. The framework should also provide an in depth metrics on interactivity of the users with the system. In addition, the importance of user engagement is on what the user finds essentially captivating according to their motivation for using a technology [2].

According to Chung [3] some studies and research has been conducted to observe people's motivations for reading content and their preferences for browsing content websites, others have concentrated on users' perceptions of interactive and bespoke content interfaces [4].

There are also several studies focused on finding different levels of interactivity on the basis of user navigation, functional and adaptive features of news websites [5], and planning interactivity on a large scale from user-technology to user- user communication [3] studies have also tried to describe and satisfy the various interests of newsreaders through personalization [4]. These studies have concluded that interactivity and personalization features are not always utilized by news-readers [3] nor do they touch the frequency in which online news is being accessed [6], but that they have a large unused potential for altering the way in which news is delivered and consumed [7].

4.3 Methods to Improve the User Engagement

The following are the popular and highly recommended methods to improve the user engagement.

4.3.1 Streamline the Content Flow

It should always be made easy for the visitors who come to your site to find what they're looking for, so that we can keep them engaged for a long time on the website [8]. Navigation should be made easy so that it helps the visitor in getting from one place to the next. Content should be relevant and should have headings so that users can search quickly what they are looking for.

4.3.2 Use Visuals

According to Garrett [9] among the human senses, studies have shown that about 80 % of human learning occurs visually as images register in mind more easily than words. The rest is divided among hearing, smelling, touching, and tasting. Visuals are a more interesting content and easier to remember than something that is written out in text, therefore using images and videos as a part to support or match the text will keep the user engaged. Images can also be involved when a pages has a lot of text which will help in engaging the user for a long time on the page.

4.3.3 Better Design and Functions

Similar to making the content easy to get to and easy to follow, the content should be accessible and legible for the user to read. For best accessibility the website should be tested for basic functionality in as many browsers as possible keeping in mind the mobile browsers as well.

The content on your site should be designed in such a way that it is very easy to be read. Proper fonts should be used with correct size on a neutral background colour, which does not dominate the text. A really easy way to stop a visitor going off the site before they've even reached your site is to have it load quickly [10]. Most important thing to be kept in mind is the load time of the website. The website should within 5 s so that the user stick to the site else he will go back to another site. Trim down your web site by removing unnecessary scripts, specially the homepage which is the most important part of the website.

4.3.4 Fresh and Relevant Content

According to Bloomstein [11] anything that is boring will not generate any kind of engagement as users have large amounts of distractions both online and offline. The users will even glimpse the content that is not interesting to them. Try and keep the user engage with to your website by providing content that is relevant to them in an attention-grabbing manner. If the content on a website is not updated and fresh, the user will less likely return for more browsing sessions. Therefore using fresh content will increase continued engagement.

Also, when trying to generate traffic to the website, it is always essential to make sure that keywords leading to the website match the contents.

4.3.5 A/B Testing

The above-mentioned techniques are relatively simple methods to use good design to immediately increase engagement from visitors to your site. There is however a more scientific and a technical approach to understanding what layouts work best for the users when they come to the site. According to Kaushik [12], the best solution to understanding how different designs work is to A/B tests them. A/B testing method shows a different layout to different visitors, when both the pages are tested at the same time.

So let's say you wanted to increase the number of users commenting on your site, you could create two different designs and deploy it alongside and monitor and compare it with the existing using heat maps which gives the real time navigation of the users.

4.3.6 Call to Actions

A website is incomplete without call-to-actions that figures what the user should do on your website. For example a contact us page, download form, product demo, login and registration forms [13] are important forms of action which engages the users more on the website and converts them into a returning visitors. A common reason for lack of engagement is the lack of call-to-actions.

4.3.7 Social Networking

With the growing power of the social networking, the readers should be able to share pages from your site on Twitter, Facebook, Google+ and Pinterest [14].

Seeing that their friends have liked a page or seen a tweet recommending a product then they're far more likely to give it the time of day. Social media not only inspires further sharing with a certain level of trust involved but also helps build a long-term relationship between the users.

4.3.8 Reward System

Rewards are also one of a key technique to drive more user engagements. The rewards could be either virtual or monetary. In case of virtual rewards, the users activities should be given points and badges to honour their contributions. The monetary rewards could be a real value vouchers. Providing incentives could set an active environment for engagement. Like any gaming system, it can also be addicting, providing users with an incentive to come back.

4.4 Co-Creation Value Platform

According to Bhalla [15], co-creation is a form marketing strategy or business strategy that emphasises on user experiences and collaborating associations and interactions.

Co-creation consents and supports an additional effective involvement from the user to create a rich value experience. The World Wide Web has drastically changed the scheme that listening to the your users and knowing the user behaviour can help improve the products and services that can be offered to them. Users are also passively involved in the development of the products and services, which are sold to them and thereby, becoming the co-creators of value. Co-creation adds a new dimension to the manufacturer/customer relationship by engaging the users directly in the production and the distribution of the value.

An ideal example of this would be Ikea, one of the biggest furniture retailers in the world. Ikea sells its furniture in a dismantled form at a very low cost to its customers, benefiting from co-creation by encouraging the customers to arrange their own transport and assembling services. Meanwhile, customer also benefit from the low cost furniture it is offering. Considering few other companies who are using co-creation to build the value, BMW's M division offers customisation of the cars, also leading to general product improvements and engineering challenges by collaborating the BMW engineers and their customers [16]. According to Sawhney et al. [17] health care professionals provided an Internet based platform to support collaborative innovation involving patients, doctors, clinicians, health care providers and the researchers. Samsung one a leading electronics and appliances in the world [18] created a Virtual Product launch center to enroll customer's help in diffusion of new product information and also influencing peer customers buying behavior. YouTube, the online video sharing service, allows users to upload their

own content and view other content generated by other users. The user-generated content can be defined as the content made publicly available on the Internet platform.

Companies who want to succeed in today's competitive marketplace cannot safely ignore co- creation. Invention and innovation are one part of co-creation, interaction and collaboration is the other part of co-creation of value. By offering a reward to the user for adding co-creation value will be a new dimension in the co-creation platform. In order to enhance the user experience and their involvement users must be given some reward in any form (points, credits, gifts, prizes, etc.) so that they actively participate and build the co-creation of value for the producers.

4.5 Reward System to Help Improve the User Engagement

Although there are various methods and techniques available to improve the user engagement, the aim of this paper is to find out specifically the impact of adding an appropriate reward platform to improve the user engagement. This paper aims to answer the question; does strategically implemented reward system delivers improvement to the user engagement? In order to answer the research question, the paper analysis a specific reward platform solution provided by Badgeville. Also developed a basic value points platform and evaluated it on FT.com.

Badgeville provides a gamification platform, it help business drive customer and employee behavior. According to Marczewski [19] "Gamification is the concept of applying the concept of gaming metaphors in non game contexts to influence behavior, improve motivation and enhance user engagement." Gamification is a process of rewarding the user's behavior on the website and it will provide a catalyst for the users to stay engaged with the website content. The content-based websites are providing a wide range of platform support to access the content. But, they don't provide a platform to motivate the users to use these features.

Adding gamification to a site, of course, means offering users points, badges, status, and rewards for the user and making him or her engage more on the site. By including it logically into the core of a site's purpose, however, gamification can improve the user experience and significantly increase both engagement and user growth.

According to the study by Gigya on billions of user actions along with big companies like Pepsi, Nike, and Dell, adding gamification to the website boosts engagement by almost a third. In fact, gamification boosts commenting 13 %, social sharing to Facebook, Twitter, and networks 22 %, and content discovery by a huge 68 %. Gamification also has some negatives, so we have to be careful, so that the user does not misuse the system and spam the networks.

"Levelling up" is a term from gaming society, in order to attain better position; gamers must beat multiple levels or sometimes engage in some repetitive tasks.

Superficially, some people do this on gaming websites for importance, fame and to win some kind of physical reward.

Also, commenting and sharing has become very common these days in the social networking platform and has proved to enhance the user engagement. It provides a form of social evidence, if the site and its content are valuable. It lets users to see what other socially connected users are doing on the site which is a method of really increasing content engagement, and when gamification is integrated into this system the user has been offered more to engage himself into this system and hence enhancing the user experience.

When combining both social networking and gamification platform commercially, helps brands to identify and target their biggest fans, and know their taste, preferences, willingness to buy, their needs. Also a person in California can share his or her thoughts to other people around the word through the social networking platform. By this the users get to connect to the vast network through their common friends and build their knowledge. Now big companies like Pepsi, Coke, Marks and Spencer's, Mango etc. are using social networking as a platform to offer customers some rewards by conducting competitions, games and contests on special days and occasions and gets visitors on to their site. Hence Gamification needs to be tied to the social platform in order to keep the users engaging persuade them to become their loyal customer.

4.5.1 EMC Case Study on Badgeville

EMC, an American multinational corporation has been at the leading authority of implementing social technologies for its customers, partners, and employees. EMC was the global leader in hardware and cloud-based computing implemented social software from Jive to power communities across its ecosystem, including those for employees, customers, and partners. With users getting distracted EMC experienced challenges in getting them to post messages, fill out profiles, answer questions, and perform other valuable behaviours that drove a healthy online community. It needed a new way to recognise users who performed these key behaviours and encourage people to do more of them to stay actively engaged. The best solution they found to solve this challenge was to integrate Badgeville.

EMC used The Behaviour Platform by Badgeville to build RAMP—the Recognition, Awards & Motivation Program—that stays on top of EMC's Community Network (ECN), a Jive-based online community of 240,000 EMC customers, partners and employees. EMC used Badgeville's strong Game Mechanics to start, encourage, and reward valuable user behaviours across the EMC's Community Network. The Behaviour Platform allowed EMC to gamify virtually any user behaviour across its ecosystem. Inside of the Behaviour Engine admin console, EMC easily allowed its users to earn points for performing loads of behaviours, which included the following

For completing a task (10 points)
For creating a video (10 points)
For starting a discussion (7 points)
For answering a question (6 points)
For creating a document (6 points)
For sharing the status update (5 points).

In addition, EMC organised and compiled together hundreds of Achievements that users answered for performing these behaviours. For example, users can earn the "Discussion Starter" achievement after they start five discussion threads. EMC also enabled Missions to take users through a structure of relevant achievements inside the EMC Community Network, which stages their knowledge and skill within any particular EMC's product area, such as cloud computing or content management.

Todd Forsythe, VP of Global Marketing, EMC says after implementing Badgeville, they in less than 6 weeks time, which was very effective for a company of that big size. In addition to suggesting a flexible platform that was compliant to their needs, Badgeville proved to be incredibly consultative in the process. By using Badgeville EMC felt that they had an expertise with regard to how to combining gaming theory to drive community behaviour and community engagement.

4.5.1.1 The Business Results

Since building and layering Badgeville's Game Mechanics on top of its Jive-based ECN Community, EMC has seen a 21 % increase in overall user activity, including lift in these key behaviours:

+10 % documents created
+10 % visits
+12 % page views
+15 % replies to discussion threads
+19 % files downloaded
+41 % videos watched.

4.6 Co-Creation Value Platform: Value Points Platform

The FT.com has one million daily digital readers, but among them only 300,000 are subscribed readers. The remaining potential subscribers could be actively reading either the monthly eight free articles provided by FT.com or using other services on FT.com. In order to convince those potential subscribers to subscribe we would need to convince them that they will receive an excelled value for their money and also they will be truly a part of a highly valued FT community, which

rewards the users engagement. At the moment there is currently no reward system on FT.com for users engagement.

Since the FT's business mostly replies on the subscriptions and the advertisement, they need to keep the standard programme keep running. In order to try out the new experiments with user engagements, FT has setup a new cross domain team called strategic products to deliver an experimental idea to the market very quickly and in turn measure it's success quickly. The prototype of gamification of the FT website is aimed to be delivered in 4 weeks. After the beta version delivery to the selected users, if proven successful it will be added to the other teams backlog to develop it into a full-blown solution. The aim of the gamification is to improve the user engagement. Although there are readily available solutions for ramifying the behaviours in the website, due to the complex integration effort, the team decided to develop quickly a small system to provide the gamification support.

Following are the basic requirements of the gamification system

- The commenting about the article should be given 10 points.
- The sharing of the article on each social platform should be given 5 points.
- The users points should be totalled and given either achievement badges or reward vouchers.
- The new feature to be AB tested on UK region for the premium subscription users.
- Google analytics should be integrated to capture the metrics.
- User behaviour monitoring service.

The first prototype of the system was developed in LAMP stack and delivered with in agreed 4 weeks time. This new prototype was deployed only for the UK based, premium subscription users for evaluation purpose.

4.7 Measuring the User Engagement

Methods to measure user engagement can be divided into three main groups: self-reported engagement,

User engagement can be divided into three main groups:

1. Self- reported engagement: In this group surveys, questionnaires and interviews are used to provoke user engagement attributes or to generate user reports and to evaluate the engagement. They can be carried out with in a lab setting or through the various online platforms. However this method has its own demerits like dependence on user subjectivity, which can be biased.
2. Cognitive Engagement: This method uses task based approach like dual task, follow on task and psychologically measures to evaluate the thinking, rational and the intellectual engagement like the facial expressions, tone and the heart rate using the tools like the eye tracking, heart rate monitoring and the mouse

tracking. However this method also has a drawback, it is suitable for measuring only a small number of interaction episodes at close quarters.

3. Online behavior metrics: This method studies the user engagement through online behavior metrics that evaluates users intensity of engagement with a site. In this method we can know how long users spend time on the site, which part of the page they visit often, which country they are from and which browser they use, how often they comeback to a site, register or subscribe. Some of the metrics include click-through rates, number of page views, time spend on a site; how often users return to a site, number of users, and so on. Although this data cannot clearly explain why users engage with a service, they act as substitute for online user engagement: the higher and the more frequent the usage, the more engaged the user. Finally, although this group of measures is really accounting for "site engagement", we retain the terminology "user engagement" as it is commonly used by the online and consultancy industries.

This study uses the third group of metrics with the help of Google analytics and custom-built user behavior monitoring service tools

4.8 Evaluation

The new feature was studied using the Google analytics and user behavior monitoring service for a period of 1 month. The following are the observations,

- The average time spent by UK based premium subscription users has gone up by 4 % compared to the previous month.
- The activities on social media especially on Facebook have increased to 12 % compared to the previous month.
- The inbound traffic from Facebook has gone up to 21 % compared to the previous month.
- The number of UK premium subscriptions has gone up by 2 % compared to the previous month.
- The average number of users commenting on the top stories has gone up by 250 % compared to the previous month.
- Top rated individual has scored 365 points during the A/B testing period.

The user activities on the website has improved a lot and the articles are started to trend more on Facebook, which in turn brings in lot of new readers to the website. Also the 250 % increase in the average number of user commenting on the top stories is clearly a positive out of the prototype. We could also claim the new feature could have possibly contributed to the 2 % increase the subscription rates, although we don't have enoughevidence to support that claim.

4.9 Limitations

The reward platform is a very basic platform and the feature is very limited. The current FT's commenting system is not based on thread conversation style, which makes the readers to follow the comments conversation very difficult. Due to the budget and time constraints the prototype is not implemented with fully configurable support. The prototype has only focused on only two behaviors of the users (1- Commenting on articles and 2- Sharing of article on social media). There should be a configurable setup to add new behaviors to the system and also the attached points to the new behavior. Although the prototype has a basic Google analytics and user engagement monitoring service, its flexibility is very limited and there was no real time analytics support provided by this system.

4.10 Recommendations

The findings from the prototype were encouraging and it has shown a good sign of improvements to the user engagement with the FT content. The prototype should be expanded and the user earned points should be Integrated into a highly valuable third party voucher redeem system like Group-on to appreciate the co creation value contributions by the users. The user behaviour data should be collected and processed as a big data to find out more accurate information about the users behaviour. Thus processed big data information should be used to provide a highly customised and valuable content to the users to provide high value for their paid subscriptions. Also from the initial findings it suggests that the high user engagement rating directly increases the paid subscriptions rate. Therefore FT should setup a separate full time cross-domain user engagement team to drive more value to the business.

4.11 Conclusion

The cross-domain team of FT's strategic products has delivered a quick co-creation value platform for the users to interact with the content by delivering the value points. The result of the study suggests the positive relation between the rewards and the co-creation to drive more user engagement. Although the prototype is not giving users any monetary rewards at the moment, but still the users are earning their points and badges by commenting and sharing the articles. The prototype is only implemented for the commenting and sharing behaviours; it still yielded 2 % more user subscriptions compared to the previous month. The study shows clear benefits in setting up a full time team to implement user engagement strategies. Also, the content providers should collect all these user behaviour data as part of

their big data and in turn they could use these information to target their users with the right content and right advertisement. There is no doubt that the premium content provides based on subscription and advertisements should clearly adjust their user engagement strategies in the coming years in order to stay competitive in their business.

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Chapter 5
Inquest for Competitive Factors of Restaurant Information Services

Does Evaluation Information Matter?

Hidenobu Sai

Abstract "Restaurant information services", which provide information about restaurants, have recently caught the attention of the public. In this study, we examined competitive factors, which are the criteria by which consumers choose one service over another and influence competition, of these services. Especially, we focused on the importance of evaluation information. To this end, we investigated the case study of Japanese restaurant information services from the perspective of costs for information behaviors. Based on the analysis of this study, we presented four hypotheses and scenarios about the future of restaurant information services in Japan.

5.1 Introduction

The development and diffusion of information and communications technology (ICT) has led to changes not only in the concepts and forms of companies and businesses but also in the roles of consumers. Inexpensive means of communication and information delivery have allowed consumers, who used to primarily *receive* information from companies, to voluntarily *send* information. Some companies have changed their conventional business model and now provide new services using information gathered from consumers which can then lead to further changes for consumers.

Among these new services, "restaurant information services", which provide information about restaurants, have caught the attention of the public. Information about restaurants was traditionally provided by print media, such as magazines and guidebooks, and broadcast media, such as TV and radio. However, restaurant

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information services using ICT have the advantage of interactivity and retrieval compared with previous services and are now very popular.

Although the first restaurant information service in Japan to use the Internet was started in 1996, several major services appeared from the late 2000 s, and they are now fierce competitors. In this competitive environment, consumers are demanding more to services, and their criteria by which consumers choose one service over another are changing. And consumers' attention to evaluation information has been particularly increasing.

In this context, the purpose of this study was to examine the importance of evaluation information in restaurant information services. For this purpose, we used a case study of restaurant information services in Japan as well as data collected via questionnaires and surveys conducted by Internet research companies. Finally, we propose four hypotheses about the future of restaurant information services in Japan.

5.2 Knowledge Management and Information Services

Knowledge management is similar to an information service. Reflecting its broad scope of application, a number of different definitions of knowledge management have been proposed. Quintas et al. [1] reviewed the broad domain of knowledge management and defined it as "the process of continually managing knowledge of all kinds to meet existing and emerging needs, to identify and exploit existing and acquired knowledge assets and to develop new opportunities." From the viewpoint of management information systems, Laudon and Laudon [2] defined knowledge management as "The set of processes developed in an organization to create, gather, store, maintain, and disseminate the firm's knowledge." Today, however, as claimed by Chesbrough [3], the need for service innovations blurs the boundary between company and its "outside," expanding the scope of knowledge management to beyond the confines of the company.

Knowledge management focusing on areas outside the company shares several features with information services. Knowledge management is a process designed to increase the value of corporate behavior by providing knowledge. On the other hand, information services are businesses designed to gain benefits by offering information that fits users' needs. Thus, information services seek to acquire and gather information, to organize information to fit user purposes, and to offer the organized information to users. Several of these information behaviors are common to both knowledge management and information services.

The information behaviors require some costs as Sai [4] mentioned. Among them, costs of information acquiring and gathering are particularly important. A company generally pays for the costs associated with an insider acquiring and gathering information for purposes of knowledge management or information services. On the other hand, use of information offered by those outside a company (e.g., consumers), which is a practice followed, for example, by Yelp.com and

YouTube, enables companies to save substantially on the costs associated with information acquisition and gathering.

Additionally, the costs of organizing information are also important as the information that is gathered must eventually be organized. The degree to which information is structured affects the costs associated with organizing it. Although well-structured information can be organized easily, organizing non-structured information costs more. When information is offered intentionally, it is possible to increase the degree to which it is structured by providing a fixed form on which it is submitted. In contrast, if information is offered incidentally (e.g., based on a certain action or transaction), such as "big data," which has been attracting attention in various fields, the degree to which such information is structured is typically low.

Thus, it is useful to analyze knowledge management or information services from the perspective of who offers the information and whether it is offered intentionally.

5.3 Types of Restaurant Information Services

Restaurant information services generally involve three players: the restaurant, the consumer, and the service provider. The service provider offers information about restaurants to consumers, and consumers who receive the information decide whether to visit a restaurant.

What is important here is the source of the original information about the restaurant. Restaurant information services can be classified into three types according to who offers the information.

In the first, the restaurants themselves offer the information. We refer to this type as "type CA" (classified ad). Restaurant information services of this type serve as intermediaries between restaurants and the public; hence, the major income for the service provider is a fee from the restaurant. Negative information regarding the restaurant does not appear in type CA services because information is offered by the restaurant from its own perspective.

The second type of restaurant information service involves information from consumers. We refer to this type of restaurant information service as "type CGM" (consumer-generated media). In these instances, the service provider generally gathers information, including word-of-mouth (WOM) information, from consumers, and the service provider profits from advertisements directed at consumers. The information offered in this type of service includes both positive and negative information about the restaurants as the information is from the consumer's viewpoint.

Information offered in the third type of restaurant information service is acquired and gathered by the service provider through its coverage of restaurants. We refer to this type of service as "type GB" (guide book). There are several business models for type GB. Some type GB service providers charge for

advertisements to consumers; others charge fees to the restaurants. Some services sell information they have gathered as paid content, in the same manner as the Michelin Guide. Information offered in this type comes from the service provider's perspective. Thus, it is difficult for the service to offer negative information about restaurants when their major source of income is fees paid by restaurants.

These three types of restaurant information service may be idealized, and service providers actually in business may use information from several sources. Indeed, the major restaurant information services in Japan—Gurunavi, Tabelog, and Hot Pepper Gourmet—combine information from several sources. In terms of the aforementioned typology, Gurunavi is fundamentally type CA, Tabelog is fundamentally type CGM, and Hot Pepper Gourmet is fundamentally type GB.

5.4 Related Researches on Restaurant Information Services

Although there is little research about restaurant information services, a few researches related with Yelp.com which classified as type CGM are found. Luca [5] and Anderson [6] show that Yelp.com has great impact on restaurants because a rating offered by Yelp.com makes consumers' behavior change .

If information offered by restaurant information service can influence consumer, it seems reasonable that restaurant of type CA or service provider of type GB has motivation to offer information about restaurant. However, researches about information-offering by restaurant to restaurant information services cannot be found. On the other hand, there are some researches concerning consumers' information-offering as occurred in type CGM.

There has been no study that tried to identify factors affecting consumers' choice about restaurant information service. However, in area of general information services including e-commerce, several studies have been made on factors which consumers consider as important from a viewpoint of service quality and information quality. Ladhari [7] reviewed researches on service quality of services using Internet and clarified six common dimensions: reliability/fulfillment, responsiveness, ease of use/usability, privacy/security, web design, information quality/benefit. Especially, information quality becomes important factor for pure service offering information only such as web portal services including restaurant information services.

Regarding information quality (data quality), Wang and Strong [8] defined data quality as "data that are fit for use by data consumers" and clarified 4 dimensions and 15 attributes of data quality. For restaurant information service, dimension of intrinsic data quality (believability, accuracy, objectivity, reputation) and contextual data quality (value-added, relevancy, timeliness completeness, appropriate amount of data) can be important.

5.5 Types of Information Offered by Restaurant Information Services

Although restaurant information services provide a variety of information, most of this information can be classified into four primary categories: identifying information, business information, evaluation information, and privilege information.

Identifying information can be used to distinguish one restaurant from another and does not change while the restaurant continues to do business. Information published in telephone directories, such as names, addresses, and telephone numbers, is included in identifying information. This category of information appears in telephone directories. In this study, category of restaurant is handled as identifying information because it appears in the *Town Page*, Japan's yellow-pages directories.

Business information is information about a restaurant's business operation, and this type of information changes more frequently than identifying information. Business information includes a restaurant's operating hours, menu, and pictures of dishes and interiors. Not surprisingly, the restaurant has its business information exactly, and the cost for information acquiring is nearly free. In contrast, because service providers and consumers operate outside the boundaries of restaurants, they would incur higher costs if they were to try to acquire such information on their own as they would typically need to visit the restaurant to do so. Additionally, compared with information acquired by a type GB service provider, which specializes in data acquisition and reporting, the information acquired by an untrained consumer is likely to be less accurate.

Evaluation information represents evaluators' subjective impressions of a restaurant, and typically comes in forms such as WOM comments or ratings. Evaluation information is less accurate and credible because it is originally non-objective information. The evaluation information offered by a restaurant is not welcomed from consumers because it comes from restaurant's perspective. Similarly, evaluation information offered by service providers may be suspect because the latter may provide only positive information about a restaurant in the expectation that this will lead to benefits from the restaurant. Evaluations offered by different consumers do not necessarily differ from one another in terms of objectivity. However, if enough evaluation information is offered by consumers, other consumers tend to consider that the overall objectivity of that information to be high.

Privilege information is information that can help someone obtain economic benefits at a restaurant. This would include coupons for free food or discounts. Although the restaurant ultimately determines whether to offer privilege information, the type of service provider also has a substantial influence in this regard.

In Japan, Hot Pepper Gourmet, a type GB service provider, is well-known for its privilege information, and Tabelog, a type CGM service provider, has the advantage in evaluation information. It is said that Gurunavi's business information and privilege information are valuable.

5.6 Changes in the Competitive Factors of Japanese Restaurant Information Services

The first restaurant information service in Japan to use the Internet was Gurunavi, which started operations in 1996. Although other restaurant information services appeared after Gurunavi, the other current industry leaders, Tabelog and Hot Pepper Gourmet, started operations in 2005. These three services are the major restaurant information services in Japan today, and they are intensely competitive.

In this study, we refer to the criteria by which consumers choose one service over another as "competitive factors". Competitive factors are influencing competition, and more than one competitive factor may exist in one competition.

Whereas Gurunavi is now classified as type CA, it used to be type GB, collecting fees from restaurants. At that time, Gurunavi company staff visited restaurants and acquired information and entered it in the service (Taki [9]). Thus, given the conditions and technology available and the limited managerial resources at that time, there was a trade-off between increasing the number of registered restaurants and improving the information about each restaurant.

To overcome these obstacles, in 2001, Gurunavi developed a system by which restaurants contracting with Gurunavi could enter information themselves. The introduction of this system transformed Gurunavi into a type CA operation. As a result, Gurunavi could focus its managerial resources on increasing the number of registered restaurants, and that number did, in fact, increase.

On the other hand, an issue arose over the wide range of information offered for each restaurant. Some restaurants offered business information to the maximum extent allowed by the Gurunavi system, and others provided only the minimum information. This was because each restaurant entered its information by itself.

In 2005, Tabelog and Hot Pepper Gourmet started their operations. Like the former Gurunavi, Hot Pepper Gourmet, operating as a type GB, was also restricted by limited managerial resources with respect to increasing the number of registered restaurants and improving the information offered for each restaurant.

Hot Pepper Gourmet, however, was able to use information from other services managed by the same operating company. This information was derived from the *Town Page* and included identifying information about almost all the restaurants in Japan. As a result, Hot Pepper Gourmet could offer extensive business information, acquired through its original reporting, about a limited number of restaurants as well as identifying information about many restaurants. In competition with Hot Pepper Gourmet, Gurunavi started offering information about restaurants that did not pay it a fee by using other information sources, including the *Town Page*, in 2006.

At Tabelog, a type CGM, the trade-off between increasing the number of registered restaurants and improving the information provided about each restaurant did not emerge from limited managerial resources but from issues related to the number of service users. Thus, the information offered by Tabelog was limited when it began the service and had few users. Subsequently, the increase in users led to an increase in the number of restaurants registered with Tabelog,

which became comparable to that registered with the two other major services. Additionally, as with Gurunavi, a wide range of information was offered about each restaurant because of the nature of a type CGM operation, which depends on information offered by consumers.

5.7 Importance of Evaluation Information

The appearance of Tabelog, which offers both positive and negative WOM comments about restaurants and evaluates restaurants via a five-star rating system, introduced evaluation information as a new competitive factor to Japanese restaurant information services. Table 5.1 presents some of the results of a questionnaire investigations focused on "searching for restaurant information" conducted by MyVoice Communications [10–12]. These investigations were conducted via Internet and Table 5.1 shows the important contributors to decisions about which restaurant information service is used. As the table indicates, the "number of WOM comments" was valued by about 30 % of all respondents, which was comparable to the number of respondents who considered the "credibility of WOM information" and the "evaluation of restaurant and dishes" to be important. These are all considered to be evaluation information.

Although Gurunavi and Hot Pepper Gourmet started to provide evaluation information in response to this new competitive factor, it is difficult to determine whether these services are fully functional. Indeed, Accumulation of evaluation information from consumers is not enough because both services collect fees from restaurants, rendering the provision of negative information about restaurants problematic. The aforementioned investigations revealed that the difference between the utilization ratios of Gurunavi and Tabelog decreased rapidly from 2010 to 2011, and some reports show that Tabelog actually overtook both of the other services during this period. In fact, the number of unique users per month of Gurunavi and Tabelog had been 20 and 12.35 million in December 2009, however, they were 34 and 40.95 million in December 2012. This changeover may have reflected users' preference for evaluation information.

Problems with the information on Tabelog were reported in January 2012, turning the use of evaluation information as a competitive factor into a social issue. Specifically, it was revealed that bad actors had entered fake information, including highly positive evaluations of specific restaurants, in exchange for fees from those restaurants. After this revelation, Tabelog implemented a range of measures including the certification of consumers intending to offer information.

A survey regarding the credibility of WOM information conducted by PR Times after this problem was identified found that negative opinions of such information had increased rapidly [13]. MyVoice's investigations of important contributors to decisions about restaurant information services also found that opinions about evaluation information had become more negative in 2012.

Table 5.1 Important factors in choosing restaurant information services (MA)

	March 2010 (n = 9032) (%)	August 2011 (n = 8847) (%)	August 2012 (n = 6939) (%)
Number of registered restaurants	36.29	35.31	42.91
Variety of search modes	27.04	21.84	23.44
Ease of searching	41.16	35.03	39.02
Comprehensibility of sites and pages	29.37	24.03	27.66
Number of WOM comments	32.33	32.89	29.90
Credibility of WOM information	–	22.00	21.63
Richness of restaurant information	33.49	27.56	27.75
Privileges, such as discount coupons	35.44	37.91	36.05
Reservations online	6.59	5.89	5.96
Ranking of restaurants	5.08	6.65	6.47
Evaluation of restaurant and dishes	22.74	23.40	21.01
Number of users	7.07	6.53	6.69
Sending information, such as mailed magazines	1.47	1.55	1.62
Fewer advertisements	1.64	1.68	1.72
Locality	–	6.59	5.55
Other	5.98	4.88	4.38

Note Responses of not using restaurant information services is excluded in advance
Source Investigations conducted by MyVoice Communications [10–12]

However, no major differences in the utilization ratios of Tabelog before and after the fake information revelations were publicized were observed.

If this problem had not occurred, utilization of Tabelog may have increased further. Instead, a decline in utilization may not have occurred because evaluation information is not that important to users. Table 5.2 shows top 10 frequently used information provided by restaurant information services based on results of aforementioned investigations by MyVoice communications. These investigations found that identifying and business information were ranked more highly than evaluation information. That is, consumers may not be using evaluation information so much in fact. Assuming that evaluation information is not critical competitive factor, it will mean that recent growth of Tabelog was brought about by other factors. In terms of type CGM information services, which offer information provided by consumers, an increase in the number of users tends to improve the amount and recency of the information available. Thus, Tabelog may be able to ensure that it offers the quality and quantity of business information that is really needed by users because it already has a sufficient user base.

Table 5.2 Top 10 frequently used information in restaurant information services (MA)

	Types of information	March 2010 (n = 9032) (%)	August 2011 (n = 8847) (%)	August 2012 (n = 6939) (%)
Place of restaurant	Identifying	79.37	74.52	75.89
Price range	Business	64.39	63.92	63.22
Category of restaurant	Identifying	58.08	58.00	56.56
Menu	Business	50.17	49.78	52.23
Operating hours	Business	48.18	44.72	51.53
Coupon	Privilege	36.86	29.73	30.29
Picture of dishes and interiors	Business	28.13	28.11	28.95
WOM	Evaluation	25.60	19.66	19.90
Special offers and benefits	Privilege	24.38	20.11	19.59
Recommended dishes	Evaluation	21.00	19.55	19.55

Note Responses of not using restaurant information services is excluded in advance
Source Investigations conducted by MyVoice Communications [10–12]

5.8 Four Hypotheses about Evaluation Information and Restaurant Information Services

The appearance of Tabelog and its success illustrate the importance of evaluation information as one of competitive factors in restaurant information services. However, consumers have also reported a decrease in the credibility of such evaluation information due to Tabelog's fake information troubles. At present, the issue of whether evaluation information is a critical competitive factor that is more important than other competitive factors remains open for discussion. According to researches of service and information quality, not only quantity but also quality of information can be important.

If evaluation information were a critical competitive factor, two hypotheses would follow. The first is that improving the quality of evaluation information, especially credibility or believability is important. Achieving this would require introduction of an architecture that does not permit users to intentionally offer inappropriate information.

Retty, an emerging restaurant information service in Japan, uses Facebook accounts for user registration. As a result, it is said that about 90 % of Retty's users do in fact use their *real* names when offering information. Retty specializes in the provision of identifying and evaluation information about restaurants. Although the credibility of Retty's evaluation information is higher than that of Tabelog's, its accumulation of evaluation information is not yet sufficient. For this reason, the trajectory of Retty's future may reflect the importance and credibility of evaluation information.

The second hypothesis is that the quantity of evaluation information is important. When enough information is offered, any fake evaluations can be rejected based on consumers' judgments. Thus, the amount of evaluation information accumulated by a service affects its competitive edge. The introduction of

appropriate systems architecture is an important way of encouraging users to offer information. The function to rate users based on the amount of information they offer and the availability of a user interface that eases the burden of inputting evaluation information are effective approaches in this regard. If this hypothesis is validated, Tabelog will grow more than ever because of its huge quantities of evaluation information.

Based on the types of information that consumers really use, it may be that it is enrichment of business rather than evaluation information that offers the greatest competitive edge. Two additional hypotheses emerge from this assumption.

The third hypothesis is that the quantity of business information is important. If this is true, it may indicate that Tabelog's recent growth comes not from the quality or quantity of evaluation information but rather from the amount of business information, which is offered by many users. It is difficult for a type GB operation, which monitors and reports on restaurants, to acquire and gather a substantial amount of information due to limited managerial resources. A type CGM operation, in which consumers offer information, and a type CA operation, in which restaurants enter information, have advantages over type GB with regard to gathering business information.

Gathering of large amounts of information is facilitated by having many information suppliers (i.e., consumers in type CGM and restaurants in type CA operations) and by introducing an architecture that encourages these sources to offer information. Type CGM operations have an advantage over type CA operations with regard to the number of information suppliers as the number of consumers is larger than the number of restaurants. For this reason, if consumers who place a high priority on the quantity of business information are dominant, Tabelog, a type CGM service, would be expected to have higher potential than would Gurunavi, a type CA service.

The fourth hypothesis is that the quality of business information is important. Regarding the accuracy of business information, however, a type CA operation has an advantage because the restaurant itself offers its own information to this type of service. Additionally, because the restaurant, the information supplier, is the source of the information, a type CA service can offer information that is current and accurate. To ensure the information continues to be accurate and current, it is important that the restaurant itself enters updated information on a frequent basis. Introducing a user interface that eases the burden of inputting information can encourage restaurants to enter current information more frequently.

However, it can be difficult for a busy restaurant operation to offer information frequently. To address this, information generated incidentally through restaurant operations should be included in the database after it is processed. For example, linking a POS system from a restaurant to a restaurant information service can provide information about dishes without additional inputs of information.

If many consumers think that the quality of business information is important, Gurunavi, with more frequent information inputs from restaurants, may have an advantage over Tabelog.

5.9 Conclusions

In this study, we examined the importance of evaluation information for restaurant information services. For this purpose, we classified restaurant information services into three types in terms of the identity of information suppliers and also classified the information offered by these services into four types. Additionally, we analyzed changes in the competitive factors in Japanese restaurant information services. Although the role of evaluation information in the competitive process has recently been the focus of attention, changing this situation may be attributable to the problems with fake information revealed in 2011. Moreover, the results of some investigations suggest that business information is used more frequently than is evaluation information.

On the basis of these findings, we propose four hypotheses about the critical competitive factor in the future competition among restaurant information services. This study presents a hypothetical scenario, which should be confirmed in the future. For that purpose, the study from a viewpoint of what kind of information and information quality is actually needed by users of restaurant information services is especially required..

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Chapter 6
Cocreation and Implementing ITIL Service Management in the Cloud: A Case Study

Ronald Stanley

Abstract Is it possible that "Cloud" is sometimes possibly being misused when "Centralised" would be a more accurate term in specific instances? This paper examines a case study of an implementation of an ITIL based Service Management System which is delivered under a Software as a Service (SaaS) model and views the implementation in terms of its alignment to the currently accepted "Cloud" (or conversely "Centralised") model. This paper then goes on to propose what factors might be examined in the future to push the current system implementation further into the Cloud model and how the issue of Customer Cocreation of Value interacts with this background setting for the current system implementation as it stands at the point in time of the writing of this paper.

Keywords ITIL · Business process outsourcing · Centralisation · Cloud computing · Cocreation · Outsourcing · SaaS · Service management · Software as a service

6.1 Introduction

What is Computing Centralisation based on a Software as a Service model versus what is true Could Computing? In practise there are characteristics that align an implemented system as being primarily within the realm of one or the other at any point in time and status can also evolve over time for any specific system instance. This paper in the form of a Case Study examines a practical implementation of an ITIL (Infrastructure Technology Information Library) based Service Management system by IBM Australia which is delivered as an SaaS based solution, marketed

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to customers on the basis of IBM hosting the software and hardware 'stack' centrally with customer having the option for IBM to undertake the entire Business Process Outsourcing for the core ITIL Transactions, or the customer being able to select a model whereby their own staff undertake the transactional processing. This paper examines the implementation as it currently stands at this point in time from the joint interaction of ITIL, Cloud Computing and Customer Cocreation experience for the customers. This paper begins with a brief review of Cocreation, ITIL and Cloud Computing. The next section introduces the concept of cocreation of value followed by the case study itself and the paper then concludes with suggestions for further research.

6.2 ITIL

Citing the ITIL Official introduction itself (OGC (2011)):

> "ITIL is intentionally composed of a common sense approach to service management—do what works. And what works is adapting a common framework of practices that unite all areas of IT service provision toward a single aim—delivering value to the business."

The value of ITIL is discussed at some length by Sugitani [16] while Fitsilis [7] defines the functional scope process area of ITIL: "Service support defines six processes to ensure that the customer has access to appropriate services to support the business functions. These key processes are: Configuration Management, Change Management, Release Management, Incident Management, Problem Management and Service Desk.

The second key process area is service delivery. Service delivery focuses on what service the business requires of the provider in order to provide adequate support to business customers. The service delivery process area consists of five processes, which are: Service Level Management, Financial Management, Capacity Management, Continuity Management and Availability Management."

6.3 Software as a Service (SaaS)/Could

At the outset it should be recognised that there are many differing definitions of "what is Cloud Computing?" A cursory search of the internet will yield very many results in an attempt to address this question but in the most brief definition Mell and Grance [10] define the 'Essential Elements' of cloud based computing on behalf of NIST to be : On-Demand Self-Service, Broad Network Access, Resource Pooling, Rapid Elasticity and Measured Service.

Mell and Grace [10] then go further to define the SaaS model for cloud based computing as having the following characteristics:

> "The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings."

Pricing models and therefore the methods of customer billing arises as an issue as a result of the implementation of the Cloud paradigm with a "pay per Use' type model being often used in the Cloud Environment (Cisco [4]): "Pay for use makes users keenly aware of the cost of doing business and consuming a resource, since the cost comes out their pockets, or, in the enterprise world, their own budgets. And with awareness of the costs comes more efficient and selective usage, thus resulting in less waste and lower costs."

6.4 Implementing ITIL on a SaaS/Cloud Platform: Implementation Risk

It is at this point where the ITIL model and the SaaS models come into some conflict, that being in the space of the Management of infrastructure, since ITIL defines not only a prescribed series of business processes for the various core ITIL Transaction types (i.e. Service Request, Incident, Problem and Change transactions) but also Infrastructure Management aspects of the ITIL model [11] From a purely "End User" perspective the use or non-use of the SaaS model to provide the core ITIL Business Process functionality should not be apparent [10] but there is a key difference in the SaaS model in terms of Infrastructure Provisioning in that these ITIL processes are in effect "subcontracted out" to the Cloud Provider [2] with resulting introduction of risk from the perspective of ITIL compliance [9], with now introduced risk with the fact that this new risk must be managed in a different way than it would be had these service been provided "in-house"[3].

6.5 Cocreation

Understanding what customers value within a particular offering, creating value for them and then managing it over time have long been recognized as essential elements of firms' business strategy [6], while Porter [14] argued that a firm's competitive advantage stems from its ability to create value for its customers that exceeds the firm's cost of creating it.

Coates [5] argues that the aim of co-creation is to enhance organisational knowledge processes by involving the customer in the creation of meaning and value and that Cocreation also transforms the consumer into an active (rather than passive 'deal taker') partner for the creation of future value.

Historically services have been typically approached in a manner with the primary objective to seek cost reduction based on Service Standardisation rather than value maximisation for the customer [18] and that service mass production pursues the line that services are very difficult to standardise which is a problem to be overcome, but another view of the issue is that the actual lack of ability to standard services is characteristic that can actually be beneficial especially when this is directed towards using variation to providing added value to customer, potentially service value that customers may be willing to pay a premium for. This concept is discussed Song and Jiao [15] who express their views that "customer knowledge becomes ("an" sic.) important strategic resource of enterprise" and that this customer knowledge, especially when introduced at the product design phase can be used to gain an ongoing competitive advantage to the fir.

6.6 Case Study Asia Pacific IT Service Management Shared Hub

6.6.1 Background

The IBM Asia Pacific IT Service Management Shared Hub (hereafter referred to as simply the AP ISM Shared Hub) is a single instance of the Tivoli Service Request Manager software with the addition of the CCMDB (Change and Configuration Management Database) packaged software offering from IBM. The key aspects of note regarding this system in terms of product offering is that the software is provided in a SaaS mode for multiple customers on a single instance of the software. At the point in time of the writing of this article there are more than 100 customers live using the system primarily in a SaaS mode with the majority of the customer base utilising a Business Process Outsourcing model for the core ITIL End User Function Transaction types:

- Service Request Management
- Incident Management
- Problem Management
- Change Management

Having in excess of 100 customers using the same instance of the system with the NIST 'Essential Elements' of cloud computing [10] in the it allows Resource Pooling to reduce operating costs for the system and also Rapid Expansion of capacity for any one customer as required (also in alignment with NIST [10]).

For the large majority of the customer base IBM provides the management of the entire business process 'end to end' for these transaction types, however there are exceptions to this model, with a small number of customers using their own staff to directly log in using proxy server access to the same system with the ultimate customer's end staff using the system online in a Self Service manner with

browser based logins (i.e.' Broad Network' access) (both factors being consistent with the NIST 'Essential Elements' of cloud computing [10]).

First hand observation forms the basis of the content of this paper with the author being on-site during the period of time in which this system was implemented and in the six month period prior to the initial customer 'Go Live' in September 2010 and also during the subsequent two years during which time 100 plus customers were migrated from an obsolete Service Management system to the new AP (Asia Pacific) ISM (IBM Service Management) Shared Hub. During this time also the BAU (Business as Usual) support processes were established as well as the necessary governance structures and processes.

6.6.2 Support

A brief description of the support arrangements is made here in order to clarify the situation regarding outsourcing opportunities discussed later in this paper.

6.6.2.1 First Level Support

First Level support is broken into two separate arms, these being the need to undertake transactions for the direct customer and support issues, both being undertaken but the First Level Help Desk. Level 1 support activities include the following: Initial phone contact for all issues, IBM Staff System Administration and Training Related Queries. System administration related issued originated with the ultimate end customer are routed to the Second and Third Level Support Team Dispatcher for further action. Suspected faults in the system are also routed to the Second and Third Level Support Team Dispatcher for further action.

6.6.2.2 Second and Third Level Support (i.e. Application Level Support)

The following details the current responsibilities to delineate between Levels 2 and Level 3 support teams:

- Level 2 Support Activities

Customer End User System Admin, Data Load, List of Values Maintenance, Halted Process Recovery, Create new Email and SMS Notifications based on system events, Report Requests

- Level 3 Support Activities

Priority 1 and Priority 2 Incidents (short time turnaround required in order to satisfy customer KPI's (Key Performance Indicators)), Websphere Middlewear Support, DB2 Support, AIX Support, System Customisation, New Workflow Design, Security based activities

All Second and Third Level Support work is routed to a common dispatcher who allocates the work to the individual analysts based on priority and a combination of a knowledge of the individual team member's skills and current workload, noting that work priority is assigned on four levels with Priority 1 and 2 issues carrying tight Service Level Agreements (SLA's) with customers therefore these types of issues carrying a high profile through the support process.

6.6.3 ITIL Support Processes

In general terms the five ITIL support processes were either undertaken or coordinated by the combined Second and Third Level Support Team as custodians and front line of support for the system. All these items were being run in an effective manner in the 'background' without end user involvement (in accordance with the NIST (National Institute of Standards and Technology) model of cloud computing [10]).

6.6.4 The Business Process Standardisation Issue

The transaction types that are undertaken under the AP ISM Shared Hub model are very typical ITIL based functions, however because the software is provided in alignment with a SaaS model then the need for standardisation of Business Process is a factor for consideration with regard to the product offerings, considering the continuum between low cost/high standardisation (i.e. low customisation) approach versus a paradigm along the high cost/low standardisation (i.e. customisation).

In terms of cocreation relating to this case there is a line of argument that it would optimise benefits (and therefore cocreation opportunities for the customers and potential new customers) if the services were offered on the basis of customisation of service provision with resultant customisation of service charging, which is alignment with the concept of 'Mass Customisation' as detailed by Piller [12] along with a counter line of argument that the lowest possible cost of service provision is to provide zero service customisation which in effect transforms the model away from a Cloud based cocreation model into a low cost of service provision model based on simple centralisation [13] as is currently the case for the system as it stands at the point in time of the writing of this paper. Customisation of service in alignment with the mass customisation concepts in Piller [12] would

see a range of customised product offerings based on the core ITIL Service Management transaction types.

The term 'customisation' also does open the issue 'what is customisation of service?' and how far could customisation be undertaken from the current form of system implementation?

ITIL describes pre-defined transaction types with standardisation of business process, but this definition is rooted at the business process layer of the Business Architecture and extends only partially to the data level, this being List of Values, codification of transaction attributes etc. [11]. ITIL is quite prescriptive in terms of the types of the various transactions (i.e. Service Request, Problem, Change etc.), the core higher level processes to be undertaken and many of the fields of data to be collected and populated as part of the undertaking of the transaction in question. However ITIL does not generally 'drill down' to defining the actual data field values to be used for the field codifications as being required (although there are some "suggested" models presented in the ITIL OGC publications). For many end user groups these "list of values" are the simplest level in the customisation layer. Above this lies screen based customisation which end user groups would typically request in order to make the core entry of data easier (i.e. faster while maintaining their key data requirements) and above this layer again would be the customisation of workflows, which would have to be undertaken very carefully in order to remain ITIL aligned as ITIL generally describes transaction process workflows down to a fair level of detail [11].

Smaller customer firms would typically seek to combine multiple steps in order to shorten the "end to end" process, therefore accruing time (and therefore long term cost) savings and these cost saving would represent true value to such customers who would therefore be willing to pay for the right to receive this service. The same logic applies to those customers for who IBM undertake the actual end user operation of the system; presumable higher levels of service (i.e. quicker response times in transactional processing and also conceivably in technical support) would deserve premium pricing for the service.

6.6.5 End User Training/Screen Based plus Business Process Based Training i.e. the Ability of the Customer to Cocreate

End User training was seen as a routine issue initially since the staff actually undertaking the daily operation of the system were the long term ITIL experienced IBM staff, but once the customer End User staff had commenced undertaking the actual screen based data entry and daily operation of the complex process especially around the 'ITIL Change Management' transactions it become apparent that training was required not only at the screen based levels but also more importantly at the business process based level. Training materials were drafted and training

conduced in response to this need. This training did serve to assist in allowing customers to be more able to readily participate positively in cocreation opportunities centred around the usage of the system. This concept of 'readiness for cocreation' is explored in the paper by Wang, Hsieh and HsiuJu [17].

6.6.6 Costing/Billing/Service Levels

Billing for the use of the AP ISM shared hub was typically cost per transaction, with reports generated from the actual transactional database (via effectively a 'mirror' reporting system database) to form the creation of the invoice to the customer in alignment with the NIST model of cloud computing [10].

6.6.7 Outsourcing of Point Specific BAU Activities

Once the AP ISM Shared Hub system had gone through the process of build, commission, 'Go Live' and then into Business as Usual (BAU) mode the process of the transition of the 100 plus existing customer base on the incumbent system was commenced and after a period of approximately 18 months this process had been substantially successfully completed.

Replacing the old incumbent system with a newer technology based 'like for like' system as far as possible had been the first objective. Another guiding principle was that the newly implemented system had to be able to offer much more in terms of future potential usage for customers, but in the initial stages cost containment had been the prime focus. In this environment the opportunities for cost reduction based on outsourcing overseas (i.e. 'off shoring') of some of the more standard processes required to undertake the support of the system had commenced. The initial areas reviewed for off shoring were the support of the Websphere Application Server support elements at the system level (not application level) and DB2 Database support (again at System level and not at the Software Application level), this being logical since the ISM System uses both these elements in a very standard manner requiring very standard support models. At the time of the writing of this paper consideration was being made as to whether it would be cost effective to outsource the Second Level support to provide further cost savings however this process has not yet been concluded.

6.6.8 Future

Future areas of ongoing study to this case study would be as follows:

Investigating the Outsourcing results over time since there is the presumption that the Outsourcing opportunity does allow cost reduction therefore altering the value proposition of the AP ISM Shared hub more attractive to those price sensitive customers, but then there may be potential adverse effects from any 'off shore' based (or 'in shore' based for that matter) outsourcing which could include issues such as:

- Decreased control and agility of the BAU operation
- Increased management overhead to manage the outsourced functions
- Possible customer impacts

At the point in time of the writing of this report these points are supported only by anecdotal evidence and conjecture, so thorough investigation would be the logical next step to pursue in order to quantify these and other associated issues surrounding outsourcing of the various BAU elements of the AP ISM shared hub.

Pursuing the investigation as to whether customers would value the ability to customise their end user usage of the AP ISM Shared Hub enough to make this economically viable is an option. There is the possibility that at least some customers may value a customised set of business processes as a business enabler of some form and as a result in these circumstances then the provision of very standard processes at low cost may in fact not be an attractive value proposition option [15]. While this argument remains theoretical to a large extend at this point in time with regard to the specific instance of the AP ISM Shared Hub there has yet to be a comprehensive investigation into the possible options to cocreate with potential customers. It could be argued that the current implementation while satisfying the NIST Cloud Computing 'Essential Elements" as put forth by Mell and Grance [10] it does however currently potentially has not explored potential customer cocreation opportunities as fully as it may have been possible to do. There currently exists a line of argument that the system has 'centralised' the core end user functionality while providing a cloud based underlying platform able to run SaaS services and that customer cocreation opportunities might not be fully maximised until the core end users software layer of the system also offers the same types of flexibility as the underlying platform layer.

6.7 Summary

The AP ISM Shared Hub in its current form has generally been a successful implementation for IBM in terms of migrating an existing customer base from an incumbent obsolete system of similar base scope into a modern supported platform, that is; in technical migration terms. However, in terms of realising Cocreation experiences with the existing (and also potentially new customers) this avenue has yet to be explored although it does represent a logical next step in terms of the lifecycle of the application.Working with customers (existing and

potentially new customers) through the various elements of the processes that are currently undertaken by the system and then to go the step further and to attempt to assign customer value to this type of service were it to be customised (or customisiable) in order to more fully understand customer preferences as per the concepts outlined in Babb [1] and therefore maximise the opportunities for customer cocreation experiences is the next logical step from the perspective of Cocreation. This must be weighed against the counter argument that in pursuing a customised path that additional costs would be incurred in order to provide this additional service and this point is discussed in Kumar and Telang [8], costs not only for the initial work to undertake the actual customisation in itself, but also the ongoing BAU costs for multiple process and the effects that this would have on system upgrades into the future.

6.8 Special Note

For reasons of commercial confidentiality no specific information regarding financials nor individual end customer firms is detailed in this paper and the information provided is limited to information that could be sourced from public sources and/or material presented freely or freely available at industry shows.

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Chapter 7
An Ontology-Based Advisement Approach for SOA Design Patterns

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Abstract In order to address the practical requirements in SOA design and implementation, this paper proposes an ontology-based approach for SOA design pattern advisement. The state-of-the-art SOA design patterns are formalized with ontology in order to be selected by the algorithm, according to user requirements. With refined results of the algorithm, the final advisement is presented to the users. Experiments show that our approach achieves the minimal set of appropriate patterns and meets the demand of an advisement system in the field of SOA design.

Keywords CP · Ontology · Recommendation system · SOA

7.1 Introduction

SOA is an architecture model for improving agility and cost-effectiveness of enterprise. It expresses conflict-handing logic through service, the main mean of expression, which can be called, published and discovered. Besides, service is abstracted from a single interface implementation that based on standard form [1, 2]. Design patterns sum up the solution of many problems in software design, is the common solutions of general issues [3]. Selecting the appropriate design pattern will reduce analysis overhead of software design, shorten the software development cycle, and improve the quality of software.

Since SOA has preferable application prospects, it has become an important mean of software development in many famous IT companies [4, 5]. The difficulty that how to determine the appropriate classification of patterns, finding the suitable design pattern for the actual demand, has become an unavoidable issue in the

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software development process based on design patterns. In practical applications, selecting design patterns manually results in the inefficiency of pattern selection. Therefore, automated tools are needed to help software developers choose the category and the appropriate design patterns effectively.

Recommendation system [6] recommends the project that users are interested in. Huang [7] proposed an uncertain neighbors' collaborative filtering recommendation algorithm, which can effectively leverage the result in uncertain environment. Chen [8] proposed a recommendation algorithm of user clustering based on social network. This algorithm could generate better recommendation result in sparse datasets and cold-start scenarios. Pan [9] proposed an algorithm of service classification and recommendation based on software networks, which classify services accurately and recommend the more meaningful service. Liu [10] proposed an approach of RGPS-guided on-demand service organization and recommendation, for finding the service that have diverse requirement. Based on the above research, the restore of data does not have a unified standard and relationship, and the needed constraints are not considered. Furthermore, SOA design patterns were just proposed recently [14], there is a little research of them. Therefore, this paper proposes an ontology-based advisement approach for SOA design patterns, storing the needed data by using ontology that have rich ability of knowledge representation and high-performance automatic reasoning mechanism [11–13], making the description of data have fixed standard. Otherwise, the modified algorithm of CP(Constraint Program) satisfies the higher constraints, improves the efficiency of CP, and provides a better effect of recommendation. There will be great significance for the developers of using SOA.

Description of SOA design patterns in Ref. [14] are based on natural language, so that there is a deviation or amount of ambiguity in different users' understand, resulting in the deviation in design pattern selection. The ontology can not only storage data, but also offer a formal description to SOA design patterns, so it lays the foundation for matching with the requirements of user. The main goals of this paper are listed as follows: (1) Describe SOA design pattern formally, and establish an ontology knowledge base of these patterns by using related ontology technology. (2) Understand the characteristics and differences of each pattern by studying the semantics of SOA design patterns, and propose a theory framework of patterns selection. (3) Design a recommendation algorithm of SOA design patterns that is suitable for software developers. (4) Test and verify practically the description theory validity and formal semantics accuracy of SOA design patterns, analysis the accuracy of recommendation method based on the experimental results.

7.2 Formal Description of Soa Design Patterns

We describe SOA design patterns formally by using ontology. According to the analysis and summarizing of SOA design patterns, we propose the class hierarchy of SOA design patterns ontology, which is shown in Fig. 7.1. Firstly, according to

elements of patterns, they are divided into Single pattern and Compound pattern. In Single pattern, they are divided into Service self pattern and Service intermediate pattern according to the pertinence of problems. In Service self pattern, according to the lifecycle of service and its attributes or functions, they are divided into Service reuse patterthe example of compoundn, Service security pattern, Service implementation pattern, Service management pattern, Service design pattern and Service contract pattern. For service Intermediate pattern, they are divided into Service composition pattern and Service interaction pattern according to the association between services. In compound pattern, they are divided into Joint pattern and Coexistent pattern according to the style of combination.

7.2.1 Single Pattern

Definition 1 Single pattern (DPSingle). The design pattern that has independent function, and not contain existed patterns is called single pattern, represented by "DPSingle".

Single pattern consists of two parts: Service self pattern and Service Intermediate pattern.

7.2.1.1 Service Self Pattern

Definition 2 Service self pattern (DPService). The design method that describes properties, structure or function of service in service lifecycle is called Service self pattern, represented by "DPService".

Service self pattern consists of the following six categories:

(1) Service reuse pattern. This pattern is the design method that describes the ability to reuse and design standards of service. Such as: Enterprise Inventory, its function is such that the released service to maximize reuse.
(2) Service security pattern. This pattern is the design method that describes the security of Service internal information, input, and the setting of consumers' permissions. Such as: Message Screening, its function is to prevent malicious information from inputting in using service.
(3) Service implementation pattern. This pattern is the design method that describes the architecture, implementation way and implementation compatibility of service. Such as: Data Replication, its function is to ensure the autonomy of the service in the process of service requiring access to data resources.
(4) Service management pattern. This pattern is the design method that describes the way of service management and service evolution. Such as: Service

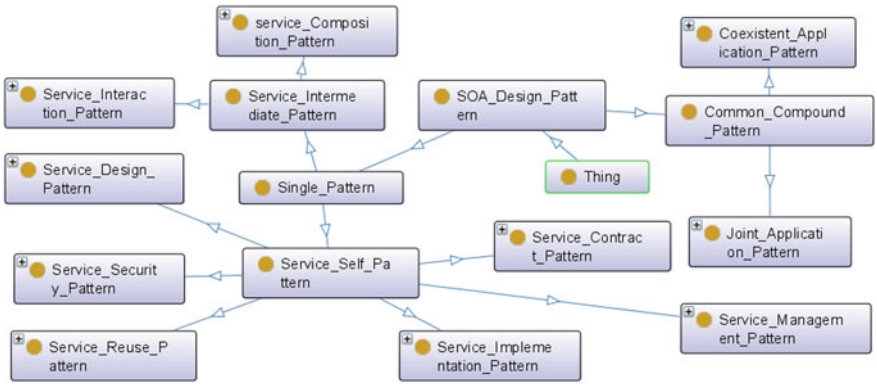

Fig. 7.1 The class hierarchy of SOA design patterns ontology

Refactoring, its function is to adapt the evolution of service without affecting the consumers.

(5) Service design pattern. This pattern is the design method that describes the coupling capability and designation way of service. Such as: Legacy Wrapper, its function is to reduce the coupling level of consumer program.

(6) Service contract pattern. This pattern is the design method that describes the designation and evolution ability of service contract. Such as: Compatible Change, its function is to ensure service contracts can be evolved or modified without affecting the consumer.

7.2.1.2 Service Intermediate Pattern

Definition 3 Service intermediate pattern (DPIntermediate). For n $(n \geq 2)$ services, The design method that describes the association between these services is called Service intermediate pattern, represented by "DPIntermediate".

Service composition pattern is used in the case of needing to solve the larger business logic. This kind of pattern solves the problems of designation, function and implementation of service in the lifecycle of service composition like service composition. Its function makes that patterns which have the same ability is helpful to multi-kind problems.

Service interaction pattern solve the problems that in the communication and calling between two or more services. For example, the interaction security pattern is the subclass of Service interaction pattern, Data Origin Authentication as an example, its function is to ensure that the source of the message is not tampered and correctness.

7.2.2 Compound Pattern

Definition 4 Compound pattern (DPCompound). The design pattern that combined by $n(n \geq 2)$ design patterns already exists in some way is called compound pattern, represented by "DPCompound".

Compound pattern is divided into Joint pattern and Coexistent pattern.

Definition 5 Joint pattern (DPJoint). The compound pattern that unite the component patterns, which are generally independent of each other, and use them together. This compound pattern is called Joint pattern, represented by "DPJoint".

For example, Official Endpoint is comprised of Logic Centralization and Contract Centralization. When interacting between service and consumer, to avoid using the wrong service, Logic Centralization brings that only call designated service specific to the process of appointed message, but the design pattern does not indicate how to get this service. For Contract Centralization, it can get service by published contract, but does not indicate which service needs to get in the processing of appointed message. Therefore, uniting the two patterns makes up the shortcoming of each other, which not only guarantee access to services for specific needs but also understand the selection criteria of the service. They each perform their own functions and fulfill their own duties independently without affecting others.

Definition 6 Coexistent pattern (DPCoexistent). For $n(n \geq 2)$ existed similar characteristics patterns, which can coexist in a compound pattern, one of these patterns can be selected to use according to current environment. This kind of compound pattern is called coexistent pattern, represented by "DPCoexistent".

For example, Service Broker is comprised of Data Model Transformation, Data Format Transformation and Protocol Bridging. In the process of interacting between services, Data Model Transformation is responsible for transforming different data model to same data model, Data Format Transformation is responsible for transforming different data format to same data format, Protocol Bridging is responsible for the connecting of different protocol. The coexistent pattern that comprised of them can use the corresponding function under different environment, so it broadens the practical environment and enriches the converted function.

7.3 Construction of Ontology Knowledge Base

In this section, we present a method to construct ontology knowledge base. We use protégé [15] to express organization structure of SOA design patterns. For each individual of patterns, we describe it by 8 data properties, as shown in Table 7.1. The establishing of data properties is on the basis of patterns' characteristics and

determined by the matched information which is needed in recommendation algorithm. The properties is determined by the union of the sets all patterns' properties.

In addition, we establish the object properties that are required between SOA design patterns according to the association between patterns in Ref. [6], increasing the degree of relevance between each pattern to achieve better recommended effect. Considering the object property is various, here we give some examples for the representative property.

Figure 7.2 shows the example of compound pattern's object property, which is represented by yellow dotted line. The object property is "is comprised of", means that Service Broker is comprised by Data Model Transformation, Data Format Transformation and Protocol Bridging.

Figure 7.3 shows the example of single pattern's object property. The dotted line of different colors represents different object property. For instance, the object property between Enterprise Inventory and Domain Inventory is "can be substituted for the repeated application of", representing that Enterprise Inventory and Domain Inventory is equivalent in function. The object property between Enterprise Inventory and Inventory Endpoint is "can be extended for external access via", representing that Inventory Endpoint can expand Enterprise Inventory by providing the access to the outside of enterprise.

The above data properties and object properties describe each pattern of SOA and associations between them formally, laying the foundation for the matching between patterns and users' requirements in recommendation algorithm.

7.4 Recommendation Algorithm

The recommendation algorithm specific to SOA design patterns faces the designer and the developer of software based on SOA. The input of this algorithm is the choice of user to proposed questions and the sorting choice of property value in CP. The output is the design patterns that according with users' requirements.

7.4.1 The Idea of Recommendation Algorithm

Since the requirements of users are represented in the form of natural language and there is not a fixed form. For this reason, this algorithm is recommended in the form of questions and answers.

Erenow, we illustrate some necessary sets and related definition in recommendation algorithm.

SetCPs: the set of recommended candidate patterns.
SetCQs: the set of completed questions currently.

Table 7.1 The illustration of data properties

Property name	Illustration
functionObject	The object that the function of this pattern specific to
solveObject	Some attribute that initiate this pattern execute its function
additionalCondition	The condition that initiate a problem this pattern need to solve
function	The function of this pattern
problem	The illustration of the problem that this pattern need to solve
solution	The illustration of method that this pattern use
application	The application scenarios of this pattern
impact	The impact that this pattern may trigger

Eg: Compatible change; functionObject: Service; solveObject: Service contract; additionalCondition: Changing of contract; function: A service contract can be modified without impacting consumers; problem: Changing an already-published service contract can impact and invalidate existing consumer program; solution: Some changes to the service contract can be backward-compatible, thereby avoiding negative consumer impacts; application: Service contract changes can be accommodated via extension or by the loosening of existing constraints or by applying Concurrent Contracts; impact: Compatible changes still introduce versioning governance effort ,and the technique of loosening constraints can lead to vague contract designs

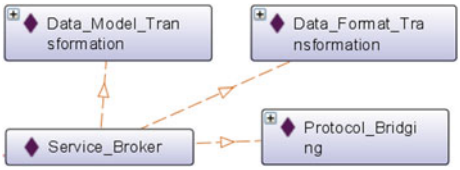

Fig. 7.2 Example of compound pattern's object property

SetFQs: the set of remaining questions currently.
SetRPs(p): the set of removed patterns for question p currently.
SetSs(p): the set of answer choices sign for question p, checked value is 1, otherwise, is 0.

Definition 7 FactorQ(p). p is a question, FactorQ(p) is the importance of p in all questions, $0 < \text{FactorQ}(p) < 1$.

FactorQ(p) = Per(functionObject(p))*Per(solveObject(p)/functionObject(p))* Per(additionalCondition(p)/solveObject(p))

X(p) represent the value of property X, Per(X(p)) represent the value that the percentage of the patterns that value of X is X(p) account for in all patterns of

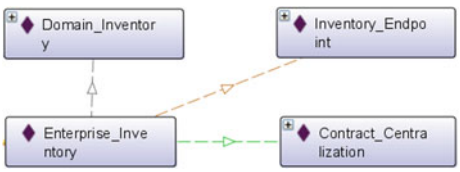

Fig. 7.3 Example of single pattern's object property

SetCPs, Per(X1(p)/X2(p)) represent the the percentage that the patterns of value of X1 is X1(p)account for in the patterns of value of X2 is X2(p).

When SetCPs is null, we need to delete the least important questions, so the sorting of questions by FactorQ(p) is a more effective way, and does not affect the final recommendation.

The designation of questions and answers are on the basis of functionObject, solveObject and additionalCondition, like the question p, "specific to service contract, what is the demand you need to reach when the contract is modified", the corresponding functionObject of p is "service", the corresponding solveObject is "service contract", and the corresponding additionalCondition is "changing of contract".

Firstly, sorting all questions according to the FactorQ(p). In the process of interaction, the algorithm removes uncorrelated patterns(matching with the data property "function") according to the choice of user. After that, the algorithm select the question, which matches with data property of current question, as the next question, so that it guarantees stronger relevance between questions. If there is not similar question, we need to compute FactorQ(p) again, because removing of patterns will affect the FactorQ(p) of remaining questions. After answering some questions, perhaps SetCPs will be null, we will show the completed questions. The user need to delete the least important question and the algorithm will ignore the influences of this corresponding answer. After completing all questions, SetCPs is the temporary result of recommendation. This method not only guarantee the dynamics of questions, but also all important questions have been answered. Consequently, the recommendation result will closer to users.

Because this algorithm is mainly based on the matching of "function", so in SetCPs, there will be some patterns that have similar functions. To simplify the result, we use the modified CP that is adapt to this study. In this paper, according to the patterns that are connected by object property "can be substituted for the repeated application of", we divide them into several equivalence classes of function and compute a Quantitative result aiming at the patterns of functional similarity.

We build a model for this problem and define several dependent sets. The set of variable: X = (X1, X2, X3, X4, X5). The set of variable's domain: D = (D1, D2, D3, D4, D5). The set of constraint: C = (C1, C2). D1 = { d1|d1 = n*r1, r1 = 1/num1, num1 is the cardinal number(the count of elements in a set) of functionObject's domain in set of similar patterns}, in the same way, D2, D3, D4, D5 correspond to solveObject, additionalCondition, problem and application, respectively. The reason to choose these properties is that they are the most important characteristics of each pattern. C1 is the constraint that the value of X need to correspond to some certain individual in the set of similar patterns. How to correspond to some certain individual, the processing method is to sort the priority of each value of every property. This operation need to be completed by user. It will be explained in the later example. C2 is the constraint that the cosine value of intersection angle between vector X and R (1, 1, 1, 1, 1) must be the biggest. The classical algorithm of CP is to solve each variable of X seriatim until the last one.

Based on the characteristics of this method, the remaining variable will be abandoned and assign the variate-value of correspond to this pattern to X when the selected partial solution of X can only confirm a pattern. In that way, we will get the complete solution of X, which reduce the running time and improve the efficiency. Besides, the method finds the biggest value of cosine in the process of the algorithm running, improves the constraint conditions and enrich the function of CP.

Give an example of CP as above, p1 and p2 are design pattern. The five attribute values of p1 is (p11, p12, p13, p14, p15), the five attribute values of p2 is (p21, p22, p23, p24, p25). Users sort each attribute value and that confirm each value of X. For example, for the first property, if user choose p11 firstly and choose p12 secondly, then D1 = {1, 0.5}. The X1 correspond to p1 is 1, the X1 correspond to p2 is 0.5. The same to other properties. For the same property, if there are several patterns that are same in this property, the value of this property will be displayed only once and Xi correspond to this property is equivalent between these patterns.

When the algorithm is over, the detail information of each recommended pattern, and the relationship between patterns will be listed. The user can understand these patterns by these information, and he or she can also realize other patterns by the listed relationships.

7.4.2 The Concrete Steps of Recommendation Algorithm

(1) Initialise SetCPs, SetCQs, SetFQs and FactorQ(p), SetCPs is all SOA design patterns, SetCQs is null, SetFQs is all questions and optional answers. FactorQ(p) is the initial importance of each questions.
(2) Sort all questions by FactorQ(p) in the form of descending order.
(3) Put the question of having the biggest FactorQ(p) to the user, put the removed patterns into SetRPs(p), add p into SetCQs, delete p from SetFQs, and then renovate SetCs(p).
(4) Delete the all individuals of SetRPs(p) from SetCPs.
(5) According to the matching with data property of current question, the order is additionalCondition, solveObject and functionObject, find the similar question. If there is not similar question, select next question by SetCs(p).
(6) Judge SetCPs, if it is null, then delete the least important question p' from SetCQs, add SetRPs(p'') of that from p' to current question to SetCPs, screen pattern again by SetCs(p''), repeat this operation until SetCPs is not null.
(7) If SetFQs is not null, return to (2).
(8) According to the equivalence class of patterns, divided SetCPs into several sets of having similar function. Leave the sets that the count of element is greater than 1, S1,…, Sn.
(9) In each set, compute each X by using modified algorithm of CP.

(10) Use the backtracking of CP to select the value of X, variable "cos" represent the biggest cosine value of the included angle between X and R, its initial value is 0, variable "dp" represent the name of corresponding pattern.
(11) In the process of backtracking, if X of having partial solution can only conform a pattern, then assign the variate-value of corresponding to this pattern to X, compute cosine value of the included angle between X and R, if it is bigger than cos, then assign it to cos, and assign the name of corresponding pattern to dp. If X cannot decide a pattern, go on the selecting of variable, repeat this operation until there is no elective value.
(12) Delete dp from the current set of similar patterns Si (i = 1,…, n).
(13) If S1,…,Sn have been completed, SetCPs = SetCPs−S1 ∪ ... ∪ Sn.
(14) It is over, SetCPs is the final result of recommendation.

7.5 The Analysis of Experiment Result

All members in computer laboratory do the test to validate the validity and accuracy, a total of 48 people. The experiment is as follows:

According to the designated requirements of service that being designed, the demands are as follows: (1) Avoid the malicious input. (2) Prevent revealing the service's internal information. (3) Service contract need to be adapt to the evolution of service without affecting consumers. (4) Maximize reusability of service as much as possible. (5) Guarantee the correctness and security of transmission of information between services.

Every member does the test, in a running process of this algorithm, due to the larger number of questions and varieties of sets which are referred on the above, so that a concrete process of execution will spend a larger space, so we show the final result of the experiment, 45 people get the six design patterns:

(1) Message Screening can prevent attacking to service by using malicious information, in order to avoid the damage of service. Corresponding to requirement (1).
(2) Exception Shielding can prevent revealing the service's internal information when the service is being implemented or in abnormity. Corresponding to requirement (2).
(3) Service Façade can guarantee that service contract is adapt to the evolution of service that consistent with the service. Corresponding to requirement (3).
(4) Compatible Change can modify the service contract without affecting the consumer. Corresponding to requirement (3).
(5) Direct Authentication can prevent intercepting the information at the time of interaction between services, avoiding getting services by illegal means, and guaranteeing the security of interaction. Corresponding to requirement (5).

(6) Data Origin Authentication can guarantee the information will not be distorted in the process of information transmission, until transfer to the correct object, guaranteeing the correctness of information. Corresponding to requirement (5).

For requirement (4), 28 people get the pattern Enterprise Inventory, the other people get the pattern Domain Inventory.

(7) Enterprise Inventory is aim at a designated enterprise, limiting all services by a unified standard, and guaranteeing the consistence of service, so that reusability of service will be maximized. Corresponding to requirement (4).
(8) Domain Inventory is similar to Enterprise Inventory. The only difference is that it is aiming at a designated domain. In a large-scale enterprise, it is a good choice that dividing it into several domains by a unified standard. Corresponding to requirement (4).

The above patterns are almost solve all requirements, guaranteeing the validity and accuracy. Besides, for requirement 4), although Enterprise Inventory and Domain Inventory are similar, different people get the different result. This approach not only reduce the scale of final set, but also provide the patterns that are closer to user's requirements, improve the precision.

7.6 Conclusion

SOA design patterns solve the common problems in practical SOA development. Proper usage of patterns will cut the time and human resource in design, improve the quality and compatibility of software, and reduce the maintenance cost after distribution. However, artificial selection of SOA design patterns is error prune and time consuming. There has been great demand for automated or semi-automated SOA design pattern advisement systems.

This paper proposes an automated approach to advise SOA design patterns. It describes the background algorithm and the system implementation. Based on the formalization of the state of the art SOA design patterns via ontology, a revised constricted programming algorithm is exploited to filter the intermediate advisements. Recursively the system reaches the minimal pattern set covering all the user requirements.

Case studies show that our approach is user friendly and helpful in selection of patterns. The system is a significative attempt to automate the usage of SOA design patterns, and the ontology of SOA design patterns developed for the system builds the firm foundation for future SOA research. Further investigation may follow the directions such as to improve the extendibility of the system for new patterns.

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Chapter 8
Creating Collaborative Innovative Environment Through Knowledge Management in Pharmaceutical Industry

Anna Závodská and Veronika Šramová

Abstract Innovation is crucial for organizations in order to remain competitive. However, not all innovations are successful. For innovation to be successful, it is important to co-create value with a customer. This paper investigates the impacts and consequences of innovation activities in three pharmaceutical companies. The study shows that two out of the three companies failed in their innovation because of the lack of co-creation of value. A model based on the co-creation of value from knowledge management was proposed.

Keywords Knowledge · Innovation · Value co-creation · Product development · Dialogue · Observation · Pharmaceutical industry · Patients · Shared vision

8.1 Introduction

Innovation is a crucial activity for companies to remain competitive. Companies have realized that they can increase their sales and customers' satisfaction only by innovation (creating new value for customers). Unfortunately, many innovations are not successful. This also happens in Slovakia where people do not adopt to new

The content of the article was correct at the time the research was conducted between 2010 and 2012 but it might not reflect the current initiatives of case companies.

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things. There are many reasons for rejection of innovations. The biggest problem coming from our research is that customers do not adopt innovation because companies do not co-create value with them. Pharmaceutical companies produce products which are the results of their long research and development activities. Companies launch their innovations with big buzz but after a while they decide to withdraw them from market because their products do not achieve the expected sales. Companies try to apply many innovations but instead of quantity they should look for quality. Companies should take more care of the customers and try to produce innovations that will meet customers' requirements—or even better—collaborate with customer on product development. This chapter investigates three pharmaceutical companies. Our case study shows that two of the three pharmaceutical companies that we have studied failed in their innovations due to the lack of co-creation of value with customers. This paper begins with brief review of innovation, followed by co-creation of value. Subsequent section describes the case study involving three pharmaceutical companies. This is followed by discussions of why two out of the three pharmaceutical companies' innovations failed. The paper concludes with suggestions for further research.

8.2 Literature Review

The generation of new ideas and their commercialization has traditionally been done internally, and companies rarely resorted to sharing innovative results, believing this could adversely affect their ability to generate competitive advantage [1]. Despite that fact, companies have realized that innovative ideas can emerge from everywhere—also from involving customers to innovation co-creation. Companies cannot be innovating separately without taking care of their customers because they might lose their competitiveness.

To understand interconnection between knowledge and innovation and co-creation in innovation there are some definitions outlined.

8.2.1 Innovation and the Role of KM in Innovation

"An innovation is an idea, practice, or object that is perceived as new by individual or other unit of adoption. "Newness" of an innovation may be expressed in terms of knowledge, persuasion, or decision to adopt [12]."

Chesbrough et al. [4] defined open innovation as 'the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation, respectively.

The essence of business is about the relentless pursuit of the company's own standard of excellence. Excellence emerges only with an unyielding commitment and practice to serve the common good of the company, its employees, its customers

and other stakeholders, and the larger society, based on the company's own vision and values. Values are created through the continuous effort of doing one's best and creating knowledge and innovation to realize the future one has envisioned [10].

Innovation is seen as the responsibility of the entire organization. For many large companies, in fact, the new imperative is to view innovation as an "all the time, everywhere" capability that harnesses the skills and imagination of employees at all levels [2].

A firm's competitive advantage depends more than anything on its knowledge: on what it knows, how it uses what it knows, and how fast it can find out new things [11].

Knowledge is the whole body of scientific evidence and human expertise that is, or could be, useful in the production and supply of commodities and in the invention and design of new products and processes [6].

The ability of an organization to create new knowledge is essential to its innovation capability [10].

A deep knowledge of customers lies at the core of identifying opportunities for innovation. This knowledge comes from being deeply interested in the details of their lives as people, not from considering customers as an impersonal collection of targets, categories, or segments. With this insight, one can move beyond merely responding to customers' requests to anticipating their desires—beyond giving customers what one believes they need to give them what they actually want [8].

8.2.2 Co-Creation and its Role in Innovation

"Collaborative innovation is first and foremost a mindset. Companies seeking to engage in collaborative innovation will have to earnestly examine their culture and beliefs, organizational design and technological infrastructure before committing to new and productive partnerships. Second, companies must examine their current collaborative models and establish a new target model of collaboration. Companies must first establish trusted partnerships in which intellectual properties will be protected and gains will be equitably shared. Finally, decision rights and redress mechanisms must be established to preserve the collaborative relationship for the long term." [1]

"Firms which do not cooperate and which do not exchange knowledge reduce their knowledge base on a long-term basis and lose the ability to enter into exchange relations with other firms and organizations". Cooperation with external firms is the core to increase innovativeness. [7, p. 6]

Collaboration capability can be defined as "actor's capability to build and manage network relationships based on mutual trust, communication and commitment" [3]. And collaboration capability can be understood as meta-capability for innovation.

The theoretical concepts of collaboration capability are derived from several developing theory of firms [3]: the resource-based view, knowledge-based view of the firm, the dynamic capability view, and the competence-based view.

One of the components of market orientation is customer orientation. Customer orientation refers to firms who understand target customers adequately to create superior value for customer. Montoya-Weis and Calantone's study [9, 1994] attributed the failure of a new product in market because firms failed to understand the needs of the customers. For the new products to succeed in the markets, firms should be responsive to both current and potential customers' needs. A customer-oriented culture facilitates innovative capability of the firm.

8.3 Case Study

Qualitative research was used as the core method for understanding observed reality. Research approach involves case studies from which data were triangulated (cross-examined). Three companies were chosen intentionally to demonstrate the way how to innovate/not innovate in the pharmaceutical industry.

Walmark Co. is a joint-stock company established shortly after the Velvet Revolution in Czech Republic. It is an international pharmaceutical company which produces and sells a variety of nutritional supplements. Companies in this industry do not sell products directly to their customers but via pharmacies, and therefore communication with customers is limited.

Eisai Co. is a mid-sized pharmaceutical company established in 1941. It is innovative and globally competitive, generating 90 percent of its revenues from products developed in-house. What enables Eisai Co. to develop and market new products globally and profitably is its unique style of management based on clear corporate philosophy and human-centered, knowledge-based management [10].

Pfizer is the largest pharmaceutical company which was established in 1862. The production of citric acid in 1880 s initiated the company's growth. Pfizer was the largest producer of Vitamin C and during World War II used its expertise in fermentation to the mass production of Penicillin and had become the world's largest producer of the "miracle drug" by 1945 [5].

Traditionally, pharmaceutical companies believe that they can simply manufacture for boosting profits. So the purpose of this study was to find out if these pharmaceutical companies could produce products and sell them to customers without the co-creation of value with their customers. The main question was: *is the new product more successful on the market if customers collaborate in developing it*? We also analyzed the role of knowledge in innovation and co-creation processes.

Research in Walmark Co. was conducted by one author as a part of internship in this company which led to an MSc Dissertation. Eisai Co. was chosen as a successful company with high level of innovation activities and co-creation of value with customers. The case of Pfizer Co. was chosen to demonstrate an innovation fiasco. Data has been collected during three years. Case study of Walmark Co. was built from quantitative data and qualitative data gathered from observations and interviews with managers. The understanding of pharmaceutical industry was gained by participation of one author at pharmaceutical conferences.

The theory built from case study research was compared with existing definitions in literature and scientific papers.

In Walmark Co. the methodology involved a case study research. In data collection, several methods were used: interviews with managers, expert opinions (doctors, nurses, pharmacists) and observation in pharmacies and Walmark Co. Content analysis was used for analyzing ideas presented in discussion forums by pregnant women and for analysis of company's documents. Comparative analysis was used for comparison of implementation of knowledge management principles in pharmaceutical companies in Japan, USA and Slovakia. The data was collected over a three-year period.

In Eisai Co. and Pfizer Co. data were collected from websites, scientific papers and literature and examined by content analysis. All data were collected from secondary research of other authors. Analysis of all data gained from these secondary sources of research were performed and enriched by authors' opinions discussed with experts. Case study approach was chosen to demonstrate how three different companies from same industry deal with innovation process.

8.4 Analyses of Case Companies, Findings

Pharmaceutical companies try to bring new innovations, new products for solving customers' problems. Usually these innovations are not successful. They just fight with symptoms of customers but they do not help in the long term (they do not really treat people). People are apathetic and losing their beliefs in improved quality of their lives. Smart companies started to take actions in order to not only make profits but also to help people live a better lives and start to listen to customer needs and problems: Walmark tried to make smaller pills so people do not have difficulties to swallow big pills anymore, Eisai Co. is a pioneer in changing the whole business philosophy towards customers and their feelings, Pfizer tried to overcome phobia of injections by making inhaled insulin. But why were most of them not successful even if companies have tried to help people with their problems and phobias?

Walmark has hundreds of products in its product portfolio. Some of them are blockbusters at core markets and are bringing most of the profits to the company. After the economic crisis, company has no longer been growing that fast. Profits had decreased and the company had to change its whole strategy. Marketers in Walmark were confronting critical commercial questions, most often whether demand would be sufficient to warrant a new-product launch. In the case of Pregnium product they underestimated customer research about demand for this product. There were huge discussions about harmful effects of multivitamin nutritional supplements to fetus going on in 2010. Vitamin A is causing damages to fetus and many of the nutritional supplements for pregnant women contained it. Therefore pregnant women were afraid to take any nutritional supplement; they preferred balanced nutrition and natural products. Although Pregnium does not

contain vitamin A, it did not succeed on the market of nutritional supplements for pregnant women. It was caused by several reasons:

- Inadequate market research and underestimated demand.
- Late launch of the product (after all pharmaceutical giants launched their own similar products).
- Ineffective marketing campaign.
- Pharmacists and doctors were not aware of benefits of the product.
- Pregnant women did not know about this product and its benefits.
- Wrong packaging of the product causing misunderstanding about purpose of consumption of the product.
- Big size of the pills.
- Not respecting recommendations of pregnant women.

In Walmark Company, the knowledge about customers' needs is provided by the marketing and sales department. Brand managers endeavor to communicate with customers and gain information in various ways (questionnaires, interview, feedback from hotlines or loyalty programs, etc.), and they send new ideas to R&D where new products are being developed. Direct contact is limited and that is the reason why some products, e.g. Pregnium are not successful on the market. Marketers are not able to identify customer needs precisely and because of that fact, products produced are not meeting customer's requirements. Since these products are of a special kind, it is difficult to find out what customers really need. Usually signals for new products come from the market, from domestic or foreign competitors or findings from international researches. Customers have to buy what the company offers them, not what they really want or need.

One of the key elements in innovation in this industry is getting support of doctors and pharmacists. Without their support it is hard to diffuse innovations and raise market share.

Another critical point is effective marketing communication. In these days there are lot of discussions about bio products and lack of balanced nutrition, healthy lifestyle and exercise. People have a lot of stress, digestive problems, etc. The fastest solution for their problems or aches is to take a pill. According to OECD Health Data, Slovakia is one of the countries with the biggest consumption of analgesics. Slovaks take annually 150 million of painkillers. Similar statistics is with nutritional supplements. Pharmaceutical industry is increasing in profitability even if there are a lot of activities in order to motivate people for healthy lifestyle instead of taking pills.

Another example of ***Walmark's innovation effort, which has had an opposite impact from Pregnium (it was successful)*** is innovation of multivitamins Cem.m for adults. Adults, especially elderly people, used to have difficulties with swallowing big pills. So marketers came up with idea of jelly multivitamins for adults with sweet flavor and colored design. The key to success in this case was listening to customer needs and problems and bringing innovation which is helping them to overcome problems.

8.4.1 Changing Whole Business Philosophy Towards Successful Innovation in Eisai Co., Ltd

Japanese pharmaceutical company Eisai Co. is a master in innovation of various kinds. They were developing the new drug Aricept as a social event. Dementia is regarded as a "social disease" because once the symptoms occur, every relationship is affected. This has a major effect on the quality of life of the patient and the people around them. The company started variety of activities in preparation for the launch of Aricept. They observed the experiences and feelings of patients taking the drug; families and caregivers kept a diary of daily events and their feelings, which could be analyzed. Through the diaries, the R&D team was able to share experiences and measure this effect. To trigger the creation of a supportive society, sales managers educated society about dementia. At that time, many people were still unaware of the disease. The team held town meetings and other similar forums to improve awareness by dedicated sessions for doctors aimed at improving their skills of diagnosis. To sustain this support mechanism, the team helped to build hospital networks in the community and established clinics specializing in dementia.

To help people to extend longevity and ensure quality of life Eisai Co. and nine other health organizations published a training manual with detailed information on care giving and resources. It is distributed free and available on Eisai Co.'s website. The creators knew that this would not necessarily boost sales of Eisai Co. products but they knew there was a strong need for manual.

Eisai Co. also changed the structure and size of their pills, made transferable labels for injections, change format of user instructions, centralized medical information to databases system useful for medical representatives, etc. This was a big step forward to maximize customer satisfaction and help them to live a better life.

8.4.2 Innovation Fiasco in Pfizer, Inc

Thanks to R&D department and numerous mergers, Pfizer became the biggest pharmaceutical company in the world. Some of the products are very successful but there are also products which did not achieve planned predictions of sales.

An example of innovation fiasco in the pharmaceutical industry can be inhaled insulin called Excubera. A vast majority of diabetics have to depend on insulin to keep their blood sugar in check. Insulin is administered through injections, which many people wanted to avoid. Scientists began investigating various alternatives to injectable insulin. It was not easy to find a less invasive and less painful process than injections to supply insulin into the body which will be similarly reliable.

Inhaled insulin had many disadvantages that Pfizer Co. could not overcome, e.g. it was not easy to adjust the dosage of the drug, it could not be administered

discreetly due to the bulky size of the inhaler, it was 30 percent more expensive than other forms of insulin, it required medical examination of patient's lungs, there were concerns that the drug would decrease the functioning of the patient's lungs, insurance companies were reluctant to pay for product that did not have any significant therapeutic benefit, etc.

Excubera was billed as the biggest failure in the history of pharmaceutical marketing and Pfizer came in for a lot of criticism. Pfizer should have communicated more with customers and doctors and explained to them the value of this product. The results of not proper communication were that many patients were clueless about the merits of the new drug (similar problem could be seen in case of Pregnium).

> *In the past few years, pharma's critics have behaved as if the industry could get patients and docs to use anything, no matter how dangerous or worthless, just by promoting it enough. Pfizer has provided a solid counter-example. (ICFAI Center for Management Research. MKTG/199)*

8.5 Discussion

Based on the previous analysis the following recommendations are provided to companies fighting similar problems.

Building the whole new collaboration model. This model needs to be created in order to improve collaboration with customers and thus developing innovations of a higher value. It should include: market orientation (shift from individual company's innovation activities to collaborative innovation activities with customers), building technological infrastructure to enhance communication and thus collaboration with external persons, developing shared vision for collaborative innovation, establishing mindset for openness, building open innovation capabilities so that knowledge can flow more effectively across existing silos and managing relationships. Some of the necessary changes are explained below.

Changing company's vision is important for changing the mindsets of employees towards helping people. This should be a primary activity when changing innovation strategy in order to maximize customers' satisfaction as well as to improve the quality of life of patients and their families. Clear vision will help R&D teams and other employees to empathize with customers, collaborate and create value with them (not "only for" them) to help them overcome their problems. A master in this is Eisai Co.

Developing a new business philosophy includes setting up new rules and values that employees should embody with to act morally and ethically towards customers to drive new knowledge sharing in order to improve the innovation process. Companies should produce products which are not harmful to patients (e.g. Excubera could cause lung problems, multivitamins could damage fetus).

Conducting precise market research to shift to better market orientation based on improving communication with customers, observation of customers and care givers, experiencing their feelings and so getting knowledge from them (Eisai Co.'s employees used ear plugs to experience senior hearing loss and wearing special glasses that simulate vision impairment, participants saw things from the elderly people's perspective and could better understand their feelings).

Observation and communication with nurses who might also help to improve products which will lead to creation of new innovations (by observing, Eisai Co.'s employees found out that liquids in injections are all clear color so nurses had problem to recognize which medicine is in which injection, so employees came up with idea of transferable labels for injections which has helped nurses to avoid giving wrong care to patients).

Ensuring customers' understanding. This means answering the question: Why is this treatment good for him/her? Explaining benefits of products.

Companies should be aware of customers' knowledge. Customers might have different view on the problem and so they might help to improve products by collaboration with the company.

Improving communication skills of health care professionals. Understanding can only be achieved through effective communication between health care professionals and customers.

Incentives for specialists to recommend product. Sometimes specialists are afraid of recommending some product, especially if they are new on the market and they do not trust the products. So benefits need to be explained and incentives changed in order to increase recommendations.

Based on the recommendations the following model is proposed. It is presenting co-creation of innovation by customers, company and caregivers. It is based on empirical evidence of studied companies and it is a subject of a discussion.

A pharmaceutical company has four types of customers: caregivers (doctors, nurses etc.), pharmacists, patients and families of patients.

All of these customers have different knowledge and different requirements which need to be identified separately in order to satisfy them. And this can be achieved only by co-creation of value. Co-creation leads to valuable innovations and mutual satisfaction of all parties. To achieve this satisfaction knowledge has to be used for identifying needs and searching for the best products that can satisfy it. The most important thing is to get explicit but also tacit knowledge of customers. Employees can get tacit knowledge only by getting practical experience in hospitals or places where health care is being provided. Practical experience means to live with patients, experience what they feel and get a deep understanding of their medical conditions by observing them. By dialogue a company can get a better understanding of what patients think and externalize their own tacit knowledge. These require various skills, mostly communication skills, also empathy as a key skill to understand feelings of patients, abilities to observe and make conclusions based on the observations. By communication patients can interpret their feelings and problems so that the company and caregivers can mutually find a solution for problems. All knowledge has to be not only gained but used for a specific purpose

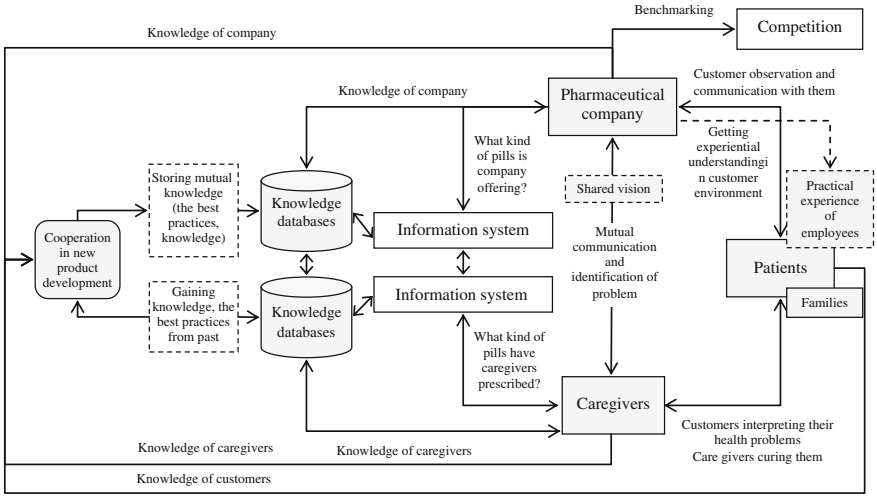

Fig. 8.1 Framework for innovation co-creation through knowledge management

– create a value for all parties. Knowledge of all parties has to be leveraged and stored for re-use in the future.

Knowledge databases play an important role for company. There can be stored and found best practices and knowledge from past. It can involve various case studies, customers' insights, information about medicinal products, etc.

Companies should understand that customers are the most important participants in the health care process. To serve them better requires understanding that they are human beings with feelings. They need to understand these feelings and get their valuable knowledge, which will help companies to improve products and help patients to live a better life. To achieve this, employees and caregivers should share a common vision and understand higher goal so that they would be driven to achieve it (Fig. 8.1).

8.6 Conclusion

An important factor for company's growth is systematic innovation of its products, services or business model. Because customer needs are continuing changing, it is important for companies to identify the changing needs of the customers and customize products to satisfy them. It is crucial to find a compromise because it is not always possible to fulfill all customers' requirements and wishes. For this reason cooperation of customers and company is very important because this enable both parties to achieve mutual satisfaction.

This paper investigates the innovation process in three companies. It shows that even big companies can fail in their innovation and diffusion. It is due to the lack

of collaboration with customers in the innovation process. Companies should realize that the world is changing and also the requirements of customers. Pharmaceutical Companies have to look at their customers not as a means to increase sales but as human beings deserving not only cure but also care. This was demonstrated in our model. It is our belief that this model can be adapted to any company (not only pharmaceutical industry). In order to verify our model, further empirical studies will be needed. It is our desire that this model will be introduced to other non pharmaceutical company to help them in their innovation.

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Chapter 9
Adoption Intention of Mobile Real Time Location-Based Advertising Service for 3G Cell Phone Users in Taiwan

Flora Peng, Chien-Hsing Wu and Hsin-Yi Liao

Abstract The current research conducts an empirical study for the 3G mobile phone users within the context of Taiwan to examine the factors that affect users adopting MRTLBAS. The empirical research model is developed based on technology acceptance model and innovation diffusion theory. According to 336 valid samples, the research results indicate that (1) perceived compatibility shows a significant impact on perceived usefulness, perceived ease of use and perceived playfulness; (2) impact of trialability on behavioral intention shows insignificantly while other variables show significantly. This implies that 3G users perceive that trying MRTLBAS will not be likely an important factor that attracts their use intention; instead they care more about the usefulness, ease of use, and even enjoyment; (3) perceived playfulness both significantly affects perceived ease of use and behavioral attitude, implying that improving the playfulness of MRTLBAS will be likely to positively improve uses' attitude and the ease of use. Implications and suggestions for the MRTLBAS are also addressed.

Keywords Location based service · Technology acceptance model · Innovation diffusion theory · Mobile value-added services

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9.1 Introduction

Advanced location-based services and location-aware applications have progressively attracted attention of corporations who want to find an efficient way to enhance their customer relationship through advanced technologies [6–8, 14, 15, 19]. For example, Facebook and mobile advertisement platform were integrated to develop a location-aware mobile social networking system [11]. In addition, a detectable system was demonstrated which can detect the loss mobile phones. Particularly, to "response timely" is important for marketers (e.g., quick response) [15]. The intention was also discussed toward location-based advertisement of 3G mobile phone users in Vietnam [19]. The main study showed that perceived usefulness and perceived ease of use have no remarkable impact on attitude but have significant impact on intention. However, the attitude of Taiwan 3G users toward this kind of service is still unknown.

Traditional way to advertise is to hang posters doors by doors or to publish on newspapers or magazines [19]. Nowadays, business advertises generally through the Internet and sends e-mails or message texts to potential customers in certain areas. Whether the traditional ways or new ways, it needs days to process. However, doing so may not be able to meet the common expectation of "advertising right now and receiving right after." Think of following situation, the boss of a restaurant picks up his phone (e.g., iPhone), logs into the website and types URL xxx.xxx.xxx.xxx, links to a system which provides mobile real time location-based advertising service (MRTLBAS). He or she types "during December 21–25, visit super Japanese ramen and you can get a free drink. Only five days; address xxxxxx,", simply clicks enter. Then the messages will be sent to the 3G users in the defined area to meet the need of advertising in time.

The conceptual framework of the MRTLBAS is illustrated in Fig. 9.1. First, the telecom service provider sets up the server of MRTLBAS and 3G mobile phone users install the client side program. Server provide a website for store marketer to put promotion (or commercial) information on it (such as sales information, when to open and close, store address, target area) and save into the database. Finally MRTLBAS on the server will detect the location of users and send promotion information to those who enters the target zone in time. Based on Technology Acceptance Model (TAM) [4] and Innovation Diffusion Theory (IDT) [13], the research conducts an empirical study for the 3G mobile phone users in Taiwan to examine whether they accept MRTLBAS or not. Importantly, according to the suggestions of the case in the research [19], the compatibility is considered as one of the independent variable of usefulness and ease of use, although not for the same country context. This consideration has also been supported [3]. The current research therefore takes this variable into account in the development of research model.

9.2 Theoretical Concepts and Hypotheses

Location-based service (LBS) with advanced ICT features becomes increasingly important [7, 15, 19, 20]. Furthermore, there are two types of services to integrate position tracking and mobile advertisement, push-oriented and pull-oriented [7]. LBS by push is based on users' characteristics (e.g., preference sightseeing spots and shopping sites) to provide location information. In such a way, users' location information will still be sent even though users did not actively ask for it. However push-oriented service causes privacy problems [2, 19, 22]. Importantly, the developers of LBS should know that trust and privacy are the most important factor to assure users' security and make LBS work properly. To avoid these drawbacks cause by pull-oriented service, LBS should allow 3G mobile phone users to pre-set their preference or recommend users the information they prefer to receive.

To predict human's actual behavior, technology acceptance model was introduced which is commonly adopted to examine adoption attitude as well as adoption intention for innovative technologies [5]. Furthermore, the theory defined perceived ease of use and perceived usefulness as the independent variables and then attitude and intention are the dependent variables. The reference also showed that perceived ease of use has significant impact on attitude and perceived usefulness for adopting LBS [19].

In addition, it is important as well that whether perceived playfulness affects the adoption of innovative technology [9, 12]. Perceived playfulness is the degree of happiness that users feel when they use the technology including personal trait and the states of playfulness. The former assumes that playfulness is users' traits and the later assumes that playfulness is the interaction between users and environment such as receiving texts or watching an interesting cartoon. This argument shows that human behavior might not be affected by external factors. Instead, they are mostly concerned with is the tacit feeling without any explicit reason. Although service commitment is one of the reasons that influence users adopting innovative technology, build emotional value and conditional value can encourage users to adopt innovative technology, such as providing fun service experience in good environment [12, 20].

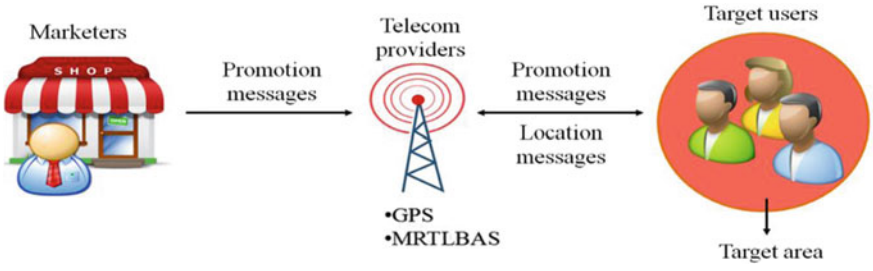

Fig. 9.1 The conceptual framework of the MRTLBAS

Moreover, innovation diffusion theory (IDT) was introduced to define the process of innovative technology (or an idea) [13] spreading to end users. There are five important features related to IDT, relative advantage, complexity, trialability, observability, and compatibility [13]. Relative advantage and complexity has been argued that both similar with perceived ease of use and perceived usefulness [10]. Some studies showed that there is a relation between trialability and adoption of ICT, although not strong. However other researchers implied that trialability will enhance the willingness of adoption. Therefore, it is still worth discussing and current research keeps this factor in the model. Yet there are two reasons that current research will not include the observability of IDT in the model. The reason comes from the definition of observability, which is the degree to which the results of an innovation are visible to others [13]. The visibility of MRTLBAS results comes from store marketers (e.g., effectiveness on product sales, enhancement of customer relationship). Therefore, the current research does not consider observability. However, this will be considered after in current research findings and suggestions.

Perceived compatibility is the link between innovation technology and the user's cognitive value, knowledge, past experiences, and current needs. In fact it is better to design MRTLBAS with push-oriented service from marketers' aspect. It uses the ability of immediate information uploading that combines the technology of location information service and immediate information sending which provides a specific time, location, and area [21]. In order to receive messages from MRTLBAS, the cell phone is capable of sending and receiving digital messages which are the functions embedded in the 3G mobile phone. Moreover, GPS must be able to locate it so that it can send back its location information. Finally, the mobile phone has to install the MRTLBAS software. It is believed that too much change to habits of mobile phone users must be an obstacle to be accepted by customers. Although users can easily use the value-added service, the compatibility of users' habits to use MRTLBAS is critical.

Moreover, compatibility has significant impact on attitude toward on-line shopping [17]. In fact, whether compatibility is the most important factor, a user will be willing to accept a free service which is easy to use. Such that they do not need too much effort to learn or set up, before they think it is useful or easy to use. Moreover, the degree of compatibility of the MRTLBAS to the value-added innovation service will more likely increase the perceived usefulness, perceived ease of use, and playfulness. As the research suggestions, though the main concern is on-line learning system, compare to the simplicity of ICT service system, and there are more choices for users, compatibility now is more important than ease of use and usefulness [3].

Base on those arguments, perceived compatibility has been regarded as the primary assumption [19]. The current research extends the use of the TAM and IDT to explore the relationships among factors that influence the adoption intention of the MRTLBAS in Taiwan's 3G cell phone users. Therefore, based on the theoretical concepts and the aforementioned concerns, 12 hypotheses are

formulated to examine the adoption intention of the MRTLBAS. The conceptual model is formed accordingly.

H1: Perceived compatibility is significantly related to the perceived usefulness of the MRTLBAS.
H2: Perceived compatibility is significantly related to the perceived ease of use of the MRTLBAS.
H3: Perceived compatibility is significantly related to the perceived playfulness of the MRTLBAS.
H4: Perceived playfulness is significantly related to the perceived ease of use of the MRTLBAS.
H5: Perceived ease of use is significantly related to the perceived usefulness of the MRTLBAS.
H6: Perceived usefulness is significantly related to the behavioral attitude.
H7: Perceived ease of use is significantly related to the behavioral attitude.
H8: Perceived playfulness is significantly related to the behavioral attitude.
H9: Perceived usefulness is significantly related to the behavioral intention
H10: Behavioral attitude is significantly related to the behavioral intention
H11: Trialability is significantly related to behavioral attitude toward MRTLBAS use intention.
H12: Trialability is significantly related to behavioral intention toward MRTLBAS use intention

9.3 Method

9.3.1 Research Model

Figure 9.2 shows the research model based on the defined hypotheses. The model consists of the independent variables and the dependent variables. In the first layer, the independent variable is perceived compatibility and the dependent variables are perceived usefulness, perceived ease of use and trialability. In the second layer, the independent variables are perceived usefulness, perceived ease of use, perceived playfulness and trialability. The dependent variables are behavioral attitude and behavioral intention. In the third layer, the independent variable is behavioral attitude and the dependent variable is behavioral intention. The research target is 3G mobile phone users with GPS in Taiwan.

9.3.2 Measure

The questionnaire was constructed with a Likert five-digit rating scale (from one to five) using bi-polar descriptors for each question, where one represented "strongly disagree" and five, "strongly agree." Perceived compatibility referred to former studies with main concept of "users don't need to change current using behavior when using MRTLBAS [3, 17, 19]." Perceived ease of use referred to the studies' initial concept [1, 4, 5, 19]. It depended on the concepts of "users have positive attitude toward MRTLBAS" and "users are willing to use MRTLBAS" to extend the research. There were 21 measure items in total.

The sample population focused on the 3G mobile phone users in Taiwan whose mobile phones are embedded with GPS. Consider the large number of questionnaires, a convenience sampling plan was used. To collect data effectively, the research adopted both channels: physical and online community. In order to help increase return rate, MRTLBAS was explained (e.g.: the purpose of MRTLBAS and how MRTLBAS works). Comments and suggestions were also collected. Because there were many 3G mobile phone users, under $1\text{-}\alpha = 0.95$, 5 % sample standard deviation, the analysis of variation and 70 % return rate, the number of sample was set to 400 which was more than 10 times of the measures items. The data analysis had three parts: descriptive statistics, factor analysis, reliability and validity analysis and hypothesis testing. Descriptive statistics include basic information of samples. Factor analysis, reliability and validity analysis were also conducted.

9.3.3 Data Analysis

According to current design of the research, most of the samples are from on-line community. There were 336 samples returned valid, showing an 84 % return rate. It was found that the number of male was more than that of female; most of samples were 20–29 years old college students. The current research adopted the

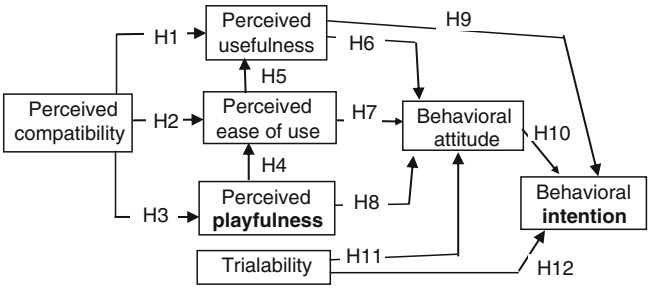

Fig. 9.2 Research model

confirmatory factory analysis (CFA) to examine the reliability and validity. The research used Cronbach's α to examine the internal consistency between the whole scales and each item. For example, pc3 was deleted to increase Cronbach's α (Table 9.1). Factor analysis was used to derive the exact factors. Result was that KMO is more than 0.8 and the correlation matrix of Bartlett's test of sphericity is significant. In terms of correlation coefficient and reliability analysis, current research used Pearson's product-moment correlation coefficient to measure the strength of linear dependence between two variables and examined co-linearity between variables (Table 9.4). Tables 9.2, 9.3 and 9.4 had confirmed the acceptance of the results. Moreover, the path tests results were shown in Table 9.5. It was found that of 12 hypotheses, only H12 was not significant.

9.3.4 Findings and Suggestions

(1) Current research results presents that perceived compatibility has a positive impact on perceived usefulness, perceived ease of use and perceived playfulness (H1, H2 and H3). This is because there are more and more application services nowadays. Consumers tend to focus on the compatibility of the functions [18]. Therefore, it is important to consider compatibility of user behavior when developing MRTLBAS.
(2) Previous study has shown that perceived playfulness plays an important role on cognitive values and behavioral attitude toward advertising. Current research also confirms that perceived playfulness shows a significant impact on behavioral attitude [H8]. Given that MRTLBAS provides playfulness, on one hand it will eliminate users' negative cognition toward advertising; on the other hand, users will feel fun and positive when adapting MRTLBAS. H4 also implies that impact of perceived playfulness on perceived ease of use shows significant. It indicates that if MRTLBAS provides playfulness, it will diminish the cognition of difficulty when users use MRTLBAS (users are willing to try). A system with playfulness will promote users to use deeply in it and eliminate the barriers to use.
(3) Impact of trialability on behavioral intention shows insignificantly (H12) which is different from the findings [19]. This shows that if MMRTLBAS is trialable, users' intention will be increased when considering adapting MRTLBAS. However it shows a significant impact on behavioral attitude (H11). It can refer that there are too many multifunction apps for users to download nowadays and users have no time to try all the new services. As a result, most of the users tend to refer to the reputation by word of mouth and adapt the service. Moreover, it shows that usefulness of the service (H9) will affect the adoption intention of MRTLBAS. It is important to provide users a useful system and enhance users' willingness with compatibility and playfulness. For example, previous findings indicated that if users think LBS will

Table 9.1 Cronbach's α of each variable

Factors	Items	Mean	S.d.	Facet mean; S.d. Cronbach's α	Item to Total	Cronbach's α if item deleted
PC	pc1	3.43	0.765	3.486; 0.670; 0.702;	0.531	0.596
	pc2	3.54	0.742		0.616	0.493
	#pc3	3.89	0.715		0.423	0.736
PU	pu1	3.67	0.783	3.871; 0.604; 0.865;	0.731	0.825
	pu2	4.00	0.774		0.619	0.853
	pu3	3.87	0.778		0.712	0.829
	pu4	3.92	0.698		0.631	0.850
	pu5	3.74	0.715		0.746	0.822
PEU	peu1	3.82	0.768	3.764; 0.690; 0.903;	0.766	0.882
	peu2	3.69	0.829		0.831	0.858
	peu3	3.80	0.818		0.751	0.888
	peu4	3.98	0.677		0.793	0.872
TR	tr1	3.99	0.738	3.952; 0.632; 0.774;	0.546	0.763
	tr2	3.89	0.859		0.664	0.637
	trt3	3.72	0.669		0.640	0.671
PP	pp1	3.44	0.714	3.584; 0.551; 0.825;	0.593	0.798
	pp2	3.45	0.750		0.679	0.780
	pp3	3.73	0.807		0.616	0.792
	pp4	3.85	0.765		0.608	0.794
	pp5	3.31	0.815		0.578	0.800
	pp6	3.87	0.703		0.501	0.818
BA	ba1	3.89	0.719	3.877; 0.641; 0.768;	0.623	–
	ba2	3.40	0.790		0.623	–
BI	bi1	3.53	0.870	3.476; 0.735; 0.854;	0.774	0.754
	bi2	3.50	0.844		0.702	0.821
	bi3	3.43	0.765		0.707	0.814

item is deleted; PU: Perceived Usefulness; PEU: Perceived Ease of Use
PP: Perceived Playfulness; TR: Trialability; PC: Perceived Compatibility
BI: Behavioral Intention; BA: Behavioral Attitude

Table 9.2 Factor analysis for independents

	Factors				
	pu	peu	pp	tr	pc
pu5	**.800**	.211	.238	.071	-.004
pu1	**.755**	.180	.248	.133	.160
pu3	**.741**	.205	.242	.149	.110
pu4	**.694**	.090	.255	.215	-.035
pu2	**.668**	.121	.310	-.009	.150
peu2	.175	**.854**	.147	.193	.079
peu4	.178	**.838**	.141	.155	.084
peu1	.134	**.823**	.210	.127	.093
peu3	.181	**.820**	.081	.124	.124
pp2	.239	.231	**.749**	.083	.054
pp6	.109	.070	**.700**	-.051	.162
pp3	.296	.071	**.690**	.066	.139
pp1	.319	.107	**.635**	.139	.050
pp4	.390	.106	**.574**	.186	-.013
pp5	.264	.288	**.530**	.316	.050
tr2	.136	.118	.216	**.814**	.011
trt3	.213	.182	-.006	**.803**	.030
tr1	.033	.175	.082	**.759**	.095
pc1	.084	.100	.120	-.009	**.873**
pc2	.117	.182	.157	.147	**.831**

KMO: 0.904; Bartlett's test of sphericity: ***p < 0.01

Table 9.3 Factor analysis for dependents

	Factors	
	bi	ba
bi3	**.859**	.240
bi1	**.856**	.308
bi2	**.733**	.440
ba2	.273	**.864**
ba1	.340	**.823**

KMO: 0.839; Bartlett's test of sphericity:*p < 0.01**

enhance their working effectiveness and quality of life, they will increase their willingness of adoption. The study also shows that increasing usefulness and ease of use will enhance users' behavioral attitude (H5, H6, H7). Moreover, the privacy issue is the problem that most participants concern. There are many studies argued that LBS will intrude into privacy. This issue has aforementioned that push-oriented advertisement makes most of the users worry. The advertisement which is not accepted by users is disfavored [16]. As a result, the suggestion for developing MRTLBAS is to design the advertisement for pull-oriented and make users choose to switch on or off. In addition, there are many participants think 3G mobile phone users can choose

Table 9.4 Correlation coefficient and AVE

Variables	Average	Standard deviation	PC	PU	PEU	TR	PP	BA	BI
PC	3.42	0.78	**0.78**						
PU	3.87	0.78	0.28**	**0.81**					
PEU	3.76	0.76	0.31**	0.45**	**0.88**				
TR	3.95	0.78	0.18**	0.36**	0.40**	**0.83**			
PP	3.58	0.75	0.32**	0.68**	0.44**	0.35**	**0.73**		
BA	3.88	0.71	0.28**	0.68**	0.49**	0.40**	0.67**	**0.90**	
BI	3.48	0.83	0.28**	0.66**	0.54**	0.35**	0.67**	0.66**	**0.88**

***p* < 0.05, The inclination is the square root of AVE**

Table 9.5 Path analysis results

Hypothesis	Path relation	Standardized regression coefficient(β)	T value	Support or not
H1	PC → PU	0.28	5.12***	Support
H2	PC → PU	0.31	5.78***	Support
H3	PC → PP	0.32	6.04***	Support
H4	PP → PEU	0.44	8.55***	Support
H5	PEU → PU	0.45	8.76***	Support
H6	PU → BA	0.37	7.01***	Support
H7	PU → BA	0.15	3.33***	Support
H8	PP → BA	0.32	6.07***	Support
H9	PU → BI	0.32	6.05***	Support
H10	BA → BI	0.66	15.56***	Support
H11	TR → BA	0.95	2.25**	Support
H12	TR → BI	0.02	0.73	Not support

the advertisements and marketers they want. Users can set their preference in advance or choose recommendation mechanism.

(4) There are feedbacks mentioning that the system needs to be secure to protect personal information. It is necessary that a system should have security measures. Therefore, current study suggests that MRTLBAS should actively inform users how it uses their personal information and how it works to protect the system. Constantly update the security technology and make a privacy agreement will make users more willing to use it.

9.4 Conclusion

The MRTLBAS is a real time based advertising service which utilizes location-positioning technology to locate users' positions, and send local information to customers by marketers. Current research targets on 3G mobile phone

users and propose 12 hypotheses based on TAM and IDT. In 12 hypothesizes, there are 11 hypothesizes showing significant impacts and only one is not supported, trialability on behavioral intention. This result in Taiwan is not consistent with that in Vietnam [19]. In Vietnam, 3G users would like to try out, but offering trialability will not directly affect the behavioral intention in Taiwan. On the contrast, 3G users consider that the usefulness of service will affect their using intention. Moreover, H1, H2, and H3 also show that designer should consider using behavior when designing the system in the future. Current research finds that enhancing the playfulness will increase the willingness of users to adopt MRTLBAS as well as to increase the ease of use and eliminate the barriers of entry. Additionally, to promote the willingness of adoption, MRTLBAS providers should pay more attention to usefulness and ease of use.

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Part II
Knowledge Management Practice and Case Study

Chapter 10
Students' Innovative Thinking and Their Perceptions About the Ideal Learning Environment

Miri Barak, Sigal Morad and Noa Ragonis

Abstract The goal of this study was twofold: to examine how undergraduate students' perceive themselves as innovative thinkers and to examine the way they express innovative ideas when asked to illustrate the ideal learning environment. The research was conducted among undergraduate students in two higher education institutes (N = 202). The 'mixed methods research' model was employed in the analysis and interpretation of data that was collected by two research tools: the Innovative Thinking survey and the Reflective Drawings analysis. Findings indicated that most students perceived their innovative thinking as average. Two groups of students expressed the highest inclination to be innovative: young students and experts in ICTs, suggesting that innovative thinkers are most likely to become experts in the use of advanced technologies. The analysis of students' drawings of the 'ideal learning environment', indicated that only few illustrated innovative scenarios. Findings showed that although most of the students made a shift from desktops to mobile computers, their drawings did not reflect the added value of ubiquity learning. This finding indicates that most of the students still adhere to traditional learning environments, and are not able to imagine learning in any other way.

Keywords Drawing analysis · Information and communication technologies · Innovative thinking · Learning environments · Undergraduate students

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10.1 Introduction

The global movement for the promotion of the 21st century skills, led by educational experts and industry elite personnel, indicates a number of familiar learning skills that are based on the constructivist and social-constructivist learning theories. These skills include: critical thinking, problem solving, decision making, information literacy, communication, and collaboration [1]. In our rapidly changing world, educators nowadays have an almost impossible task—to prepare students to become contributing citizens and employees in a world that does not yet exist and cannot yet be clearly defined. There is a wide consent among education experts that innovation and innovative thinking, are key in current enterprises [1, 2]. Indeed, todays' economy is driven by innovation that is the primary basis for income and generation wealth of [3].

Innovation is conceptualized as the process of making changes to something established, by introducing something new. According to Dyer and colleagues [4, 5], innovative thinking is a skill that has to be acquired since most people lack this ability. It evolves when one has a need for something that cannot be attained by regular means. Innovative thinking is actually a highly sought skill in the business world. It has been an important topic in the study of economics, business, technology, and engineering, but it has rarely been discussed in relation to education and learning.

The current study presents a snapshot of how undergraduate students' perceive themselves as innovative thinkers. It also examined the way they express innovative ideas when asked to illustrate the ideal learning environment.

10.2 Literature Review

The literature review includes three sections. The first section discusses the role of information and communication technologies (ICTs) as change promoters in education. The second section discusses progressive education, an innovative approach for learning that has not been fully realized in higher education. The third section presents the Reflective Drawing Analysis, an innovative qualitative research tool, applied in the study.

10.2.1 ICTs as Change Advocates in Education

It has been assumed that by providing technological infrastructure, teachers' practice will be changed [6]. In particular, it has been argued that technology can promote the constructivist and social-constructivist approaches to teaching and learning advocated by educational reform movements [7]. In the context of

education, Information and communication Technologies (ICTs) can serve as tools for enhancing conceptual understanding [8] and for creating learning communities [9, 10]. They can also enhance transitions from concrete to abstract mental operations and vice versa, thus promote higher order thinking skills among students [11]. However, although ICTs (devices, software, and applications) can be used to support cognitive operations essential for learning, there are many educators and students that are still adhering to traditional methods of teaching and learning. Apparently, if learners are not subjected to ICT-enhanced learning environments, many of them continue to rely on old practices such us textbook reading and exercise drills.

Most higher education classes and lecture hall in developed countries are equipped with internet connections. However, recent studies on the integration of ICTs for educational purposes, criticize their simplistic inclusion. Recent studies indicated that the use of ICTs in learning and teaching is techno-centric and tokenistic [12, 13]. Instead of using ICTs as means for promoting innovative learning, many academic lecturers use them in a traditional classroom setting. This situation has been shown in part to be due to their reluctance to change the familiar teaching methods [13, 14]. Further our students are part of what is called Net generation or Generation Y [15]. Generation Y students were born in the 1980s–1990s years. They grew up with technology and rely on it to perform all their life tasks. Armed with smart phones, laptops, tablets and other gadgets, Generation Y preferences and abilities to use technologies are obvious, but the question is whether this situation is changing their perception about innovative use of these tools in teaching and learning processes [16].

In order to obtain a successful change in the way lecturers teach and students learn, ICTs should be perceived as change promoters. It seems that there are still many lecturers and students that did not undergo a conceptual change regarding teaching and learning in the 21st century. Indeed, the techno-centric approach, described above, falls short of addressing innovative and progressive education that emphasizes student-cantered, hands-on, and exploratory learning.

10.2.2 Progressive Education: An Innovative Approach that has not been Fully Realized

Progressive education is an innovative approach to teaching and learning that has not been fully realized in educational systems thus far. Progressive education is originated in the works of John Dewey, aiming to make schools more effective agencies of a democratic society [17]. It proposes that societies' ability to learn and to live together is measured by how freely and effectively their members act and interact. Followers of Dewey's theory claim that education is not a process of loading data into the learners' mind, but a continuous process of change and development, resulting in a better society to live in [12, 17].

Progressive education also relates to constructivist and social-constructivist learning theories [18, 19]. The constructivist theory puts the construction of knowledge in one's mind as the centrepiece of the educational effort. Its basic assumption is that knowledge cannot simply be transmitted; therefore learners must be engaged in constructing their own knowledge [18, 20]. The social constructivist theory states that knowledge is best constructed within the individual mind while involved in social interactions, with a teacher, a guide, or fellow students [19]. Both learning theories assert that knowledge construction occurs when learners are actively engaged in learning, during which they are exposed to different experiences and practices [20]. Accordingly, progressive education emphasizes learning by doing, exploratory learning, personalized learning, and students' social skills [21]. It place emphasis on hands-on experience, higher-order thinking, and social interactions, as the basis for meaningful learning [22]. Throughout the years, the progressive education theory was subjected to different interpretations and alterations. There are differences in styles and methods among progressive educators, but they all share the belief that learners should be active, involved, and take responsibility for their learning. Although progressive education ideas exist for almost a century, its implementation in higher education is still limited.

10.2.3 Reflective Drawing Analysis

Drawing analysis is a qualitative research tool that has not yet been widely used, but it is starting to spread among researchers. The use of drawings as a research tool is unique because it enables to collect data that might not be obtainable by using other research methods [12, 23]. Drawings are used as tools to uncover hidden thoughts and to understand situations that are sometimes difficult to express in words [24]. Subconscious thoughts and feelings, that are difficult to express verbally, are more likely to be uncovered via participants' drawings than any other qualitative method such as interviews and observations [25]. Issues that have been suppressed (knowingly or not) in speech or writing, might escape into the drawing page, uncovering dilemmas, contradictions, and unsolved issues [26].

Nossiter and Biberman [27] conducted a study specifically for the purpose of examining the usefulness of drawings as a research tool. They concluded that drawings "focus a person's response" and lead to "respondent honesty and parsimony" (p. 15). A few years later, other researchers found that using drawing as a qualitative-naturalist research tool enables a thorough representation of the participant's experiences and helps to understand their feelings and thoughts. It enables to establish research trustworthiness by triangulating data gathered by other tools [26].

Although several studies have used drawing analysis techniques [23, 26] only few provide a structured analysis framework. In our study, we implemented a consistent and coherent framework for the analysis of reflective drawings based on previous research [12].

10.3 Research Goal and Participants

The goal of this study was twofold: to examine how undergraduate students' perceive themselves as innovative thinkers and to examine the way they express innovative ideas when asked to illustrate the 'ideal learning environment'.

The research was conducted among randomly selected undergraduate students in two higher education institutes ($N_{total} = 202$). Most of the students, 75 % studied in their first or second year and had experience diverse teaching and learning methods including: lectures, active learning sessions, collaborative learning, and the use of advanced ICTs for promoting problem- and inquiry-based learning. Most of the students, 68 %, were female, 54 % were under the age of 26, 54 % studied social sciences and humanities, and the other 46 % studied sciences and engineering.

The students were asked to state their expertise in using ICTs for learning by marking one of the following options: a. Novice—one who is partially familiar with educational ICTs and will use them only when necessary (38 %), b. Experienced—one who is aware of the use of educational ICTs and would like to learn more about them (48 %), c. Expert—one who is well acquainted with educational ICTs and frequently uses them for learning (14 %).

10.4 Methodology and Research Tools

The 'mixed methods research' model [28] was employed by using both quantitative and qualitative methodologies in the analysis and interpretation of data. The study included two main research tools: the Innovative Thinking survey and Reflective Drawings analysis.

The Innovative Thinking Survey was conducted in order to indicate students' ability to 'think differently' and identify the ways they gain new ideas. The Innovative Thinking survey included 22 Likert-type items on a 5 point scale, adapted from Dyer et al. [4]. The original survey included only 19 items and was administered to business and industry people. In our study, we added three more items and changed some of the items to fit undergraduate students. Similar to the original survey, the items were divided into four categories:

Questioning (6 items)—Indicating students' inclination to ask inspiring questions and challenge the status quo.

Observing (6 items)—Indicating students' inclination to be a passionate observer, carefully watch the world around, gaining insights into and ideas for new ways of doing things.

Networking (5 items)—Indicating students' inclination to discover new ideas through diverse networks of individuals, listening to people who may offer different view of things.

Exploring (5 items)—Indicating students' inclination to try out new experiences both intellectually and experientially, constantly testing assumptions along the way.

The survey's validity was established by three experts in education, and the reliability was established by internal consistency Cronbach's Coefficient Alpha, that was 0.87 for items in all categories. For each separate category, Cronbach's Coefficient Alpha was: Questioning: $\alpha = 0.74$, Observing: $\alpha = 0.74$, Networking: $\alpha = 0.74$, and Exploring: $\alpha = 0.70$, and. Data was statistically analyzed using the general linear model (GLM) [29].

The Reflective Drawing Analysis framework was conducted in order to examine students' innovative thinking about learning environments. The undergraduate students were asked to draw an "ideal learning environment" and explain the drawing in writing. They were not given any other instructions. The drawings were analyzed by applying six drawing indicators adapted from previous work [12]. They include: a. Drawing surrounding, b. Type and number of images that appear in the drawing, c. Location and relative size of each image, d. Details presented in each image, e. Facial expressions, and f. Interactions among images and their movement. The analysis indicators helped to construct and validate the categories that indicated students' perceptions about the ideal learning environment.

In the analysis, we looked for innovative thinking, by examining progressive education indicators, such as: student-centered learning, learning by doing, exploratory learning, learning in context, collaborative learning, and fun (enjoying the learning process). The drawing analysis indicators and their interpretations were examined by two experts in education for validation purposes, reaching complete agreement through deliberations.

10.5 Findings

This section includes two parts. The first part details the results of the Innovative Thinking survey, specifying students' innovative thinking. The second part depicts the way students' perceive the ideal learning environment, focusing on ICTs as means for enhancing progressive education.

10.5.1 Undergraduate Students' Perceptions About Their Innovative Thinking

The mean scores and standard deviations of the undergraduate students' perceptions about their ability to think innovatively were not high. On a scale of 1-to-5, their total average was 3.68 with standard deviation of 0.49. The Observing category received the highest means (3.86 ± 0.57) while the Networking category received the lowest means (3.59 ± 0.67). This suggests that students are inclined to carefully observe the world around them and gain insights into new ways of doing things, but they are less inclined to discover new ideas through diverse networks.

Considering the idea that most students are involved in one or more social network, this finding is quite surprising. We can assume that students do not perceive social networks as platforms for gaining innovative ideas.

The examination of students' perceived innovative thinking by gender, age, major field of study, and ICT expertise, are presented in Tables 10.1, 10.2, 10.3, 10.4.

No statistically significant differences were found between male and female students. However, Table 10.1 shows that in average, male students perceive themselves as innovative thinkers more than female students in all categories, except one—Networking. Female students assigned higher marks to Networking—the inclination to discover new ideas through diverse networks of individuals. It seems that female students are more inclined to be innovative when listening to people who may offer different view of things.

Table 10.2 shows that the undergraduate students with the highest perceived thinking skills were those in the ages 18-to-20 years old. Multivariate ANOVA indicated a statistically significant difference between groups in the Observing and Networking categories ($F = 3.26$, $p < 0.05$, $n^2 = 0.46$; $F = 3.82$, $p < 0.05$, $n^2 = 0.53$, respectively). LSD Post Hoc test indicated that the group of very young students (ages 18–20) indicated the highest inclination to think innovatively, compared to the other groups in both observing and networking categories.

No statistically significant differences were found between science and engineering students and social studies and humanities students. However, Table 10.3 indicates that, in average, science and engineering students perceive themselves as innovative thinkers more than the social studies and humanities students in all categories, except one—Networking. It seems that science and engineering students are more inclined to receive their innovative ideas from observing, questioning and exploring—activities that are individual in nature; whereas, the social studies and humanities students, are inclined to interact with people in order to gain new ideas.

Table 10.4 shows that the undergraduate students with the highest perceived thinking skills, in average, were those who self-reported that they are experts in ICTs. Multivariate ANOVA indicated a statistically significant difference between the groups in the Exploring category ($F = 8.24$, $p < 0.001$, $n^2 = 0.75$). LSD Post Hoc test indicated that the ICTs experts, those who are well acquainted with educational technologies, are most inclined to try out new experiences. This result may also indicate that students with high innovative thinking are most likely to

Table 10.1 Students' perceived innovative thinking by gender

	Female (N = 137)		Male (N = 65)	
	Mean	SD	Mean	SD
Observing	3.83	0.59	3.94	0.50
Questioning	3.60	0.67	3.69	0.62
Exploring	3.63	0.50	3.68	0.52
Networking	3.60	0.70	3.55	0.64
Total	3.66	0.45	3.71	0.51

Table 10.2 Students' perceived innovative thinking by age

	18–20 (N = 35)		21–25 (N = 74)		26–30 (N = 34)		30+ (N = 59)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Observing	4.01	0.50	3.74	0.54	3.76	0.68	3.98	0.55
Questioning	3.78	0.52	3.51	0.63	3.57	0.83	3.71	0.63
Exploring	3.80	0.48	3.58	0.47	3.56	0.50	3.67	0.56
Networking	3.90	0.68	3.48	0.66	3.45	0.71	3.60	0.63
Total	3.87	0.46	3.58	0.45	3.59	0.57	3.74	0.48

Table 10.3 Students' perceived innovative thinking by major field of study

	Science and engineering (N = 94)		Social studies and humanities (N = 108)	
	Mean	SD	Mean	SD
Observing	3.89	0.57	3.85	0.59
Questioning	3.65	0.63	3.62	0.69
Exploring	3.65	0.48	3.64	0.55
Networking	3.58	0.67	3.61	0.69
Total	3.69	0.49	3.69	0.49

Table 10.4 Students' perceived innovative thinking by ICT expertise

	Novice (N = 78)		Experienced (N = 96)		Expert (N = 28)	
	Mean	SD	Mean	SD	Mean	SD
Observing	3.77	0.58	3.91	0.52	3.92	0.69
Questioning	3.58	0.69	3.64	0.58	3.74	0.67
Exploring	3.57	0.51	3.61	0.49	4.00	0.42
Networking	3.51	0.69	3.66	0.66	3.57	0.71
Total	3.61	0.53	3.71	0.44	3.81	0.50

become experts in the use of ICTs, since they are inclined to explore new ventures and they constantly test contemporary assumptions along the way.

10.5.2 Undergraduate Students' Perceptions About the Ideal Learning Environment

The reflective drawing analysis was conducted among a sample of 38 science and engineering students. The analysis indicated three main learning environments: Inside a classroom (60 % of the drawings), outdoors (15 %), and a mixture of both in- and outdoor learning (25 %). Although the students were asked to draw an "ideal learning environment", only few drew (5 %) settings that might be considered as relatively innovative. Many of the drawings (40 %) depicted a traditional classroom with rows of desks and a teacher standing in front of the

classroom. These drawings indicated a teacher-centered approach and individual learning. Some added technologies such as desktop computers (only 8 %), laptops or tablets (37 %), interactive whiteboard (16 %), books and models (18 %), and laboratory equipment (11 %). It seems that most students made a conceptual shift from the use of desktop computers to laptops or i-pads. However, the drawings do not reflect the added value of the use of these mobile devices, in facilitating ubiquity learning, anytime anywhere. This finding indicates that most of the students (60 %) are still clinging to traditional learning environments, and are not able to imagine learning in any other way.

Contrary to this, 15 % of the students depicted learning situation that are situated out of the classroom, in the nature. Their drawings illustrated student-centered learning, learning by doing, exploratory learning, and learning in context. Only 50 % of the outdoor drawings included the use of mobile devices (laptops, i-pads). This may suggest that ICTs should be used only when they enhance the learning process.

A quarter of the students' drawing illustrated a mixture of in- and out-of classroom scenarios. Most of these drawings (80 %) indicated that the students who drew them are in a transitional stage. They believe that science education can be enhanced when learning is situated in natural environments; but they still adhere to traditional models of learning. The other 20 % of the "mixture drawings" (merely 5 % of the total drawings) indicated innovative, non-conventional learning environments. These drawings were characterized by depicting a comprehensive educational environment that brings into consideration the strengths of both classroom and outdoor learning.

Figures 10.1, 10.2 and 10.3 represent the different "ideal learning environments" that were depicted by the students. Figure 10.1 shows an example of a traditional classroom learning environment.

Figure 10.1 was drawn by Ruth (pseudo name), a second year undergraduate student. Ruth explains the drawings as follows:

> *The teacher asks students to participate by approaching the white board. The classroom includes a projector that shows the teacher's presentations or movies.*

Although the drawing illustrates the use of ICTs, there is no indication of a perceptual change toward progressive education. This drawing, and others similar to it, does not provide evidence for innovative thinking in the context of educational transformation.

Figure 10.2 shows an example of an outdoor learning environment. It includes three images—a teacher and two students with laptop computers. All the images are smiling and it seems that they are enjoying the learning process.

Figure 10.2 is a drawing made by David (pseudo name), a first year undergraduate student. David explains the drawings as follows:

> *An ICT-enhanced learning environment is pleasant. For example, learning outdoors, sitting on the ground, in the nature. It can encourage inquiry-based learning in authentic environments, especially in Biology education, where different topics can be demonstrated. Learning is more pleasant and interesting when learning outside of the classroom.*

David, together with 15 % of the students, depicted learning situations that are situated out of the classroom. All these drawings illustrated student-centered learning, learning by doing, exploratory learning, and learning in context. Since only 50 % of the students illustrated the use of mobile devices, it can be assumed that these students see ICTs as means for promoting meaningful learning, used only if they have an added value.

Figure 10.3 shows an example of mixture of in- and outdoor learning.

Figure 10.3 is a drawing made by Hannah (pseudo name) a second year undergraduate student. Hannah explains the drawings as follows:

> *The learning environment should feel as if we are in the nature. The classroom should be decorated with a relaxing atmosphere. This calms the students.*

Another mixed environment is described by Ben (pseudo name), a first year undergraduate student:

> *Sitting in groups, every student has an i-pad, the teacher is using an interactive white-board, the learning environment is dynamic and attractive with a huge fish aquarium covering one of the classroom's walls.*

Mary (pseudo name), a second year undergraduate student: describes her ideal learning environment:

> *The classrooms are arraigned around a fountain. Outside the classroom there are many trees and plants and from the other side the sea, with surfers and a boat.*

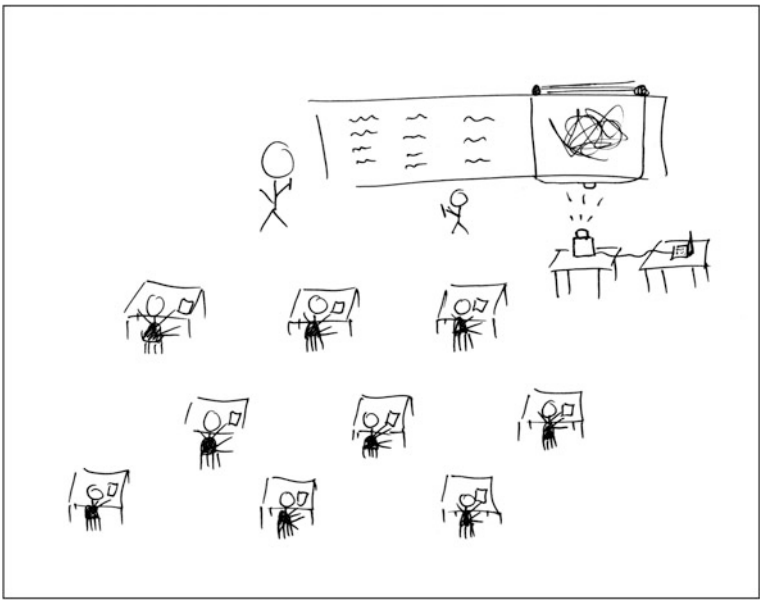

Fig. 10.1 Leaning inside a classroom

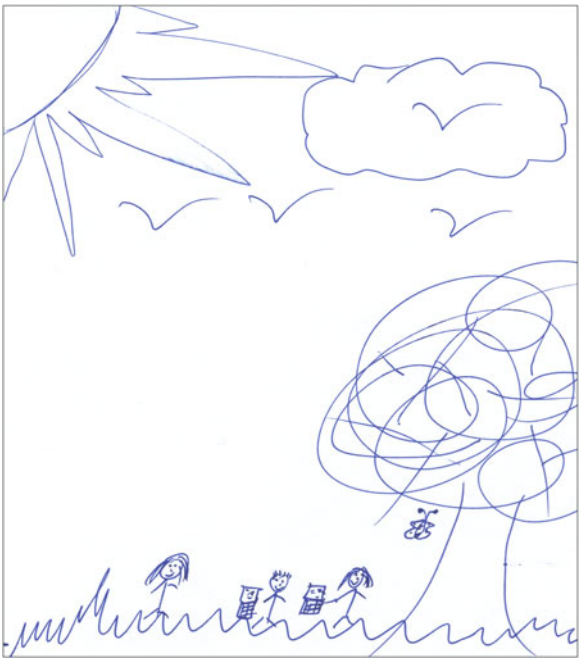

Fig. 10.2 Learning outside of a classroom

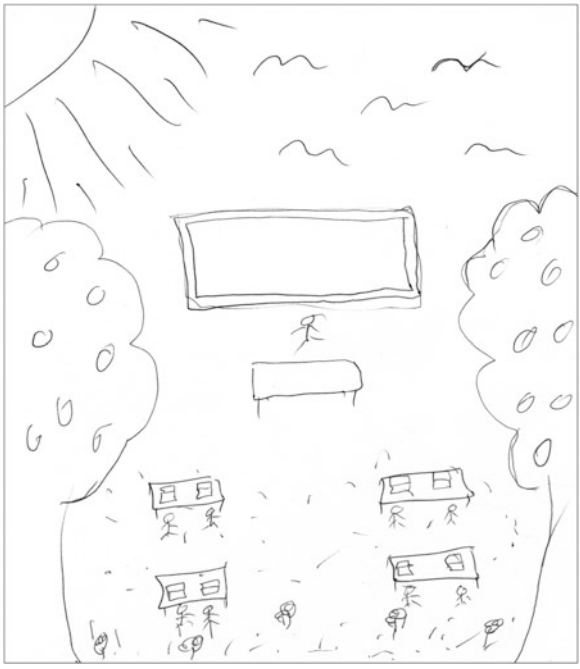

Fig. 10.3 A mixture of in- and outdoor learning

Hannah and Ben's drawing are example of students who seemed to be in a transitional stage. They believe that science education can be enhanced when learning is situated in natural environments; but they still adhere to traditional models of learning. Mary and one other student illustrated relatively innovative learning environments. Their drawings were characterized by depicting a comprehensive educational environment that brings into consideration the strengths of both classroom and outdoor learning.

10.6 Summary and Discussion

The first goal of this study was to examine how undergraduate students perceive themselves as innovative thinkers. Our findings indicated that their perceptions were not high, with an inclination to gain insights into new ways of doing things by carefully observing the world around them. In general, the students were less inclined to discover new ideas through networks of individuals or by listening to other people who may offer different viewpoints in a collaborative surrounding. The fact that the Networking perceived the lowest mean, although most of the students belong to generation Y, is less expected. This can be interpreted as to the fact that even though generation Y appreciate and use vary kinds of networking, they were not exposed in their education period to good ways for using these tools to investigate phenomenon or to discuss meaningful ideas. Considering the idea that most students are involved in one or more social networks, we can only assume that they do not perceive social networks as platforms for gaining innovative ideas, rather as a platform for being updated and keeping in touch with friends.

Findings indicated two groups of students that expressed the highest inclination to be innovative: young students—ages 18–20 and those who self-reported as experts in ICTs. No correlations were found between the two groups indicating that ICTs' experts are among all groups of ages. Although the literature shows that young people may be more innovative [30], our study indicate that no matter what their age is, those who are well acquainted with educational ICTs are most inclined to be innovative thinkers. This result may also indicate that students with high innovative thinking are most likely to become experts in the use of ICTs, since they are inclined to explore new ventures and they constantly test contemporary assumptions along the way. Findings also indicated that female students are more inclined to be innovative when listening to people who may offer different view of things. This coincides with literature that suggests that female students tend to be more active in social and interactive environments than males [31]. Compared with males, female students are more social and comfortable in group learning, and are likely to be more productive in such situations [32].

The second goal of this study was to examine the way students' express innovative ideas when illustrating the 'ideal learning environment'. In the analysis, innovative thinking was identified by progressive education indicators. Findings showed that only few drew settings that might be considered as relatively innovative.

Many drawings depicted a traditional classroom, indicating a teacher-centered approach and individual learning. Although most of the students made a conceptual shift from the use of desktop computers to laptops or i-pads, their drawings do not reflect the added value of these mobile devices in facilitating ubiquity learning. This finding indicates that most of the students are still clinging to traditional learning environments, and are not able to imagine learning in any other way.

The reflective drawing analysis indicated that some of the students are in a transitional stage. They believe that science education can be enhanced when learning is situated in natural environments; but they still adhere to traditional models of learning. Only few illustrated innovative, non-conventional learning environments. These drawings were characterized by depicting a comprehensive educational environment that brings into consideration the strengths of both classroom and outdoor learning.

The findings above are in line with other studies that indicated that ICTs are usually incorporate into traditional practices (such as lectures and exercise), with no change of the teaching and learning methods [33, 34]. Even more recent studies on the integration of ICTs for educational purposes, criticize their simplistic and tokenistic inclusion [13, 14]. Many criticize the teachers in schools or the lecturers in the academia; however, our study provides an additional explanation to this phenomenon that lies upon the undergraduates' low self-perceptions as innovative thinkers. This affects the way they apply innovative ideas, including new teaching and learning methods. Students' low self-perceptions as innovative thinkers can explain why they, similar to many of their lecturers do not adhere to innovations in education.

In this study, we applied two tools for examining students' innovative thinking. One is a quantitative tool that examined students' inclination to be innovative and the ways they gain new ideas. The second is a qualitative tool—the Reflective Drawing Analysis that provided a direct route to participants' innovative thinking through their metaphorical power. Building upon the work of similar studies [12, 24], we suggest Reflective Drawing Analysis as an important method for understanding students' learning and thinking in the 21st century.

Although this study was conducted among 202 students from two higher education institutions, there is still a need to conduct further research, in order to prove external validity and provide generalized conclusions.

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Chapter 11
Sensor-Data-Driven Knowledge Creation Model: A Model and Empirical Test

Norihiko Moriwaki, Kazuo Yano and Dai Senoo

Abstract A new knowledge-creation model, called sensor-data-driven knowledge creation (SDD-KC), which utilizes sensor data for discovering tacit knowledge, is proposed and tested. The proposed model utilizes wearable sensors to digitize tacit activities such as location, motion, and social interaction of people. To derive practical knowledge, the obtained data is statistically analyzed and associated with performance outcome. An empirical test at a retail store demonstrated that the SDD-KC model was able to derive a rule that leads to customers' behavioral change, which contributed to a sales increase. In contrast, the traditional knowledge-creation model, applied in the same setting, failed to identify effective ideas. The proposed SDD-KC model was thus shown to be effective for knowledge creation by overcoming cognitive limitations of people.

11.1 Introduction

Information technologies (IT) as knowledge-creation tools and people with knowledge-creation capabilities are of paramount importance in regard to becoming a *knowledge-creating* company [1]. Since IT has mainly been utilized for dealing with the explicit dimension of knowledge, the quality of tacit-knowledge discovery has been dependent on people's capabilities [2, 3].

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Nonaka and Takeuchi base their knowledge-creation model on dynamic interaction between tacit knowledge and explicit knowledge [1]. Tacit knowledge, according to Nonaka and Takeuchi, is personal, context-specific, and therefore hard to formalize and communicate. Explicit knowledge, in contrast, refers to knowledge that is transmittable in formal, systematic language. Nonaka and Takeuchi's model is thus based on the central idea that new knowledge is created by converting tacit knowledge into explicit form. In this tacit-explicit conversion process, the socialization and externalization modes of the SECI (*socialization*, *externalization*, *combination,* and *internalization*) spiral process matter [1].

Socialization, the first knowledge-transfer process, is the process of bringing together tacit knowledge through shared experiences. The effectiveness of socialization depends on the organizational culture and the balance between individual competition and group cooperation [4, 5]. Tacit-knowledge transfer therefore meets several individual and organizational barriers. Externalization, the next mode after socialization, is for transforming context-specific tacit knowledge into explicit forms of knowledge. It, however, is not done automatically; that is, it takes some cognitive efforts. The capacity of a given individual to perform externalization and his or her motivation are therefore dependent on the quality of the socialization and externalization processes. Accordingly, when creation of knowledge is completely left to people's capabilities, organizations tend to remain focused of capturing current tacit knowledge (such as re-using business processes) rather than inventing new models.

To date, few knowledge-creation-supporting IT systems that explicitly incorporate information associated with the tacit dimension have been implemented. Although Panahi et al. proposed that tacit knowledge can be shared in social-media spaces [6], it is generally thought that knowledge cannot be effectively shared through IT that involves a static repository because such knowledge can never convey the richness of the context in which it was applied [7]. Wu et al. proposed clarifying the knowledge-creation process in ontological dimensions as well as epistemological dimensions [8]. They proposed an ontological-shift SECI model as a diagnosis tool, which utilises IT to visualise key activities of a knowledge-creation project. Although this work proposed the concept of *visualizing knowledge-creation* by IT support, this visualization is not sufficient to overcome people's cognitive limitation for the following reasons. Firstly, the model neglects how to employ IT for capturing people's tacit activities. Secondly, merely visualizing a current situation does not necessarily lead to creation of new actionable knowledge.

Aiming to overcome the above-mentioned cognitive limitation, a new knowledge-creation model, namely, a *sensor-data-driven knowledge-creation model* (hereafter, called SDD-KC), is proposed in this study. SDD-KC utilizes sensor technologies to promote a new kind of people-IT cooperation. SDD-KC redefines the roles of people and IT on the basis of the SECI model as follows:

- First, social situations, such as people's location, face-to-face (F-to-F) interaction, and motion, are automatically captured by wearable sensors.

- Then, a rule is derived by computer in a way that the sensor data is aggregated and statistically associated with performance outcome.
- Finally, following the identified rule, people make a decision to try and practice new performance-outcome-related activities.

In this way, SDD-KC creates new actionable knowledge especially from the tacit dimension systematically by overcoming people's cognitive limitation. In this study, the effectiveness of SDD-KC is demonstrated at a retail- store setting in comparison with the traditional approach of knowledge- creation.

11.2 Sensor-Data-Driven Knowledge Creation

11.2.1 Tacit Knowledge and IT Utilization

Alongside other forms of knowledge, tacit knowledge is seen as constitutive of innovation. The conversion of knowledge from a tacit towards an explicit form is inherently a creative act using metaphors, analogies, and images [9]. For example, in an organization, people may first have a tacit sense of inequality, such as how decisions are being made or incentives used. Next, people may articulate knowledge, share it, and then act to change their situation for the better. It is, however, important to note the fact that these processes are not done in an automatic way, but with some cognitive efforts. As shown in Fig. 11.1, therefore, it is natural that IT has not been utilized in regard to the tacit dimension of knowledge but mainly in regard to the explicit dimension [2].

As Vygotsky noted, written text is the prototypical cognitive tool that can be used for de-contextualization [10]. Computers have been primarily used for dealing with de-contextualized media in the explicit dimension of the knowledge-creation process.

The present study takes up this issue and attempts to construct a model that utilises technologies to overcome people's cognitive limitation concerning tacit knowledge.

11.2.2 Sensor-Data-Driven Kc Model

The proposed SDD-KC model aims at overcoming human cognitive capacities and therefore enables new people-IT cooperation. Utilizing sensor technology is a promising way to capture the situation concerning a socialization process such as people's location, motion, and F-to-F interactions. The proposed SDD-KC model utilizing sensor-data is shown in Fig. 11.2.

The SDD-KC model consists of two layers, namely, an *IT-involvement* layer and a *people-involvement* layer concerning KC activity. On the IT-involvement

layer, a social situation (such as people's location, F-to-F interaction, and motion) is automatically captured by wearable sensors. Tacit activities can thus be digitized as sensor data. The sensor data is then aggregated and statistically associated with performance outcome by computers. On the people-involvement layer, people try to practice newly identified activities for internalization as a learning process [1]. Their activity level is thus changed, and a new knowledge spiral is created. That is to say, in the case of the SDD-KC model, as opposed to a traditional *human-centric* knowledge-creation model, IT (sensors and computers) plays the central role in tacit-knowledge discovery to overcome people's cognitive limitation. The following hypothesis concerning the SDD-KC model is proposed.

Hypothesis: The proposed SDD-KC model is effective for creating new knowledge and is superior to a traditional knowledge-creation model in terms of overcoming people's cognitive limitations.

The detailed functions of the IT-involvement layer in SDD-KC model are explained as follows.

11.2.2.1 Sensing Technologies

Tacit activities, which are hard to formalize and communicate in business situations, are digitized by utilizing wearable sensor technology. Hitachi's *Business Microscope* is one such technology, namely, a name-tag-type sensor node, for measuring face-to-face interaction and body motion (Fig. 11.3) [11]. Interactions between people are captured automatically and unobtrusively when the people wear the sensor node. Interactions between people are captured and stored as follows: sensor nodes send and receive IDs, which are uniquely pre-assigned to all nodes, by directional infra-red signal automatically when they are facing each other within a range of two meters and an angle of 120°. In this manner, the nodes capture the IDs of each other with timestamps. This ID exchange with time information enables analysis of face-to-face interaction in terms of quantity and frequency.

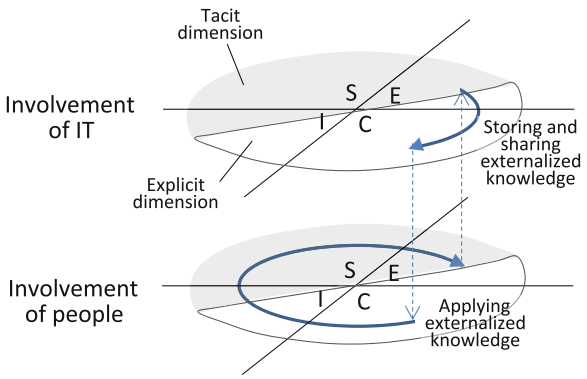

Fig. 11.1 Nonaka and Takeuchi's SECI model [1] and conventional IT utilization

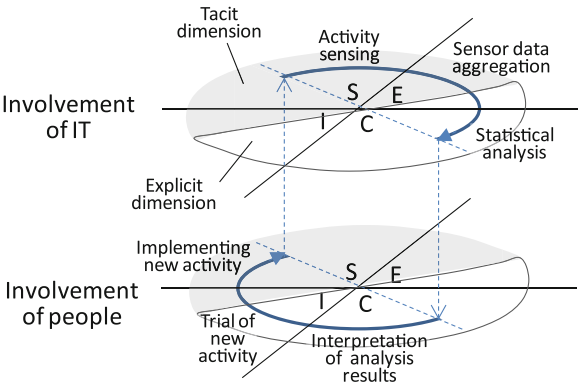

Fig. 11.2 Proposed SDD-KC model utilizing sensor-data

Body-motion rhythm of the wearer is captured by an accelerometer on the sensor node. The accelerometer precisely captures slight movements like nodding as a frequency rhythm. From characteristics of the frequency rhythm, people's emotional states, as well as activities like walking and running, can therefore be inferred [12, 13]. These data are the unique situational data obtained by the wearable sensor.

IR (infra-red) beacons for detecting sensor-node wearers around them are installed at specific locations. Each IR beacon transmits a unique ID continuously over a range of approximately two meters so that the sensor nodes capture the ID with a timestamp when they are around an IR beacon. Situational digitization is thus attained, and the dynamics of a business situation is traced as objective, quantifiable data. This measurement can capture real-world situations including peoples' tacit activities.

11.2.2.2 Situation Variables Obtained from Sensor Data

The obtained situational data are aggregated and converted into situational variables, which can be calculated from sensor data, and defined as *environment*, *location*, *social*, and *motion* as listed in Table 11.1. Each variable is defined per unit time and calculated per person.

The situational variables obtained above are aggregated and aligned as follows. Firstly, a timeframe of each person's activity (*start time* and *end time* in Table 11.1) is retrieved. For example, a timeframe would be work start and finish times of company employees or shopping start and finish times of customers. Next, all situational variables, including other people's, during the time-frame are obtained and aggregated. The variables are then aligned in a way that social and motion variables are combined and sorted at each location. The result of the aggregation and alignment contains each person's multi-dimensional situational valuables, which could affect his or her behavior.

Function	Description
Motion	Captures 3-axis acceleration at 50 Hz.
F-to-F Interaction	Detects interaction between nodes within 2 m at an angle of 120 degrees via infrared sensor.
Other sensing	Temperature/brightness.

Fig. 11.3 Wearable sensor and its functions

11.2.3 Statistical Analysis for Decision-Making Support

The obtained situational valuables are associated with business outcome. For this statistical association, regression analysis is applied to the outcome variables and all the other situational variables comprehensively. For simplicity, linear-regression analysis is used [14]. The situational variables having significant correlation with the outcome variable are selected, and a regression slope for each selected variable is then calculated. The rule with statistical significance is thus selected as a candidate for performance improvement. The selected rule is a source of new knowledge that people cannot presume but is closely linked to business performance. Applying the obtained rule, people can make a decision to start practical activities.

In summary, the proposed SDD-KC model gives a data-driven rule forming the basis of new knowledge. Since the rule explains statistical significance in relation to improving a business outcome, it helps people make practical decisions and start new activities beyond their experience and intuition.

11.3 Demonstration of Sdd-KC: The Case of a Retail Store

To demonstrate the effectiveness of SDD-KC model, it was applied to a retail store in comparison with the ordinary knowledge-creation approach. The target store was a mid-sized home center (one of a home-center chain in Japan). The primary

Table 11.1 Situational variables converted from sensor data

Category	Variables	Calculation method using sensor data
Time	Start time	Start time of sensor measurement
	End time	End time of sensor measurement
Environment	Sound	Sound energy from microphone
	Temperature	Temperature sensor
Location	Stay	Detection of IR beacon ID
Social	F-to-F/solitary	Detection of other wearable sensor ID
Motion (behavior)	Walking	Walk/still judgment from accelerometer
	Walking distance	Summation of detected IR beacon's physical distance
	Moving or still	Move/still judgment from beacon ID
	Motion rhythm	Frequency from accelerometer
	Motion energy	Energy from accelerometer
	Activeness	Active judgment from motion rhythm

task of an employee is stacking and shelving items, order placement, and servicing customers when needed. Each employee is pre-assigned a specific area in the store. Their task operation is not routine but rather discretionary in manner. The following data was collected for the SDD-KC model:

- Data-collection period: 20 days (10 days each before and after executing ideas)
- Employees: 17 people (regular staff and part-time staff)
- Customers: 608 people (304 before and 304 after)
- Collected data: location, F-to-F interaction, motion in the store (employees and customers)
- Business outcome: average sales per customer.

Situational data such as customer-service activity and locations were collected by wearable sensors and IR beacons. First, data was collected over 10 days from the employees working in the store and from 304 sample customers who visited the store. The ideas for increasing sales were generated by analysing the data. After the ideas were implemented, data was collected again over 10 days from the employees working in the store and from 304 sample customers in the same way as the previous data collection. For data collection, customers were randomly chosen from the customers who visited the store during the study period. The number of sample customers corresponds to approximately 2 % of all the customers who visited the store during the experiment. According to the experimental setup explained above, information such as where and when the customer stood still, received service from the employees, and where the sales employees were located was recorded automatically.

To evaluate business outcome, POS (point-of-sales) data during the data-collection period was gathered. The POS data contain the same information as a sales receipt, namely, commodity code, quantity of purchase, and purchase amount. Combined analysis of receipt number and sensor ID therefore makes it possible to analyze the purchase process. For example, relations between stopping in front of store shelves, servicing customers, and purchase results can be analyzed quantitatively.

As for the ordinary knowledge creation approach, a consulting service was tried in the same setting. The consultants had domain knowledge regarding in-store marketing. Their job included interviews with the executives and managers, customer-satisfaction evaluation, financial analysis, and observation of the store to derive ideas to increase sales. The results of these two approaches were compared after the execution of sales-increase ideas to show knowledge-creation effectiveness.

11.4 Data Analysis and Results

According to the SDD-KC model, IT (sensors and computers) has the potential to discover rules that people cannot assume hypothetically. Regarding F-to-F interaction activity, F-to-F interaction between employees and customers significantly

correlates with total average sales per customer ($r = 0.39$, p-value < 0.001). Regarding employees' location, an employee's stay at the location *Magnet 2-1* relates to average sales per customer most as shown in Fig. 11.4. This means that an employee staying at this specific location (called a *hot spot* hereafter) for one second relates to average sales per customer of 14.5 yen ($r = 0.27$, p-value < 0.001). Here, *Magnet* means a point in a store that attracts customers' attention after appropriate products are arranged so as to promote sales.

To evaluate the cause-and-effect relationship concerning the identified rule, a regular employee was encouraged to stay at the hot spot even when doing regular tasks, and the sensor measurements were conducted for 10 days. As a result of this repositioning, employees' stay time at the hotspot was increased by 70 %. This increase caused the customers' circulation in the store to change. As shown in Fig. 11.5, it is notable that customers' stay at the deep-in-store area and the central-store area increased 11 and 3 % respectively, while customers' stay at the near-entrance area decreased 15 %.

It is therefore concluded from this result that the rule derived by the computer was effective in changing behaviors of people (employees and customers). In summary, SDD-KC was effective in creating a knowledge spiral by converting the tacit knowledge extracted from social activities into explicit knowledge, which was used to mobilize people. As a result of these behavioral changes, the average sales per customer increased by 15 %.

As for the effect of the derived rule on sales increase, asking for the customers' cooperation in the survey and giving them wearable sensors may have worked positively in terms of increasing purchases. Nevertheless, the number of sample customers consists of only about 2 % of all the customers. The effect of sample customers on total sales increase is therefore negligible.

As for the ordinary KC approach, the consultants had frequent meetings with the executives and managers, and they also spent time in the store for close situational observations and customer-satisfaction evaluation to extract ideas for increasing sales. According to these *human-centric* processes of *socialization* and *externalization*, the consultants decided to put out POP (point-of-purchase) signs in front of special sales categories aiming at attracting customers. However, their ideas did not produce any visible behavioral change in the store.

Table 11.2 compares the two approaches; namely, SDD-KC and ordinary KC through the consulting process. According to this comparison, SDD-KC effectively created new knowledge, which was difficult to hypothesize by experts with domain knowledge.

11.5 Discussion and Evaluation

Applying the SDD-KC model revealed new knowledge that leads to behavioral change and an improved business outcome. According to the traditional social-practice view, tacit knowledge is acquired through socialization of organizational

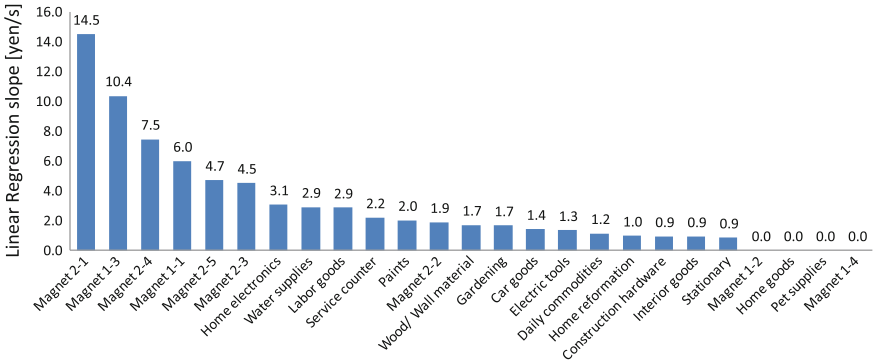

Fig. 11.4 Employees' location stay and relation to customers' average sales

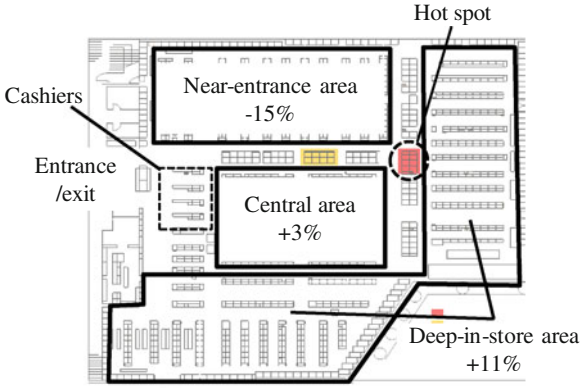

Fig. 11.5 Location of the hot spot and changes in customers' circulation

members into a group under the guidance of a mentor. As several authors point out, repetitive recognizable patterns of interdependent actions carried out by multiple actors or routines emerge; thus, so-called *organizational routines* are conserved in organizations [15, 16]. In contrast to the traditional view, the present study is one of the first demonstrations that knowledge in the tacit-dimension acquired through IT is utilized for people to make decisions regarding activities in a way that increases business performance. In other words, the proposed SDD-KC model is able to effectively give a *breakdown* opportunity for organizations to rethink and improve their routinized work procedures [17]. The SDD-KC model can also be effectively applied to service industries such as call centers, and educations, where precise performance metrics data is easily available. Moreover, the model brings the possibility of an entirely new knowledge-management style, in that front-line workers improve their work-procedures in a self-organizing way, unlike the ordinary top-down management style.

Table 11.2 Comparison of SDD-KC and ordinary KC

Item	SDD-KC	Ordinary KC
Process of idea generation	The results from sensor-data analysis are interpreted by people	Two consultants spent about two-weeks on ordinary consulting process
Implemented ideas	Increasing employees' stay at the hotspot	Setting up POP signs in front of particular sales items to attract customers
Output	Customers' circulation change in the store	No significant output
Outcome	15 % increase of sales per customer	No significant outcome

The proposed model is effective in creating new knowledge; nevertheless, some limitations should be taken into consideration. Firstly, since the candidates of selected rules from statistical analysis could contain both new and ordinary knowledge for people, the rules have to be selected manually by people in consideration of their novelty, feasibility, and expected returns. Secondly, the proposed model utilizes wearable sensors to obtain situation data unobtrusively. Privacy issues should therefore be taken care of, and to diminish a wearer's privacy concerns the purpose of data usage should be clarified.

11.6 Concluding Remarks

The SDD-KC model features extraction of tacit knowledge regarding social activities and conversion of the extracted knowledge into actionable explicit knowledge by utilizing sensor data and statistical computing. In other words, sensors and computers are effectively utilized to generate rules concerning people's activity and therefore helps people make a decision to start a new experience and discover new knowledge.

An empirical test at a retail store demonstrated that implementing the actionable knowledge from the SDD-KC model changed customers' circulation and thereby contributed to a 15 % increase in average sales per customer. On the contrary, the traditional approach of human-oriented knowledge creation failed to create new knowledge regarding customers' behavior or sales performance. The result from the test thus indicates that the SDD-KC model is superior to an ordinary knowledge-creation model in that the rule derived from the SDD-KC is useful to help people make decisions concerning their activities and increase business performance.

Overall, using innovative sensor technology to capture physical situations and performing statistical analysis made it possible to discover practical knowledge by overcoming cognitive limitations of people. This work explores a new paradigm of knowledge creation based on new human–machine cooperation.

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Chapter 12
A Structural Equation Model of Knowledge Management Practices and Library Users' Satisfaction at Malaysian University Libraries

Muhamad Saufi Che Rusuli, Rosmaini Tasmin, Josu Takala and Norazlin Hashim

Abstract Most organizations, such as University Libraries focus on enhancing their capability of knowledge processes to create new knowledge. The aim of this paper is to revealed empirically levels and types of KM practices applied at Malaysian university libraries. Based on 300 questionnaires through online, a survey was administered to a Lead User group of libraries (PhD candidates) in Malaysia. This is to elicit opinion of the prime users on the linkage between Knowledge Management Practice (KMP) and Library Users' Satisfaction (LUS). SPSS software and AMOS 18 were utilized to analyze research data. Furthermore, a meaningful linkage was observed between Knowledge Management Practice (KMP) and Library Users' Satisfaction (LUS) based on the empirical findings. Major contribution of the paper is to provide groundwork empirical evidence about the linkage between Knowledge Management Practice (KMP) and Library Users' Satisfaction (LUS) at Malaysian university libraries.

Keywords Knowledge management practice · Malaysia · University libraries · Library users' satisfaction · Structural equation modeling · AMOS · SPSS

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12.1 Introduction

In the 21st century, university libraries have gone through an evolutionary process of change. However, these libraries are still practicing conventional processes, which are to collect, process, disseminate, store and utilize information to provide services to the university community [7, 10, 12, 37]. Recently, a library's status is no longer defined by the collection it housed, but, it is extended to include online and seamless access to information resources [22]. Kumar [22] assert that KM is a form of expertise-centered management which draws out tacit knowledge making it accessible for specific purposes to improve the performance of organizations. Successful application of KM practices involves understanding and constructively utilizing information for organizational learning. As such, the question of whether libraries deal with KM is often asked especially at Malaysian university library. It can be due to lack of a deeper understanding of various dimensions of KM [20]. We know that whatever influences universities activity also affects the environment of academic libraries operate today. In other words, what individuals come to know in their life benefits their colleagues and, eventually, the larger organization [34]. The success of KM practices in libraries also depends on their ability to utilize information and knowledge of its staff to better serve for the organizational needs. Today, we do what we have to do as librarians in the library to maintain the library function and be relevant in current times. Researchers in library science realize that there is a need and demand for new evolutionary of technology especially in KM processes in library environment [10]. Respondents to a survey conducted by Ernst and Young in 1997 identified the following 6 types of organizational knowledge, namely knowledge about customers, knowledge about best practices and effective processes, knowledge about the company's own competencies and capabilities, knowledge about the company's own products and services, knowledge about the emerging market trends, and knowledge about competitors [23].

In recent decades, knowledge management (KM) has been perceived as another potential viable response to the challenges that the Library and Information Science profession is facing in a continuously changing environment [39]. There are a number of definitions related to knowledge management practice in libraries. Tandale et al. [42] defines KM is to create a process of valuing the organization's intangible assets in order to best leverage knowledge internally and externally. Knowledge management, therefore, deals with creating, securing, capturing, coordinating, combining, retrieving, and distributing knowledge. In contrast, Tasmin and Woods [43] defines KM as a socio-technological system that facilitates integration and collaboration among various functional departments within organization to enhance innovation of new products and services for customers. However, again Skyrme and Amidon [41] defines KM as a "process or practice of creating, acquiring, capturing, sharing, and using knowledge, wherever it resides, to enhance learning and performance in organizations." Brendan [2] broadly defined KM as a acquisition, sharing and use of knowledge within organizations,

including learning processes and management information systems (MIS) or, more specifically, the explicit and systematic management of vital knowledge associated with processes of creating, gathering, organizing, diffusion, use and exploitation. On a similar note, White [45] defines KM as "a process of creating, storing, sharing and re-using organizational knowledge (know-how) to enable an organization to achieve its goals and objectives". In a similar view, KM is seen as distinct from both librarianship and Information Management (IM), as it includes knowledge creation and knowledge sharing, and the interplay of tacit and explicit, individual and collective knowledge [17, 28]. However, in this study KM is defined as "process of creating, acquiring, capturing, sharing, recording and preserving" knowledge. Knowledge management is a dynamic and cyclical process that involves the whole organizational processes, trying to map the existent learning, linking the essential processes and their strategy, in search of better organizational performance, development of the products and services, quality and client's management among others [6, 9, 46]. Zack et al. [48] and White [45] hold similar opinions and view knowledge as a strategic resource. Organizations that succeed in knowledge management are likely to view knowledge as an asset and to develop organizational norms and values, which support the creation and sharing of knowledge [38]. It is a strategic and action oriented approach for managing knowledge. In the context of this study, academic libraries refer to university libraries only. Wen [44] states that to prove their relevance and value, academic libraries must strive to provide the right amount of information to the right client at the right time with a right expense of financial and human resources. With a stagnant or dwindling library budget, academic libraries have to increase their operational efficiency in order to meet the challenge. One management tool that can help in this regard is Knowledge Management (KM). Therefore, to implement Knowledge Management Practice in academic libraries is mainly driven by its mission rather than by the competition from Internet-based reference services or electronic books. From the above understanding of definitions, KM is a process of creation, acquisition, capturing, sharing, record and preserving in the library. It is obvious to say that KM does not consist of only tacit knowledge as indicated in some KM literature. It comprises both tacit and explicit knowledge, which are complementary. Jain [20] stated that KM can be characterized as below:

- KM core process of several activities; creating, acquiring, capturing, sharing, using and re-using it;
- It includes both explicit and tacit knowledge;
- It is an ongoing activity;
- Information is the building block of KM;
- It is action oriented or application based; and,
- The main drive behind KM is to improve organizational performance.

As the practice of Knowledge Management (KM) across the world, issues' concerning knowledge processes in the library has moved to the forefront. More specifically, the objectives of this paper are formulated as follow:

RQ1. To investigate the type and level of knowledge management practices in the library.
RQ2. To compare significant relationships between knowledge creation, knowledge capture, knowledge acquisition and knowledge sharing associated with Knowledge management practices.
RQ3. To evaluate significant influential relationship between KM practices and library users' satisfaction.

12.2 Results and Methods

The selected population for this study was Malaysian University Libraries. The sample size of this pilot test is approximately 35 PhD candidates who are the lead user at Malaysian University Libraries. A total number of 35 set of online survey were uploaded to the PhD students who visited the library. This implies that each lead user who went to the library has the same chance of being selected to answer the questionnaire [40]. A total of 35 filled-in questionnaires survey through online was returned which showed an overall response rate of 100 %. The study used two parts of questionnaire construct. In Part A, the respondents were asked using close ended questions about the demography of the Lead User, while, Part B is related to KM Practices namely Knowledge Creation (KCr), Knowledge Acquisition (KAc), Knowledge Capture (KCa), Knowledge Sharing (KSh), Knowledge Record (KRe), Knowledge Preserving (KPr) and Library Customer Satisfaction (LCS). It consists of 43 statements rated on a 5-point scale (1—Strongly Disagree; 5—Strongly Agree). A principal components factor analysis with varimax rotation and Kaiser Normalization was conducted and explained 65.3 percent of the variance. However, the result indicates that 96.3 % of the lead user rated "Yes" that KM Practice should be applied in the library, while, 3.7 % were rated "No". This shows that most of the lead users have good knowledge about library's KM processes such as Knowledge Creating (KCr), Knowledge Acquisition (KAc), Knowledge Capturing (KCa), Knowledge Sharing (KSh), Knowledge Record (KRe) and Knowledge Preserving (KPr). This study applies SPSS statistical tests and AMOS 18 Structural Equation Modeling (SEM) software to determine relationship between KM practices and library users' satisfaction activities. Maximum Likelihood Estimation (MLE) is one most widely used estimation procedure under a Structural Equation Modeling (SEM) approach. Hair et al. [16] suggested that minimum sample sizes between 100 and 150 are required to achieve stable MLE results. Mundform, Shaw and Ke [32] stated that Kline [21] recommend a minimum sample size of at least 100, whereas Comrey and Lee [5] indicate that 50 is very poor, 100 is poor, 200 is fair, 300 is good, 500 is very good, and 1,000 is excellent. Therefore, this study used 300 sample size suggested "good" by Kline and Comrey and Lee to perform the SEM. The research conceptual diagram shows the linkage between Malaysian University Libraries demographics, KM practices, and Library User Satisfaction (LUS) in Fig. 12.1.

12.2.1 Respondent's Demographic

Respondents involved in this study are 100 % PhD candidates from six selected Malaysian universities in Peninsular Malaysia such as University of Science Malaysia (USM), University of Technology Malaysia (UTM), University of Malaya (UM), Universiti Tun Hussein Onn Malaysia (UTHM), Universiti Teknikal Malaysia (UTeM) and Universiti Tenaga Nasional (UNITEN). Figure 12.2 indicates the types of KM Practices in the library. There are 31.3 % of lead users rated knowledge sharing is the most applicable types of KM practices in the library at Malaysian university libraries. However, 22.3 % of lead users rated knowledge record in the second place, 14.7 % of lead users rated knowledge acquisition in the third place and 14.3 % of lead users rated knowledge creation in the fourth place. Nevertheless, knowledge preserving were rated 12.3 % by lead users and knowledge capture were rated very low which is only 5.0 % by lead users. This serves as the answer to the first research question.

12.2.2 Cronbach's Alpha

Data collected during the pilot test were analyzed using Cronbach's Alpha coefficient to check its internal consistency. The Cronbach's Alpha coefficient is commonly used to measure reliability of questionnaire construct in the surveys.

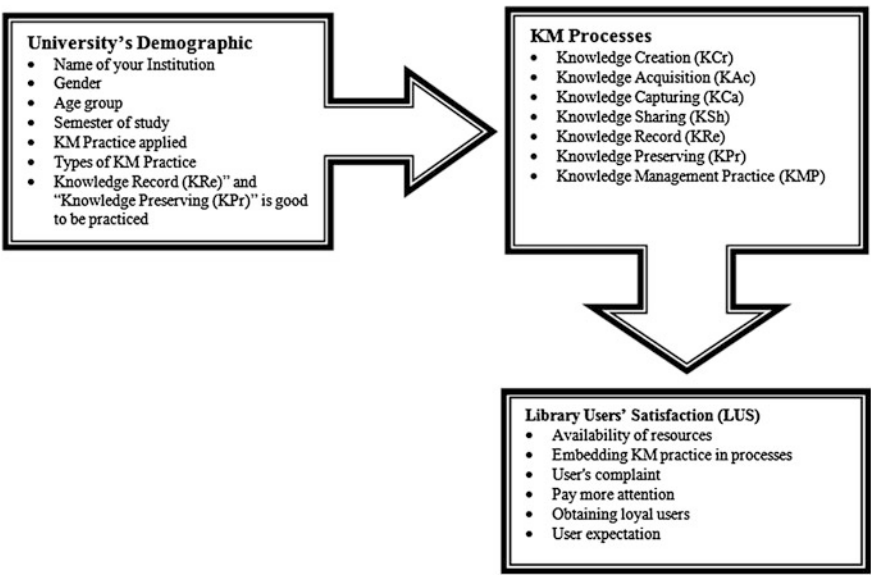

Fig. 12.1 Conceptual study of KM and LUS

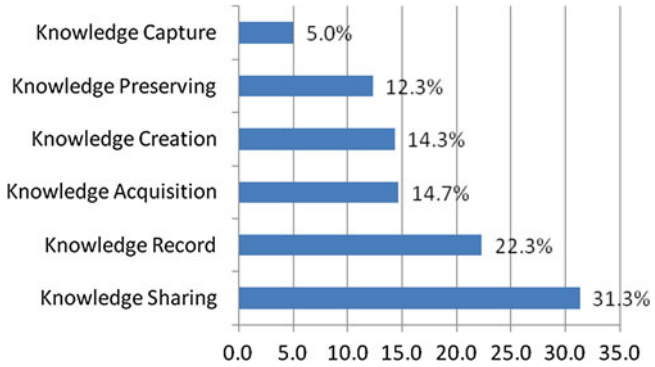

Fig. 12.2 Types of KM Practice at Malaysian university libraries

Hair et al. [16] and Garver and Mentzer [13] note that Alpha and construct-reliability values greater than or equal to 0.70 and a variance-extracted measure of 0.50 or greater indicate sufficient scale or factor reliability. Therefore, the Cronbach's Alpha coefficients of the variables in the conducted pilot study were shown in the Table 12.1. All instruments showed high reliability values (exceeding cut off point 0.6), and therefore were accepted as reliable to be used in this study.

Table 12.2 indicates the correlation coefficient between Knowledge Management Practice (KMP) overall and Library Users' Satisfaction (LUS) is 0.731. In facilitating the interpretation, the coefficient of determination is found. This is simply the square of correlation coefficient implied by 100. This shows that there is a positive and significant relationship between the level of Knowledge Management Practice (KMP) overall and Library Users' Satisfaction (LUS). Thus, the significant level is 0.000 which is lower than the stated significance level 0.01. Therefore, this suggests that the relationship is statistically significant. The extent of correlation coefficient refers to Cohen and Holliday [4].

12.2.3 Measurement Model

Confirmatory Factor Analysis (CFA) was applied in ensuring only high loading items were used in the data analysis. Measurement model analysis and composite score approach were used to confirm significant relationships between variables and their respective KM construct. Furthermore, structural model analysis was applied to test the theory of structural relationship between KM practice and library users' satisfaction as shown in Fig. 12.3.

The measurement model analysis of Knowledge Creation (KCr) in Fig. 12.3 consists of 9 variables, namely KCr1, KCr2, KCr5, KCr6, Knowledge Creation, e1, e2, e5 and e6. The measurement model for knowledge creation was evaluated using a covariance matrix of the four indicators. Modification indices (MI) were

Table 12.1 Cronbach's alpha coefficient

Knowledge management practice	Cronbach's alpha	No. of items
1. Knowledge Creation (KCr)	0.779	6
2. Knowledge Acquisition (KAc)	0.695	5
3. Knowledge Capture (KCa)	0.688	5
4. Knowledge Sharing (KSh)	0.733	6
5. Knowledge Record (KRe)	0.911	6
6. Knowledge Preserving (KPr)	0.607	5
7. Library Users Satisfaction (LUS)	0.749	6

Table 12.2 Overall correlations between KM Practice and Library User Satisfaction (LUS)

		LUS	KMP
LUS	Pearson correlation	1	0.731[a]
	Sig. (2-tailed)		0.000
	N	35	35
KMP overall	Pearson correlation	0.731[a]	1
	Sig. (2-tailed)	0.000	
	N	35	35

[a] Correlation is significant at the 0.01 level (2-tailed)

evaluated based on the MI values which are two covariances of measurement errors were allowed to be correlated at (1) e1 and e2. According to Hair et al. [16], the five determiners are ratio of cmin-df, goodness-of-fit index (GFI), normed fit index (NFI), comparative fit index (CFI), and root mean square error of approximation (RMSEA). The model fit indices are all within specifications. Cmin/df is 1.423 (spec. < 2.0), GFI $= 0.998$ (spec. > 0.95), NFI $= 0.996$ (spec. > 0.95), CFI $= 0.999$ (spec. > 0.95), and RMSEA $= 0.038$ (spec. < 0.080). The model indicates that recent trends in education emphasizing collaboration and group study are causing a demand for creating new knowledge [27]. The need for "knowledge creation" workspace has also encouraged librarians, faculty, and computer specialists to work together to provide the necessary technology, information, and services [14, 26].

The measurement model analysis of Knowledge Acquisition (KAc) in Fig. 12.4 consists of 9 variables, namely KAc1, KAc2, KAc3, KAc5, Knowledge Acquisition, e1, e3, e4 and e5. Knowledge Acquisition has covariance of measurement errors: (1) e1 and e3. The model fit indices indicates that Cmin/df is 1.831; GFI $= 0.997$; NFI $= 0.995$; CFI $= 0.998$; RMSEA $= 0.053$. This result indicates the measurement model of Knowledge Acquisition provides a good fit to the data. This means that university libraries provides acquisition of materials, training to assists lead users' needs. Thus, libraries as trusted institutions should play an important role in this respect. Furthermore, librarians need to be conversant and prepared for active participation in this process [3].

Knowledge Capture (KCa) in Fig. 12.5 indicates 9 variables, namely KCa1, KCa2, KCa4, KCa5, Knowledge Capture, e1, e2, e4 and e5. Knowledge

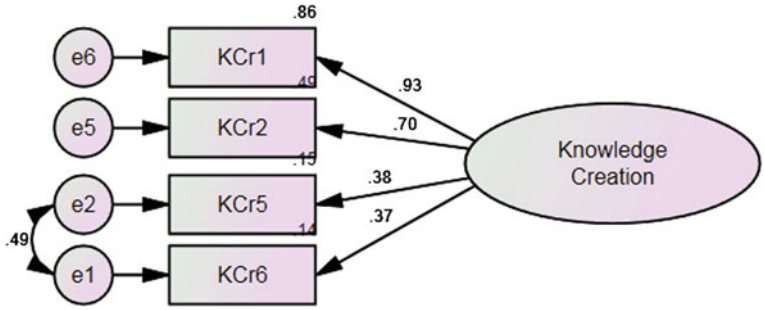

Fig. 12.3 Measurement model for Knowledge Creation (KCr) factor

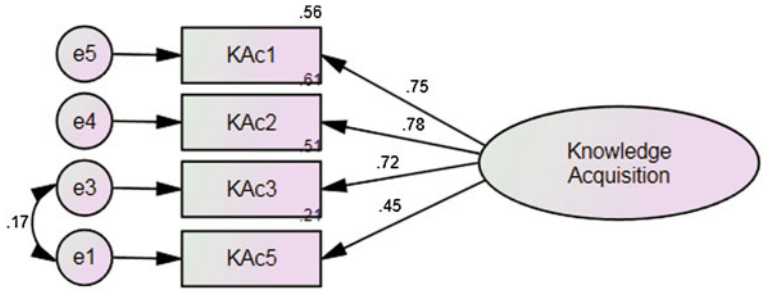

Fig. 12.4 Measurement model for Knowledge Acquire (KAc) factor

Acquisition has covariance of measurement errors: (1) e4 and e5. The model fit indices indicates that Cmin/df is 0.004; GFI = 1.000; NFI = 1.000; CFI = 1.000; RMSEA = 0.000. In sum up, all indices exceed their acceptance levels, suggesting that the measurement model provides a good fit to the data. This means that knowledge capture is organized and it would be easier for users to identify and use the knowledge. According to Daneshgar and Bosanquet [7], KM activities will build a greater understanding of customers and their requirements and as these requirements will hopefully lead to the delivery of more appropriate and timely services. For this to occur, it is imperative that the knowledge is organized appropriately [7, 28].

Knowledge Sharing (KSh) in Fig. 12.6 indicates 9 variables, namely KSh1, KSh3, KSh4, KSh6, Knowledge Sharing, e1, e3, e4 and e6. Knowledge Sharing indicate no covariances of measurement errors. The model fit indices indicates that Cmin/df is 2.675; GFI = 0.992; NFI = 0.987; CFI = 0.992; RMSEA = 0.075. This result indicates that all indices exceed their acceptance levels, suggesting that the measurement model provides a good fit to the data. This means that library encourages sharing culture within communities of practice and promotes sharing activity among librarians, student and staffs. According to M Saufi et al. [25], this signifies the importance of trust in knowledge sharing culture. The involvement

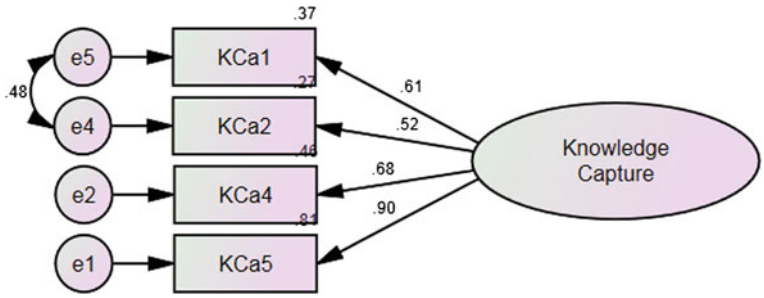

Fig. 12.5 Measurement model for Knowledge Capture (KCa) factor

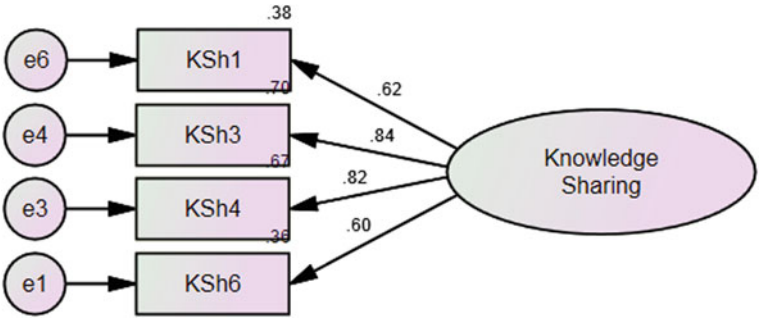

Fig. 12.6 Measurement model for Knowledge Sharing (KSh) factor

from people or individual in organization could be some of the best cultures is where everybody believes their knowledge is respected, valued and used to inform decision. Knowledge sharing practice could make people and individual become valuable [25, 36].

Moreover, Knowledge Record (KRe) in Fig. 12.7 indicates 13 variables, namely KRe1, KRe2, KRe3, KRe4, KRe5, KRe6, Knowledge Record, e1, e2, e3, e4, e5 and e6. Knowledge Record indicates covariances of measurement errors: (1) e4 and e5 (2) e5 and e6. The model fit indices indicates that Cmin/df is 1.860; GFI = 0.986; NFI = 0.983; CFI = 0.992; RMSEA = 0.054. All indices exceed their acceptance levels, suggesting that the measurement model provides a good fit to the data. This signifies that university library streamlines its daily operations to record institutional memory such as documents, videos, theses, patents and putting them aside for future use and reference [1, 33].

Knowledge Preserving (KPr) in Fig. 12.8 indicates 11 variables, namely KPr1, KPr2, KPr3, KPr4, KPr5, Knowledge Preserving, e1, e2, e3, e4 and e5. Knowledge Preserving has covariances of measurement errors: (1) e2 and e5. The model fit indices indicate that Cmin/df is 1.669; GFI = 0.991; NFI = 0.986; CFI = 0.994; RMSEA = 0.047. All indices exceed their acceptance levels, suggesting that the measurement model provides a good fit to the data. This signifies that university

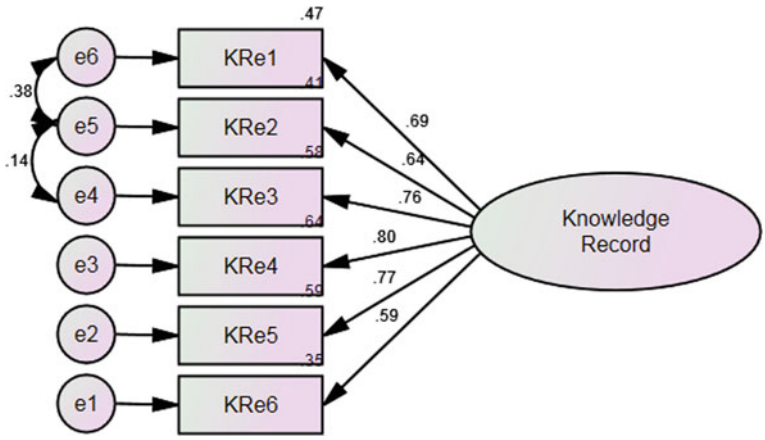

Fig. 12.7 Measurement model for Knowledge Record (KRe) factor

library has concentrated on the preservation of their materials and their collections from loss for future references. According to Gupta et al. [15], librarians will not be merely the custodians of information but they will act as knowledge managers who will work with users in collecting and analyzing strategic intelligence and to act as trainers and consultants to transfer knowledge throughout the organization.

Library Users' Satisfaction (LUS) in Fig. 12.9 indicates 13 variables, namely LUS1, LUS2, LUS3, LUS4, LUS5, LUS6, Library Users' Satisfaction, e1, e2, e3, e4, e5 and e6. Library Users' Satisfaction indicates covariances of measurement errors: (1) e1 and e4 (2) e1 and e6. The model fit indices indicate that Cmin/df is 1.154; GFI = 0.991; NFI = 0.985; CFI = 0.998; RMSEA = 0.023. All indices exceed their acceptance levels, suggesting that the measurement model provides a good fit to the data. This signifies that university library is embedding KM practice in processes, products and services in order to meet user satisfaction. According to Hsu et al. [18] and McGill et al. [31], few studies have noticed that continuously monitoring factors that affect customer satisfaction constitutes invaluable information. Therefore, university library needs to pay more attention in generating new knowledge to meet user satisfaction.

Subsequently, the structural model is the second stage and last step in the SEM approach. This model integrates and correlates all factors to the KM constructs. It also provides a structural link from the KM construct to the Library users' satisfaction factor in Fig. 12.10.

The full structural model result shows that there are 15 correlations and covariances to achieve stable model fit estimates. Figure 12.9 displays its indicators of fit: Cmin/df = 3.323 (Cmin = 16. 614, df = 5); GFI = 0.987; NFI = 0.990; CFI = 0.993; RMSEA = 0.088. In sum, Fig. 12.10 empirically shows that KM has a highly significant influence (ß = 1.09, p = 0.0001) on Library Users' Satisfaction LUS (R^2 = 0.58). These indices suggested that the structural model provided a good fit to the data and yielded a corroborating value

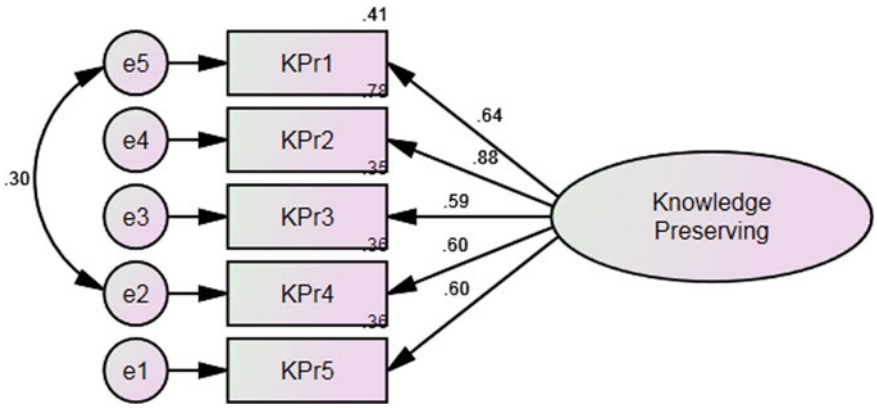

Fig. 12.8 Measurement model for Knowledge Preserving (KRe) factor

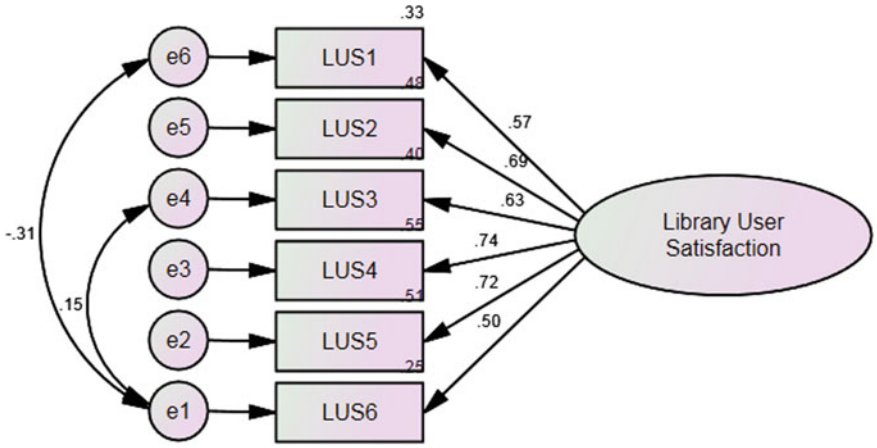

Fig. 12.9 Measurement model for Library Users' Satisfaction factor

for good model fit. However, it was interesting to note that the covariance link between e1 KMP and e2 LUS had a negative magnitude of 0.64. It implied that KMP with unknown element was not positively associated with an unknown element of LUS. It is fair to state that "when information and knowledge flow can be captured, organized and made accessible for reuse, there exists the potential for subsequent creation of new knowledge" [11, 47]. This is consistent with qualitative data (interview) which reflects the fact that KM practices were implemented at Malaysian university libraries in their daily work culture. Besides, the importance of understanding the KM process and cultural issues in organizations becoming essential for the organizations to obtain benefit from KM processes [29, 30]. Therefore, Libraries, with limited budget and human resources, should utilize

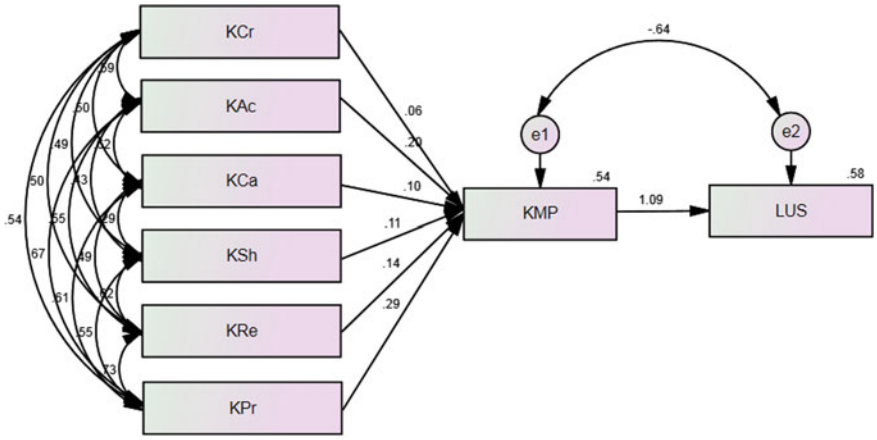

Fig. 12.10 Structural model of KM Practice and Library Users' Satisfaction (KMP-LUS)

the current management structure and technology to implement KM either through bottom-up or top-down approaches [22]. With this effort, KM will help to increase libraries operational efficiency and later to the ever increasing needs of their lead users. In sum, it is fair to state that the KM practices stand in a good position of supporting LUS activities in Malaysian university context.

12.3 Discussion and Conclusion

The primary aim of this paper is to outline the research objectives and the procedure in Structural Equation Modeling (SEM) followed by developing scales to measure KM practices and Library Users' Satisfaction at Malaysian university libraries. The scales are measured for each of knowledge creation, knowledge acquisition, knowledge capture, knowledge sharing, knowledge record and knowledge preserving. By measuring the KM processes in KM practices using Confirmatory Factor Analysis (CFA), it is revealed that these KM processes have a significance influence with a higher cut-off Goodness-of-Fit Index (GFI) ≥ 0.95 and RMSEA (spec. ≤ 0.080). However, the results prove that structural model of KMP-LUS has strong relationship between KM practices and library users' satisfaction. The result shows that the library has been regarded as a treasure house that attracted countless individuals for realizing their own learning and knowledge acquisition [8, 24, 35]. As we notice, individuals demand knowledge, and they need flexible and diversified resources. The library can utilize its abundant amount of resources, advanced technology and facilities, and its understanding of users' demands to develop campaigns that support individuals' learning. In addition, the library has been regarded as a knowledge navigation station, because it can hold

events such as exhibitions for newly published books, educational conferences, seminars, book reviews and discussion meetings.

In addition, Jain et al. [19] assert that librarians should have excellent skills in organising and codifying information sources and making them reachable to others. To manage knowledge fully, they need to understand the holistic approach of KM and equip themselves with multi-disciplinary skills to provide grater value to their customers. The way forward can be recapitulated as follows:

(1) Well-equipped libraries with modern technologies.
(2) Re-building of a new type of library culture (sharing and creativity).
(3) Holistic thinking to build partnerships across the organisation.
(4) Development of KMpolicies and strategic plans.
(5) To revitalise the library undertakings, proactive, self-confident, self-promoting, well-trained and well-prepared library staff.
(6) Strong partnerships, internally, regionally and globally.
(7) Conductive environment for KM practice including all the resources and incentives.

In conclusion, these are all potential opportunities for future research which has to be conducted to find out the linkage between KM practice and Library Users' Satisfaction for stronger structural point of view. Furthermore, this research can also be executed in other countries to explore the status of knowledge management practices in other parts of the world.

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Chapter 13
A Bibliometric Study on the Mechanical Science and Engineering Researches in Taiwan

Wen-Lin Wang and Gregory Siy Ching

Abstract Knowledge productions within the academe have been strongly focused on publication in journals included in the Thomson's ISI Web of Science (WOS) database. Within the WOS database, mechanical science and engineering researches ranks among the top five of the most highly presented topics in Taiwan. Since 1997 mechanical science research contributions have been steadily growing. To date there are a total of 9,576 mechanical science articles included in the WOS database with a contributing author coming from Taiwan. Many bibliometric theorists have proposed that within a specific field of study, 80 % of the articles are contributed by 20 % of the field's source journals. In light of this issue, the current study seeks to understand what type of publication distribution exists in the pool of mechanical science researches in Taiwan. The understanding of publication trends is able to bring about valuable insights regarding significant contributions of key journals and the corresponding articles within them. Key finding shows that mechanical science researches follows the majority trend of older articles having the most number of citations, while, newer articles having a significant higher number of authors and references. Lastly, distribution analysis shows that the mechanical science researches in Taiwan behave in a likely pattern somewhat similar to the Revised Welch Vitality Curve. Additional, insights and trends are also provided to have a more complete picture of the mechanical science and engineering research field in Taiwan.

Keywords Bibliomteric · Web of science · Mechanical science and engineering researches · Pareto distribution · Welch vitality curve · Distribution analysis

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13.1 Introduction

Recently, the push for academic publications is seen at its peak. Scholars have noted that university rankings, funding, and even the prestige of a certain field of study are all interconnected with the number of academic publications and their subsequent citations by later articles [1]. Furthermore, the ubiquitous nature of the internet has also inspired research related tools such as the Thomson Reuters' ISI Web of Science (WOS) website, which provides a window of access to published articles of interest [2, 3].

Tandem with such prevalent usage of the WOS, many studies have emerged discussing the actual contributions of such tools [4]. More specifically, the practical implications of bibliometric researches and studies that are able to provide various insights to both novice and experts [5]. Two practical application of bibliometric studies are the evaluation and comparison of research performance either across universities or countries [6, 7] and research trend analysis of a specific field of study [8–10].

The concept of bibliometric originated from the Greek word for book *biblios* and measure *metron* [11]. Broadus [12] noted that the word bibliometric first appeared in a study by Fairthorne [13]; wherein the words *bibliometric description* was used. With the increased in bibliometric researches, the question regarding how data is dispersed or distributed within the citation databases has become of great interest [14]. Various distribution laws have been incorporated to such studies, such as the Pareto distribution [15], Bradford distribution [16], and many other variations and combinations. Many bibliometric theorists have proposed that within a specific field of study, 80 % of the articles are contributed by 20 % of the field's source journals [17]. Hence, the objective of this study is to determine if such phenomenon also exists in the pool of mechanical science researches in Taiwan.

Since 1993, contributions to the WOS database have been gradually changing with strong emphasis coming from Asian countries; Taiwan included [18]. In Taiwan, engineering researches are among the highly cited papers within WOS database [19]. However, majority of the contributions are papers coming from twelve key universities in Taiwan. This also holds true in the areas of mechanical science and engineering [20]. Furthermore, graduate students also played an important role in increasing the number of contributions [21]. With regards to the research trends in mechanical science, one seminal study on mechanical engineering papers' bibliometric information reveals that technological advancement played an important role in shifting the entire research focus of the field [22]. Currently, there seems to be a gap in the literature regarding the overall implications of the mechanical science and engineering researches in the WOS database. Hence, a study focusing on the distribution characteristics of the mechanical science and engineering researches in Taiwan is provided.

13.2 Research Method

The current study is designed as a descriptive research; wherein the focus of the study is placed on the conditions or relationships that exist, practices that prevail, beliefs, points of views, or attributes that are held, processes that are ongoing, effects that are currently being felt [23]. To summarized, the bibliometric database was accessed through the use of the WOS website. The database included the various citation indexes or bibliographic indexes which allow users to search for articles included in certain categories. The database consisted of the Science Citation Index (SCI), the Social Science Citation Index (SSCI), and the Arts and Humanities Citation Index (A&HCI); which are some of the most commonly used tools for bibliometric researches [24]. For the current study, a total of 9,576 bibliometric entries from articles in the field of Mechanical Sciences are downloaded. Besides the normal bibliometric information (author/s, year, source, title, abstract, and keywords), other facts including the total number of words and pages, author's affiliations, funding information, geographical location, number of citations are also downloaded and analyzed.

13.3 Results and Discussions

After the data is downloaded, analysis is then undertaken with regards to their publication year, while correlation analysis of the articles' age with author counts, number of references, number of citations, authors' supplied keywords, and publisher supplied keywords. Such analysis is undertaken with the intention of better understanding how bibliographic information is affected by the passing of time.

Table 13.1 shows the yearly frequency of publications with their corresponding article's field of studies. Data shows that majority of the articles (around 85 %) are related to three major fields such as engineering with 47.32 %, thermodynamics with 24.63 %, and mechanics with 13.85 %. More importantly, Table 13.1 also shows the rate of increase/decrease in yearly publication frequency. Here data points out that there is an overall average increase of 0.045 % starting from 1996 till 2012.

To further understand the nature of the articles, Table 13.2 shows the yearly article distribution with their corresponding subject areas. Data shows similar distributions tendencies as of Table 13.1 with the three major subject areas as mechanical engineering with 60.24 %, mechanics with 59.98 %, and thermodynamics with 24.61 %. Although both tables shows similar trends, Table 13.2 provides a more disperse but clearer bibliometric information.

With regards to the bibliometric information, Tables 13.3 and 13.4 shows the various summary. Table 13.3 shows that 19.70 % of the articles are accomplished

Table 13.1 Publications by year and field of studies

	1977	1984	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	1	1	170	193	197	157	188	198	252	227	252	241	284	420	390	306	373	323	348
2	0	0	107	139	123	107	116	129	110	110	114	146	156	183	181	164	152	167	151
3	0	0	48	51	52	71	68	74	70	86	73	81	87	105	100	73	97	76	112
4	0	0	26	43	45	27	37	48	36	34	44	42	42	49	34	32	19	46	37
5	0	0	9	11	14	16	15	11	14	12	12	6	13	10	20	15	17	34	14
6	0	0	4	7	7	6	10	12	10	12	14	6	9	7	4	5	19	11	16
7	0	0	6	3	5	7	6	9	5	8	10	13	6	12	9	16	9	18	8
8	0	0	11	14	9	9	8	11	6	6	8	2	4	7	5	8	7	7	8
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	5	0	0
10	0	0	0	0	0	0	0	0	1	2	0	0	1	0	2	0	0	1	1
11	0	0	0	0	1	0	0	0	0	1	1	0	1	0	0	0	2	2	0
12	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0
%[1]	0.01	0.01	3.98	4.81	4.73	4.18	4.68	5.14	5.27	5.20	5.51	5.61	6.30	8.28	7.82	6.50	7.33	7.16	7.27
% inc./dec.[2]				1.21	0.98	0.88	1.12	1.09	1.03	0.99	1.06	1.02	1.12	1.32	0.96	0.83	1.12	0.97	1.01

Note. [1] Percent of 9576

[2] A value higher than 1 denotes increase, while a value less than 1 denotes decrease in publication rate

1 Engineering; 2 Thermodynamics; 3 Mechanics; 4 Acoustics; 5 Computer Science; 6 Mathematics; *7* Automation and control systems; 8 Materials science; 9 Literature; 10 Construction and building technology; 11 Energy and fuels; 12 Astronomy and astrophysics; and; 13 Environmental science and economics

Table 13.2 Publications by year and subject areas

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	%[1]
1	273	293	324	305	317	309	362	498	417	381	396	399	415	**60.2**
2	262	313	278	288	314	345	364	453	452	376	417	436	431	59.9
3	116	129	110	110	115	147	156	183	181	164	152	167	151	24.6
4	35	41	47	31	67	77	70	85	93	60	67	48	66	10.1
5	12	25	33	29	55	76	66	88	84	57	62	59	56	7.73
6	42	52	57	54	46	39	49	64	38	32	34	28	40	7.62
7	37	48	36	34	44	42	42	49	34	32	19	46	37	6.69
8	39	34	22	21	20	22	27	42	47	45	56	74	49	6.18
9	22	20	28	14	11	20	22	42	45	45	61	64	39	5.20
10	24	19	24	20	24	30	25	31	35	25	40	25	41	4.67
11	5	11	20	11	33	52	40	57	59	32	38	28	42	4.57
12	6	11	19	13	33	51	42	56	58	30	38	24	35	4.45
13	25	15	24	23	20	10	20	21	31	18	26	31	28	3.59
14	9	6	7	12	21	31	27	38	34	53	28	48	22	3.59
15	15	11	14	12	12	6	13	10	20	15	17	34	14	2.54
16	4	10	14	12	12	6	9	12	8	16	36	7	12	1.78
17	6	9	5	8	10	13	6	12	9	16	9	18	8	1.57
18	2	2	2	9	12	15	8	16	18	14	15	21	8	1.50
19	12	4	8	5	9	18	11	5	15	9	12	8	7	1.47
20	7	11	7	12	6	3	9	6	4	6	8	9	9	1.26
21	6	6	4	12	11	7	5	13	7	3	11	4	10	1.25
22	6	6	9	5	8	4	11	7	13	9	7	8	5	1.25
23	0	2	8	3	0	4	5	8	8	17	32	7	11	1.10
%[2]	10.1	11.3	11.5	10.9	12.5	13.9	14.5	18.8	17.9	15.2	16.5	16.6	16.0	

Note [1] Including all publications since 1996 till the present

[2] Percent of 9576

1 Engineering, Mechanical; 2 Mechanics; 3 Thermodynamics; 4 Materials Science, Multidisciplinary; 5 Engineering, Electrical and Electronics; 6 Engineering, Manufacturing; 7 Acoustics; 8 Mathematics, Interdisciplinary Applications; 9 Engineering, Multidisciplinary; 10 Physics, Fluids and Plasmas; 11 Instruments and Instrumentation; 12 Nanoscience and Nanotechnology; 13 Eng., Civil; 14 Energy and Fuels; 15 Computer Science, Interdisciplinary Applications; 16 Mathematics, Applied; 17 Automation and Control Systems; 18 Physics, Nuclear; 19 Engineering, Chemical; 20 Materials Science, Characteristics and Testing; 21 Transportation Science and Technology; 22 Water Resources; and 23 Physics, Mathematical

through projects funded majority by the Taiwan National Science Council; a government research agency with 16.60 %. In addition, data suggests that majority of the studies; around 4 out of 5 are not funded. At first, this seems to indicate an unhealthy situation. Further analysis shows that project funding starting from 2008 have been steadily increasing. Table 13.4 shows the summary of the bibliometric information. Data shows that the maximum number of authors is 12, which when compared to other major fields seem to be low. Furthermore, correlation analysis shows that the title and abstract word counts significantly increases in newer

Table 13.3 Article funding information

Funding agency		*n*	%
Funded		1889	19.70
	Local Government Organizations	78	0.80
	International Organizations	97	1.00
	Taiwan National Science Council	1590	16.60
	Local Private Organizations	124	1.30
Unfunded		7687	80.30

Table 13.4 Bibliometric summary

Bibliometric information	Maximum	Mean	SD
Author count	12	2.56	1.63
Title word count	31	12.11	3.70
Abstract word count	519	159.23	56.48
Number of references	211	20.27	10.39
Times cited	120	5.72	9.47
Page number	52	11.96	5.53

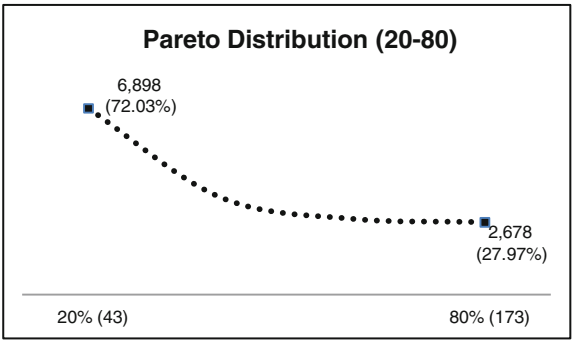

Fig. 13.1 Pareto distribution graph

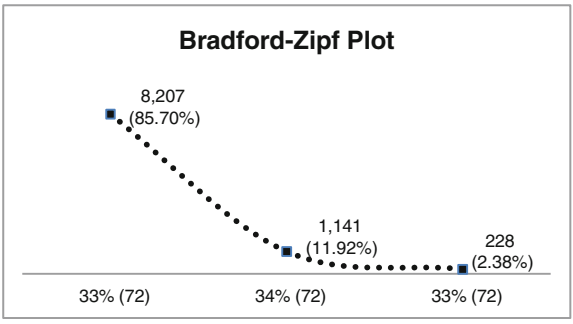

Fig. 13.2 Bradford-Zipf's plot

articles. In addition, the number of references also increases in younger articles. In sum, result also shows that mechanical science researches follow the majority trend of older articles having the most number of citations.

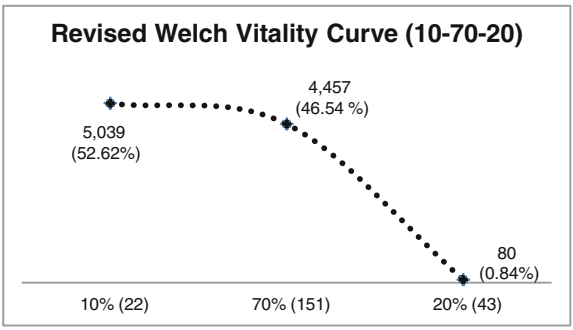

Fig. 13.3 Revised Welch vitality curve

Table 13.5 Top 12 keywords

Keywords	*n*
Flow	530
Heat transfer	455
Model	428
Design	423
Systems	300
Simulation	275
Optimization	265
Performance	228
Stability	223
System	208
Behavior	201
Surface	180

As for the article distribution analysis, Fig. 13.1 shows the Pareto distribution graph of the articles. In terms of publication analysis, when the publications are arranged by means of source journal contributions from highest to lowest; Pareto distribution denotes that 20 % (43) of the journals should be responsible for 80 % of the articles and the remaining 80 % (173) of the journals should be responsible for 20 % of the articles [25]. However, in the current study; 20 % of the journals

Table 13.6 Comparison of article and journal distributions

Distribution type	%	Citations	Articles	Journals	Citations/ Articles	Articles/ Journals
Pareto	20	42497	6898	43	6.16	160
	80	12301	2678	173	4.59	15
Bradford-Zipf	33	49445	8207	72	6.02	114
	34	4688	1141	72	4.11	16
	33	665	228	72	2.92	3
Revised Welch	10	31939	5039	**22**	**6.34**	**229**
Vitality curve	70	22512	4457	151	5.05	30
	20	347	80	43	4.34	2

represent around 72.03 % (6898) articles, while the remaining 80 % of the journals represent around 27.97 % (2678) of the articles.

Figure 13.2 shows the Bradford-Zipf plot; denoting the exponential diminishing returns of article contributions [26]. This is computed by dividing the contributing journals into three equal groups. Figure 13.2 show that the first 33 % (72) of the journals represents 85.70 % (8,207) articles. The next 34 % (72) of the journals represents 11.92 % (1141) articles and the remaining 33 % (72) of the journals represents 2.28 % (228) of the articles (Fig. 13.3, Table 13.5).

With regards to the Welch's Vitality Curve; this is demonstrated by having the 20-70-10 concept. Wherein, the top 20 % of the journal is the leading (representing) journals of the field, while the following 70 % is the adequate majority with the remaining 10 % of the journals considered as negligible [27]. For the current study, a revised Welch Vitality Curve is proposed, wherein the distribution is 10-70-20 with the top 10 % being the leading journals of the field. An important factor of distribution analysis is determining the least number of journals with the most prominent impact in the field; hence, Table 13.6 shows the citations per article breakdown across the different distribution schemes. Result shows that the revised Welch Vitality Curve has provided the most likely suitable condition. Wherein, a researcher will need only to looked into 22 major journals and be able to gather the article with the highest impact in the field. In essence, saves time and effort, while not sacrificing the quality of the work.

Additional information is provided in Table 13.5, wherein the all-time top 12 keywords used by authors are listed. While the top 5 contributing journals are the following: International Journal of Heat and Mass Transfer, Journal of Sound and Vibration, Journal of Micromechanics and Micro-engineering, International Communications in Heat and Mass Transfer, and Journal of Mechanics. These 5 journals represent almost 25 % of the article pool in the entire Mechanical Science researches in Taiwan.

13.4 Conclusion

The objective of this study is to determine how knowledge in terms of journal publications is distributed within the field of mechanical science and engineering in Taiwan. Many bibliometric theorists have proposed the use of Pareto distribution; wherein 80 % of the articles are contributed by 20 % of the field's source journals. Result of the bibliometric analysis shows that articles are somewhat distributed in a Pareto like form. However, results can be better explained through the use of the Revised Welch Vitality Curve. Wherein, the distribution is 10-70-20 with the top 10 % being the leading journals of the field, while the following 70 % is the adequate majority with the remaining 20 % of the journals considered as negligible. Furthermore, bibliometric result shows that mechanical science researches follow the majority trend of older articles having most number of the citations with newer articles having a significant higher number of authors and

references. It is urged that future researchers test the distribution model, to confirm whether the Revised Welch Vitality Curve also exists in other field of studies.

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Chapter 14
Comparing Knowledge Management Application in Chile and Other OECD Countries

Dario Liberona and Darcy Fuenzalida

Abstract There is not many studies regarding the use of Knowledge Management (KM) practices in Chile, and not a study that compares this usage with other countries. This research is aimed to find out the level of use of selected KM practices in Chile, the importance that has in the companies and if it is a formal part of the company strategy (level of institutionalization).The Center for Educational Research and Innovation of the OECD performed during the years 1999–2003 a series of studies based on a survey developed by a joint working group from Canada, France, Italy, the Netherlands and Sweden and representatives of research organizations in Australia, Denmark, Germany and Ireland. This study uses the methodology developed by these research centers to analyze motives and effects of using knowledge management practices in the Chilean industry, in the light of the recent addition of Chile as a full member of the OECD in 2010 and compare the levels of adoption with Germany and Canada. To achieve the stated objective a survey to 147 Chilean executives from various industries was conducted. The results indicate that the Chilean industry has an average of 8.6 practices in use of a total of 17 selected practices for this research, being the use of the Internet to capture external knowledge the most used and common practice. Both in this study as those in other countries, the results indicate a positive correlation between firm size and average utilization of practices. Along the same lines the KM correlates positively with innovation, where countries with greater use of KM, have in turn increased rates of innovation measure by the global innovation index. Both the use and efficiency reasons attributed to the KM by the Chileans are below the results obtained in studies by the OECD in Germany and

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Canada, denoting a low industrial use of KM practices in the country and correlated with a low innovation index.

Keywords Knowledge management · Customer knowledge management · Innovation · OECD

14.1 Introduction

Knowledge management are a new set of management theories for managing and improving processes in which these data becomes information, are shared by the organization and used for decision-making, for innovation and creating sustainable competitive advantages [8, 9].

It is essential for organizations to have sustainable competitive advantages, therefore, to use the appropriate knowledge management techniques is strategic for companies in the actual Knowledge Society. Currently there are no indicators or works that reveal the use of knowledge management practices in Chile that can be compared with other countries.

There are several international studies that review how companies are addressing knowledge management in different industries, but there are no national studies. Recently, Chile has joined the OECD and is considered appropriate to make a comparison with other member countries. Recognizing the importance of the implementation of KM programs and practices in Chile, this study seeks to have a preliminary assessment of its use in the country and its comparison with other OECD countries, in order to diagnose and suggest courses of action. This work also seeks to establish the levels of use in leading industries of the national economy in a differentiated manner.

14.1.1 General Purpose

The main objective of the work is to understand the use of knowledge management practices in Chile, what are the most common KM practices being use, how is KM appreciated or value by the executives in different industries and to know if there is a formal structure in the companies devoted or responsible of KM.

The second objective is to compare the level of use with other developed OECD members in Europe and NorhtAmerica (Germany and Canada), in order to make a preliminary diagnosis of the Chilean adoption of KM.

In order to compare the use of practices with other countries, the methodology validated by the technical team of the OECD for the project "Measuring knowledge management in the business sector, first steps" [10] was used.

14.1.2 Comparison of OECD Economies

The methodology for this research was developed within the OECD countries by the following partners: Germany, Canada, Denmark and France.

The Organization for Economic Cooperation and Development (OECD) was officially created on September 30, 1961. Other countries joined, starting with Japan in 1964. Currently, 34 OECD countries worldwide meet regularly to identify emerging problems, discussing, analyzing, and promoting policies to solve them.

In analyzing the GDP per capita, human development index, inflation, the index of competitiveness, economic growth and innovation index shows the importance of this global organization that brings together the most developed economies. Economies that are present from the beginning varied realities. There are economies like Turkey or Greece are not positive indicators today, unlike economies like Norway to its indicators support a good development.

Figure 14.1 illustrates comparative indicators of GDP growth, human development, inflation, innovation and competitiveness, to Germany, Canada and Chile, where Chile is clearly behind in these indicators except for growth and inflation management, but Chile's biggest gap with Canada and Germany is Innovation.

14.1.3 Knowledge Management

There are different definitions of Knowledge Management on the one hand [7], we can find definitions of authors who point to it as the systematic process of finding, organizing, filtering and presenting information in order to improve the understanding of people in a specific area of interest.

There are other definitions associated knowledge management to strategic concepts. Hubert Saint-Onge [6] defined it as the "ability to develop, maintain, influence and renew intangibles called knowledge capital or intellectual capital."

Both definitions have much validity to define Knowledge Management. This paper considers the definition used by the OECD "any activity related to the capture, use and sharing of knowledge in the organization."

14.1.4 Research Methodology

The survey conducted in this study, to measure the use of KM practices in Chile is the one develop by OECD in 2001. The survey took his first steps in a pilot study done by Jakob Edler in 2002 as the first initiative of the OECD to generate advances in matters of KM. Jakob took the survey which was made by OECD experts and conducted a pilot study in 2002 in Germany and then present the details of the results, in 2003.

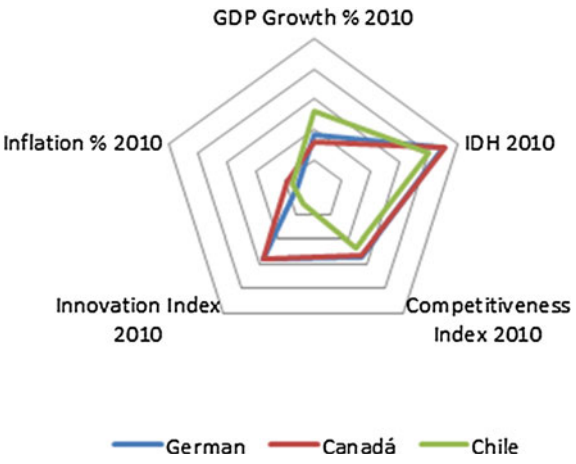

Fig. 14.1 Comparison of indicators from OECD. Own elaboration. *Source* Based on data from UN, CCS and Economic Forum (Growth, Inflation, Innovation, competitiveness, HDI)

This KM survey considers a total of 17 practices which are distributed along four themes: communication, training and mentoring, KM policies and finally, knowledge acquisition and capture.

The equivalent survey has been conducted in countries such as Germany, Canada, France and Denmark. In the first instance defined pilot studies in these countries, to test and analyze the implementation of the survey. In a second instance OECD brings together the country's final studies and delivers the final tool in order to measure the use of the KM.

14.2 Analysis

14.2.1 KM Practices in Chile

In Chile KM practices averaged 8.6 out of 17, this is an average of 50.58 % of the total being used. The most commonly used practice is to use the internet to obtain external knowledge where 74.82 % of respondents reported using this practice.

At first glance, these numbers do not reflect a negative scenario in terms of KM, but when doing contrast to a develop economy like Germany, which used 61.05 % of practices a decade ago, is beginning to see the big gap between the Chilean use and the reality of world powers in terms of KM (Fig. 14.2).

Figure 14.3 shows the average number of KM practices used by company size. Companies with more than two thousand workers have the highest average practices, however, smaller companies do not have a lot of KM practices in use, in terms of KM the company size does matter, this happens in all the countries.

When comparing the two studies stated that the German had more use of KM practices 10 years ago than the Chilean counterparts. Indicating the lower use of practices in Chile (Fig. 14.4).

Knowledge Management Practices Within your Firm or Organisation	Knowledge Management Practices Within your Firm or Organisation	Knowledge Management Practices Within your Firm or Organisation
1.1 Communications In your firm or organisation workers share knowledge or information by: A regularly updating databases of good work practices, lessons learned or listings of experts B preparing written documentation such as lessons learned, training manuals, good work practices, articles for publication, etc. (organisational memory.). C facilitating collaborative work by projects teams that are physically separated ("virtual teams")	1.2 Training and Mentoring Your firm or organisation: A provides formal training related to knowledge management practices B provides informal training related to knowledge management C uses formal mentoring practices, including apprenticeships D encourages experienced workers to transfer their knowledge to new or less experienced workers E encourages workers to continue their education by reimbursing tuition fees for successfully completed work-related courses F offers off-site training to workers in order to keep skills current	1.3 Policies and Strategies Your firm or organisation: A has a written knowledge management policy or strategy B has a values system or culture promoting knowledge sharing C uses partnerships or strategic alliances to acquire knowledge 1.4 Knowledge capture and acquisition Your firm or organisation regularly: A uses knowledge obtained from other industry sources B uses knowledge obtained from public research institutions C dedicates resources to obtaining external knowledge D uses the Internet to obtain external knowledge E encourages workers to participate in project teams with external experts

Fig. 14.2 The four categorizations groups defined and the 17 practices surveyed

14.2.2 More Used Practices

As shown in Table 14.1 using the internet to obtain external knowledge is the most widely used practice, where 3 out of 4 companies noted that occupied this practice, however, a third of respondents said that there is no KM policy or strategy written, which is the least used practice. The fact that the practice is less used to have a policy or strategy written KM refers to poor strategic vision we have of the KM and how Chileans faced with concrete knowledge management.

As a comparison among countries that conducted the study was designed Table 14.3 that meets all three practices used in this study, in the German study and the Canadian study. Delivering well as the percentage of respondents who indicated that they used the practice (Figs. 14.5, 14.6, 14.7).

Germany is the leader in the processes of the acquisition and capture of knowledge and the subgroup of communication practices, in contrast to Canada where policy and strategy is the most used subgroup of KM practices. Chile

Chile has and evident minor use of all KM practices compared with Germany and Canada.

14.2.3 Reasons for Using KM Practices

To make further progress in the study on the use of KM practices is important to understand what are the main reasons why companies are using these tools. Coming to understand what are the most important reasons that indicate Chilean companies to use KM practices or if you can see a pattern of motivation, could better explain the results obtained in the previous section.

In the survey released by the OECD were consulted for 19 different reasons why using the KM, where they were asked to rate on a scale of 1–5 (1 = very important,

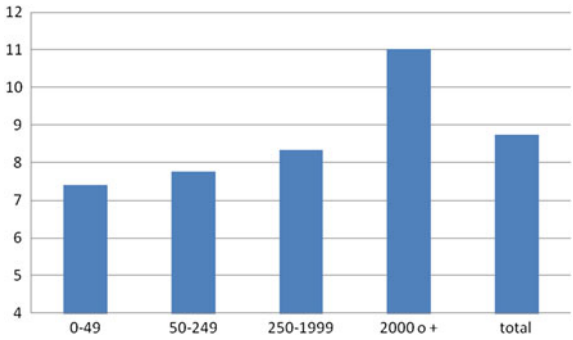

Fig. 14.3 Average KM practices by company size. *Source* Own survey

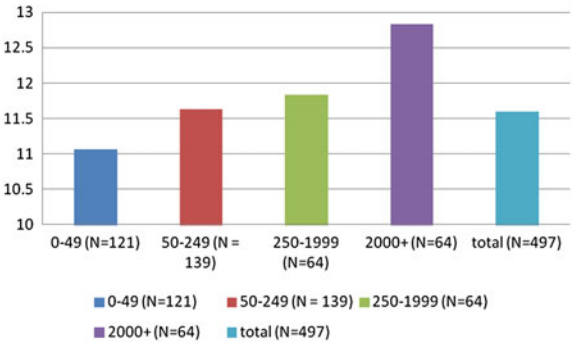

Fig. 14.4 Average size practices used by German companies

to 5 not important at all) if considered important or not that ground also add a sixth possibility should not apply to the company or the individual does not handle the information. Table 14.2 provides the results of the study, delivering the ranking and the total percentage that considers the range very important or important.

The main reasons for the use of KM practices are similar in the German study and the Chilean, but there are fundamental differences in the vision we have of why using the KM. In the German study the most important reason is to accelerate and improve the transfer of knowledge to new workers, which gives a more long term and strategic, in turn, the fact that one of its main purposes is to protect your company or organization for loss of consciousness due to the exit of workers indicates that values knowledge within the internal human resource and workforce looks like a strategic asset. On the contrary, the results obtained in the study of the reasons for Chilean using KM line again a short-term vision and are related to daily activities of daily living company.

14.2.4 Effective Practices Attributed to KM

Another important part of the study is to understand how effective are companies in the use of KM practices? Unfortunately there is no indicators that meets entirely

Table 14.1 More common use practices in countries

KM practices more used by country					
Chile		Canada[a]		Germany	
Name	Percentage (%)		Percentage (%)	Name	Percentage (%)
Internet is used to obtain external knowledge	75	Knowledge is captured and used, obtained from industry sources such as competitors, customer and suppliers	9	Using the	
knowledge gained from other sources in the industry	97				
We use the knowledge gained from other sources in the industry	68	The company encouraged experienced workers to transfer their knowledge to new workers	82	Internet is used to obtain external	
knowledge	95				
Training is offered outside the workplace for Employees to keep their skills up to date	59	The company gave informal training related to knowledge management	81	Off-site Training offered to workers to maintain current skills	95

[a] Indicates a percentage only for KM users, non-users define as companies that do not use any practice of KM

Sources Based on information from "Knowledge Management in German Industry" and "Measuring Knowledge Management in the Business Sector" [4, 10]

the KM wide practices throughout the company, and if they exist, are linked to specific areas such as the IT or human resources limited to the KM. The study conducted by the OECD in its questionnaire delivery 7 attributes associated with the use of KM practices. Table 14.3 provides the results, where it is considered a valid effectiveness those noted that the attribute has a high efficiency.

The results show that for Chileans, improve production efficiency by the workforce is the attribute that is considered more effective in KM, followed by improving the skills and knowledge of workers which shows that human resources is the knowledge section where Chileans attributed greater efficiency.

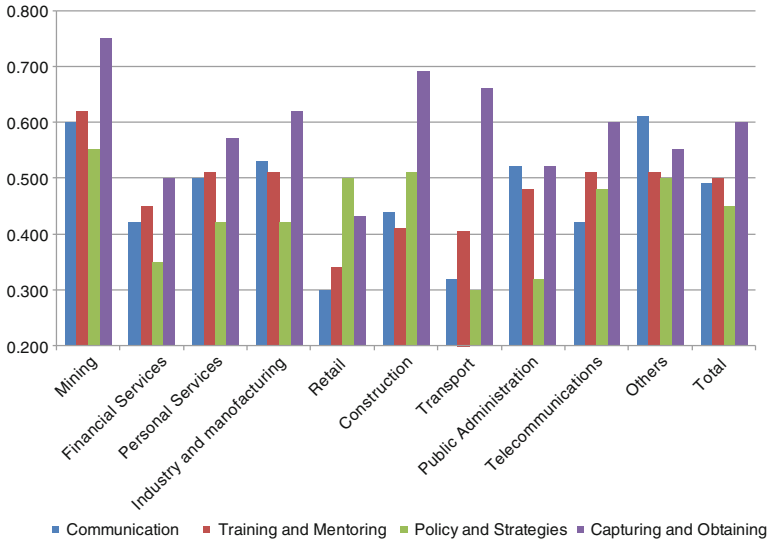

Fig. 14.5 Utilization of KM practices (communication, training and mentoring, strategy, capture and acquisition) grouped by Chilean industries

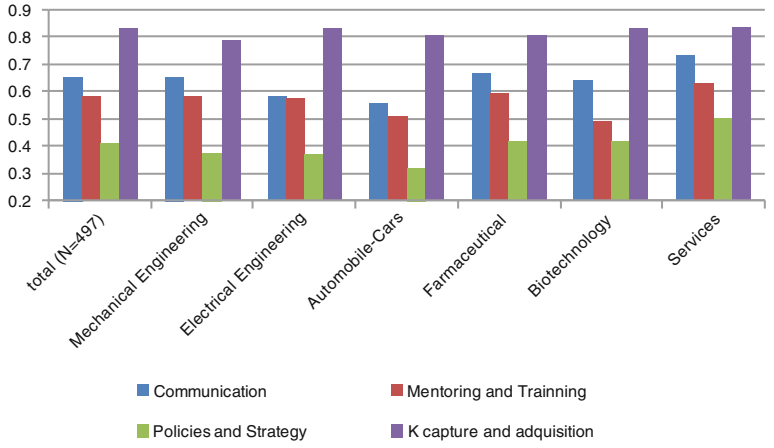

Fig. 14.6 Utilization of KM practices (communication, training and mentoring, strategy, capture and acquisition) grouped by German industries

As done throughout the study Table 14.3 gives the results obtained from the three attributes rated has the most efficient of the three studies. The study analyzed only those attributes that were common the three studies.

It is surprising to find out the low level of practices used in Chile, being a country with a high growth rate during the last decade. The explanation is not part

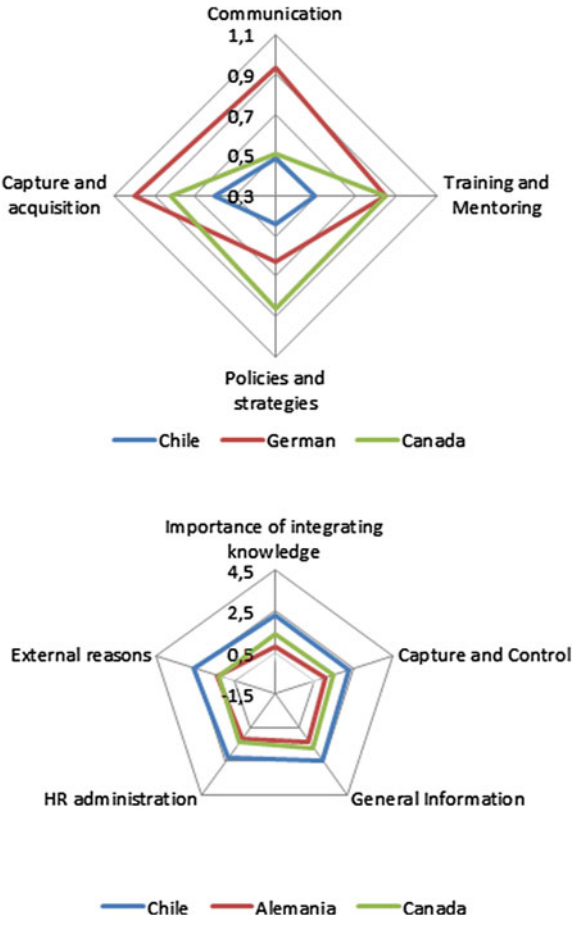

Fig. 14.7 Comparative analysis of the use of KM practices and their importance between Canada, Chile and Germany. *Source* Based on information from German Knowledge Management in Industry study, Canadian and own study

of the study but some lights are refer to the low importance of KM use in the Chilean executives, the lack of programs, research and promotion in Chilean Universities and some cultural aspects related to innovation and knowledge sharing.

14.3 Conclusions and Recommendations

14.3.1 Importance of KM and Innovation for Development

Knowledge management is undoubtedly an important tool for companies to achieve sustainable competitive advantage and encourage innovation and the use of intellectual capital in organizations [1-3, 5].

Table 14.2 Reasons for using KM practices by country

Reasons to use KM by country					
Chile		Canada[a]		Germany	
Name	Percentage (%)		Percentage (%)	Name	Percentage (%)
Help to integrate the knowledge within the firm or organization	78	Improving the		company's competitive advantage	93
To accelerate and improve the transfer of knowledge to new workers	98				
Facilitate collaborative work of projects or teams that are physically separated(i.e. different work places)	76	Train workers to meet the strategic		objectives of the company	81
To help integrate knowledge within your company or organization	86				
Accelerate and improve the transfer of knowledge to new Workers	75	Improve worker retention	74	To protect your business or organization to the loss of consciousness due to the exit of workers	82

[a] In the case of the rationale for using KM practices, the canadian study using motifs
Fuente: Elaboración propia

The knowledge economy offers new challenges for businesses and governments, being intangible assets as fundamental knowledge at present, and therefore knowledge management can contribute to the productivity and value creation of companies, managing the knowledge. In a recent global survey of McKinsey [7] with more than 1,700 executives in 40 countries worldwide, 69 % of them declared significant quantifiable benefits of using knowledge management practices related to Web 2.0 in their businesses.

Innovation correlates positively and significantly with the use of KM practices, those countries with high innovation indicators, are also more practical use of KM. The German study reviewed these factors in particular, corroborating the correlation between the use of KM practices and most innovative industries in the

Table 14.3 Best results attributed to the KM practices by country

Attributes and benefits of KM evaluated by country					
Chile		Canada*		Germany	
Name	Percentage (%)		Percentage (%)	Name	Percentage (%)
Improving the efficiency and		productivity of workers	72	Improving the skills and knowledge of workers	88
Increasing our adaptation of products or services to client needs	73				
Improving the skills and knowledge of workers	71	Improved worker efficiency and/or productivity	80	Improving the skills and knowledge of workers	73
Increasing our ability to capture knowledge from other businesses	67	Improved worker efficiency and/or increased productividadEI adaptation of products or services to customer requirements	78	Improved efficiency and workers	
		productivity	69		

Source Own elaboration

country. In the case of Chile all industries had low use of KM practices, implying a low level of innovation, the strategic focus is on the search for operational efficiency. Virtually no company has considered innovation as a strategic pillar.

Figure 14.8 shows the relationship between innovation and economic development, if we divide this chart first divided into quadrants that an indicator of development (GDP per capita of U.S. $ 20,000) and a high innovation index (out of 40), we can see that there are developing countries with high rates of innovation (higher than Italy and Spain), and that the developed countries of the OECD with major economic problems, have a relatively low rate of innovation. It is also possible to note that economies with higher rates of innovation are those that have developed more quickly.

Chile has the lowest innovation index of the 31 countries, even with a higher GDP per capita than Mexico, Turkey and Poland, which is directly correlated with the low use, culture and adoption of KM practices in the industries.

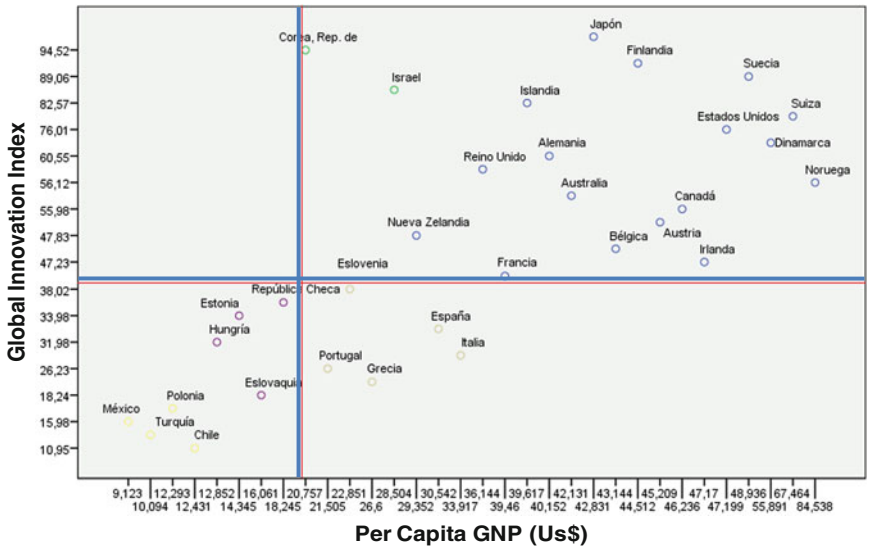

Fig. 14.8 Analysis between innovation and economic development (GDP per capita)

14.3.2 Using KM Practices

The presence of international companies seems to be a positive factor in the use of KM practices.

The study also analyzes the situation of the reasons that supports the use of KM in enterprises, being the support and integration of knowledge within the firm the most important reason to use KM practices in Chile. In contrast, be up to date in your signature about knowledge management tools and practices used by the competitors is the least important reason mentioned by respondents.

The human resource management is the most important group of reasons for using KM practices.

Regarding the reasons for using the KM concluded that the Chileans have a less strategic view of KM, compared to other OECD member who participated on this study. Again this emphasizes the gap between develop nations (Canada, Germany) with Chile which has the lower indicators.

When considering the attributes related to efficiency, improve efficiency and productivity of workers, is the attribute of the KM that Chilean executives considered the more important reason for using the KM tools.

As in the use and the reasons for the KM in the attributes associated with the effectiveness gaps were observed considering the different view we have about the KM. Germany focuses on increasing efficiency and adaptation of products or services to client needs which is very strongly related with the innovation process, this study indicates that Chileans are focused more on production improvements

using KM practices, while the Germans considered more important the use with innovation aspects.

The last point to mention is focused on the institutionalization of KM in the Chilean organizations. Institutionalization is divided into two distinct factors that were reviewed in the study, the first refers to the existence of an organization budget allocated to the KM programs and the second with a formal responsible for this programs.

The results show that 32 % of Chilean companies have an existing budget, which is slightly better than the results obtained in the German study (almost 10 years ago).

With a more global view of the results it is concluded that the use of KM in Chile, is far below what is required in a globalized and competitive environment and will harder to continue on the path of development. The only aspect that is favorable for Chile lies in the institutionalization, which is equivalent to those in Germany and Denmark, but both use, motives and efficiency gaps for KM practices are important and even more considering that the other studies (Canada, Germany) where done almost a decade ago implying that Chile is behind a decade in comparative terms.

The diagnosis is generally negative for the Chilean study, but within the same analysis can be defined to follow the guidelines for further development of the KM, it is no coincidence that countries with more developed economies possess a much greater advance in KM use than the Chilean. We conclude that this lack of application and use of KM in government and Chilean companies will have negative effects on the development of Chile and their companies.

A point we must stress is the little knowledge of the executives and managers in Chile about KM practices, this speaks of the low priority and lack of strategical considerations on the matter, which also manifests itself in the few resources allocated to these programs.

The culture of sharing information and ideas, is not well developed in the country and there are no incentives for collaborative work but rather incentives for individual performance. Chile is the country with the lowest rate in the OECD innovation, knowledge management could wealth of organizationswealth of organizations innovation related initiatives.

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Chapter 15
Electronic Portfolio as a Knowledge Management Tool: A Comparative Analysis

Wardah Zainal-Abidin, Lorna Uden and Rose Alinda Alias

Abstract Traditionally, electronic portfolio tools focused mainly on the presentation of information, with an archive of digital data that are derived from the associated purpose of the presentation. Today, new electronic portfolio tools include digital environments for assembling and managing documents and all forms of media in a digital archive, and/or software applications for assembling and sorting portions of that archive for a particular purpose. This shares many features with knowledge management tools. Central to both tools is the knowledge creation stage. Based on our experiences of using electronic portfolio, this paper explores the potential use of electronic portfolio as a knowledge management (KM) tool for knowledge workers in organizations. Salient features of characteristics of KM tools are studied and these are matched against various electronic portfolio features. The paper then shows how the electronic portfolio can be used as a means to tackle the challenges faced at the individual context of the knowledge creation phase.

Keywords Electronic portfolio system · Knowledge management tool · Knowledge creation · Comparative analysis · Knowledge management

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15.1 Introduction

Electronic Portfolio (e-portfolio) which is digital presentations of skills and competences of the e-portfolio owner have been in use in education for nearly a decade [1]. The main objective of using e-portfolio in higher education is to provide students the opportunity to reflect upon their actions as learners to become knowledgeable learners. The capability of the e-portfolio as a tool for an organization other than a learning institution has not been studied by many IT researchers. The potential for e-portfolio to replicate its benefits in a business environment should be explored.

Hence this paper attempts to explore the use of e-portfolio as a tool to get individuals to capture, document, reflect and learn from their individual experiences in their working lives, and then selectively and willingly share their knowledge to fill the organizational memory reservoir. A comparative analysis is conducted to investigate the suitability of e-portfolio as a KM tool based on related works in terms of their knowledge creation attributes and activities. This paper starts with a brief review of knowledge management in Sect. 2, followed by electronic portfolio in Sect. 3. In Sect. 4 the comparative analysis is described and results of the comparison between e-portfolio and KM are shown. Section 5 summarises and recommends future research.

15.2 From Knowledge to Tools

15.2.1 Knowledge and Knowledge Management

Alavi and Leidner [2] suggest that knowledge is information possessed in the mind of individuals once it is articulated and presented in the form of text, graphics, words or other symbolic forms: it is personalized information (which may or may not be new, unique, useful or accurate) related to facts, procedures, concepts, interpretations, ideas, observations, and judgments. This gives rise to two important implications—(i) for individuals to arrive at the same understanding of data or information, they must share a certain knowledge base, and (ii) systems designed to support knowledge in organizations may not appear radically different from other forms of information systems but rather should be geared toward enabling users to assign meaning to information and to capture some of their knowledge in information and/or data.

Apart from this, knowledge can be seen differently based on different views. These different perspectives make knowledge to be either (i) a state of mind (ii) an object, (iii) a process, (iv) a condition of having access to information, or (v) a capability [2]. These different perspectives are important for organizations to understand and recognise before embarking on initiatives involving KM or KMS.

KM is not technology but rather a concept to which involves identifying and leveraging the collective knowledge in an organization to help the organization compete [3]. The collective knowledge is also called organizational knowledge which comprises of collections of personal knowledge which resides in the minds of individuals [4–6].

15.2.2 Knowledge Management Systems (KMS)

KMS refers to a class of information systems applied to managing organizational knowledge. They are IT-based systems meant to support and enhance the organizational process of KM. These processes are namely knowledge creation, storage/retrieval, transfer and application. These four processes however are not linear nor discrete but iterative, fluid and are not monolithic set of activities [7].

15.2.3 KM Tools

Ruggles [8] defines KM tools as tools, supporting the performance of applications, activities or actions such as knowledge generation, knowledge codification or knowledge transfer. In August 2009 the Asian Productivity Organization (APO) in Singapore had compiled and agreed on a list comprising of 20 KM tools. Prior in 2002, Tyndale [9], in his paper listed 17 KM tools which are based on technology types. These two lists have different components except for Document Management. The total list is adapted and used in Tables 1a, b and c.

15.3 Electronic Portfolio

15.3.1 Purposes and Types of Electronic Portfolio

Based on [1, 10–12] the electronic portfolio can be defined as

> *A digital repository comprising of authentic and diverse evidence of acquired knowledge, skills, and abilities drawn from a large archive, that reflects what the owner (person or organization) has learned and reflected over time, designed for presentation to one or more audiences for a particular rhetorical purpose. In addition it works as a toolbox and an information management system for the owner to save work and information about the owner's career or lifelong learning.*

The e-portfolio has many uses depending on its purpose and audience. Purpose can range from learning, professional development, assessment, job applications or promotions. Consequently this determines the audience type [10]. In addition an

e-portfolio can be developed at the individual, group or organizational level. This ability to be flexible in terms of catering for different needs is only possible with the digital portfolio and not so easy with the hardcopy one.

15.3.2 Benefits of the e-portfolio

The e-portfolio can benefit various stakeholders affected by its use. These include the students (builders), tutors (advisors), university management (deans), potential employers (audience) and parents (sponsors). Owing to the space limitation it is suffice to say that each entity uses the e-portfolio according to their individual needs [13]. As an example, some benefits to the students [10] include self improvement in using multimedia technology, general literacy, communication and problem solving skills; finding meaning to one's actions via reflection; and fostering a sense of pride in one's achievements.

E-portfolio allows a more organised, maintainable, portable and sharable artefacts to be stored conveniently in a standardized manner within acceptable privacy terms. It empower students to take ownership of their own learning while the tutor provides guidance and advice allowing students to make connections between different aspects of their lives and help them to form their social identities, and their identity within their discipline of study.

15.4 Comparative Analysis

Comparative Analysis [14] is used here to make a direct compare and contrast analysis between the e-portfolio (A) and the KM tool (B). In this approach, comparison(s) are made on characteristics and attributes of A and B for their similarities or differences. Hence when one compares A against B, one uses A as a "lens" through which to view B. Lens comparisons are useful for illuminating, critiquing, or challenging the stability of a thing that, before the analysis, seemed perfectly understood.

15.4.1 Grounds for Comparison

The justification for this investigation can be summarised as follows:

(a) The corporate world lacks reflective learning culture which is much needed if they want to stay competitive and innovative. Reflection by employees after completing a certain task can be done using the e-portfolio.

(b) The weakest point in KM initiatives is the slack in knowledge creation by individuals. This makes learning not readily possible thus not contributing to the accumulation of organizational knowledge. By keeping e-portfolios repositories of experiences for the organization can be realized.
(c) The e-portfolio is a flexible application which grows at the hands of the creator. The creator/builder architects his own personal portfolio according to his desire and purpose by capturing, coding, storing and reflecting upon selected artefacts primarily for personal improvement.
(d) The work force demography is quickly changing with the techno-savvy generation replacing the Baby Boomers. This new generation readily embrace technology to build e-portfolio.

Table 15.1 Comparison on attributes of KM versus e-portfolio

K/KM/KMS attributes	E-portfolio attributes
(i) *State of knowledge*: is personal experience oriented; is a state of mind; is personal knowledge reside in the mind of individuals; is an object; is a condition of access to information; is a capability; Same understanding can be derived from sharing a certain knowledge base	is privately owned by an owner; a collection of digitalised significant authentic and diverse evidence, drawn from a large archive; designed for presentation to one or more audiences for a particular rhetorical purpose; is a toolbox for the owner to organise knowledge; eP–an inventory of acquired knowledge, skills, and abilities with deep learning; promotes–self reflection; shows evidence of learning; allows feedback from others; has psychological benefits; allows portability, sharing and accessibility; makes organisation of organisations; motivates standardization across the board; an inventory of acquired knowledge, skills, and abilities with deep learning
(ii) *Knowledge Management*: Knowledge creation–Internalization; Knowledge creation–Externalization; Knowledge creation–Socialization; Knowledge creation–Combinations; Knowledge creation–Ba; Knowledge Transfer–formal/informal and personal/impersonal	
(iii) *Knowledge Management Systems*: to support KM; can be typical IS; Knowledge Storage/Retrieval–found externally; Knowledge Application–knowledge in effective action	web-based or stand alone PC; proprietary with a fee, freeware/open source or developed home-grown; supports database; is an information management system that uses electronic media and services; supports multi-storage types; various uses including for research; interface accepts feedbacks from audience; stores users reflective writings
(iv) *Knowledge Management tools*: to support KMS; variety; situational	multiple uses–for learning, professional development, assessment, job applications and promotions; multiple types–learning, credential, showcase, process, assessment, dossier, training, reflective, personal development planning; multiple audience–peers, employers, ownself

Table 15.2a Comparison on principles of KM [17] and e-portfolio [18]

(Learning) e-portfolio principles	KM principles
#1: *Learning Outcomes*	No: 1; 5; 9
student guide; clearly articulated individual, course, programmatic, or institutional outcomes in their collection, selection, reflection upon, and presentation of "artefacts" in the e-portfolio; students structure portfolios around their own learning goals.	shared vision, values; Learning and knowledge driven organization; Embed continuous learning and knowledge processes in routine works
Principle #2: *Digital Environments*	No: 11; 12; 13; 14
optimal use of the technological features of electronic writing, collaboration, and records-keeping, and making e-portfolios accessible on the Internet.	Knowledge ecology breeds knowledge; 'Federal' organizations; 'organization of organizations' (interdependent); knowledge asset driven, not tools driven
Principle #3: *Virtual Identities*	No: 15; 16; 17; 18
Students represent themselves through personalized information that conveys a web-savvy and deliberately constructed ethos for various uses of the e-portfolio; identities are managed by having control over artefacts and audience	knowledge on a needs basis; If only we knew…; Personal and team success determine organizational success; Demonstrate the KM principles (pilot first)
Principle #4: *Authentic Audiences*	No: 19; 20; 21; 22; 23
Students engage in audience analysis of who they intend to read their e-portfolios (internal and external); they coordinate access to their e-portfolios	Teamwork as one entity; Organizations learn only through individuals who learn; What gets rewarded gets done; it's a virtuous circle; 'learn how to learn'
Principle #5: *Reflection and E-portfolio Pedagogy*	No: 7; 8; 9; 10
Creation of "reflective artefacts" which identify and evaluate the different kinds of learning that e-portfolios represent; explain how various forms of instructive feedback have influenced learning via composition and revision of the artefacts, making teaching and learning transparent to readers.	No re-inventing of the wheel; No second mistakes; Embed continuous learning and knowledge processes in routine works; repetition produces efficiency
Principle #6: *Integration and Curriculum Connections*	No: 11; 12; 13
Students link artefacts in a flexible structure (synthesizes diverse evidence and ideas; invites linear or non-linear ways to read and evaluate e-portfolios; makes evidence available across the Internet); shows curriculum connectivity	Knowledge ecology breeds knowledge; 'Federal' organizations; 'organization of organisations' (interdepence)
Principle #7: *Stakeholders' Responsibilities*	No: 2; 3; 4; 5; 6; 19
Students receive the necessary support from faculty, program directors, and university administrators via assessment for program improvement and also informed about resources are essential for implementing, maintaining, and accessing e-portfolios.	Lessons learnt from doing tasks; 'situational'; Quantum Physics; Learning and knowledge driven organization; Practice Competitive Collaboration; Teamwork as one entity
Principle # 8: *Lifelong Learning*	No: 20; 21; 22; 23
Students are able to adapt their e-portfolios to various purposes/uses beyond their academic careers, enabling their various readers, in turn, to track their learning longitudinally.	Organizations learn only through individuals who learn; What gets rewarded gets done; it's a virtuous circle; 'learn how to learn'

Table 15.2b List of KM principles (referred by Table 15.2a

KM principles (knowledge associates international Ltd) [17]	
Principle 1: People will focus and work more effectively through a shared vision and values, and the KM strategy must be aligned to this	*Principle* 14: Knowledge systems and tools are implements for knowledge working. They should be to support knowledge asset driven strategies, processes, methods and techniques. Be knowledge asset driven, not tools driven.
Principle 2: What have we learned today, as a 'learning organization', is sometimes more important than what tasks we performed today	*Principle* 15: Partners, customers, stakeholders don't know what they need to know until they need to know it
Principle 3: KM is 'situational'	*Principle* 16: If only we knew what we know, we would be three times more effective tomorrow
Principle 4:KM and Quantum Physics: holistic approach to invisible tacit and visible explicit knowledge	*Principle* 17: Effective organizational KM is the natural result of effective personal and team KM
Principle 5: Be both a learning organization and knowledge driven	*Principle* 18: Demonstrate the KM principles, manage the risk, gain success and then, naturally, implement across the organization
Principle 6: Practice Competitive Collaboration	*Principle* 19: Team KM is concerned with creating, sharing and applying knowledge as a team, by working more effectively together as one
Principle 7: No re-inventing of the wheel	*Principle* 20: Organizations learn only through individuals who learn
Principle 8: No continual repeating of the same mistakes	*Principle* 21: What gets rewarded gets done
Principle 9: For effective organizational KM to occur, work plans, work processes and systems must be improved to include more collective, systematic and continuous learning and knowledge processes.	*Principle* 22: Naturally trust, communicate, learn and share knowledge—it's a virtuous circle
Principle 10: Every time we do something repetitive we should strive to do it better than the last time	*Principle* 23: Teach people to 'learn how to learn'
Principle 11: Knowledge naturally resides, thrives, and grows in knowledge ecologies	
Principle 12: Knowledge is created and applied best in 'Federal' organizations	
Principle 13: The Knowledge Society is at its best as an 'organization of organisations'	

Table 15.3a Contrasting e-portfolio against KM Tools (similar fully)

KM tools features	Notes
Learning and Idea Capture; Learning Reviews; After Action Review; Storytelling; Building Knowledge Clusters; Collaborative Virtual Workspaces; Social Network Services; Content Management; Knowledge creation applications	Core attribute and essence of e-portfolio
Knowledge Bases (Wikis, etc.); Expert Locator; Blogs	e-portfolio can be compiled and shared with consent by owners

(e) The employer-employee relationship can also escalate to a higher level if the e-portfolio environment is handled with trust and respect by all parties. This relationship is analogous to the teacher-student relationship at universities.

Table 15.3b Contrasting e-portfolio against KM Tools (similar partly)

KM tools features	Notes
Peer Assist; APO KM Assessment Tool; Web Portals; Electronic publishing systems	Only with e-portfolio owner's consent
Community of Practice; Advanced Search Tools; CRM	Features exhibited by e-portfolio
Intranet; Groupware;	Environment of e-portfolio

Table 15.3c Contrasting e-portfolio against KM tools (not similar)

KM Tools features	Notes
Brainstorming; collaborative physical workspace; knowledge café; taxonomy; document libraries leading to a DMS; Voice and Voice-over-Internet Protocol; push technologies; agents; document management systems; workflow; BPR; information retrieval engines; relational and object databases; help-desk applications; data warehousing; data mining	Not directly representative nor similar

15.4.2 Compare and Contrast

To examine the extent of the appropriateness of the e-portfolio as a KM tool or method, comparisons are made between the e-portfolio and its KM counterpart.

Firstly comparison is made on attributes of both KM and e-portfolio as depicted in Table 15.1. Four main domains of KM (knowledge, KM, KMS, KM Tools) according to [2, 9] have been identified and these are matched against similar attributes of e-portfolio [1, 10, 15, 16]. As can be seen e-portfolio has characteristics which are also found in all the four domains of KM. As an example, e-portfolio which is built by an individual is therefore a representation of personal knowledge.

Secondly, further investigation is made by comparing the principles or fundamental truth, rule or norm found in both KM and e-portfolio. This is best portrayed by practitioners of either fields because this would mean the principles are tried and tested. Hence for e-portfolio the principles are taken from community of practice called CCCC (Conference on College Composition and Communication which supports and promotes the teaching and study of college composition and communication). Likewise for KM the principles are taken from a KM community website organised by Ron Young (an experienced KM consultant of Knowledge Associates International Ltd). The output of this comparison between e-portfolio and KM is found in Table 15.3a (Table 15.3b lists the principles for KM). To determine similarities between the two, the authors have adopted keywords and semantic in context. The result shows that principles from both tools can be mapped seamlessly and this indicates the degree of compatibility is positive.

After establishing grounds of similarities between the two concepts (Tables 15.2 and 15.3a), the next step is to examine the contrasts between them. Here a contrast profile is made directly on e-portfolio against KM tools.

Table 15.1a, b and c show the KM tools features which are fully similar, partially similar and not similar to e-portfolios features respectively.

In Table 15.1a, all the given features of KM tools are consistent with the core attributes and essence of e-portfolio. Table 15.1b shows the KM tool features listed may or may not be exhibited by e-portfolio unless for special purpose. Lastly Table 15.1c shows clearly what e-portfolios are not in terms of KM tools.

15.5 Conclusion

With this analysis on the similarities and differences between KM tool and e-portfolio, it shows that e-portfolio can be used as a KM tool for organization to capture knowledge found in individuals in a non-structured manner which may be more appealing for people when sharing their knowledge voluntarily.

E-portfolio can help to promote a rich KM culture by getting individuals to create personal e-portfolio, as contributing inputs to the organization's knowledge repository. The use of e-portfolio as a KM tool can be beneficial. Individuals in organization have opportunities to put their thoughts, and reflections to improve their decision making which is recognised by their organization as part of knowledge creation. This empowerment is similar to the concept of student personal development planning (PDP) which is the core of e-portfolio building. Compilation and sharing of e-portfolios at the organization level is directly contributing to the realization of the organizational memory. Since individuals can control their own portfolios, without fear of being discriminated but rather with respect and trust, the willingness to share (push) their propositional knowledge to their peers and organizational can be profitable to the organization's performance and growth. Peer collaboration can also be a welcoming outcome when individuals have a better understanding of their roles in a team-setting environment, as a result of self-reflection and deep thinking.

In order to validate the effectiveness of using e-portfolio as a KM tool, further research will be needed. This is especially in business where knowledge sharing is crucial for the organisations. Our desire will be to use eportfolio in an organisation as a case study to validate our proposed framework.

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Chapter 16
Knowledge and Community Formation via Cascading Modes of Communication with a Case Study and Research Design

Paul Wu Horng-Jyh

Abstract This paper introduces a conceptual model called Cascading Modes of Communication (CMC), which is designed by integrating social media and traditional seminars for concurrent formation of community and knowledge. It is inspired by Open Source processes and follows a SECI knowledge creation model. A case study was described to demonstrate how CMC works in professional seminars and a research proposed to validate the design.

16.1 Introduction

A Master Program in a Singapore University has been offering a Professional Seminar for its incoming batch of Master of Science programs. The student intake has been growing over the years with the number reaching over 200. The cohort was heterogeneous in that the students came from very diverse background; belonging to varied age groups, cultures that spoke different native languages. They also had divergent goals in enrolling in the program: some were aiming for a new career or career advancement; others were interested in immersing themselves in diverse cultures as self-enrichment and life-long learning. Under this backdrop the goal of Professional Seminar has been set to cultivating students' soft skills such as leadership, ethics, communication, entrepreneurship, and critical/creative thinking which would be relevant across the broad spectrum of interests and motives.[1]

Further, we recognize that it is the practice of soft skills rather than the knowledge of them that will truly benefit the students. Thus in accordance with the

[1] More details of a particular run of Professional Seminar can be found in Appendix A.

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principles of Action Research,[2] we assume that the learning and practice of these soft skills will need to take place iteratively. That is the knowledge and skills presented by established practitioners in the respective domains would manifest themselves in the formation of a vibrant, collaborative learning community. Thus, we take the dual goals of soft skills learning and community formation to be integral, which should therefore be achieved simultaneously.[3]

16.2 Knowledge and Community Formation

Within the context of Professional Seminar as described in Sect. 16.1, knowledge formation is thus conceptualized as "knowledge emerging simultaneously with the community formation process." As identified by [1], knowledge can be experience, ground truth, complexity, judgment, rules of thumb and values and beliefs. In particular, when we consider knowledge such as leadership, ethics, communication and critical thinking, they are distinct from analytical knowledge, which one used to represent mainly objective world. They are more like reflective knowledge, which one used to understand subjective world, which are also very much about practice rather than representation. In Professional Seminar, community is instantiated collaboratively, thus knowledge is formed collaboratively.

Cast in an economics context, knowledge is considered as a critical asset of the organization that can be transacted in a marketplace [1]. However, when there exists little structure as in an institution or an organization, it is unlikely a marketplace could readily function by itself as theorized by Davenport and Prusak. Rather the formation of the community in itself will need to occur before knowledge formation will.

16.2.1 Scaffold Emulating Open Source Practice to Overcome Barriers

Sufficient amount of knowledge needs to be freely exchanged before any new meaningful knowledge can be consolidated. This may not take place if the participants encounter knowledge exchange barriers. In the corporate context, researchers have identified the barriers, which are categorized into Individual,

[2] Action Research's emphasis on integration of practice and research, and community of practice is followed in this project.

[3] The details of how professional seminar works are beyond of the scope of this paper. Appendix A is an overview of the structure of Professional Seminar. Note that, the break-out sessions are self-organized by the students, who are encouraged to practice the soft-skills they learned during the seminars.

Table 16.1 Mapping between open source and professional seminar's learning scaffold

Scaffolding objective	Professional seminar's scaffolding learning process	Parallel open source process
1	Contribution from readily sharable life experiences related to soft skills of concern	Contributions depend not on proprietary techniques but on knowledge that is widely available
2	Knowledgeability of self and the importance of community as an effective source of social capital during the study and beyond	There is a substantive 'core' that holds a promise of becoming something quite interesting. The product is perceived as important, valuable, and of widespread use
3	The sense of community can be formed through recursive groupings and participation in these groups	The product has a complexity of the kind that can be disaggregated into parallel modules

Organizational, and Technological barriers [2]. Thus, we noted that a solution has to take into accounts all three dimensions not just only one particularly area.

Similarly, in the Professional Seminar's context, the barriers arising from individual students, teaching faculty, and learning platform, should be addressed, together with the more deeply rooted issues in a student's motivation to learn. The particular pedagogical approach for this is called scaffolding [3], which is defined as the support given during the learning process that is tailored to the needs of the student with the intention of helping the student achieve his/her learning goals.

We observed that the success of Open Source Software development, as well as other Open Source efforts, such as Wikipedia, confirms the importance of a robust community. More specifically, a parallel can be demonstrated between Open Source practice [4][4] and learning scaffolds in Professional Seminar as shown in Table 16.1.

Firstly, as shown by the parallel in Table 16.1, as an individual's life-experiences are widely available to every individual person, these experiences, as long as they are in common with others (not personal, or "proprietary"), can be contributed quite readily. That is, according to Open Source process, the "bits of knowledge" that can readily and widely transacted to get the knowledge marketplace going via Scaffolding Objective 1. Secondly, many students are faced with common issues at work and in life in general, the Professional Seminar provides a platform for students to form groups with mutual identification so they can face common issues more effectively, through their sharing of soft-skills in leadership, ethics, communication and critical thinking. Thus, like an Open Source process, Scaffolding Objective 2 ensures the students are directed with a common goal that promises to be of great value for the individuals in the community. Lastly, by dividing students into sub-groups, the complexity of forming the community is achieved through recursively forming bigger groups based on these smaller sub-groups that eventually constitute the entire community; that is, the goal of Scaffolding Objective 3 is

[4] There are actually five conditions stated in [4]; the other two are: (1) The product is perceived as important, valuable, and of widespread use. And (2) There are strong positive network effects.

to ensure the same characteristics of an successful Open Source process in being able to disaggregate complexity and handle it.

Given the constructive, non-interventional, approach to pedagogy, how can we ensure the above objectives of scaffolding are achieved? For this, we need to design a mechanism that leverages on the success of social media, which is known to foster effective online community and is elaborated in the next section.

16.2.2 SECI and Cascading Modes of Communication via Social Media

Interestingly, the scaffolding processes that characterizes Professional Seminar and model the knowledge community we aim for, is quite similar to the classic knowledge creation spiral model (SECI) proposed by Nonaka, and his collaborators [5, 6] that underlies the success of several Japanese manufacturers. According to SECI model, knowledge is depicted as being created in a continuous upward spiralling process starting with socialization, externalization, combination and internalization. Furthermore, SECI has also been proposed as a model of professional learning process in general more recently [7].

As shown in Fig. 16.1, Socialisation is the process of converting new tacit knowledge through shared experiences; this is achieved through spending time together in informal social settings that may be outside the normal boundaries. This stage should authenticate free sharing of mental models and generate mutual trust. Externalization is the process of articulating tacit knowledge into explicit knowledge so as to rationalize it. This stage enables the sharing, clarifying and 'breaking down' of the articulated knowledge so that it can become the basis for new knowledge. Combination is the process of consolidating explicit knowledge collected from inside or outside of the organization setting, and combined, edited and synthesized to form new common knowledge in the explicit form. The new explicit and common knowledge will form the norms (or normality) of the community. Internalisation is the process of adopting and embodying explicit knowledge into tacit knowledge. Reading, reflections and experiments would play major part of this process. It is at this stage that knowledge is internalised to become part of individual's tacit knowledge base, or individuality, which would then set off a new spiral of knowledge creation when shared with others through yet another round of SECI cycle.

Table 16.2 shows how the SECI Model of Knowledge Creation can be mapped into the four modes of communication in a cascade of social media. First, in column 3, the four modes of communication are distinguished by four different speech patterns[5] that carry different intents of the speakers in the corresponding steps of a

[5] Speech patterns are inspired by Speech Act Theory [8], which regards ordinary speech as action—as it reveals speaker's intent that binds his action in the future.

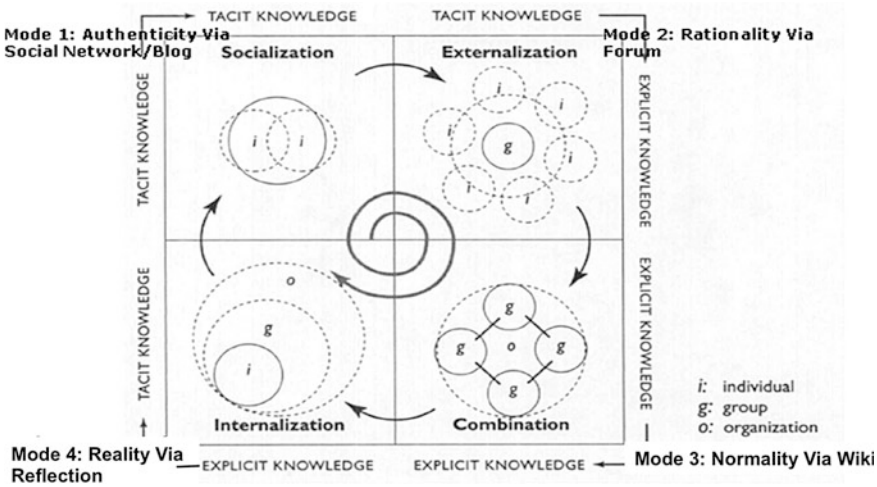

Fig. 16.1 The integration of CMC and SECI

Table 16.2 Cascading modes of communication (CMC) and SECI model

	SECI space	Criteria of meaningfulness	Communication mode (speech pattern)	Social media and reports
Mode 1	**S**ocialization	Authenticity	This, P(X), is truly what I believe/feel/like	Blog or social network
Mode 2	**E**xternalization	Rationality	I agree/disagree with/need to clarify about P(X), because of W	Forum
Mode 3	**C**ombination	Normality	Regardless of P(X), Z is what most of us believe/feel/like	Wiki
Mode 4	**I**nternalization	Reality	Given Z, how do I do about X	Reflective report

SECI spiral. As explained above, these intents convey different criteria to the meaningfulness of the speakers' speech when they create knowledge in a community. Most interestingly, in column 4, these speech patterns are shown to correspond to the prevalent modes of communication in different types of social media. Namely, what is most meaningful in a Blog or Social Network is that the information communicated is authentic or not (as contrasted with rationality, normality or reality). Thus the speech pattern "This, P(X), is truly what I believe/feel/like" is appropriate; an example speech can be "I really like to be a rock singer."

Similarly, what is most meaningful in forum (or online discussion) is rationality where a speech pattern modeling an argument/clarification "I agree/disagree with/need to clarify about P(X), because of W," such as "It's good for someone to be a rocker singer as it is a kind arts." In wiki, normality is essential and is expressed in a pattern "Regardless of P(X), this Z is what most of us believe/feel/like" in a

speech such as "Regardless of the fact that we all think to be a rock singer is good, most people in our community think it is just vanity," and in reflective report, reality is the point "Now that most people think being a rock singer is a vanity; on the other hand, since I love it, so I decide to press on to prove that being a rock singer is indeed no different than an artist."

When an individual goes through the four modes of communication about the knowledge that they felt most authentically, argued most rationally, considered most carefully with the norms held by the community, and could reconcile their own views with communal norms, such knowledge would then allow them to decide on a course of action and carry it out in reality, achieving the goal of a truly internalized knowledge.

16.2.3 Integration of Social Media and Traditional Seminars in Professional Seminar

The offline components of Professional Seminar are detailed in Appendix A. It has a structure of a typical seminar series, consisting of speaker's presentations and breakout discussion, collaborative group activities and reports. To implement CMC/SECI, social media are integrated with traditional seminar structure to facilitate the SECI knowledge creation spiral, which is detailed in Table 16.3.[6]

Fig. 16.2 shows how the social media are deployed in Professional Seminar in support of the SECI cycle. The social media create online spaces that are closely interleaved with traditional offline places. First, blog and social network spans the entire Professional Seminar to allow the socialization of the participants to be taken place readily. Second, following the offline seminars and breakout sessions, there is the forum space to continue their discussion online where participants externalize and rationalize their knowledge. Third, the group report and online wiki provide a space for the group to combine their knowledge into a common understanding. Fourth, the presentation and individual reflective report requires each participant to internalize their understanding to form a reality that they can situate their knowledge and action upon; thus completing and initiating a new SECI cycle of knowledge creation.

16.3 Assessing Knowledge Quality in Professional Seminar

As described in Sect. 16.2, Professional Seminar is designed based on SECI/CMC that aims to overcome the knowledge sharing barriers by paralleling Open Source processes. The sense of shared community is set as priority of the scaffolding

[6] Alternative model of SECI and Social Media integration could be found in [9].

Table 16.3 Integrated online and offline activities for SECI in professional seminar

SECI stage	Traditional interpretations	Social media	Integrated online and offline activities
Socialisation (tacit to tacit)	Knowledge conversion begins with the tacit acquisition of tacit knowledge by people who do not have it from people who do	Blogs	*Offline activities* • Tea breaks *Online activities* • Pre-course self-introduction and quiz on group blogs
Externalisation (tacit to explicit)	Involves converting tacit into explicit knowledge, and holds the key to knowledge creation as new concepts are formed	Discussion forum	*Offline activities* • Tea breaks • Participation in discussions during breakout sessions *Online activities* • Debate on issues on discussion forum
Combination (explicit to explicit)	A process of "systematizing concepts into a knowledge system", which happens when people synthesize different sources of explicit knowledge into, for example, a report	Wiki discussion forum	*Offline activities* • Moderation duty to facilitate discussion and produce group report • Presentation to external panellists *Online activities* • Wiki group reports
Internalisation (explicit to tacit)	Described as "a process of embodying explicit knowledge into tacit knowledge". It is "closely related" to "the traditional notion of learning", and to "learning by doing" although somewhat confusingly they also say that internalization is 'triggered' by learning-by-doing. Finally, internalization also involves, or is achieved through, the dissemination of explicit knowledge throughout an organization		*Online activities* • Reflection reports • Story for preparing for panel presentation

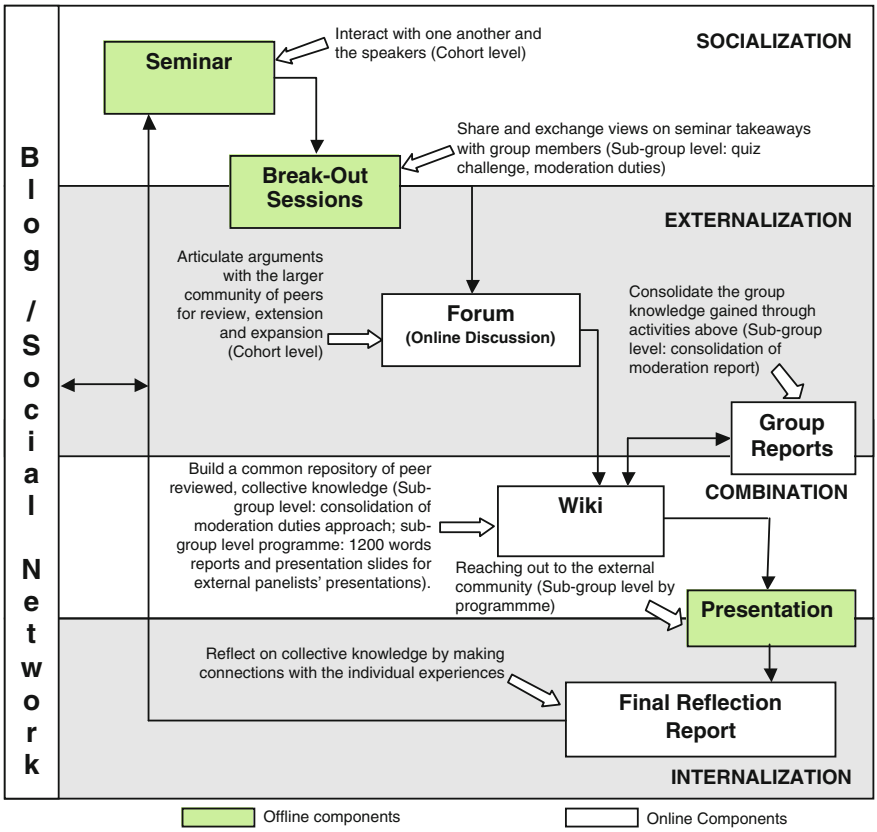

Fig. 16.2 Offline and online social media spaces in professional seminar for SECI cycle

Table 16.4 Improvement of online activities in the consecutive runs of professional seminar

	1st run	2nd run	Improvement
No of participants	212	231	+21
No of forums	3	8	+5
No of threads	71	82	+11
Unique contributors in threads	32	62	+30
Rate of new participation	45 %	76 %	+31 %
No of posts	456	689	+233
Average post per student	2.15	2.98	+0.83
No of Blog entries	376	495	+119
No of Wiki entries	0	18	+18

learning processes. As mentioned, this is because we recognize that it is the practice of soft skills rather than the knowledge of them that will truly benefit the students. Table 16.4 shows that in consecutive runs of Professional Seminar, quantitatively, the participation of students seemed to have improved.

However in accordance with the principles of Action Research, we need to investigate the factors more closely to ascertain whether the learning and practice of these soft skills, such as leadership, ethics, communication, and critical thinking, has indeed taken place simultaneously in Professional Seminar. That is the knowledge and skills presented by established practitioners in the respective domains would, through SECI/CMC spirals, learned and applied in the formation of a vibrant collaborative learning community. In order to do that, we adopt the study of the Social Capital Theory [10, 11], and certainly, another factor is individuals' cognitive efforts in comprehending the knowledge, if it produces positive feedback then the quality of the knowledge will be considered high—this points to the Social Cognitive Theory [12, 13]. The following is a potential model that can be used to assess the Quantity of Knowledge Sharing and the Knowledge Quality adopted from [11].

As shown in Fig. 16.3, the left-hand side of the model factors is motivated by Social Capital Theory where the strength and their influence on knowledge are measured according to social interaction ties, trust, norm of reciprocity, identification, shared language and share visions. We further adopt the factor of altruism that is taken to influence the trust, norm of reciprocity and identification factors. The right-hand side of the model factors is motivated by Social Cognitive Theory where the strength and their influence on knowledge are measured according to personal outcome expectation and community outcome expectation. Similarly, we added the factor "robustness of outcome expectation" to take into account the resilience/leadership in a personal pursue of a goal that can overcome temporary

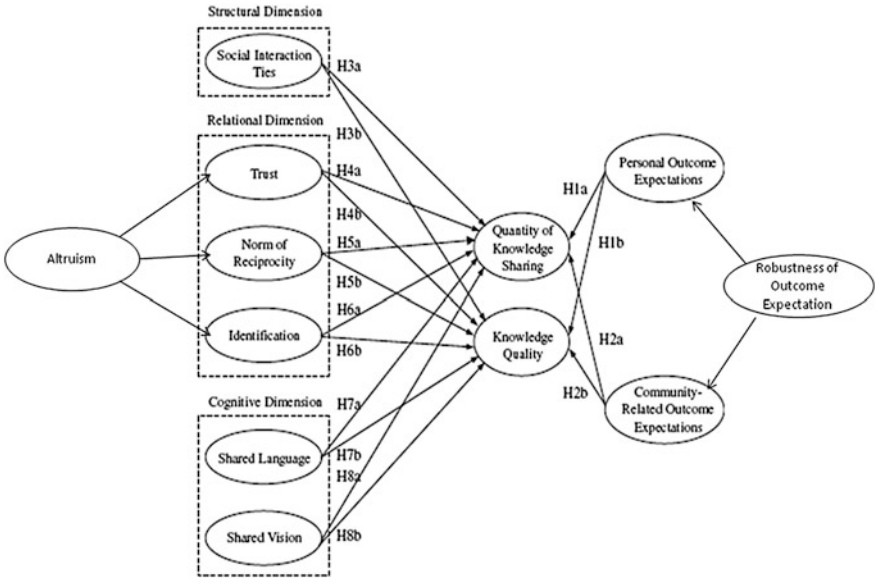

Fig. 16.3 Structure equation model (SEM) of knowledge quantity and quality

setbacks in outcome expectation, and postulate that it can influence the personal and community outcome expectations.

16.4 Conclusion

This paper introduces Cascading Modes of Communication (CMC) designed by integrating social media and traditional seminars for concurrent community and knowledge formation. The design was first inspired by Open Source knowledge sharing processes, which has demonstrated its effectiveness to overcome barriers at the individual, organization and technology levels. As the concept of CMC develops, more significantly, we've realized CMC parallels a knowledge creation model SECI, which is shown to be effective in learning organizations that underlie the success of Japanese manufacturers.

A Professional Seminar for a Master Program with traditional offline components has been re-designed based on CMC. More specifically, following the SECI knowledge creation model, blog, forum and wiki spaces are closely integrated with offline activities such as seminars, breakout sessions, and presentations to sustain the knowledge creation activities across time–space boundaries. In two consecutive runs, the Professional Seminar was shown to have improved in quantity of online learning activities, in terms of the number of posts in social media. The initial positive effects of the design need to be verified by a systemic follow-up investigation to show the knowledge and community formation process has indeed occurred simultaneously. And the knowledge quantity and quality are indeed positively correlated with the factors postulated in Social Capital Theory and Social Cognitive Theory resulting from the skills and knowledge acquired and practiced in ethics, communication, collaboration, leadership and critical thinking.

In the next step of the project, the questionnaire as detailed in Appendix B, which addresses the knowledge barriers discussed in [2], will be administered to students taking Professional Seminar to assess whether the model indeed can be validated, and that the CMC/SCEI design is indeed working to achieve community and knowledge formation simultaneously.

Acknowledgments The author gratefully acknowledges the contribution of Thara Ravindran, Thomas Chee, Vincent Leong and Lyncoln Lee for their research work under my supervision and data obtained from their field work.

Appendix A: Professional Seminar Curriculum

The programme for Profession Seminar which was scheduled each month from on 3 selected Saturday was captured in Tables A.1, A.2 and A.3. Seminar I started with an activity planning and introduction to Professional Seminar by Prof Paul

Wu, followed by a presentation on the "Trend and Issues of Information Professions" by a panel of invited speakers in the morning. This is followed by a panel discussion on "Leadership, Ethics and Collaborative Culture" with the three speakers who spoke on the previous Professional Seminar in the afternoon session. To prepare students for the panel discussion, they were told to preview last year video recordings of the three speeches which were posted in their e-learning platform.

Mandatory participation in all three seminars was required of all the students enrolled in the course. The interaction carries on beyond the seminar conducted in the physical (offline) space. In between the seminars, the students were required to extend these discussions in the virtual (online) space using blogs, forums and eventually consolidate their viewpoints under the wikis on the e-learning platform.

For Seminar 2, students were to perform moderation duty for the break-out discussion sessions where the students in their groups moved to separate lecture theatres or "ba" to discuss the key take-aways of the Seminar I, identify points to supplement or enhance the speaker's views or identify diverged areas from the speaker's views. For each session, five sub-groups were assigned moderation duties. The groups on moderation duty were required to facilitate and moderate the discussions of the other groups as well as consolidate the points that were brought up during the discussions into a 1,200 words report in preparation for the final panel presentation on the third seminar.

Table A.1 Programme of Seminar I- Building a vibrant community

Seminar 1: Information profession and learning community		
Time (in hours)	Agenda	Speaker/moderator/student
0900–1000	Activity planning for professional seminar	Dr. Paul Wu Horng-Jyh
1000–1030	Tea break	
1030–1100	Topics on information service	Prof. Paul Gandle, CIO SMU
1100–1130	Topics on knowledge management	Mr. Gopinathan, CKO CSC
1130–1200	Topics on IT service	Mr. Foong Sew Bun, CTO IBM
1200–1230	Q&A	Speakers and Dr. Paul Wu
1230–1330	Lunch break	
1330–1500	Panel discussion on leaderships, ethics and collaborative culture	Prof. Cheong Hee Kiat, President, UniSIM Mr. Heng Chiang Hee, CEO, Maritime Sustainability Pte Ltd Mr. Ivan Chew, Librarian, NLB
1500–1530	Tea break	
1530–1630	Building online learning community on e-learning platform	Dr. Paul Wu Horng-Jyh
1630–1700	Ice breaker for the sub-group (visit to tutorial rooms)	Dr. Paul Wu Horng-Jyh, TAs and Facilitators

Table A.2 Programme of Seminar 2- Moderation sessions

Seminar 2: Trends and contextual issues in information professions					
Time (in hours)	Agenda	Speaker/moderator/student			
0900–1000	Activity planning for Seminar 2	Dr. Paul Wu Horng-Jyh			
0930–1030	Break-out discussion (trends in information professions)	Group 1.1	LT9	Group 2.1	LT10
		Group 3.1	LT11	Group 4.1	LT12
		Group 5.1	LT13		
1030–1100	Tea break				
1100–1200	Break-out discussion (leadership issues in information professions)	Group 1.2	LT9	Group 2.2	LT10
		Group 3.2	LT11	Group 4.2	LT12
		Group 5.2	LT13		
1200–1300	Lunch break				
1300–1400	Activity debrief for Seminar 2	Dr. Paul Wu Horng-Jyh			
1400–1500	Break-out discussion (ethics issues in information professions)	Group 1.3	LT9	Group 2.3	LT10
		Group 3.3	LT11	Group 4.3	LT12
		Group 5.3	LT13		
1500–1530	Tea break				
1530–1630	Break-out discussion (collaborative issues in information professions)	Group 1.4	LT9	Group 2.4	LT10
		Group 3.4	LT11	Group 4.4	LT12
		Group 5.4	LT13		
1630–1700	Activity debrief and planning for Seminar 3	Dr. Paul Wu Horng-Jyh, TAs and facilitators			

Table A.3 Programme of Seminar 3- Plan ahead and reach out

Seminar 3: Academic and professional life		
Time (in hours)	Agenda	Speaker/moderator/student
0900–0930	Advice and resources to engage for better research skills	Ms. Wendy Ong, head, ACRC and senior assistant director
0930–1000	Advice and resources to engage for better communication skills	Dr. Sng Bee Bee, communication consultant
1000–1030	Advice and resources to engage for better career planning skills	Ms. Charmaine Ng, senior assistant director, CAO
1030–1100	Tea break	
1100–1200	Q&A	Speakers and Dr. Paul Wu
1200–1300	Lunch break	
1300–1400	Presentation with students	Students
1400–1430	Tea break	
1430–1600	Panel presentations	Each representative sub-groups
1600–1700	End of professional seminar	Faculty members, TAs and facilitators

For Seminar 3, students were to identify areas of self-improvement in research, communication and career development skills through the series of talks presented in the morning. The Professional Seminar was then concluded with the students engaging the extended community through a 20 min panel presentation of their consolidated group reports to a team of external panellists from the information industry. Lastly, students were expected to turn in a final individual reflection report of 500 words on what they have learned in this Professional Seminar course.

Appendix B: Part of the questionnaire pertaining to model of knowledge at a particular moment of formation pathway, adapted from [11]

(A) Personal Outcome Expectations

1. Sharing my knowledge will help me to make friends with other members in the virtual community.
2. Sharing my knowledge will give me a feeling of happiness.
3. Sharing my knowledge can build up my reputation in the virtual community.
4. Sharing my knowledge will give me a sense of accomplishment.
5. Sharing my knowledge will strengthen the ties between other members in the virtual community and me.
6. Sharing my knowledge will enable me to gain better cooperation from the outstanding members in the virtual community.
7. Sharing will ensure that I fulfill the requirements of the course.
8. Sharing will enable me to clarify some of my understanding of the subject matter.

(B) Community-Related Outcome Expectations

9. Sharing my knowledge will be helpful to the successful functioning of the virtual community.
10. Sharing my knowledge would help the community continue its operation in the future.
11. Sharing my knowledge would help the community accumulate or enrich knowledge.
12. Sharing my knowledge would help the community grow.
13. Sharing my knowledge would help the community fulfill the requirements of the course.

(C) Outcome Robustness

14. I have experienced some disappointment when I share my knowledge, but I decided that it is worthwhile to press on.
15. I have received adverse feedback from other people when I share my knowledge, but I decide to ignore them and continue to share.
16. I have experienced moments of confusion but I persevered and came to a better understanding of the course later.

(D) Social Interaction Ties

17. I maintain close social relationships with some members in the virtual community.
18. I spend a lot of time interacting with some members in the virtual community.
19. I know some members in the virtual community on a personal level.
20. I have some things in common with many members of the community.

(E) Trust

21. Members in the virtual community will not take advantage of others even when the opportunity arises.
22. Members in the virtual community will always keep the promises they make to one another.
23. Members in the virtual community would not knowingly do anything to disrupt the conversation.
24. Members in the virtual community behave in a consistent manner.
25. Members in the virtual community are truthful in dealing with one another.
26. Members of the community will not deliberately mislead others by providing factually wrong information.
27. Members of the community have the requisite competence to make contributions.

(F) Norm of Reciprocity

28. I know that other members in the virtual community will help me, so it's only fair to help other members.

29. I believe that members in the virtual community would give me help if I need it.

(G) Altruism

30. I enjoy sharing experiences in general; It does not matter whether it is rewarded in any way.
31. I think such sharing results in the 'greater good' for all.
32. I am grateful that I have the opportunity to share what I know, so I try NOT to let this opportunity lapse.

(H) Identification

33. I feel a sense of belonging towards the virtual community.
34. I feel a sense of togetherness and closeness within the virtual community.
35. I have a strong positive feeling toward the virtual community.
36. I am proud to be a member of the virtual community.

(I) Shared Language

37. The members in the virtual community use common terms or jargons.
38. Members in the virtual community use understandable communication patterns during the discussion.
39. Members in the virtual community use understandable narrative forms to post messages or articles.
40. Members of the virtual community share a common level of understanding of relevant concepts.

(J) Shared Vision

41. Members in the virtual community share the vision of helping others solve their professional problems
42. Members in the virtual community share the same goal of learning from each other.
43. Members in the virtual community share the same value that helping others is pleasant.
44. Members in the virtual community share compatible cultures and social norms.

(K) Knowledge Quality

45. The knowledge shared by members in the virtual community is relevant to the topics.
46. The knowledge shared by members in the virtual community is easy to understand.
47. The knowledge shared by members in the virtual community is accurate.
48. The knowledge shared by members in the virtual community is complete.
49. The knowledge shared by members in the virtual community is reliable.
50. The knowledge shared by members in the virtual community is timely.
51. The knowledge shared by members in the community is comprehensive.

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Chapter 17
One-Size-Fits-All? Towards a Taxonomy of Knowledge Workers

Rémy Magnier Watanabe and Caroline Benton

Abstract Instead of focusing on one-size-fits-all policies for knowledge management (KM), this research attempts to establish a taxonomy of workers based on their KM readiness expressed through their attitudes and participation in KM activities. A questionnaire survey conducted with Japanese engineers reveals four distinct groups—advocates, skeptics, busy, and hopeful—derived from their perceived importance of and time spent on KM actions, with significantly differentiated perceived enablers and barriers of KM. The data, containing answers to both open-ended and ordinal scale questions, was analyzed with both text-mining and statistical analyses. Broadly, KM advocates and busy people recognize the importance of intention and autonomy while skeptics give very little credit to any established KM enabler. Advocates, busy people and skeptics recognize information and people as important barriers to knowledge acquisition, storage and system as impediments to knowledge storage, understanding as an obstacle to knowledge diffusion, and application as a hurdle for knowledge application. Advocates, representing the most actively-involved faction in KM, consistently acknowledge intention and autonomy as enablers, while they cite people as barriers of KM. The results of this study suggest that to improve KM, organizations should first segment their workers based on their attitudes and participation in KM activities, and then implement different strategies aimed at different subgroups of employees based on their level of preparation or readiness for KM.

17.1 Introduction

Several knowledge management (KM) strategies have been proposed and devised at the firm-level and have for instance been defined as "the overall approach an organization intends to take to align its knowledge resources and capabilities to the

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intellectual requirements of its strategy" [1, p. 135]. More recently, Donate and Canales [2] described four types of knowledge strategies—proactive, moderate, passive, and inconsistent—with each having different effects on business performance and innovation. Those KM endeavors aim at entire departments or companies, treating employees as homogenous knowledge workers, and uniformly applying knowledge strategies, policies, and systems. Beyond customarily segmenting workers by occupation or job-content [3–5], it can be argued that knowledge policies will be more effective if they are tailored to the behaviors and expectations of particular target groups. Magnier-Watanabe and Senoo [6] contend that "the workforce is not a uniform body and […] intrinsic differences need to be taken into account to maximize the efficiency of knowledge management" (p. 109).

KM research focusing on the employee as level of analysis has highlighted the need to "understand employee motives for participating in the development of KM initiatives" [7, p. 264]. Lin [7], acknowledging the existence of a human resource challenge, found that higher levels of employees' intrinsic motivation and openness in communication led to greater KM implementation levels. Other findings support this approach, whereby a strong corporate mission shared and put into practice among the workforce was determined to be a powerful driver of KM, and open-mindedness and more inclusive reporting could substitute for a strong corporate mission and support KM activities [8]. Benton and Magnier-Watanabe [9], examining the impact of several factors on KM in domestic and foreign-affiliated firms in Japan, found that empowerment and supplier embeddedness influenced knowledge acquisition, and that more broadly, the culture of the parent company affected the employees' resulting involvement in KM activities. Geisler [10] proposed a typology of KM behaviors and suggested that these knowledge-related types—generators, transformers, and users—clarify individual roles and incentives to be provided by the organization.

However, beyond changing employee attitudes and behaviors towards KM and related practices [11], KM programs should first assess employees' KM readiness, evaluate their perception of and time spent on various knowledge-related tasks, and then identify where gaps should be filled with relevant countermeasures. Argyris and Schön [12], in their theory of action, differentiated espoused theories—used to convey our actions to others—from theories-in-use—that govern actual behaviors. Using a similar dichotomy, Magnier-Watanabe and Senoo [6] separated workers' perceived importance of and time spent on several knowledge management practices, remarking that "the former predict very well what people will say when asked about their perceived importance of knowledge management activities, but may differ from the latter which drives how much time they will actually devote to the same knowledge management activities" (p. 121). They found that, even in a single office within the same organization, distinct groups of employees in terms of KM considered different factors as sources of competitive advantage, thus calling for "tailored knowledge management strategies targeting each group of worker according to their perception of and involvement in knowledge management activities in order to improve their productivity" (p. 123).

The purpose of this study is therefore to examine enablers and barriers of KM for different groups of Japanese engineers, based on their perceived importance of and time spent on KM. Engineers exemplify knowledge workers who deal with one of the most important resource of all—knowledge—besides traditional factors of production, such as labor, capital, and land [13]. Indeed, "engineering practices are about knowing and using knowledge" and "the job of the engineer requires knowledge and the ability to utilize knowledge to solve real life problems" [14, p. 595]. This research can make important contributions for firms which could implement different strategies aimed at different subgroups of employees based on their level of preparation or readiness for KM.

17.2 Literature Review

17.2.1 Knowledge Management

Most KM frameworks adopt a value-chain approach which decomposes the knowledge activities of the firm into a sequence of tasks during which knowledge workers participate in building the organization's competitive advantage [15]. Although these value-chains offer different names for each KM element, extensive reviews have identified common activities in these value chains, consisting of knowledge creation, conversion, circulation, and completion [16] and knowledge creation, storage, sharing, and application [17]. Magnier-Watanabe and Senoo [18] provide a definition of KM incorporating the knowledge value chain model and assert that KM is "the process for acquiring, storing, diffusing and applying both tacit and explicit knowledge inside and outside the organization's boundaries with the purpose of achieving corporate objectives in the most efficient manner" (p. 22).

First, knowledge acquisition is the process of gaining new knowledge, from either inside or outside the organization and in either tacit or explicit form [19]. Knowledge acquisition, which can be focused or opportunistic, is a social process that occurs between individuals, where the role of the organization is to provide the proper contexts or situations for knowledge acquisition to occur according to the corporate objective [18, 20]. Second, knowledge storage refers to the structuration and storage of knowledge to make it more formalized and accessible [19]. Knowledge storage can be public or private, depending on whether it is formalized, accessible, and enables sharing, or conversely whether it is kept informal and is therefore not readily accessible and hinders sharing [18]. Third, knowledge diffusion deals with efficient knowledge flows in order to consolidate and make knowledge available to and useable by all relevant members of the firm [18]. Knowledge diffusion paths, embedded within the firm's pattern of systematic relationships, are either prescribed, where an organization dictates its form and content, or adaptive, where employees can dictate knowledge flows. Lastly, knowledge application is the process of incorporating knowledge into an organization's products, services and practices to derive value from it [19]. It can be viewed in terms of the type of learning

in the difference between knowledge exploration and exploitation [21, 22]. Where learning occurs along a trajectory that has already been followed, then it is exploitative or incremental learning. Where learning occurs along an entirely different trajectory, then it is exploratory or experimental learning.

17.2.2 Enablers and Barriers of Knowledge Management

In Polanyi's [23] theory of knowledge, tacit knowledge is defined as highly personal and deep-rooted in the knowledge holder even after it is made explicit through verbalization or visualization. That is to say, tacit knowledge, which Nonaka and Takeuchi [20] characterize as the experiential knowledge of experts, is very contextual and cannot be easily separated from the holder and fully communicated to another individual. Beyond this difficulty of transferring highly contextualized tacit knowledge, the sharing of both tacit and explicit knowledge involves the willingness of the knowledge holder to actively spend energy to communicate and transfer vital information and knowhow that can otherwise be a source of individual power. As such, the sharing of knowledge does not proceed naturally without some type of incentive. Barriers to knowledge sharing include individual, organizational, and technological impediments to the flow of knowledge from person-to-person, person-to-organization and organization-to-organization.

Davenport and Prusak [24] state that knowledge "is moved by a variety of forces" within organizations, and that "if we want knowledge to move and be utilized more effectively, we need to better understand the forces that drive it" (p. 25). One of the earlier references to barriers to knowledge flows in an organization was a study by Bullinger et al. [25] which proposed that the major factors that impede KM activities are scarcity of time, lack of awareness and lack of top management support. Riege [26] purports three categories of KM barriers: individual, organizational, and technological. Singh and Kant [27, p. 142] explain that, "Organizational barriers are lack of leadership, organizational structure, processes etc. Individual barriers are lack of time, job security, low awareness and realization of the value, etc. Technological barriers are lack of integration of information technology system, unrealistic expectation of employees, and lack of training, etc."

In light of such barriers, Nonaka and Takeuchi [20] propose the following enabling conditions to promote the sharing and creation of organizational knowledge: intention, autonomy, fluctuation/creative chaos, redundancy, and requisite variety. Intention refers to the organization's intention to promote organizational knowledge creation. The many barriers to KM must be actively neutralized by the organization for knowledge to be shared and created within an organizational context. Autonomy allows employees the freedom to discover new unexpected opportunities to gain or create new knowledge as well as being a motivating factor for seeking innovation. Fluctuation and creative chaos are

necessary to stimulate the interaction between the organization and the external environment, and cause breakdowns in routines, habits or cognitive frameworks, which can lead to the reevaluation of current perspectives and paradigms. Redundancy gives room for organizational knowledge creation activities: without duplicate and superfluous resources, the sharing of knowledge beyond current and immediate operational needs is not possible. Requisite variety refers to the need for the organization to match the variety and complexity of the environment in order to develop innovation that can deal with the challenges posed [20].

This paper therefore focuses on knowledge needs and the enablers, barriers and perceptions of KM of Japanese engineers in relation to their all-important product and service development activities.

17.3 Methodology

17.3.1 Survey Instrument

The questionnaire, written in Japanese, asked a combination of open questions and ordinal scale questions on a 5-point Likert scale. Ordinal scale questions measured (1) organizational KM practice, (2) the perceived importance and time spent on each of the KM activities, and (3) perceived enablers of KM. Organizational KM practices were measured using validated questions on organizational knowledge acquisition, storage, diffusion, and application [6, 18]. For knowledge acquisition, a higher score reflected opportunistic acquisition, whereas a lower score reflected focused acquisition. For knowledge storage, a higher score represented public storage, whereas a lower score represented private storage. For knowledge diffusion, a higher score indicated adaptive diffusion, whereas a lower score indicated prescribed diffusion. And for knowledge application, a higher score signaled explorative application, whereas a lower score signaled exploitative application.

Value questions measured on the one hand the respondents' perceived importance and time spent on knowledge acquisition, storage, diffusion, and application, and on the other hand their perceived importance of five identified enablers of KM at the organizational level, namely intention, autonomy, fluctuation and creative chaos, redundancy, and requisite variety [20].

Open-ended questions asked about the (4) barriers the respondents identified pertaining to knowledge acquisition, storage, diffusion, and application; those were analyzed using text-mining software (SPSS Text Analytics). The extraction of keywords from unstructured data allows the discovery of meaningful patterns in large quantities of textual data. Keywords were identified and insignificant words such as "none" or "unsure" were omitted. Categorization of the keywords was then undertaken to group words with very similar meanings—such as "boss" and "superior"—to produce a meaningful and operable final list of keyword categories.

17.3.2 Sample

The data was gathered in February 2012 using a Japanese Internet Survey service. Respondents were selected among Japanese employees working in Japan involved in research and development and other engineering services with more than three years of related experience. The respondents (N = 206) were asked to reflect upon their daily tasks and try to understand previous work done, products designed, services performed, or projects carried out in order to modify, improve, upgrade, maintain or use the content or results for their current tasks today or in the future.

Demographic questions included gender, age range, the degree of formal education, and the level of the respondents' current job (Table 17.1).

In terms of sector, respondents worked mostly in the IT and telecom industry (35.4 %), electrical manufacturing industry (13.6 %), chemical and pharmaceutical industry (7.8 %), construction industry (7.3 %), and the iron, steel, and machinery industry (7.3 %).

17.3.3 Taxonomy of Workers for Knowledge Management

Following Magnier-Watanabe and Senoo [6] who pointed out that "aggregate statistics only give the big picture", we decided to also "divide the population into a taxonomy based on the respondents' perceived importance and time allocation" of KM activities (p. 118). Answers on the perceived importance of KM activities were grouped together and the mean of the four scores was calculated for each case, and the same was done for the answers on the time spent on KM activities. The resulting clusters in relation to the mean of each respondent's aggregate score for KM were labeled as shown in Fig. 17.1. A dummy variable reflecting each respondent's position in the taxonomy was added to the data set (1 = advocate; 2 = skeptic; 3 = busy; 4 = hopeful).

When the mean of the respondent's aggregate scores for the perceived importance of and for time spent on KM activities are both equal to or greater than 3, he/she is called a knowledge management advocate. KM advocates account for 44.7 % of the sample (n = 92). When the mean of the respondent's aggregate scores for the perceived importance of and for time spent on KM activities are both equal to or lower than 2, he/she is called a knowledge management skeptic. KM skeptics account for 14.1 % of the sample (n = 29). When the mean of the respondent's aggregate score for the perceived importance of KM activities is equal or greater than 3 and that for the time spent on KM activities is equal or lower than 2, he/she is called knowledge management busy person. KM busy people account for 39.3 % of the sample (n = 81). And when the mean of the respondent's aggregate score for the perceived importance of KM activities is equal or lower than 2 and that for the time spent on KM

Table 17.1 Sample demographics

Indicator	N	%	Indicator	N	%
Gender			Work experience		
Male	193	94	3–5 years	14	7
Female	13	6	6–10 years	41	20
Age range			11–20 years	92	45
20s	7	3	21–30 years	52	25
30s	67	32	31 years and above	7	3
40s	90	44	Final education		
50s	39	19	High school	38	18
60s	3	2	Junior college	38	18
Marital status			University	99	49
Married	134	65	Graduate studies	31	15
Area			Position		
Hokkaido	9	4	Design engineer	25	12
Tohoku	8	4	Service engineer	28	14
Kanto	99	48	Software engineer	78	38
Central	26	13	Production engineer	29	14
Kinki	39	19	Maintenance engineer	26	13
Chugoku	11	5	Other	20	9
Shikoku	2	1	Job type		
Kyushu	12	6	Unskilled labor	7	3
			Professionally-trained engineer	99	48
			Academically-trained engineer	42	20
			Manager of one or more non-managers	36	18
			Manager of one or more managers	18	9
			Others	4	2

activities is equal or greater than 3, he/she is called knowledge management hopeful. KM hopeful respondents account for 1.9 % of the sample ($n = 4$). In subsequent analyses, the dummy variable "KM Profile" was created and used to compare these four mutually exclusive groups in the taxonomy.

The hopeful group is too small to be included in subsequent analysis and yield significant results. Consequently, only advocates, skeptics and busy people are included in the analysis. Significant differences were found for education between advocates ($M = 2.72$, $SD = 0.906$) and skeptics ($M = 2.07$, $SD = 0.799$) ($t(119) = 3.45$, $p < 0.001$), and between skeptics and busy people ($M = 2.67$, $SD = 1.012$) ($t(108) = 2.87$, $p < 0.005$). An education score of 2 corresponds to an associate or a 2-year degree, while a score of 3 signifies having graduated from university. Therefore, advocates and busy are significantly more educated than skeptics. No differences for education were found between advocates and busy people.

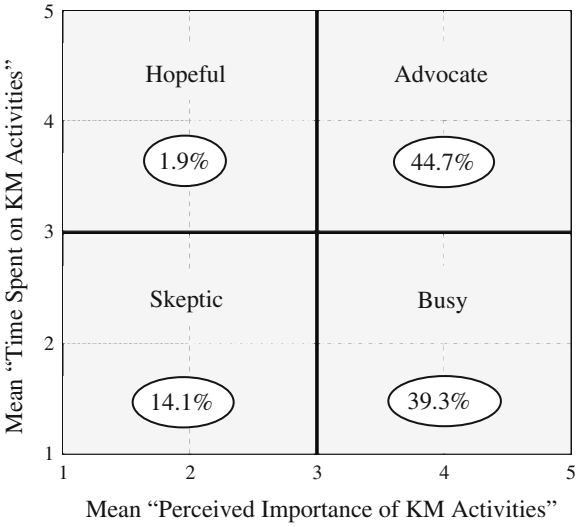

Fig. 17.1 Taxonomy of engineers' perceived importance and time allocation of KM activities

17.3.4 Validity

A factor analysis was conducted for questions pertaining to the independent constructs—organizational KM practices dealing with knowledge acquisition, storage, diffusion, and application—to ensure that the questions displayed highest loadings on the intended constructs and to assess divergent validity. A confirmatory principal component analysis, with the number of factors set to four, revealed four factors consistent with our intended constructs of knowledge acquisition (ACQ), storage (STO), diffusion (DIF), and application (APP) (Table 17.2). One question dealing with knowledge diffusion was deemed unreliable based on measurement of Cronbach's alpha and therefore removed. The four factors represent knowledge acquisition, storage, application, and diffusion, and explain 49, 13, 13, and 8 % of the total variance respectively. Collectively, they represent 83 % of the total variance.

The internal consistency of both the independent and dependent variables was assessed by examining Cronbach's alpha (Table 17.2). Cronbach's alpha measurement varies from 0.712 to 0.799 for three KM factors with two questions each, which suggest their reliability as measurement instruments [28]. As knowledge diffusion was assessed with only a single question, a Cronbach's alpha measurement could not be calculated.

In addition to divergent validity, all constructs were assessed for their convergent validity as recommended by Hair et al. [29]. The item-to-total correlation, between each item and the sum of the remaining items, was used to assess convergent validity. All item-to-total correlation scores were higher than 0.3, which indicates good reliability [30] (Table 17.2).

Table 17.2 Rotated component matrix of factor analysis of questions on organizational KM practices

	1 ACQ	2 STO	3 APP	4 DIF
ACQ1	0.856			
ACQ2	0.787			
STO1		0.875		
STO2		0.804		
DIF2				0.985
APP1			0.806	
APP2			0.808	
% of variance	49.185	13.632	12.599	7.978
Cumulative %	49.185	62.817	75.416	83.394
Items	2	2	2	1
Cronbach alpha	0.799	0.737	0.712	N/A[a]
Convergent validity	0.665; 0.665	0.584; 0.584	0.553; 0.553	N/A[a]

Extraction method Principal Component Analysis. *Rotation Method* Varimax with Kaiser Normalization. Rotation converged in 5 iterations

[a] Cronbach alpha and item-to-total correlation scores cannot be calculated for factors consisting of only one item

17.4 Analysis

17.4.1 Differences in KM Practices

In order to compare the constructs of organizational KM practices and KM enablers between the groups in the taxonomy, two-tailed independent samples t-tests between mean scores for advocates and skeptics, advocates and busy people, and busy people and skeptics were calculated. The hopeful group was left out of the analysis since its very low number of cases ($n = 4$) would not yield any significant results.

Our data shows that advocates work in organizations with relatively opportunistic knowledge acquisition, public storage, adaptive diffusion, and explorative application, as demonstrated by mean scores above 3 for these questions. Conversely, skeptics work in companies with relatively focused knowledge acquisition, private storage, prescribed diffusion, and exploitative application, as suggested by mean scores below 3 for these questions. Busy people rated their work environment as average for the four modes of knowledge management, as displayed by mean scores clustered around 3, and specifically ranging from 2.8 to 3.1. The differences in organizational KM practices between advocates and skeptics are all significant ($p < 0.05$ or $p < 0.001$), while those between advocates and busy people are only significant for knowledge acquisition and application ($p < 0.05$), and those between busy people and skeptics are significant for all

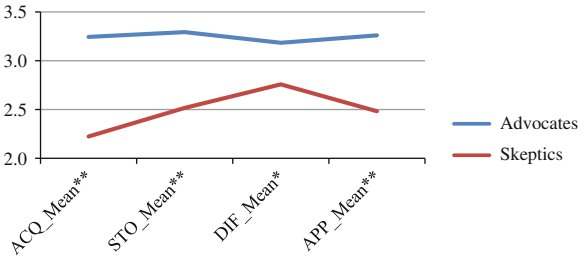

Fig. 17.2 Comparison of organizational KM practices between advocates and skeptics (**p < 0.001; *p < 0.05)

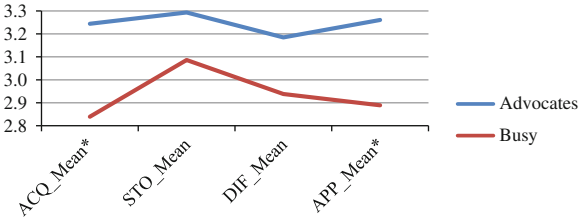

Fig. 17.3 Comparison of organizational KM practices between advocates and busy people (*p < 0.05)

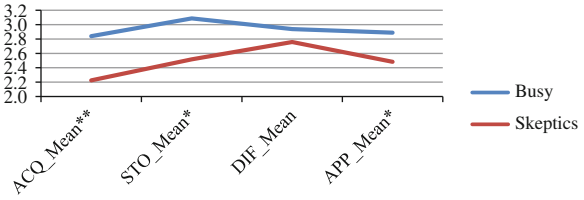

Fig. 17.4 Comparison of organizational KM practices between busy people and skeptics (**p < 0.001; *p < 0.05)

organizational KM practices ($p < 0.05$ or $p < 0.001$) except knowledge diffusion (Figs. 17.2, 17.3 and 17.4).

17.4.2 Differences in KM Enablers

Based on Nonaka and Takeuchi's [20] KM enablers, advocates and busy people recognize the importance of intention and autonomy (with mean scores consistently above 3), while skeptics rate those five KM enablers as rather unimportant (with mean scores ranging from 1.8 to 2.3) (Figs. 17.5, 17.6 and 17.7).

While concepts of intention and autonomy are self-explanatory, those of fluctuation and creative chaos, redundancy, and variety may not be as easy to understand without explanation. Since the questionnaire did not offer any clarifications of KM enablers, lower scores for those three KM enablers could be attributed to a lack of familiarity with these notions. Nevertheless, advocates and busy people rated intention and autonomy much higher in importance for KM compared to skeptics.

17.4.3 KM Barriers

Text-mining analysis on open-ended questions pertaining to barriers for each KM activity reveal that all three groups recognize information and people as important obstacles to knowledge acquisition, storage and systems as impediments to knowledge storage, understanding as a hindrance to knowledge diffusion, and people and application as hurdles for knowledge application (Table 17.3).

Beyond these common barriers, text-mining results provide insights about impediments unique to each category of workers—advocates, busy people, and

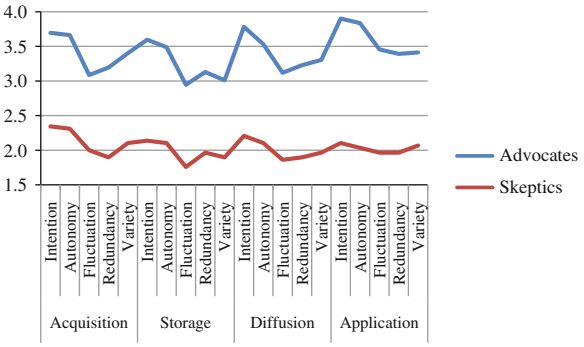

Fig. 17.5 Comparison of KM enablers' perceived importance between advocates and skeptics (all differences significant at $p < 0.001$)

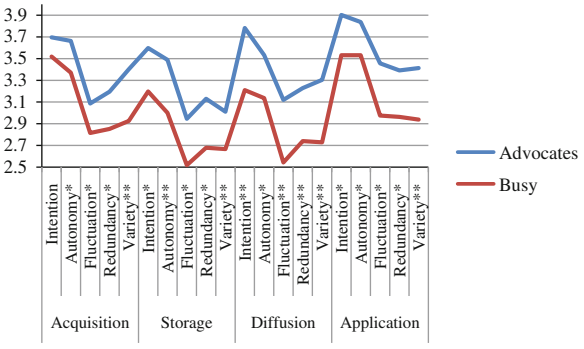

Fig. 17.6 Comparison of KM enablers' perceived importance between advocates and busy people (**$p < 0.001$; *$p < 0.05$)

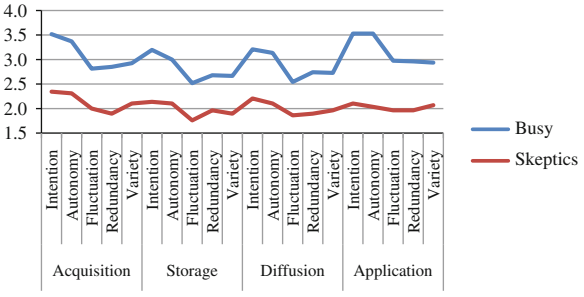

Fig. 17.7 Comparison of KM enablers' perceived importance between busy people and skeptics (all differences significant at $p < 0.001$)

skeptics—based on their attitudes and actions related to KM. Hindering knowledge acquisition, advocates refer to storage/access and cost, busy people to organization, security/privacy, and time, and skeptics to sharing. Impeding knowledge storage, advocates allude to people, busy people to information and time, and skeptics to policy. Hampering knowledge diffusion, advocates refer to intention, busy people to information and time, and skeptics to databases. And deterring knowledge application, advocates and busy people hint at people, with busy people also mentioning time and skill, and skeptics cite application.

17.5 Discussion

17.5.1 Differences in KM Practices

Advocates perceive their organizations to have relatively opportunistic knowledge acquisition, public storage, adaptive diffusion, and explorative application. Previous research established several relationships between the firm's KM practices and organizational characteristics, whereby vertical structure (relative to horizontal structure) is positively related to focused knowledge acquisition (relative to opportunistic knowledge acquisition), individual membership (relative to collective membership) is positively related to private knowledge storage (relative to public knowledge storage), systematic relationship (relative to ad-hoc relationship) is positively related to prescribed knowledge diffusion (relative to adaptive knowledge diffusion), and reactive strategy (relative to innovative strategy) is

Table 17.3 Keyword frequencies for advocates and skeptics' KM barriers

Barriers to:	Advocates (n = 92)	%	Busy (n = 81)	%	Skeptics (n = 29)	%
Acquisition	Information	15.2	Information	13.6	Information	20.7
	People	20.7	People	14.8	People	10.3
	Storage/Access	13.0	*Organization*	13.6	*Sharing*	10.3
	Cost	9.7	*Security/Privacy*	9.9		
			Time	9.9		
Storage	Storage	20.7	Storage	13.6	Storage	13.8
	Systems	8.7	*Information*	9.9	Systems	13.8
	People	8.7	Systems	8.6	*Policy*	10.3
			Time	12.3		
Diffusion	Understanding	19.6	Understanding	19.8	*Database*	10.3
	Intention	12.0	*Information*	9.9		
			Time	7.4		
Application	People	18.5	People	16.0	Application	17.2
	Application	17.4	Application	11.1		
			Time	2.3		
			Skill	11.1		

Unique keywords for each group are in *italics*

positively related to exploitative knowledge application (relative to explorative knowledge application) [6, 18].

Using these results, we can make inferences about the types of organizational characteristics—structure, membership, relationships, strategy—perceived and/or experienced by each major engineer group in the taxonomy. Based on their reported organizational KM practices, advocates work in an environment with a relatively horizontal structure, collective membership, ad-hoc relationships, and innovative strategy, while skeptics perceive their workplace to have a relatively vertical structure, individual membership, systematic relationships, and reactive strategy. We can infer that respondents KM perception and practice depend on their organization's characteristics, and that therefore, top management can influence their employees' KM beliefs and behaviors by altering those organizational features.

17.5.2 Differences in KM Enablers

Those workers who perceive KM to be important consistently value intention and autonomy. Intention depends on whether the organization actively promotes KM, for instance through a strong corporate culture emphasizing the importance of KM. A clearly articulated mission, fully implemented across an organization, was found to make a positive difference for knowledge management [31, 32]. Similarly, previous research has found that employees with higher levels of comprehension and implementation of the corporate mission in their daily work spend significantly more time on KM activities [8]. Autonomy is a direct function of how horizontal the organizational structure is allowed to be. These two KM enablers are therefore highly firm-specific and can only be encouraged by the organization through the careful crafting and execution of its corporate culture and structure, which are themselves not easily changed.

17.5.3 Differences in KM Barriers

Specific barriers were uncovered for each stage of the KM cycle. People and information-related factors account for the most often cited obstacles to knowledge acquisition, storage and systems for impediments to knowledge storage, understanding for hindrance to knowledge diffusion, and people and application as hurdles for knowledge application.

Assuming advocates spend the most time on KM activities, as suggested by their highest self-reported score in the questionnaire, they can be used as a proxy for model KM practitioners. Their most-cited impediment to KM across all four stages is people, therefore putting KM responsibility on human actors. Our data shows they believe that knowledge acquisition is slowed by difficult access or inefficient storage, that knowledge storage is negatively influenced by people, that

knowledge diffusion depends on people's intention, and that again people are to blame for hindering knowledge application. In other words, they believe that engaging in KM is highly personal and that non-cooperating or knowledge-hoarding coworkers make their task more difficult.

One possible solution is to make busy people and skeptics spend more time on KM activities. For busy people, as expected, a lack of time is a major issue. So this group could either be given additional time to engage in KM activities, or more realistically, their daily tasks should include spending time on KM actions, a process documented and recognized in their employee evaluation. For skeptics who identify policies and databases as barriers to knowledge storage and diffusion, clear procedures and tools could be designed to accommodate their needs.

17.6 Conclusion

The results of this study suggest that to improve KM, organizations should first segment their workers based on their attitudes and participation in KM activities, and then implement different strategies aimed at different subgroups of employees based on their level of preparation or readiness for KM.

This research shows that first, rather than using one-size-fits-all policies, organizations should differentiate their staff based on their perceived importance of and time spent on KM, with larger groups found among advocates and busy people. Drawing on past research, it can be further inferred employees' KM attitudes and participation depend on their organization's characteristics, and that therefore, top management can influence their employees' KM beliefs and behaviors by altering particular organizational features, such as structure, membership, relationships, and strategy. Second, the most important enablers of KM were found to be intention and autonomy, which are highly firm-specific and can be promoted by a strong corporate culture and a more horizontal business structure. And third, various factors were cited as barriers to KM by each group in the taxonomy, suggesting that organizations should first assess their staff to identify perceived barriers to KM and then alter job descriptions and supporting processes to affect the resulting perception and time spent on knowledge-related activities. Indeed, changing perceptions and individual behaviors is critical, since advocates, who spend the most time on KM, blame people-related factors for hindering KM.

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Chapter 18
A Conceptual Model for Privacy Preferences in Healthcare Environment

Fiza Abdul Rahim, Zuraini Ismail and Ganthan Narayana Samy

Abstract As the amount of electronic medical record (EMR) denoting its big data characteristic are being collected by several healthcare institutions increases, privacy concerns also increases. Patients need to disclose their private information in order to be diagnosed and given appropriate treatments. There are several mechanisms used today to protect patients' personal information but there are few studies conducted from patients' perspective. This paper highlights the literature review on privacy preferences in healthcare environment. It then, further identifies the factors that influence privacy preferences based on secondary data obtained from journals, conference papers and books. The findings of this on-going study proceed with designing a proposed conceptual model.

Keywords Privacy preferences · Healthcare environment · Big data · Electronic medical record

18.1 Introduction

Organizations capture, manage and administer such a big amount of personal data from individuals in their business operations [1, 2]. According to McKinsey Global Institute in their report, billions of individuals are able to contribute to the amount of available big data with the technology advances over time such as social

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media sites, smartphones, PCs and laptops [2]. As the amount of personal data being collected from various organizations increases, there is come privacy concerns for the individuals when submitting their details using computing resources for online shopping, visiting healthcare provider, social networking and etc. [2, 3]. For instance, the problem occurs when the usage of personal information may lead to gain financial benefit from selling access to the third parties.

Despite of privacy concerns to the individuals, big data can also contribute a benefit to private institutions as well as national level. Several research found that big data can increase operational efficiency, better decision making and customer service, improve performance by collecting more accurate and detailed data and innovating new business models [2, 4, 5].

In healthcare environment, big data consists of a huge amount of electronic medical record (EMR) about patients in order to be used by the healthcare professionals gathered by an autonomous device [6]. EMR of patient can allow users to increase the accessibility of sharing the records among individuals or groups. EMR also may help healthcare professionals to identify the right medical treatment for the patients by getting such a detailed information about patient containing identification, history of medical diagnosis, treatment and medication history, dietary habits and several other assessments from the information system [7].

Most of the researches on privacy focused on privacy preservation and challenges faced by the designer and administrator of electronic healthcare system (e-Health) on how to safeguard patients' private information [8–12]. However, in getting diagnose and treatment from healthcare providers, the patient may have their own preferences when giving out the data. Patients are now increasing concerned about privacy threats and worried if their personal information is released to other parties [13]. Therefore, further research on the key factors associated with patient such as privacy preference is needed [14] that may help the organization to select an appropriate privacy mechanism technology [15].

This paper aims to identify the key factors of privacy preferences in healthcare environment with several sections. This paper is organized into five sections. The first section is introduction, followed by the details about related issues in privacy. The third section describes the research methodology. The following section will elaborate in details on the model development for privacy preferences in healthcare environment and followed with the conceptual model. The last section will summarize the discussion and suggestion for future research.

18.2 Privacy Issues

The most challenging issues in the design and implementation of e-Health systems is safeguarding the big data consists of patients' private information [9] while protecting patients' privacy is a compulsory according to privacy legislation and regulations, such as the Health Insurance Portability and Accountability Act (HIPAA) [16]. Based on Title II of HIPAA, there is a procedure to assure that any

information is utilized and protected appropriately to ensure the confidentiality of the information and the privacy of individuals receiving healthcare services and items.

In current practice, a patient's consent must be obtained before his or her private information can be disclosed. The patient need to specify their privacy preferences about which part of data can be disclosed, to whom the data will be disclosed and for what purposes that data will be disclosed [8, 14]. By understanding the key factors of privacy preferences, it may help the organization, for instance, healthcare institutions to define related policies and regulations and to design their e-Health system that align with patients' privacy preferences.

Several issues have been discussed on suggestion to preserve patients' privacy in healthcare environment as highlighted in Armellin et al. [10], Sandıkkaya et al. [6], Appari and Johnson [17], Shoniregun et al. [18]. However, only few studied on factors that influence patients' privacy preference such as Kolter and Pernul [13], Damschroder et al. [19] and Mobach [20]. Three main issues in privacy were revealed in healthcare environment. Each of the main issues may denote one or more hypothesis. The first issue highlights on privacy concerns while the second issue is related with privacy breaches. Subsequently, the third issue discusses on privacy policy.

18.2.1 Privacy Concerns

Most researches have been conducted into information privacy concerns, not only in healthcare domain but other fields as well such as e-commerce [21, 22] and social network [23, 24]. Schwaig et al. suggested that corporations need to design information practices that address consumer concerns, formulate privacy policies that highlight their information practices and make sure that the policies are applied throughout the organization [22].

In business environment, it is important to know consumers' rights and investigate corporate privacy practices before disclosed any personal information. For EMR, many patients agree for to share information among physicians and third parties, such as employers and family members [17, 25]. This is because some of the information might relate with their family members such as genetic testing or might affect their work performance. Therefore, they might prefer to disclose their private information to the respective parties because of the needs to do so [19].

From the perspective of privacy concerns, there is a necessity to share the information among physicians and third parties in healthcare environment. Hence, it is expected that the higher the degree of sharing needs, the higher will be the patients disclosing their private information. To this, we hypothesize;

Hypothesis 1: Sharing needs has a positive relationship with privacy preferences in healthcare environment.

In the context of concerning about the reliability and reputation of the organization, Mekovec found that a strong company's reputation positively influences user's trust [21]. Hassan and Ismail also highlighted that security culture of the

organization may lead to greater internal and external trust [12]. The same situation also applied in healthcare institutions because some of patients with sensitive information might be more likely disclosing their personal information to certain individuals only because they realize about the implication [19, 26–28]. The organization must ensure to adequate privacy and security for EMR. Therefore, it would seem that patients' trust on healthcare institutions would affect the level of patient to disclose their information. From this argument, we offer the following;

Hypothesis 2: Trust has a positive relationship with privacy preferences in healthcare environment.

18.2.2 Privacy Breaches

According to Samy et al. [29], security threats have increased in recent years and over than 1.5 million names related with EMR were exposed during data breaches from 2006 to 2007. Few observations found that a major threat to patient privacy comes from insider who are getting legal access to EMR [17, 30, 31]. The insiders might not directly come from healthcare institutions but other organizations as well who are legally privileged such as employer and insurance firms. For instance, an employer may decide to terminate or deny promotion of the employee because they do not want to hire and rely to an employee who is always on medical leave due to their medical history. The healthcare institutions must apply and monitor proper security policies for access control managements [1, 32, 33]. From this finding, we suggest the following;

Hypothesis 3: Access control has a positive relationship with privacy preferences in healthcare environment.

18.2.3 Privacy Policy

As the usage of Internet allows information sharing and distribution, there is a need to address specific requirement within security policy to highlight on privacy. The healthcare organization also must ensure the appropriate security training and awareness programs about their privacy policy are being given to their respective employees who are dealing directly to the patient [29]. Trojer et al. suggested a process of authorization policy authoring for patients in order to control over their personal record [34]. While Samsuri et al. [35] recommended that patient consent, patient free accessibility and transparency in EMR management must be included in privacy policy.

A quantitative research done by Tesema [27] showed that there is a relationship between security awareness and patient's concern towards their EMR. It also reported that raising security awareness, providing guidelines on data protection and applying privacy legislation become more critical when referring to healthcare environment [18]. Therefore, it is predicted that the higher the degree of security

awareness, the higher will be the patients disclosing their private information. In concluding, we hypothesize;

Hypothesis 4: Security awareness has a positive relationship with privacy preferences in healthcare environment.

18.3 Research Methodology

The literature review on privacy preferences in healthcare environment were based on secondary data resources obtained from journals, conference papers and books were summarized in developing the proposed conceptual model. The online databases that were given particular attention include: Springer Link, Elsevier Science Direct, ACM digital library, IEEEXplore Digital Library, AIS Electronic Library (AISeL), EBSCO host, and Emerald Library. All the databases were chosen due to its relevancy and pertinence based on the keyword chosen such as 'privacy preference', 'privacy issues', patient privacy', 'healthcare environment', 'healthcare information system' and 'big data'.

18.4 Model Development for Privacy Preferences in Healthcare Environment

Privacy preferences define the way on how individuals determine the usage of their EMR. The antecedents are characterized as awareness, trust, sharing needs and environment. Each antecedent is defined in detail based on the related literature and summarized in Table 1.1.

Table 1.1 Factors influencing on privacy preferences in healthcare environment

Factors	Authors	Definition
Sharing needs	Tesema [27], Appari and Johnson [17], Damschroder et al. [19]	The clarification by the healthcare providers in explaining how the EMR is being used throughout the organization
Trust	Hassan and Ismail, [27], Samsuri et al. [35], Tesema [27], Bansal et al. [28]	The reliability of the healthcare practitioners or institutions might affect the degree of privacy preferences
Access control	AbuKhousa et al. [32], Mont et al. [1], Ardagna and Capitani [33], Appari and Johnson [17]	The responsibility of the healthcare organization to apply and monitor proper security policies for access control managements
Security awareness	Schwaig et al. [22], Tesema [27], Shoniregun et al. [18], Samy et al. [29]	The realization among individuals about their rights and related policy towards the implication of their EMR if being disclosed without their consent

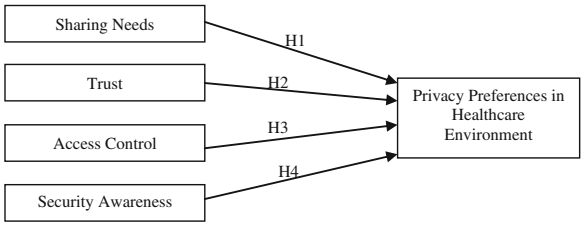

Fig. 1.1 Proposed conceptual model for privacy preferences in healthcare environment

From Table 1.1, we illustrate the proposed conceptual model in Fig. 1.1. Hence, based on Fig. 1.1, it can be hypothesize that:

H1: Sharing needs has a positive relationship with privacy preferences in healthcare environment.
H2: Trust has a positive relationship with privacy preferences in healthcare environment.
H3: Access control has a positive relationship with privacy preferences in healthcare environment.
H4: Security awareness has a positive relationship with privacy preferences in healthcare environment.

18.5 Conclusion and Future Works

This on-going research emphasized on the importance of privacy preferences in healthcare environment. Through the review from secondary data resources, this study had succeeded in identifying the factors influencing privacy preferences, namely sharing needs, trust, access control and security awareness. The related literature showed that these factors have association with privacy preferences. A proposed model hypothesizes the four factors that might influence privacy preferences. This in-progress work also may help the organization to select an appropriate privacy mechanism technology to address patients' privacy preferences. Therefore, the next stage of this study is to test this proposed conceptual model to determine its influencing relationship. The unit of analysis for this study will be from government supported hospital in Malaysia.

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Part III
Information Technology and Knowledge Management

Chapter 19
A Hybrid Patent Prior Art Retrieval Approach Using Claim Structure and Description

Fu-Ren Lin, Ke-Ren Chen and Szu-Yin Lin

Abstract In the highly competitive business environment, companies use patents as the intellectual asset to gain strategic competiveness. Patent prior art retrieval is a nontrivial task for invalidity and patentability search, which could help enterprises to plan their R&D strategies, patent portfolio, and avoid patent infringement issues in the future. This study adopts an efficient and effective hybrid patent prior art retrieval approach using claim structure and patent description to enhance prior art retrieval performance in terms of recall rate and exam the robustness through performing experiments in a large dataset. We obtained the best result by combining the information of claim structure and top 70 % sentences in description. We have achieved the competitive result in terms of raising the recall rate with the proposed hybrid approach, which also demonstrated the usefulness of including claim structure into patent prior art retrieval system.

19.1 Introduction

In the knowledge economy era nowadays, many industries face the challenge to effectively and efficiently create and use their core knowledge to enhance their competiveness. Intelligent property rights protect the tangible and intangible

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inventions, which can be used as intellectual asset for corporate strategic planning. It's no doubt that patents play the most important roles in many intelligent property types, not only granting inventors the exclusive rights of invention, but also authorizing others to access the detailed description of patents in the public database. Published patent documents allow other individuals and enterprises to design around or against the existing patents, which may even revise their R&D strategies to manage the risk on technological innovation. Patents provided the ample source about technical, marketing, and invention information [1], are expected to bring the value for inventors. Therefore, most of inventors and enterprises file patents to get the protection and additional benefits from innovation. Patents bring the protections and exclusive rights of the invention, and further bring the following two big benefits: compensation and licensing fees. If a patent owner accuses the infringed products or patents owned by others and wins the lawsuit, the losing side may pay a large amount of compensation. If the patent owner, for example, Qualcomm, holds the key patents in 3G mobile technology, other companies need to pay the large amount licensing fee if they want to use the technology covered by these key patents. That's why so many inventors actively hold patents as the valuable asset.

There are some types of patent retrieval, such as informative search, patentability search, validity search, infringement search, due diligence search, etc. Patent prior retrieval can achieve the above patent retrieval purposes for different usage. USPTO has experienced a significant increase in the number of patent application filings and the complexity of technologies in recent years [2], which justifies the prior art retrieval is worthy. In technology management perspective, patent prior art retrieval plays a very important role in technology strategy. In R&D perspective, prior art retrieval provides the knowledge on the patentability. For marketing competitors, prior art retrieval can also help them know the patent layout. For legal managers, prior art retrieval can help them find the infringed patents and further avoid the damage from litigations. That is, patent prior art retrieval system could become a useful tool to help enterprises to plan their R&D strategies, patent portfolio, and avoid patent infringement issues in the future.

As the sharp rise in patent documents, and the ever-increasing complexity of emerging technologies, efficient and effective prior art retrieval tools are in a great demand. There are some existing researches on prior art retrieval, such as text-based [3, 4], citation-based [5], and patent class based [6]. All of these past studies attempted to make accurate patent prior art search through the documents and data analysis or information retrieval methods. Lin and Huang proposed the claim tree methodology for patent prior retrieval, which obtained a good result by taking the patent text to build the corresponding claim tree structure [7]. Besides the claim text, they aligned description with claim to specify the relation between claim and description. However, due to the reasons of long execution time and heavy system loading, this proposed method only performed in a small data set for domain experts to assess its performance. In this study, we built a prior art retrieval system and examined its efficiency by performing experiments in a large dataset. Based on [7], a simplified and more efficient claim structure construction method was

designed. We modified the method of building claim structure to propose a hybrid approach by inputting claim and description text as the basis for prior art retrieval. We also conducted experiments to evaluate the effects by using different parts of patent information to obtain the most effective prior art retrieval system.

19.2 Literature Review

19.2.1 Patent Prior Art Research

In recent years, the number of patent applications is growing dramatically, especially in United States, Europe, Japan, and China. As the substantial increase in patent documents, many of the patent prior art retrieval researches have been proposed. The existing proposed researches in patent prior art retrieval are employed in different methods with different data sources. They can be categorized into text-, cluster-, and citation-based methods. In addition, Yu proposed prior art retrieval technique based on summarization, and obtained good search results [8]. However they set some restrictions of testing patents. For example, they chose the patents with the number of prior art between 10 and 50, and the testing data set was not representative samples, which made the result biased. On the other hand, the result shows that summarization method is helpful in prior art retrieval, but claim text does not.

Text-based method is the basis for patent analysis [9] and patent retrieval, because patent text is structurally well formed [3] and provides ample source of technical, marketing, and invention information. Some researches in prior art retrieval topic were based on text-based [2, 4], in which Verberne and D'hondt proposed the bag-of-words approach on prior art retrieval, but they only extracted the claim text as their raw data [4]. They converted the claim text into bag-of-words by removing the stopwords and punctuations, and then used those bag-of-words as their queries to retrieve prior arts. They paid the great effort on dealing with large CLEF-IP corpus, which consists of EPO documents with publication date between 1985 and 2000, covering English, French, and German patents (1,958,955 patent-documents pertaining to 1,022,388 patents, 75 GB). They obtained the acceptable result by using bag-of-words as queries, which also showed the importance of claim text.

Cluster-based patent retrieval methods are built on the basis of the assumption that related documents are grouped into the same cluster. Kang and his co-authors proposed the cluster-based patent retrieval approach, which used the smoothing- and topic-oriented clustering models to generate the clusters automatically, to conduct the invalidity search [3]. They used the large collection which consists of 1,707,185 patent documents of unexamined Japanese patent applications published in 1993 through 1997, and selected 101 existing patent claim and filing date as queries, trying to judge the invalidity of those patent applications. Their result can help reject the patent applications which have some parts highly similar with existing patents.

The citation of patent also provides the useful information for patent analysis and patent retrieval, and many researches are in this topic. Lai and Wu proposed a classification system by citation [10]. Fujii proposed a method for invalidity patent search which combines text- and citation-based retrieval methods [5]; however the author defined invalidity patent search as similar with prior art search. In text-based aspect, Fujii only used Okapi BM25 as weighting scheme to compute the score for each claim text with respect to a query, denoted as ST(d). In the citation-based, Fujii used two methods to implement and compare the results. First, they used PageRank method to estimate the probability that a user visits a document on the Web, and used this probability as the citation-based score for each document, denoted as SC(d). Second, they used topic-sensitive method, which calculated citations among the top N documents, and not only considered the citation number but also considered the cited number. The SC(d) score is computed by summarizing the reciprocal of citation number for each cited patent of *d*. Then, they computed ST(d) + SC(d) as the final score as their model both for PageRank and topic-sensitive method. They performed three experiments, using text-based only, text-based with PageRank, and text-based with topic-sensitive method. Finally, they obtained the best result of text with topic-sensitive method.

19.2.2 Claim Tree Structure

Lin and Huang proposed a method to represent the claim structure as a claim tree [7]. Four relations between components are used to build the tree: comprising, linking, preposition, and verb relations. Comprising relation denotes ingredients of the components, linking relation denotes the equivalence of the components, preposition relation contains the term of "of", "with", or other prepositions between the components, and verb relation exists a verb between two components. However, the method doesn't consider the relation under the adjective clause because an adjective clause contains too much detailed information that increases the hierarchical complexity of a claim tree. A claim tree is constructed by components and relations. A component is the basic unit of a claim tree, and it maybe a single word (unigram) or a phrase (*n*-gram). The relation between one component and another can help judge the meaning of a claim; thus, two different relations between two components can be assigned different meanings. In the implementation, the components are found from claim sentences by the alignment between the claim and its specification. The relations are extracted by finding the pattern which describes the regular expression. Because of considering relation, claim tree methodology provides more comprehensive information than the traditional keyword method [11].

19.3 A Hybrid Approach Using Claim Structure and Claim-Related Description

This study proposes a new claim structure formation method based on [7], and then extracts highly claim-related sentences in description as the supplement to form a hybrid approach to retrieve patent prior arts. The approach consists of three main parts: claim structure building and comparison, claim-related sentence retrieval, and the hybrid approach.

19.3.1 Claim Structure Building and Comparison

The claim tree structure of [7] can help inventors and patent managers efficiently find the prior arts from the given candidate patent set. However, the methodology of claim tree structure is too complicated, which occupies a large amount of computation resource and time to covert from original patent full text, so that the method is not able to deal with a large data set. In order to improve the efficiency, we simplify the architecture of claim tree structure through reducing the number of levels of a claim tree and the types of relation used. We found that the height of claim tree structure could become the burden of comparison in the matrix form, and complicated relations are error prone due to the limitation of nature language processing tools. We retained the comprising and linking relations in a claim tree, and abandoned preposition and verb relations.

19.3.1.1 Claim Structure Formation

The typical independent claim sentence contains preamble, transitional word and essential portions. Take the following sentence in patent'' 3716759″ as our example.

> "A silicon carbide semiconductor device comprising: a semiconductor substrate; a first silicon carbide single-crystal layer formed on said semiconductor substrate; an aluminum nitride single-crystal layer functioning as an electrically insulating layer is disposed on the first silicon carbide single-crystal layer; and a second silicon carbide single-crystal layer

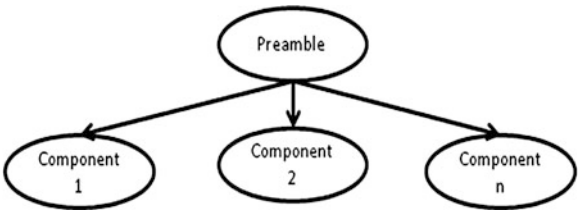

Fig. 19.1 Comprising relation

formed on said aluminum nitride single-crystal layer, said second silicon carbide single-crystal layer having a device active region."

We found that "A silicon carbide semiconductor device" is the preamble, "comprising" is the transitional word which described the preamble are comprising of the following essential components "a semiconductor substrate", "a first silicon carbide single-crystal layer formed on said semiconductor substrate", "an aluminum nitride single-crystal layer functioning as an electrically insulating layer is disposed on the first silicon carbide single-crystal layer", and "a second silicon carbide single-crystal layer formed on said aluminum nitride single-crystal layer, said second silicon carbide single-crystal layer having a device active region". From the independent claim, we can retrieve those preamble, and essential components to build the comprising relation. In this study, we call the preamble as main component. Fig. 19.1 shows the comprising relation built on the claim tree.

A dependent claim further describes the component with more specific words. However, if we only extract words in unigram, we lose some important phrases. Thus, we need to extract phrases in the dependent claim text. We used the natural language parsing tool OpenNLP[1] to generate the POS tags and the Penn Treebank [12], and then we extracted the noun phrases through the tree. We only extracted the noun phrases, for example, in this example, we extracted the phrases "A silicon", "semiconductor device", "field-effect transistor", and "an inversion mode", and we filtered out the noun phrase which contains the word "claim", so the phrase "claim 2" is not in the phrase list. After retrieving the noun phrases, we compared the dependent claim text with components in the independent claim to find the linking relation. We chose the highest cosine similarity score between component text and dependent claim text to build the link. We add all the noun phrases in dependent claim into the corresponding components.

19.3.1.2 Claim Structure Comparison Algorithm

The comparison of the patents using claim structure approach is a recursive comparison process starting from the root preamble component, and then go down to the every component in claim structure. We describe each step of comparison, and introduce the weighting and setting parameters that need to be optimized in the experiments.

19.3.1.3 Comparison of Two Patents

We build a claim structure with one independent claim and its dependent claims, in other words, how many independent claims a patent has is how many claim structures we built. That also means there are more than one claim structures in a

[1] http://opennlp.sourceforge.net/

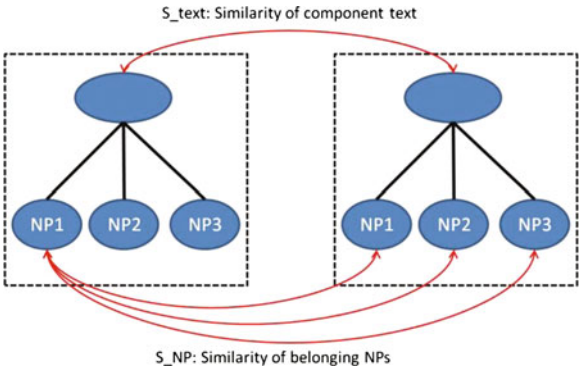

Fig. 19.2 Comparison of two claim structures

patent. When we compare the similarity of two patents, we need to deal with each claim structure of both patents. Given two patents with n and m independent claims, there are $n*m$ times of comparison. We can obtain three types of similarity score: (1) to compute the average similarity value of $n*m$ comparisons, (2) to choose the maximum similarity value of $n*m$ comparisons, and (3) to choose the minimum similarity value of $n*m$ comparisons.

19.3.1.4 Comparison of Two Claim Structures

The comparison of two claim structures could be divided into two parts: (1) to compute the similarity of main component (preamble), and (2) to compare the components which contain essential components text and its corresponding noun phrases, as shown in Fig. 19.2.

We computation of similarity of two items as follows. The first step is to compare the main component by cosine similarity, and then to compare all pairs of components to get the maximum score as component similarity. Then, we derive the similarity formulation of two claim structures.

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n_1 = Component of claim structure 1
n_2 = Component of claim structure 2
S_m = Cosine similarity of main components
$Sc(i, j)$ = Similarity of components i in structure 1 and component j in structure 2
Similarity of claim structures = $w_m S_m + \max\{S_c(i,j) |\ 1 < i < n_1, 1 < j < n_2,\ i,\ j\}$

19.3.1.5 Comparison of Two Components

A component in our claim structure model consists of two parts, essential component text and noun phrases retrieved by its corresponding dependent claims.

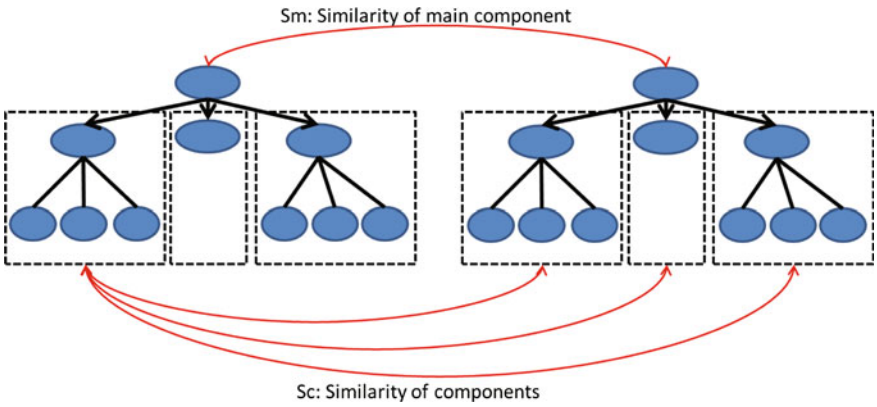

Fig. 19.3 Comparison of two components

The computation of the similarity between components also contains two steps: to compute cosine similarity of component texts as "*S_text*" and then compute similarity of all noun phrases as "*S_NP*" shown in Fig. 19.3.

The similarity of two components computed by the linear combination of those two scores "*S_text*" and "*S_NP*", and we set two weights w_1 and w_2, so the formulation of similarity is shown below.

n_1 = NP amount of component1
n_2 = NP amount of component2

$$\text{Similarity of components} = w_1 * S_{text} + w_2 * \sum_{i=1}^{n_1} \sum_{j=1}^{n_2} S\_NP(i,j)$$

19.3.2 Claim-Related Sentence Extraction

According to Yu's research [8], to use claim text only cannot achieve the acceptable result of prior art retrieval. In this study, we designed a hybrid method to combine text from claim and description of a patent. In [7], the alignment between claim structure and description text took extensive execution time by using nature language parsing tool (Stanford NLP parser) to parse every sentence in description in which more than 200 sentences in a patent in average. To improve the time efficiency, we decided to retrieve sentences which are highly related to terms in claim, according to [13], these sentences might be relevant to a patent's claims in prior art search. Because claims are the protection scope description of the invention, and when it comes to litigation or infringement, patent managers or judges read the claims to judge the infringement. Thus, this study retrieved the claim-related sentences in patent description based on claims. The algorithm is shown below.

Input: Sentences in description, NPs in claim structure, retrieve *n* %
Output: Top *n* % related sentences in the description
Process:
For each sentence in the description
TotalSimilarity = 0
    For each NP in claim structure
      Compute the cosine similarity between sentence and NP as *S*
      TotalSimilarity += *S*
Sort sentences by its TotalSimilarity in descending order
Retrieve top *n* % sentences from the sorted set

19.3.3 Hybrid Approach

In this study, we proposed the hybrid approach for the patent prior art retrieval, and analyzed its condition of usage. We expected to use this approach to raise the recall rate by merging two different prior art retrieval methods. The basic idea of the hybrid approach comes from the union concept since we thought those prior arts retrieved by the claim structure approach were different from prior arts which retrieved by full-text comparison, and we could retrieve prior arts more completely by merging these two results. However, the outcome of merged results in terms of recall rate may depend on the intersection ratio of original retrieved results and the distribution status. Intersection ratio is defined as the common prior arts retrieved by both methods. Distribution status is used to describe the number of matched prior arts for top *n* retrieved candidate prior arts in a given number of queries. Therefore, we need to check the intersection ratio of the original two results, and analyzed the effect of the distribution status of each original result in order to obtain the best fit of the hybrid prior art retrieval system. We summarize the step below.

Input: SC (Candidate sets by claim structure method),
    SR (Candidate sets by related sentences method),
    W (watershed of retrieval amount)
Output: S (The merged prior art candidate set)
1. Check the intersection ratio of SC and SR
2. Check the distribution status for SC and SR
3. Retrieve the top intersection patents of SC and SR and put into S and remove the intersection part in SC and SR
4. Sort patents in SC and SR by similarity in descending order
5. While size of S < n
    Put patent in SC and SR gradually into S from higher similarity
6. Output S as the result of the hybrid approach

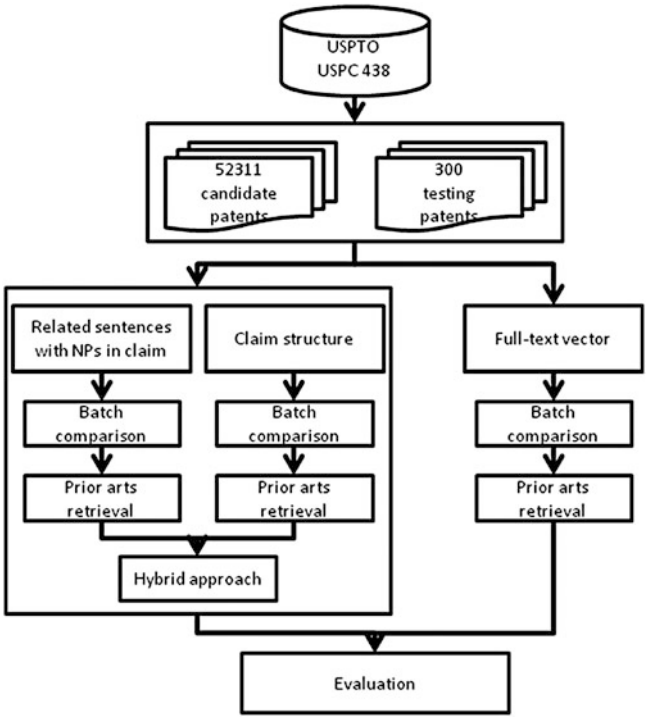

Fig. 19.4 The experimental design

19.4 Experimental Design

We designed a series of experiments to verify the proposed hybrid patent prior art retrieval approach. First, we tested many parameter arrangements in the claim structure comparison algorithm, and expected to find the best parameter setting. Second, we tested the different proportions of retrieved sentences in description according to the noun phrases in claim structure, and expected to know the appropriate proportion. Finally, we tested how to merge the results of these two parts and concluded the hybrid method. The experimental design is illustrated in Fig. 19.4.

19.4.1 Data Sources

We performed the experiments in a large data set instead of given a candidate set by the patent experts. The ideal goal is to compare all the patents in USPTO database, and retrieve some high claim-related patents as our output prior arts. However, due to the large amount of patents, comparing all patents is impossible, so we need to restrict

in some domain and compare limited patents in reality. To compare the large candidate set can achieve the similar goal as comparing all patents because of the domain separation that most prior arts are in the same patent class. So, we can use the result computed by a large candidate set to estimate the result of patent population.

We chose the US classification class 438 (Semiconductor Device Manufacturing: Process) and all its subclass as our data source, and get the patent full-text from United State and Trademark Office (USPTO[2]) database. We collected 47,003 patents from 1976 to 2005, and we randomly selected 300 testing patents in 2005. However, some prior arts of these 300 testing patents are not in class 438. Thus, we put additional 5308 patents into the data set, and obtained 52,311 patens as our candidate patents for prior arts retrieval. We further analyzed these 300 testing patents, in which the minimum prior art numbers is one, the maximum is 287, and the average is 15. That shows that we kept the real face of the testing data to fit the real population. To evaluate the proposed hybrid approach, we designed a series of experiments. First, we identified the best parameter settings in claim structure. Second, we decided the best ratios of sentences in description as relevant contents

19.4.2 Evaluation Criterion

This study used recall as the evaluation criterion because the research objective is to help patent analysts or R&D managers identify the highly claim-related patents by a given target patent set. We used the confusion matrix to state why we chose recall as our evaluation criterion instead of others. In this study, the false negative is the worst case that we should avoid since some highly claim-related patents are not retrieved by the system, which may render to huge damage especially in the litigation process. On the contrary, the false positive is not important for this research. So, we chose recall as our evaluation criterion, and the formulation is shown as follows.

$$\text{Recall} = \frac{p'}{P} = \frac{\text{the number of matched outcome}}{\text{the number of prior art}}$$

19.5 Experimental Results

19.5.1 Baseline Experiment and Text Part Selection

In the general articles, researchers often extract the keywords to compare and then judge their domain similarity or content similarity. Those keyword extraction methods are usually constructed in text base, such as TF-IDF, Okapi BM 25, etc.

[2] http://www.uspto.gov/

In the patent domain, Sheremetyeva proposed an algorithm to extract the keywords and key phrases in patent text [14]. That method extracted all the n-grams ($n = 1$, 2, 3, 4) and then calculated the score of the frequency, and got the efficient result on machine translation domain. But in the prior art retrieval topic, we cannot use this model to extract keywords and key phrases to run the comparison because there exist the important words in the patent claim, but those words appear just only one or two times. So if we extract the keyword by frequency, we will miss those words. Therefore, we performed the full-text comparison experiment as the baseline method to compare with the result of the claim structure and hybrid approach. We found that description has the main influence on prior art retrieval result, but claim text does not. Since claim text cannot influence prior art retrieval result too much, so in this study, we extracted more information in description to build the claim structure and influenced more on the final results.

19.5.2 Parameter Arrangements in Claim Structure Comparison

We designed the comparison algorithm of the proposed claim structure model to identify the most suitable parameters in claim structure formation. For each of 300 testing patents, we used baseline (full-text) method to extract the top 100 most similar patents as our candidate set, and then we used our claim structure method to compare and output the top 50 patents as prior arts. To make sure the reliability of this setting, we compared the results, and found that the methods with higher recall rate in top 50 are always higher in top 1000. That is the strong support to test the parameter settings. So we design two rounds of experiments to verify that.

Round 1: Parameter settings of w_m

We examined the influence of the main component in the prior art retrieval by gradually increasing the w_m from 0 and observed the recall rate. We increased w_m 0.05 each time until w_m 0.3, and we discovered the trend of recall rate change. We found that zero weight of main component obtained the better result than others, so that we judged that the main component has low influence of prior art comparison. The result is identical with other research on claim structure [15], which identified that the preamble was not the deterministic factor of patent retrieval especially on prior art retrieval.

Round 2: Parameter settings of w_1 and w_2

In the second round experiment, we tested the parameter settings of w_1 and w_2. We used the same comparison method as Round I, and we started w_1 from 0.1, in which we set $w_1 + w_2 = 1$, so that we only tuned w_1. We found that the best result within w_1 is between 0.2 and 0.3, so that we further did the additional experiments

wherein $w_1 = 0.25$ and $w2 = 0.75$, when both $w_m = 0$ and 0.05. Finally, we obtained the best parameter setting in the claim structure comparison algorithm, and we adopted this parameter setting to conduct the further comparisons in this study. We also concluded two points: first, the main component has no influence to decide whether the target patent is a prior art or not. Second, the components in independent claim have the strong influence on patent prior art retrieval, and that is the good discovery for text-based prior art retrieval.

19.5.3 Comparison Algorithm Settings

Based on the experimental results from the aforementioned two phases, we obtained the best parameter settings. Then, we used these parameters to test the hybrid method of prior art retrieval for 300 patents from a large set of patents under three scores in the claim structure comparison algorithm: maximum, minimum, and average. In the comparison of the recall of the proposed claim structure model with the claim text only method, we found that the claim structure algorithm obtained the best result under maximum score computing formula.

19.5.4 Sentence Retrieval in Description

The second part of the proposed model is the sentence retrieval, and we need to know the proportion we should take in the description to obtain the best result. We designed six experiments in extracting top 10, 30, 50, 70, 90, and 100 % claim-related sentences in description, given noun phrases retrieved by claim structure method. We computed the cosine similarity between target sentence in description and all noun phrases retrieved by claim structure, and then we obtained several similarity scores. We computed the sum of these scores as the total score, and sorted in descending order, and then we can easily get top n % sentences in this part. We converted top n % sentences into vector format, and retrieved the prior arts by a large amount of comparisons. We concluded the findings as follows: if we take too few sentences, we will miss important words and cannot identify prior arts effectively; however, if we take all sentences in description, they contain noises and cannot become the most efficient one. Thus, we aimed to remove noises as many as possible but keep key concepts as much as possible in order to obtain better results.

19.5.5 Hybrid Approach

We proposed the hybrid approach of patent prior art retrieval, and conducted experiments in testing different parameters to obtain the best result.

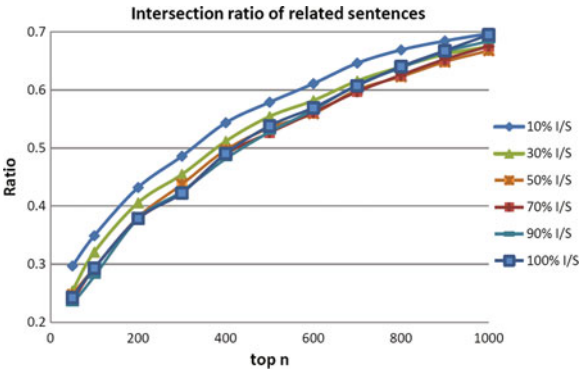

Fig. 19.5 Intersection ratio of claim-related sentences

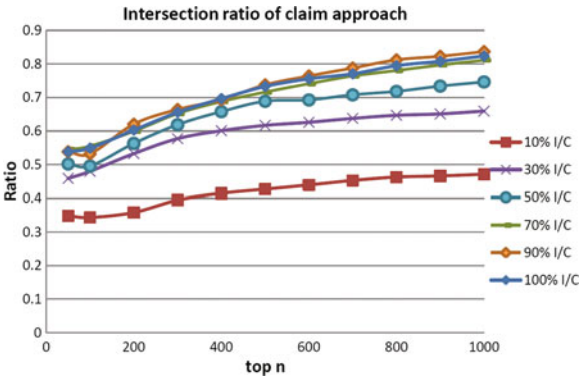

Fig. 19.6 Intersection ratio of claim approach

19.5.5.1 Intersection Ratio

The lower intersection ratio is the prerequisite condition of a good hybrid result. However, it doesn't mean the lower intersection ratio can always lead to the better result, but only show that it will have a higher possibility than the original two results retrieved from claim structure and claim-related description sentences, respectively. We evaluated the intersection ratio obtained under different ratios of claim-related sentences and claim structure, respectively, and the results are shown in Figs. 19.5 and 19.6. From these two figures, we found that the intersection ratio of claim structure approach is increased when the ratio of claim-related sentences is also increased, but in the intersection ratio of claim-related sentences, the situation reversed. From the results, we can judge that merging two methods of claim structure and 10 % claim-related sentences is more likely to raise a bigger range than merging results of claim structure with 30 % claim-related sentences. However, it does not mean that we will always get the best result of merging results of claim structure with 10 % claim-related sentences.

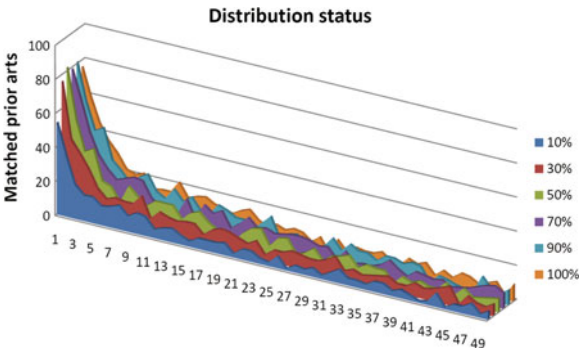

Fig. 19.7 Matched prior arts under different distribution statuses

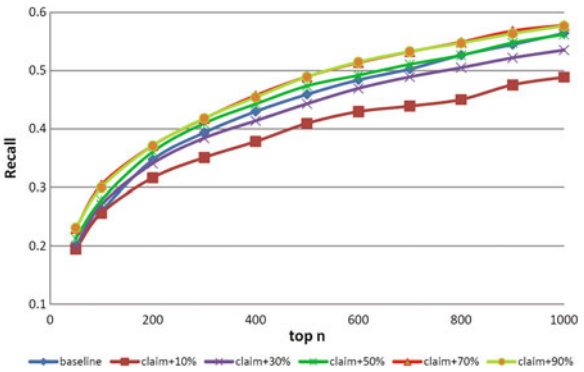

Fig. 19.8 The recall of hybrid approach

19.5.5.2 Distribution Status

We need to check the distribution of the target results in different percentages of claim-related sentences, then we can judge whether merging the target results increases the recall. In other word, if the distribution of the target results is more concentrated in the front, the possibility of raising recall rate by taking the front part of retrieved results will raise. Fig. 19.7 shows the same distribution pattern of various percentages of merging claim-related description sentences. This result indicates that we can get improved results by merging top matched prior arts based on the claim-related description sentences.

19.5.5.3 Hybrid Prior Art Retrieval Method

In Fig. 19.8, we found that a hybrid prior art retrieval method in claim +70 % and claim +90 % settings are higher than the baseline result. We performed *t* test to test the significance of difference between the proposed hybrid method and baseline method, and obtained the significant results from both settings comparing with the baseline. Besides, the experimental results show that the best result is to

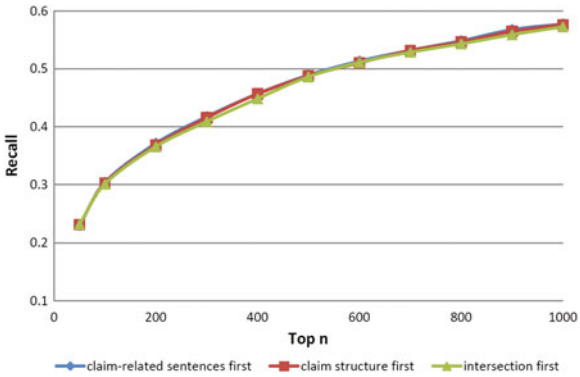

Fig. 19.9 The recall rate of different merging order

take top 60 % results generated by claim-related sentences and fill up the merged results by the candidate set of claim structure.

We performed an additional experiment to evaluate the order of merging process in the hybrid method. The experimental results shown in Fig. 19.9 concludes that taking the results from claim-related sentences first will obtain better results but the difference is too small to differentiate. Thus, we conclude that the outcomes of the hybrid method are independent from the order of merging results from original prior art retrieval methods. Since the best result appears in claim +70 %, we think this result could be obtained by removing the noise in description sentences which is more useful than extracting important sentences in description. That is the great discovery for users to deal with patent text, especially in description text.

19.6 Conclusions

In this paper, we proposed a hybrid prior art retrieval approach and conducted experiments to evaluate its performance in recall. First, we successfully improved claim structure approach both in efficiency and effectiveness. We achieved better results by the revised claim structure methodology comparing with untreated claim text, so that we can prove that the claim structure is useful in prior art retrieval. The recall rate of accessing 1000 patents as prior arts is 47 % using claim structure, higher than 34 % using claim text only.

Second, we proposed the hybrid approach to merge the results retrieved by claim structure and that retrieved by claim-related sentences. The experimental results show that the hybrid approach is suitable to merge different results retrieved by different methods because different methods are expected to output different results which have the lower intersection ratio. Finally, we raise the recall rate to 58 % using the hybrid approach in accessing 1000 patents as the prior arts, where 47 % using claim structure, 55 % using claim-related description sentences.

This study has some limitations although it generated good outcomes. First, we used the nature language processing tool, but either OpenNLP or StanfordNLP trained content sources with general topic articles, so that they were not expected to perform for patent text as effectively as general topics. Second, we cannot compare all the patents in USPTO to find the prior arts, so that we restricted the data source on US patent class 438. In this study, we focused on the claim structure, and used simple comparison method such as cosine similarity to compare terms. However, other text mining based methods, such as BM25, TFIDF, mutual information, etc. could be used to identify informative terms. We didn't use machine learning approach on claim structure and hybrid prior art retrieval methods in this study. This is a good direction for combining the machine learning approach and claim structure approach in future research.

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Chapter 20
Improving Near-Duplicate Detection in Multi-Layered Collaborative Requirements Engineering Discussions Through Discussion Clustering

Christian Sillaber and Ruth Breu

Abstract Existing methods for finding near-duplicate content often fail when applied to informal user discussions spanning multiple messages, which can be found in collaborative requirement discussions. As a result, although the underlying knowledge sharing platform already contains duplicated entries the stakeholders often recreate already existing requirements discussions without contributing to the existing discussions. In this paper we therefore identify common reasons leading to near-duplicate content and develop a new algorithm for detecting near-duplicate content in multilevel requirement discussions. The algorithm is implemented using a large case study of real-world collaborative requirements engineering platforms serving hundreds of thousands of stakeholders. Our preliminary results show, that we outperform existing search algorithms and that we are able to identify near-duplicates in multilevel requirement discussions with high precision.

20.1 Introduction

Increasingly, businesses make use of knowledge sharing platforms to leverage the knowledge of broad groups of stakeholders in both internal and external software engineering processes (e.g. [1–3]). One particular example for such a (specialized) knowledge sharing platform is a collaborative requirements engineering system, where large groups of stakeholders actively discuss, collaboratively elicitate and refine software requirements [4–7].

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It is obvious that as the number of participating stakeholders increases the number of discussion threads grows drastically and becomes unmanageable over time. Therefore it becomes necessary to provide the participants with appropriate tools to efficiently manage the high influx of information and avoid duplicate or potentially conflicting requirements.

To cope with the problem of identifying related content, technologies such as tagging and search engines have been successfully introduced to a broad range of knowledge sharing and related platforms. Various recent research has brought forward algorithms and frameworks capable of identifying discussion threads with near-duplicate content to a satisfactory degree (e.g. [8–10]). However, these approaches often fail to identify multilevel requirements discussion where several different requirement discussions take place in one discussion thread and a "drowning" effect can be observed: Consider a user submitting a feature request *A*. During the resulting requirements discussion process, requirement *A* is refined and within the discussion, a stakeholder has a good, related, idea and posts requirement *B* within the same discussion thread. The contribution is well regarded by other stakeholders and briefly discussed. Then the discussion returns to *A* and *B* "drowns" under other posts (unless an attentive moderator acts accordingly). As a result, if in the future a stakeholder is interested in *B*, current search engines would not be able to successfully identify the previous (sub) discussion as related to *B*, as the majority of the thread is considered to be related with *A* and those results on *B* "drown" again in the search results.

We observed that especially new users are often unable to identify already existing discussions relating to their request, which in turn often frustrates "older" users, as they view new users as incapable of using the search engine (similar findings were reported for instance in [11, 12]). As a result, the average reply time for duplicate requirement discussion entries may range from a few hours to even weeks—and often the discussion was manually "closed" as a duplicate by a moderator or a user simply submitted a link to the related discussion. Such threads then enter the list of search results—further cluttering future searches.

While this is a very interesting research problem to us, we acknowledge that a solution to this rather isolated problem might only benefit a very small percentage of the overall activity in such a platform. Therefore we could not introduce a CPU—or memory—intensive algorithm that would have a negative performance impact or would introduce disproportional costs or heavy modifications to the already existing platform.

To provide a solution that addresses this problem without modifying the underlying platform, we developed a clustering algorithm. This algorithm can either be used in a stand-alone application or packaged as a plugin to extend existing search functionality. As a result, users are able to browse threads provided by the search engine of the collaborative requirements engineering platform more efficiently and can spot existing discussions faster. Furthermore, stakeholders willing to analyze and specify requirements can immediately oversee, which new threads have already contributed to the discussions of a particular requirement.

Normally, requirement discussion threads in particular and web forum threads in general are assumed to revolve around one particular topic, following a simple pattern [13–15]: A user asks a question or puts forward a requirement request. Then, other stakeholders contribute to this particular requirement by posting refinement or implementation suggestions. While it would be desirable to limit this particular thread to the discussion of the requirement that is outlined in the post submitted by the first user, in reality discussions diverge from the "common theme" and often contributions are created, just to be immediately "drowned" under the messages of the original discussion. Fig. 20.1 shows the stark contrast between the assumptions made about threads and the therein contained discussions in established work as [9] and the reality, collaborative requirements engineering platforms and other related knowledge sharing systems are often faced with.

We define a **single layered collaborative requirement discussion** within a collaborative requirements engineering platform as a sequential set of user generated content that (a) starts with a message being posted by a stakeholder, and (b) is then discussed (e.g. refined or extended) by other stakeholders participating in the discussion, and (c) each contribution to the discussion is contained in one message and one message contains one contribution to the discussion (cf. upper half of Fig. 20.1).

We define a **multi-layered collaborative requirement discussion** within a collaborative requirements engineering platform as a sequential set of user generated content that (a) starts at an arbitrary position within a thread, that might be (b) then discussed (e.g. refined or extended) by other stakeholders at an arbitrary position within a subsequent post, and c) each user generated content might contain more than one contribution to more than one requirements discussion.

The remainder of this paper is structured as follows: Related work is presented in Sect. 20.2. In Sect. 20.3 we present the main contribution of this paper: the proposed framework and the developed algorithm are described. Section 20.4 presents the results of our evaluation conducted on data from large, globally distributed requirements engineering platforms. Finally, the paper is concluded in Sect. 20.5.

20.2 Related Work

Clustering algorithms are used in many Natural Language Processing tasks to either group words [16, 17], sentences [18], documents [19–21] or languages [22–24]. Clustering languages and documents is a well-established research area in Information Retrieval literature. Sentence clustering plays an important role in extractive multidocument summarization [25], or in more general text mining tasks, including web-page mining [26].

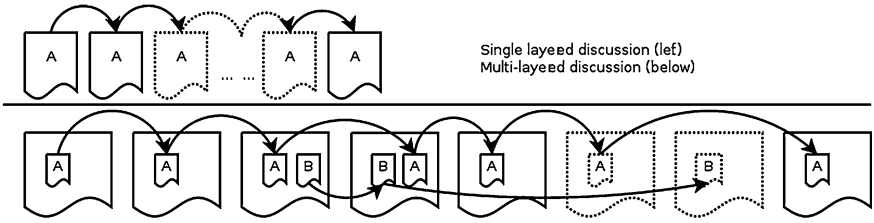

Fig. 20.1 Assumed discussion content in one layered discussions compared to multilayered discussions

The most common practice [27] is to generate vectors from potential key phrases of the sentences and applying a k-means [28] clustering algorithm (e.g. [29, 30]). These algorithms take as input a document that is, in a first step, split into sentences and unique terms are identified as potential key phrases [29]. Then these terms are correlated with the sentences and data clustering is performed on this space. Other clustering algorithms have been investigated for this purpose, including Markov clustering [31], density clustering [32] or naïve Bayes classification [33].

Skabar and Abdalgader develop a fuzzy relational clustering algorithm in [34] to identify overlapping clusters of semantically related sentences. Various graph clustering algorithms, where sentence connectivity graphs are analyzed, have been successfully utilized (e.g. [35–38]). While these approaches achieve superior performance to the "classical" approaches presented above, their major disadvantage is their time complexity [34]. Grouper, a document clustering interface, presented in [39] uses contiguous phases of variable length drawn from website snippets by means of a suffix tree data structure. Unlike in our solution, inter-sentence-relationships and inherent links are not sufficiently considered.

These links between textual artifacts that are present in our problem space (short messages where users reply to each other's messages) have been already described in existing research that can be classified into two categories: clustering hypertext documents and clustering web search results. The requirement discussion entries can be seen as search-able hypertext documents that are linked through their inherent tree-like "reply structures". As it is obvious that the available links between such messages are by no means related to the content provided in the messages, these algorithms would only be able to cluster the messages by their discussion threads. This would provide no further insights as this information is already available beforehand. Our approach is markedly different from each of these and tries to capture the links between messages through the sentences contained in the messages.

We found that none of the above approaches to clustering selects text artifacts based on the content of the sentence and the relation of the sentence to the other artifacts. Our algorithm is based on identifying relations among sentences in multilevel-discussions and is suitable for automatic near-duplicate identification unlike almost all previous approaches.

20.3 Detecting Near-Duplicate Content in Multi-Layered Requirements Discussions

In this section we present the framework we developed for detecting near-duplicates in multi-layered discussions. We provide a model for multi-level requirements discussion and present the proposed similarity extension.

20.3.1 Overview

The overall proposed framework for identifying multilevel near-duplicate requirements discussions is shown in Fig. 20.2. To demonstrate the applicability of the algorithm a prototype application has been developed. For this implementation, GO,[1] a concurrent programming language developed by Google was used. The process implemented in the prototype application consists of the steps presented in Fig. 20.2. The following sections describe each sub–process in detail.

20.3.2 Raw Data Loading

In this step raw data is loaded from an external source via plugins. The plugin system of the prototype system can be used to import data from any source into the application. For the evaluation two reference data import plugins have been implemented. The first plugin imports the MBOX format used in old fashioned email based knowledge sharing systems. The second plugin reads and imports RSS feed data, which can be predominately found in web based discussion forums and knowledge sharing platforms. Support for other technologies and data sources can be easily implemented.

Raw data incorporates unstructured user-generated content (i.e. the message) and additional structured meta-information (i.e. author and message identifier, timestamp, link to previous message). In the next step, the extracted features are described in more detail.

20.3.3 Preprocessing

In the preprocessing step, imported raw dated is cleaned and prepared for the next processing step. Each raw message is parsed and the following features are extracted: Message body, author identifier, message identifier, thread identifier and

[1] http://www.golang.com

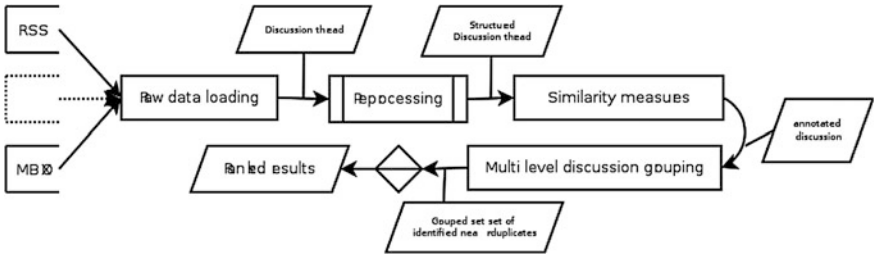

Fig. 20.2 Process for identifying multi-layered near-duplicates in requirement discussions

a time stamp for reference. All message bodies are tokenized according to the algorithm as proposed in [40]. In this step all stop words are removed and all words are transformed to their ground form ("stemming") to remove unnecessary ambiguity as proposed in [41]. All punctuation marks are discarded and capital letters are transformed into lower-case. The result is an initial set of tokens for each message. The stop words list consists of commonly used words, like articles and prepositions that say nothing about the specific requirement and was automatically generated according to [42] on a per-dataset basis.

After tokenizing and the initial cleanup of the message body, a simple spell-checker substitutes misspelled tokens with their correct version. Aspell[2] suggestions were used as a replacement when the Levenshtein distance [43] of both words was less than 4.

Globally unique words that could not be found in Aspell were automatically removed. To decrease the computational load on the spell checker, frequently misspelled words were replaced beforehand according to the list provided by the University of Washington.[3] It is obvious that differences exist in which words are used to signify a given meaning ("synonyms"). Based on this observation we implemented a thesaurus to properly handle words that can be used interchangeably and to further reduce the set of tags available by removing ambiguous words. The list of synonyms has been retrieved from WordNet [44].

20.3.4 Similarity measures

In this step the discussion threads are extracted by means of clustering. Before going into detail on the algorithm, the essential similarity measures are introduced.

In the following, the notation $R_0 \ldots R_n$ denotes different requirements being discussed in messages $M_0 \ldots M_m$. Each message belongs to a discussion thread $T_0 \ldots T_o$ with $o < m$ and has the attributes discussed in the previous sections. The

[2] GNIU Aspell: International Ispell Version 3.1.20 (Aspell 0.60.6.1).

[3] http://public.wsu.edu/~brians/errors/errors.html (Accessed: 2012-09-11).

goal is to assign the messages to clusters that correspond to the requirements. The major problem in this step is that the set of requirements and its size is unknown beforehand. Ideally, n is equal to o, meaning that for each requirement one discussion thread exists and no duplicates are present. However, in reality neither upper nor lower bounds can be assumed.

In [25], "word form similarity" is introduced according to formula 20.1, where S_1 and S_2 are two sentences and $\mathrm{WordSim}(S_1, S_2)$ is the number of same words in S_1 and. S_2

$$\mathrm{WoSim}(S_1, S_2) = 2 \cdot \frac{\mathrm{SameWordCount}(S_1, S_2)}{\mathrm{WordLen}(S_1) + \mathrm{WordLen}(S_2)} \tag{20.1}$$

In formula 20.1, $\mathrm{SameWordCount}(S_1, S_2)$ is the number of the same words in both sentences, and $\mathrm{WordLen}(S_1)$ is the number of words in the sentence S_1. Word thread similarity (cf. [25, 34]), shown in formula 20.2, is used to describe the relevance of a word w used in a sentence of a message M in relation to the words used in other messages of the discussion thread T.

$$\mathrm{WtSim}(S_1, S_2) = \lambda_1 \cdot \cos(V_{11}, V_{21}) + \lambda_2 \cdot \cos(V_{12}, V_{22}) \tag{20.2}$$

In formula 20.2, V denotes a vector $V_1 = \{i_1, i_2, \ldots, i_n\}$ where the index i_a is the term frequency of the word in all messages M that were created before the message containing the word under analysis. Likewise, each index of V_2 is the term frequency of the word in all messages M that were created after the message containing the word. λ_1 and λ_2 can be used to shift the weight between older and newer messages (here, 0.5 was used as an initial value for both, cf. Sect. 20.4). To take into account that it is more likely that users more likely comment on recently created requirement discussion posts rather than "digging up" old ones, the sentence message distance Smd is introduced in formula 20.3

$$\mathrm{Smd}(S_1, S_2) = 2 \cdot \lambda_1 \cdot \frac{\mathrm{TimeDiff}(S_1, S_2)}{\mathrm{TimeDiff}(0, S_1) + \mathrm{TimeDiff}(0, S_2)} \tag{20.3}$$

In formula 20.3, $\mathrm{TimeDiff}(S_1, S_2)$denotes the time difference between the creation of the messages containing S_1 and S_2 (e.g. [18, 19]). It is ∞ if both sentences are from the same message. To weight sentences of messages from the same discussion thread more than messages from different discussion thread, λ_1 is set to 1 if both messages are from the same discussion thread, 0.5 otherwise. This gives precedence to same thread messages over messages from different threads during the clustering step.

Building on formulas 20.1–20.3 the multilevel-discussion sentence similarity MDSim can be calculated. It is usually described as a number between zero and one, zero stands for non-similarity, and one stands for total similarity. The larger the number is, the more related they are and the similar the contained contribution to the same discussion topic is.

$$\mathrm{MDSim}(S_1, S_2) = \lambda_1 \cdot \mathrm{WoSim}(S_1, S_2) + \lambda_2 \mathrm{WtSim}(S_1, S_2) + \lambda_3 \mathrm{Smd}(S_1, S_2) \tag{20.4}$$

In formula 20.4, $\lambda_1, \lambda_2, \lambda_3$ are constant, and $\lambda_1 + \lambda_2 + \lambda_3 = 1$. In this paper, we assume $\lambda_1 = 0.3, \lambda_2 = 0.5, \lambda_3 = 0.2$ as initial values (without claiming that these values represent the global optimum; these values were chosen for simplicity's sake).

20.3.5 Multilevel Discussion Clustering

In this step, the search query from the user is taken and the clustering algorithm is applied to each search result. The search query matches n sentences in m messages. Determining K, the optimal number of clusters is a difficult issue and its value differs from discussion thread to discussion thread. To avoid time expensive calculation schemes, we assumed $K = \max\left(\frac{n}{2}, \frac{\mathrm{avg}_n}{2}\right)$, where K is either the global average number of message per thread divided by two or the number of messages in the current thread divided by two. The clustering algorithm is described as follows [28, 36]:

Step 1: Add the initial n sentences to the cluster and randomly assign sentences from the thread to the remaining cluster. These sentences represent the initial cluster central sentences. **Step 2:** Each sentence is assigned to the cluster that has the closest central sentence. **Step 3:** When all sentences have been assigned, recalculate the central sentence of each cluster. The central sentence is then one which possesses the lowest accumulative similarity. **Step 4:** Repeat Steps 2 and 3 until the central is stable. This produces a separation of the sentences into K clusters from which the metric to be minimized can be calculated.

20.3.6 Ranking of Results for Identification of Group Representatives

In this step, for each search result, the clustered messages are extracted, and a group representative is selected for the user. In a first step, the search results were ordered according to the resulting cluster density to bring search result to the top that contained few clusters with rather large discussion content. Then, for each search result, the clusters were sorted by their size and the oldest message per-cluster was selected as the representative of the group.

20.4 Results and Analysis

In this section we present at first the data set and chosen methodology, then present the results of evaluating our approach. As the requirements discussions from our research knowledge sharing platform, *TechnoWeb* 2.0, are not publicly available, we chose to conduct our evaluation on requirements discussions from (a) well-known open source projects that are (b) publicly available. The data set is based on a sample of 7,900 threads containing roughly one million user generated messages collected from three, randomly chosen, Apache developer mailing lists obtained between 2000 and 2011: incubator.apache.org, ws.apache.org, and jakarta.apache.org. From this data set three evaluation data sets were created with the help of *wget*, *grep* and *ack*:

(A) A reference data set where only empty messages were removed;

(B) A "quote-less" data set where those lines that quote sentences from a previous message were removed from each message. For this purpose a regular expression was used that removed lines starting with > or |; also empty messages were removed.

(C) A subset of threads where only one user has replied to a previous message with the words "*good idea*".

The data set A is used to evaluate the real-world run-time performance of our approach on a huge data set. Data set B is used to evaluate the clustering performance without duplicate content. By comparing the results of this data set against data set A, where the quotes make the inherent multi-level discussion visible, it is possible to evaluate the clustering performance. Data set C is a small subset used as reference data for evaluation to show that if a user searches for a randomly chosen sentence out of a message in C, all other threads of that discussion are found in (a) data set B without redundant quotations and (b) data set A with redundant quotations.

Table 20.1 shows the results in terms of Purity, Recall (R), Precision (P), F_5, F_1 and F_2 (see "Evaluation of clustering", [45]. The presented solution outperforms the baselines for all three datasets. For the evaluation, true positive (t_p) results were all returned messages that belonged to the original thread, false positive results (f_p) were all returned messages that did not belong to the original thread and false negative results (f_n) were all messages that belonged to the original threat but were not returned.

20.5 Conclusion and Further Work

To the best of our knowledge, no other work has tackled and solved the specific problem of identifying near-duplicates in multilevel requirements discussions in collaborative requirements engineering systems. We have shown in this paper how the identification of multilevel requirements discussions in collaborative requirements engineering platforms is possible. In a broad study, we could identify

Table 20.1 Evaluation results

		Results				
Dataset	Eval	Precision	Recall	$F_{0.5}$	F_1	F_2
Incubator	A	0.91	0.80	0.89	0.85	0.83
	B	0.90	0.78	0.87	0.83	0.80
ws	A	0.86	0.80	0.85	0.83	0.81
	B	0.83	0.77	0.82	0.80	0.78
Jakarta	A	0.87	0.84	0.86	0.85	0.84
	B	0.78	0.79	0.78	0.79	0.79

technical factors, such as the platforms inability to distinguish between various different discussions on different requirements taking place at multiple places within one discussion thread, but also non-technical factors, such as aggressive, or dominating behavior within discussion threads as major reasons for the existence of duplicate, multilevel discussion. For identifying and linking multilevel discussion threads together we use clustering algorithm to refine the data provided to the user. We developed an analysis model incorporating unstructured text as the message body, semi-structured information as quotations and structured information as explicit links within the discussion thread.

The results from our study, where hundreds of thousands of messages were analyzed has shown that the applied algorithm generates results with a sufficient high precision. Work in the near future will focus on four directions that also address the currently existing shortcomings of our approach:

Larger Evaluation Data Set: To understand better, how to detect near duplicate requirement discussions we will run our experiments on larger data sets. Especially in the context of inter-organizational collaborative requirements engineering platforms a stark contrast exists in the terminology and language used by participating stakeholders. As the precision of near duplicate detection largely depends on the natural language used by the participating stakeholders, it is important to evaluate the algorithm against multiple datasets stemming from different business contexts. While we believe that the chosen approach should be flexible enough to account for differences in speech between various groups of stakeholder, we would like to prove our findings in other business domains.

Improved means of group sorting: The currently offered means of sorting a group of identified near-duplicates is limited to a time based sorting order. While this might suffice for the majority of cases as all group members are always shown on the screen, in some cases the relevant near-duplicate might be shown off-screen and still remain hidden from the user who are known to ignore all but the first page search results to a large degree.

Improved efficiency of the prototype can be achieved in the future by further leveraging the tools and features provided by the development framework. For instance, optimizing the algorithm in terms of concurrency and using a multi-processor or distributed cluster architecture would lead to immense speed improvements. As the codebase of the core algorithm is rather small, manual

optimization measures might further increase the efficiency without demanding too much work on the code base.

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Chapter 21
Concepts Labeling of Document Clusters Using a Hierarchical Agglomerative Clustering (HAC) Technique

Rayner Alfred, Tan Soo Fun, Asni Tahir, Chin Kim On and Patricia Anthony

Abstract The most common way to organize and label documents is to group similar documents into clusters. Normally, the assumed number of clusters may be unreliable since the nature of the grouping structures among the data is unknown before processing and thus the partitioning methods would not predict the structures of the data very well. Hierarchical clustering has been chosen to solve this problem by which they provide data-views at different levels of abstraction, making them ideal for people to visualize the concepts generated and interactively explore large document collections. The appropriate method of combining two different clusters to form a single cluster needs affects the quality of clusters produced. In order to perform this task, various distance methods will be studied in order to cluster documents by using the hierarchical agglomerative clustering. Clusters very often include sub-clusters, and the hierarchical structure is indeed a natural constraint on the underlying application domain. In order to manage and organize documents effectively, similar documents will be merged to form clusters. Each document is represented by one or more concepts. In this paper, concepts that characterize English documents will be generated by using the hierarchical agglomerative clustering. One of the advantages of using hierarchical

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clustering is that the overlapping clusters can be formed and concepts can be generated based on the contents of each cluster. The quality of clusters produced is also investigated by using different distance measures.

Keywords Hierarchical agglomerative clustering · Concepts aggregation · Automatic document labeling · Distance measure · Knowledge management

21.1 Introduction

The dramatic rise in the use of the web and the improvement in communications in general have transformed our society into one that strongly depends on information [4, 5]. Vast amounts of text documents are also available in various fields. The huge amount of various documents accumulates daily in databases on web are astonishing. The accumulations of available text documents have raised new challenges for information retrieval (IR) technology. Therefore, in order to facilitate the knowledge management process, various approaches and techniques applied on text classification (categorization) and text clustering are being compared and studied. In short, it is essential and important for us to manage the unstructured and random documents by labeling these documents automatically.

This paper proposes a novel approach to manage English text documents by clustering and labeling them automatically. Clustering is a frequent performed task and technique for machine learning, data mining, pattern recognition, image analysis and bioinformatics. It can be applied in various type of tasks related to improving the quality in the structure and usage of large and high dimensional data. It is a method of unsupervised learning in which a descriptive task will be performed. There are many potential applications and advantages that will accrue from being able to reliably and automatically cluster, categorize and label corpora of documents. Many of these document clustering works are based on supervised or unsupervised learning techniques in order to label particular web documents as belonging to a specific category, or grouping together similar documents into clusters.

In this paper, an unsupervised learning technique will be used to implement the proposed algorithm in which a hierarchical clustering is applied to unlabeled documents. The hierarchical clustering is chosen instead of partitional clustering (K-means) [3] because the hierarchical clustering is able to form overlapping clusters which is more suitable for this research. The taxonomy (tree) is able to show the sub-clusters of the parent cluster and thus the aggregation of concepts can be illustrated [9]. The two types of hierarchical clustering are agglomerative (bottom-up) and divisive. Hierarchical agglomerative clustering is applied in this research since the concepts obtained from sub-clusters can be aggregated [1]. Distance measures such as single linkage and complete linkage will also be compared in order to compare the results of clusters based on different distance methods.

This is paper is organized as followed. Section 2 introduces some related works and we present the details of our approach and our dataset. Section 3 describes the concept labeling of document clusters by using the hierarchical agglomerative clustering technique. Section 4 presents the experimental design set-up and the experimental results. This paper presents the evaluation of several structures of hierarchical agglomeration clustering results that are produced by using different types of inter-clusters distance measurements, namely Single, Complete and Average links. This paper is concluded with future works in Sect. 5.

21.2 Related Works

Earlier works include the comparison of Chi Square (X2), most frequent words, most predictive words and a combination of most frequent and predictive words methods [6]. In this comparison, Popescul and Ungar found that the most frequent and predictive words method produced the best labels, capturing the words which both occur frequently in a cluster and effectively discriminate the given cluster from the other clusters. Unfortunately, none of the methods gave uniformly satisfactory results when disciplines corresponding to clusters are very diverse in the vocabulary used and encompass very broad topics.

In other works, Lamirel et al. present a new approach combining original hypertree construction techniques for multidimensional clustering results visualization with novel cluster labeling techniques based on the use of cluster content evaluation criteria, like the F-measure on cluster properties [7]. Treeratpituk and Callan proposed a simple linear model that considers the structure of the hierarchy when automatically assigning labels to document clusters in a hierarchy [8]. They conducted a study to show the effectiveness of different statistical features in selecting cluster labels. They also showed that such a simple model is likely to tolerate the type of noise in the cluster hierarchy that is normally generated by clustering algorithms.

Newman et al. [9] explored visualizations of document collections, which they call topic maps. In their works, they found that while topics are a useful way to organize an entire collection, producing a static global topic map of the collection may have limited value for exploring the collection. Therefore local topic maps may ultimately be more useful for better understanding and navigating local structure in a collection.

Magatti et al. addressed the task of labeling topics that are induced by a hierarchical topic model [10]. Their label candidate set is the Google Directory (gDir) hierarchy, and label selection takes the form of ontological alignment with gDir. The disadvantages of this method are that the method is only applicable to a hierarchical topic model and crucially relies on a pre-existing ontology and the class labels contained therein.

Automatic labeling of document clusters can also be associated with the problem of topic extraction. The problem of topic extraction is attracting a great

deal of attention due to its wide applicability; extraction of scientific research topics, author-topic analysis, opinion extraction and information retrieval. Several probabilistic models have proved to be effective to discover topics [1–3].

In this paper, the authors propose a framework for concept aggregation based on hierarchical agglomerative clustering. This paper explores and describes the interplay between inter-cluster distance methods and the aggregated concepts extracted from the hierarchical concept model.

21.3 Concepts Labeling of Document Clusters

The document labeling problem can be tackled in two different ways: human labeling and computer labeling. The first approach maps a document into a set of pre-specified categories, usually such categories form a taxonomy or a topic hierarchy. The latter approach has recently emerged to be well suited, i.e. to be efficient and effective, in several settings. While human labeling usually benefits from the availability of a domain specific topic hierarchy, agreed by experts, it is extremely time consuming and in some particular situations universally agreed labeling cannot be achieved. On the contrary, computer labeling is economically attractive, while the achieved labeling must be accurately checked by specific domain experts to ensure that it is consistent. Furthermore, effective methods for automatically building a hierarchy of topics have been very recently proposed in the specialized literature [17]. The approach we propose offers an efficient way to extract concepts automatically from the document clusters. We apply the hierarchical agglomerative clustering technique to group documents. Hierarchical clustering has been chosen to solve this problem by which they provide data-views at different levels of abstraction, making them ideal for people to visualize the concepts generated and interactively explore large document collections.

21.3.1 Clustering Parallel Corpora

In this experiment, we use the vector space model [12], in which a document is represented as a vector in n-dimensional space (where n is the number of different words in the collection). Here, documents are categorized by the words they contain and their frequency. Before obtaining the weights for all the terms extracted from these documents, stemming and stopword removal is performed. Stopword removal eliminates unwanted terms (e.g., those from the closed vocabulary) and thus reduces the number of dimensions in the term-space. Once these two steps are completed, the frequency of each term across the corpus is counted and weighted using term frequency—inverse document frequency (*tf-idf*) [12], as described in Eq. (21.1).

$$tf - idf = tf(t,d) \cdot idf(t) \tag{21.1}$$

$$idf(t) = \log\left(\frac{|\mathrm{D}|}{\mathrm{df(t)}}\right) \tag{21.2}$$

$$\mathrm{sim}\left(d_i, d_j\right) = \frac{\left(\mathrm{d}_i \mathrm{d}_j\right)}{\left(\|\mathrm{d}_i\| \cdot \|\mathrm{d}j\|\right)} \tag{21.3}$$

Weights are assigned to give an indication of the importance of a word in characterizing a document as distinct from the rest of the corpus. In summary, each document is viewed as a vector whose dimensions correspond to words or terms extracted from the document. The component magnitudes of the vector are the *tf−idf* weights of the terms. In this model, *tf−idf*, as described in Eq. (21.1), is the product of term frequency *tf*(*t*,*d*), which is the number of times term *t* occurs in document *d*, and the inverse document frequency, Eq. (21.2), where |D| is the number of documents in the complete collection and *df*(*t*) is the number of documents in which term *t* occurs at least once. To account for documents of different lengths, the length of each document vector is normalized so that it is of unit length [13].

21.3.2 Hierarchical Agglomerative Clustering

In this work, we concentrate on hierarchical agglomerative clustering. Unlike partitional clustering algorithms that build a hierarchical solution from top to bottom, repeatedly splitting existing clusters, agglomerative algorithms build the solution by initially assigning each document to its own cluster and then repeatedly selecting and merging pairs of clusters, to obtain a single all-inclusive cluster, generating the cluster tree from leaves to root [11]. The main parameters in agglomerative algorithms are the metric used to compute the similarity of documents and the method used to determine the pair of clusters to be merged at each step.

In these experiments, the cosine distance, Eq. (21.3), is used to compute the similarity between two documents $\mathrm{d_i}$ and $\mathrm{d_j}$. This widely utilized document similarity measure becomes one if the documents are identical, and zero if they share no words. The two clusters to merge at each step are found using either, the single link, complete link or average link method. In this scheme, the two clusters to

Table 21.1 Five categories of english news extracted from the star online news

Categories	Number of text documents	Average words
Business	1550	315
Entertainment	610	753
Generals	1560	453
Politics	380	785
Sports	340	459

merge are those with the greatest minimum (Single link), maximum (Complete link) or average (Average link) similarity distances between the documents in one cluster and those in the other [15, 16].

21.3.3 Extracting Concepts of Document Clusters

Concepts that characterize English documents will be generated by using the hierarchical agglomerative clustering. This is done by computing terms that have large weights assigned to them to indicate the importance of a word in characterizing a document as distinct from the rest of the corpus.

21.4 Experimental Design and Evaluations

The experiment is designed in order to investigate and compare the effectiveness of clustering English text documents using three different types of inter-cluster distance measurement, namely minimum (*Single Link*), maximum (*Complete Link*) and average (*Average Link*). Depending on the type of inter-cluster distance used, cluster result that provides the lowest DBI value will be taken into consideration for the extraction of concepts to characterize the document clusters. There are five categories of English news collected from the Star Online in the year of 2010 (Malaysian local online news—thestar.com.my). The details of the text documents used in this experiment are shown in Table 21.1.

There are two main stages in this experiment that includes (a) Clustering English Documents using a Hierarchical Agglomerative Clustering technique and (b) Concepts Extraction.

21.4.1 Clustering English Documents Using a Hierarchical Agglomerative Clustering Technique

In the first stage, we perform the task of clustering English texts by using the Hierarchical Agglomerative Clustering. We look at the similarities of pair of clusters based on three inter-distance methods (*Single*, *Complete* and *Average* links). We evaluate the structure of tree-like cluster results that minimizes some objective function applied to *k*-cluster centers. In our case, we consider the *cluster dispersion.*

$$d_{centroid}(Q_k) = \frac{\sum_i \|xi - c_k\|}{N_k} \tag{21.4}$$

$$c_k = 1/N_k \sum_{xi \in Q_k} xi \tag{21.5}$$

$$d_{between}(Q_k, Q_l) = \|c_k - cl\| \tag{21.6}$$

$$DBI = \frac{1}{K}\sum_{k=1}^{K} \max l \neq k \left\{ \frac{dcentroid(Q_k) + dcentroid(Q_l)}{dbetween(Q_k, Q_l)} \right\} \tag{21.7}$$

Typically *cluster dispersion metric* is used, such as the Davies-Bouldin Index (DBI) [14]. DBI uses both the intra-cluster and inter-clusters distances to measure the cluster quality. Let $d_{centroid}(Q_k)$, defined in (4), denotes the average link distances within-cluster Q_k, where $x_i \in Q_k$, N_k is the number of samples in cluster Q_k, c_k is the center of the cluster and $k \leq K$ clusters. Let $d_{between}(Q_k, Q_l)$, defined in (6), denotes the distances inter-clusters Q_k and Q_l, where c_k is the centroid of cluster Q_k and c_l is the centroid of cluster Q_l. In this study, we also cluster the text documents based on the minimum (single link), maximum (complete link) and average (Average link) distances between clusters. Therefore, given a partition of the N points into K-clusters, DBI is defined in (7). This *cluster dispersion* measure can be incorporated into any clustering algorithm to evaluate a particular segmentation of data.

Table 21.2 Comparison of DBI values for the clustering results when using single, complete and average links with different number of clusters, k = 5, 10 and 15

Categories	k	DBI		
		Single link	Complete link	Average link
Business	5	29.1	28.1	28.4
	10	29.9	28.2	28.3
	15	30.4	28.7	28.1
	Average	**29.8**	**28.3**	**28.3**
Entertainment	5	35.2	31.1	32.8
	10	36.0	30.2	33.8
	15	36.5	32.3	33.9
	Average	**35.9**	**31.2**	**33.5**
Generals	5	29.1	27.5	28.2
	10	28.9	27.2	28.8
	15	30.5	28.6	29.6
	Average	**29.5**	**27.8**	**28.9**
Politics	5	34.2	30.1	33.8
	10	35.0	30.2	34.8
	15	35.7	31.3	34.9
	Average	**34.9**	**30.5**	**34.5**
Sports	5	28.2	28.1	28.1
	10	28.9	28.1	28.9
	15	29.2	28.6	29.1
	Average	**28.7**	**28.3**	**28.7**

Table 21.3 Comparison of actual concepts and extracted concepts for all five news categories for k = 10

Categories	Actual concepts	Extracted concepts	% of concepts aligned
Business	**car**, **oil industry**, **income tax**, market,	**income**, high, country, **proton**, **petrona**	60
Entertainment	industry, idol, **artist**, life style, **tourism**	film, **tourist**, **artist**, vacat, trip	40
Generals	**transportation**, **cabinet appointment**, economy, weather	**transport**, ministry, long, secretary, **appoint**	40
Politics	**election**, government, opposition, **minister**, **voting**	najib, indian, **voter, regist, minist**	60
Sports	**badminton**, **open**, championship, **soccer**, bowling	play, set, **chong**, round, **open**, **football**	60

21.4.2 Concepts Extraction

Next, in the second stage, we compute the weights of terms (*tf*−*idf*) considered in clustering English documents for each cluster. The top five terms with high weights for each cluster will be extracted as concepts that characterize each corresponding cluster. The extracted concepts are then compared with the actual concepts derived manually.

21.4.3 Experimental Results

Table 21.2 shows the comparison of DBI values for the clustering results using *Single*, *Complete* and *Average* links with different number of clusters produced. Based on the results obtained, on average the quality of clusters produced is better for documents when the *Complete* link is used as the inter-cluster distance in the process of clustering them. This is due to the fact that when the *Complete* link method is used to cluster English documents, two clusters, C_i and C_j having two elements, e_a and e_b where $e_a \in C_i$ and $e_b \in C_j$, with the highest value of distance are merged into one cluster. As a result, the final clusters produced may be well separated and thus produces lower DBI value. The results also show that the quality of clusters produced is better when we have smaller number of clusters. Another important finding that can be obtained from this experiment is that when the number of words is high, the DBI values are also high as shown in Table 21.2 for the Entertainment and Politics categories.

Table 21.3 shows the concepts extracted from English clusters using the hierarchical clustering technique with $k = 10$ and Complete link method. We compare

the actual concepts derived manually and the extracted concepts by referring to the tree-like document representation and computing the top five terms based on the *tf*−*idf* weights. Based on the results shown in Table 21.3, the percentage of concepts aligned between the actual concepts derived manually and the extracted concepts derived from the HAC technique is quite encouraging, with the exception of the Entertainment and Generals news categories. This is probably because the Entertainment and Generals news are very diverse in the vocabulary used and encompass very broad topics.

21.5 Conclusion

In this paper we have presented the framework of using a tree-like document clusters representation which is produced by clustering English documents using the Hierarchical Agglomerative Clustering (HAC) technique to automatically extract concepts that characterize each cluster. We have empirically showed that better clustering results can be produced by using the *Complete* link method in computing the inter-cluster distance measurement when merging two different clusters. By using the *Complete* link method to merge two different clusters, the concepts extracted from each cluster should be more relevant and applicable in labeling the English clusters as shown in the experimental results. In order to improve the results obtained, future works include comparing actual concepts with extracted concepts derived based on other weights computation and implementing a semi-supervised HAC technique to extract concepts automatically from English document clusters more effectively.

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Chapter 22
A Visualization Approach to Automatic Text Documents Categorization Based on HAC

Rayner Alfred, Mohd Norhisham Bin Razali, Suraya Alias and Chin Kim On

Abstract The ability to visualize documents into clusters is very essential. The best data summarization technique could be used to summarize data but a poor representation or visualization of it will be totally misleading. As proposed in many researches, clustering techniques are applied and the results are produced when documents are grouped in clusters. However, in some cases, user may want to know the relationship that exists between clusters. In order to illustrate relationships that exist between clusters, a hierarchical agglomerative clustering (HAC) technique can be applied to build the dendrogram. The dendrogram produced display the relationship between a cluster and its sub-clusters. For this reason, user will be able to view the relationship that exists between clusters. In addition to that, the terms or features that characterize each cluster can also be displayed to assist user in understanding the contents of whole text documents that stored in the database. In this paper, a Text Analyzer (VisualText) that automates the categorization of text documents based on a visualization approach using the Hierarchical Agglomerative Clustering technique is proposed. This paper also studies the effect of using different inter-cluster proximities on the quality of clusters produced. Cophenetic Correlation Coefficient is measured in order to evaluate the quality of clusters produced using these three different inter-cluster distance measurements.

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Keywords Interactive visualization · Hierarchical agglomerative clustering · Text analyzer · Text categorization · Data summarization · Cophenetic correlation coefficient

22.1 Introduction

The wide availability of huge collections of text documents (news corpora, e-mails, web pages, scientific articles and etc.) has fostered the need for efficient text mining tools. Information retrieval, text filtering and classification, and information extraction technologies are rapidly becoming key components of modern information processing systems, helping end-users to select, visualize and shape their informational environment [1].

Nowadays, information extracted from documents is becoming more significant. Most organizations and companies store their documents in relational databases for data analysis purposes in order to support organizational decision making. Some organizations keep organizational resources such as documents for referral purposes whereas some would keep it as collections. However, these documents will be accumulated everyday it will be very critical and tedious for these documents to be represented in an understandable yet simple and interactive manner. For instance, there are a large number of documents in the database but what does each and every one of it contains are hard to be recalled. By only reading the title of the document, it does not always give meaningful categorization of the contents correctly. It will thus take up plenty of time in the event when one is searching for documents in a particular field because each document in the database needs to be inspected. The best data summarization technique could be used to summarize data but a poor representation or visualization of it will be totally misleading [2]. Hence, efficient tools used for organizing and maintaining these documents are becoming more and more valuable as it can be very useful in numerous ways. Therefore, there is a need for an efficient and effective tool that is capable to visualize data summarization obtained from clustering text documents. The proposed tool is potentially very useful for analyzing text documents automatically for summarization purposes and thus facilitates decision making process.

This paper is organized as follows. Section 22.2 explains some works related to document categorization based on visualization approach. Section 22.3 describes the proposed text analyzer tool which assists user to visualize terms or features that characterize each cluster of text documents, particularly English news articles. There are a few functionalities that will be implemented for the proposed text analyzer. By using the proposed text analyzer, users are able to analyze and categorize text documents automatically, visualize the overall structure of their informational environment by visualizing each cluster and its sub-clusters, identify words or terms used to categorize each cluster and its sub-cluster and finally

evaluate the quality of the text categorization based on the distance method. Section 22.4 discusses the experimental results obtained in investigating the effect of using three different inter-clusters proximity methods, namely the MIN, MAX and Average Group Linkage. This paper is concluded with future works in Sect. 22.5.

22.2 Related Works

There are quite a number of researches conducted on visualizing documents and articles that have been categorized or clustered to show hidden information stored in the clustered documents [2, 3, 4–6]. Yen and Wu [4] have proposed a Growing Hierarchical Self-Organizing Maps (SOM) approach to documents categorization and visualization. In their approach, documents are first encoded into similarity matrix that is constructed based on bibliographic coupling. The bibliographic coupling of two documents is computed by counting the number of common references cited by these two documents. The higher the number of common references cited by these two documents, the more similar areas or concepts covered by these two documents. Thus, in this approach, documents are clustered together based on common areas or concepts derived from the common references cited. Then, this similarity matrix is used to train a Growing Hierarchical Self-Organizing Map (GHSOM) that clusters document items into a hierarchical order. The Ranked Centroid Projection (RCP) is then used to project the input vectors into a hierarchy of two-dimensional maps. Based on this result, users will have a better understanding of the information hidden in a large collection of documents as these documents have been clustered based on their respective categories. This approach results in document maps with various levels of details. Unfortunately, GHSOM fails to show details relationship between two different levels of SOM.

Jeremy et al. [6] proposed a document clustering and visualization method based on Latent Dirichlet Allocation and self-organizing maps (LDA-SOM). LDA-SOM combines probabilistic topic models and Self Organizing Maps to cluster and visualize document collections. The LDA-SOM approach to document clustering uses LDA for dimensionality reduction and the SOM for clustering and visualization. This approach produces a map of topical clusters that indicates documents within each cluster share similar topics, and neighboring clusters may have one or more topics in common. This unique layout allows users to quickly browse through a document collection. It can also indicate relationships between documents that might otherwise go unnoticed. However, LDA-SOM does not show topics in common shared by documents in the same cluster or neighboring clusters.

Lehmann et al. [2] described an interactive visualization called Wivi which enables users to intuitively navigate Wikipedia by visualizing the structure of visited articles and emphasizing relevant other topics. Wivi assists users to read up on subjects relevant to the current point of focus and thus opportunistically find relevant information, by visualizing the potential paths that could be taken. However, Wivi does not provide the overall structure of all articles stored in the database.

Hsiao [5] introduced a new clustering algorithm to categorize and spatially cluster text documents. He employed TF-IDF and term co-occurrence to measure similarities between two different documents. Then, a modified minimum spanning algorithm tree is applied to cluster similar documents. The results obtained show that the system is capable of distinguishing different topics and producing unique and informative clusters.

Other works involve studying methods to improve the categorization of documents. One of the techniques used is CFC, which is also known as collaborative-filtering based personalized document-clustering [7]. CFC technique combines target user's and other users' partial clustering when evaluating the categorization preferences of the target user. There are also organizations that provide solution to their clients such Vivisimo. Vivisimo provides Velocity, a program that is able to locate, extract and produce relevant information of data regardless of where this information resides. A lot of researches have also been conducted in data summarization on various techniques of data clustering such as hierarchical clustering [8], fuzzy clustering [9], genetic algorithm [10] and many more. Some has also taken the approach to combine a few clustering techniques such as effective hybrid approach based on PSO, ACO and k-means for cluster analysis [11]. Regardless of what technique these researchers have chosen, their common purpose is to group text documents into a meaningful cluster. Hence, in this paper, the main challenge is to visualize findings in an interactive way so that it can be easily understood by the user. Besides choosing the right algorithms to perform stemming and removal of stop words in order to reduce the number of terms, a right technique is also needed for clustering text documents so that the results can be visualized in a clear manner.

22.3 VisualText: An Interactive Visualization Approach to Automatic Documents Categorization

As in most text mining and information retrieval tasks, the process begins by preprocessing the text document collection. Terms that carry small discriminative values are removed from the collection's vocabulary. This includes Stop-words, i.e., definite articles and pronouns. Additionally, exceptionally rare words, e.g., those appearing in fewer than three documents, can be also removed. Documents are then encoded as word histograms based on word occurrence frequency. Additional weighting scheme such as inverse document frequency is also applied at this stage.

The most common way to organize and label text documents is to group similar documents into clusters by clustering them and then extract concepts that characterize each cluster. Normally, the assumed number of clusters may be unreliable since the nature of the grouping structures among the data is unknown before processing and thus the partitioning methods would not predict the structures of

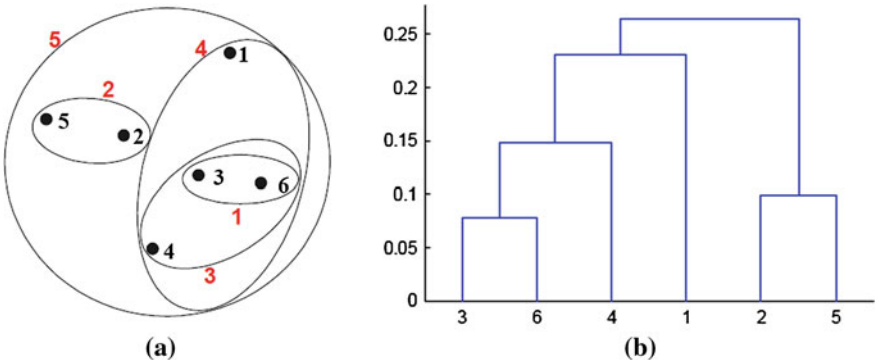

Fig. 22.1 An example of **a** nested cluster and **b** dendrogram respectively

the data very well. Hierarchical clustering has been chosen to solve this problem by which they provide data-views at different levels of abstraction, making them ideal for people to visualize the concepts generated and interactively explore large document collections. Hierarchical clustering's basic concept is to group data objects into a tree of clusters. It will produce a set of nested clusters organized as a hierarchical tree [12, 17]. Basically, it is divided into two main types, bottom-up, or also known as agglomerative, and also top-down, which is also known as divisive. The results can be displayed in the form of a nested cluster or dendrogram. At any level, it can be shown as joining two clusters from the next lower level or breaking a cluster from the next higher level [13.]. Figure 22.1a and b show an example of nested cluster and dendrogram respectively.

The agglomerative clustering is also known as a merging method where it starts with the points as individual cluster. Then at each step, it will join the closest pair of cluster until it is left with one cluster or k clusters. As for divisive clustering or splitting, it starts with only one cluster. Then, it will split at each step until each cluster contains one point or there are left with k cluster. As agglomerative hierarchical clustering is more common, focus is placed on this method. The basic algorithm for hierarchical agglomerative clustering is shown below;

1. Calculate the proximity matrix.
2. Assume each data point as a cluster.

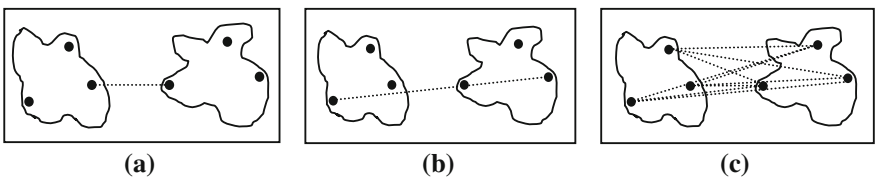

Fig. 22.2 Points that are considered in **a** MIN cluster proximity **b** MAX cluster proximity and **c** Group Average cluster proximity

3. Repeat
   Combine the two closest clusters.
   Recompute the proximity matrix.
4. Until only a single cluster remains.

As defined in the algorithm above, two clusters need to be merged and in order to implement this, the cluster proximity is used. Different hierarchical agglomerative clustering techniques can be formed from the definition of cluster proximity, namely, MIN, MAX and Group Average.

MIN, or also known as single link, defines cluster proximity as the shortest distance or closest between any two points in two different clusters. This means that it is the maximum similarity between any two points. In terms of a graph, it is the shortest edge between two nodes in different subset of nodes. If all points are started as singleton clusters, the shortest links are first added between points, one at a time. After that, these single links will merge the points into cluster. The strength of MIN is that it can handle non-elliptical shapes well. Nonetheless, it is sensitive to noise and outliers. Figure 22.2a shows which point is considered in the MIN cluster proximity.

MAX is also known as complete linkage or CLIQUE. The cluster proximity of MAX is the furthest two points in different clusters. The maximum distance between these two points also indicates the least similarity between it. It is the longest edge between two nodes in different subsets of nodes in terms of a graph. If all points are started as singleton clusters, then the shortest link are first added between points, one at a time. However, a group of points is not a cluster until all the points in it are completely linked or if it forms a clique. MAX is less susceptible to noise and outliers. Nevertheless, it can break large clusters and is bias towards globular shapes. Figure 22.2b illustrates which point is chosen in the MAX cluster proximity.

Last but not least is the Group Average where the proximity of two clusters is the average pair-wise proximity among all pairs of points in different clusters. In terms of a graph, it is the average length of edges between all pair of points in different clusters. This approach is an intermediate approach between the MIN and MAX approach and it compromises between these two approaches. Figure 22.2c shows that all points are considered in computing the average length between two different clusters in Group Average.

There are various methods to measure the quality of clusters produced such as Davies–Bouldin index (DBI) [15] and Sum of Squared Error (SSE) [16]. However, in this paper, the quality of the cluster is measured using the Cophenetic Correlation Coefficient by verifying their dissimilarity and their consistency. Cophenetic correlation is the correlation between the actual dissimilarities as recorded in the original dissimilarity matrix, and the dissimilarities which can be read off of the dendrogram. In essence, this is a measure of how well the dendrogram, which is a model of the similarity behavior, models the actual behavior. The formula used to calculate the Cophenetic Correlation Coefficient [14], C^3 is given as below,

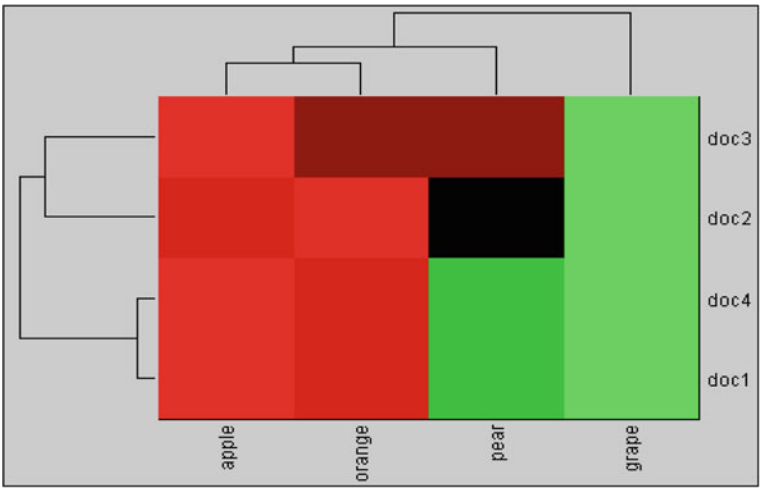

Fig. 22.3 Sample clustergram produced with four features in four documents

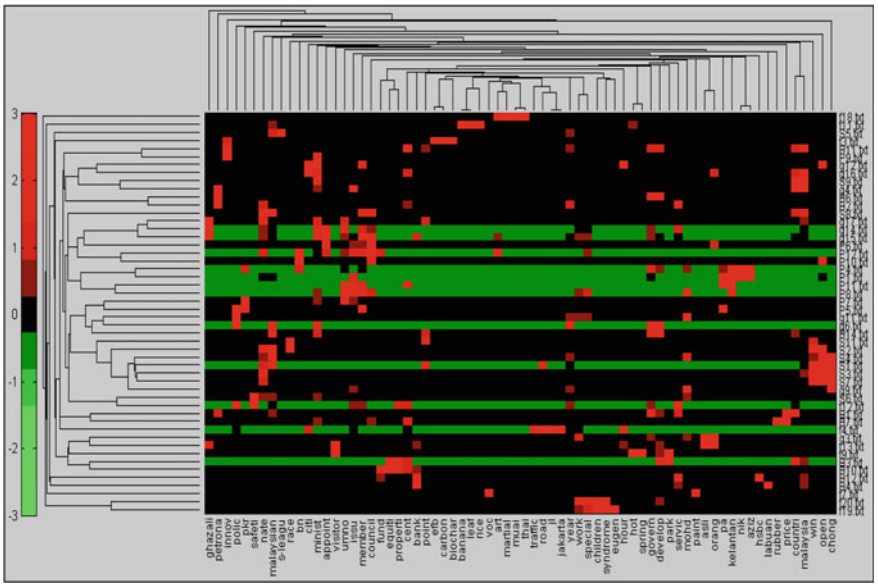

Fig. 22.4 Clustergram produced using MIN linkage

$$C^3 = \frac{\sum_{i<j}(x(i,j)-x)(t(i,j)-t)^2}{\sqrt{\left[\sum_{i<j}(x(i,j-x))^2\right]\left[\sum_{i<j}(t(i,j)-t)^2\right]}} \tag{22.1}$$

where x(i, j) is the distance measurement between the *i* and *j*th observation and t(i, j) is the dendrogrammatic distance between model T_i and T_j. This distance is the height of the node at which these two points are first joined together. If the value of the Cophenetic Correlation Coefficient, C^3 produced by this formula is closer to 1, it shows that the clustering solution reflects the original data more accurately. The main purpose of using this measurement is to determine which type of inter-cluster distances (MIN, MAX and AVERAGE linkages) should be used in the hierarchical agglomerative clustering in order to cluster text documents more efficiently and effectively. A better interpretation of the cophenetic correlation can be explained by looking at each step of the building of the dendrogram. Sudden decreases or increases in the cophenetic correlation indicate that the cluster just formed has made the dendrogram less faithful to the data.

Based on the best results obtained by considering the value of the Cophenetic Correlation Coefficient measurement, an interactive user interface is designed to assist users to view the relationship that exists between clusters. In addition to that, the terms or features that characterize each cluster can also be displayed to assist user in understanding the contents of whole text documents that stored in the database. User will also get to view what are the documents that reside in each cluster based on two different distance matrixes which are Euclidean Distance and Cosine Similarity.

In this paper, we apply the clustergram to illustrate the relationship that exists between clusters. Clustergram is formed from a combination of a dendrogram and a heat map.

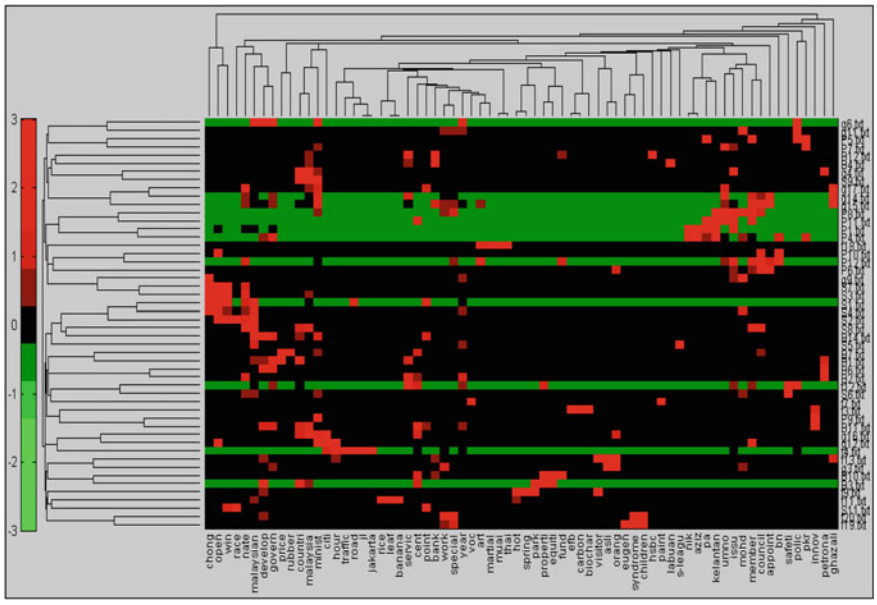

Fig. 22.5 Clustergram produced using MAX linkage

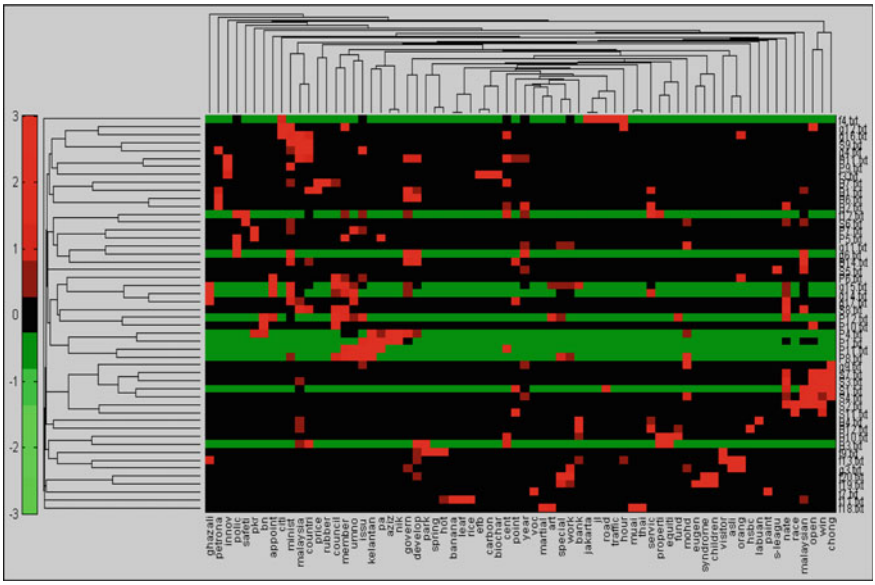

Fig. 22.6 Clustergram produced using Average Group linkage

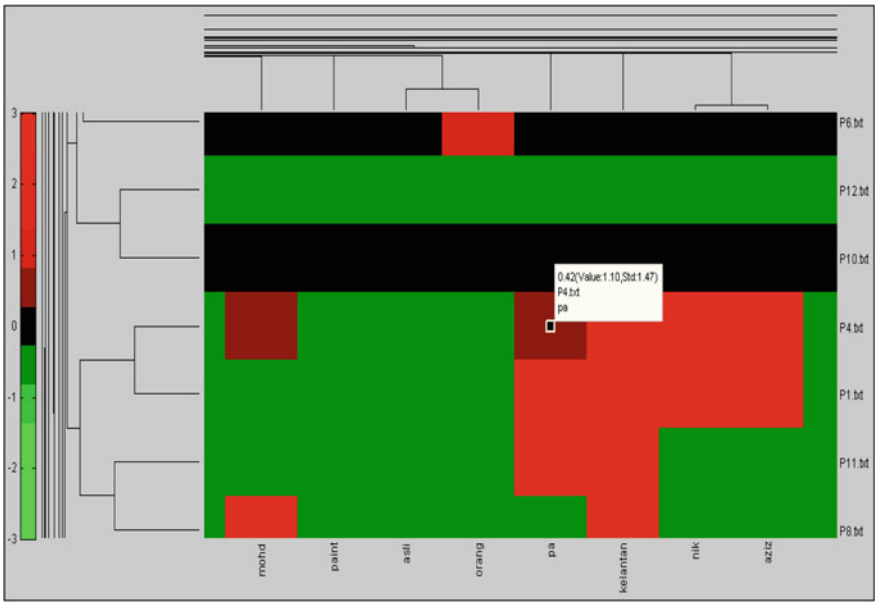

Fig. 22.7 Clustergram produced using Average Group linkage

Figure 22.3 shows the sample clustergram produced based on four documents that consist of four features (apple, orange, pear and grape). The X-axis represents the terms or words used in the documents, while the Y-axis represents the

Table 22.1 Cophenetic correlation coefficient for three different types of cluster proximities based on euclidean distance and cosine similarity

Cluster proximity	Similarity distance	Cophenetic correlation coefficient
MIN	Euclidean distance	0.983366
	Cosine similarity	0.700378
MAX	Euclidean distance	0.983332
	Cosine similarity	0.771906
Group Average	Euclidean distance	0.988687
	Cosine similarity	0.873056

document ID. In Fig. 22.4, there is a color bar at the left hand side of the clustergram. This color bar shows different color intensity to differentiate the term's importance. By activating the data cursor function (clicking the symbol ) in the clustergram window, a more detailed explanation of the terms can be seen. At the top of the color bar, light red or a value near to 3 signifies that the term is more important in the document. For instance, when user clicks on any part of the heat map, a datatip which is similar to a tool tip will appear. It will contain a value between the range of −3 to 3, the term, and the corresponding document in that selection. In short, the importance of the term is rated based on the range of −3 to 3 where −3 reflects that the term has the lowest importance or does not appear in the document. On the other hand, a value nearer to 3 will mean that it is very important in the document.

22.4 Experimental Evaluation

In this experiment, 50 text documents related to politics, business, sports and entertainments, are used for the clustering task. These documents are clustered based on 70 unique features that are selected and extracted automatically based on the degree of relevancy of the features (TF-IDF weights) to the set of all documents [5]. The analysis of the degree of importance of each term that exists in text documents can be performed by referring to Figs. 22.4, 22.5, and 22.6. This can be analyzed by investigating the intensity of the color on the left with respect to each document. The X-axis represents 70 terms or words used, while the Y-axis represents 50 documents that are used for clustering these documents. At the top of the color bar, bright red signifies that the term is very important, black in the middle signifies that the term is averagely important whereas at the bottom, bright green indicates that the term is not important or the term does not exist in that particular document. For instance, a close up of clustergram using the MIN linkage can be observed in Fig. 22.7. The term 'pa' appears to be more important in document P4.txt with a value of 0.42 whereas the term 'asli' shows a lower degree of importance with a value of −0.32. On the other hand, when comparing between

documents, the term 'pa' is more significant in document `P11.txt` compare to `P4.txt` with a value of 2.73.

Table 22.1 summarizes the results obtained for the Cophenetic Correlation Coefficient with three different forms of cluster proximity based on Euclidean and Cosine Similarity distances. Group Average linkage produces the best clusters structure as it shows a higher Cophenetic Correlation Coefficient value of 0.988687 when using Euclidean Distance. However, when using the Cosine Similarity distance, the Cophenetic Correlation Coefficient value fluctuates for three different cluster proximities.

22.5 Conclusion

In this paper, we have formally presented a Hierarchical Agglomerative Clustering (HAC) approach to visualize the relationship that exists between clusters. In addition to that, the terms or features that characterize each cluster can also be displayed to assist user in understanding the contents of whole text documents that stored in the database. By visualizing the relationship that exists between clusters, the proposed approach enable user to analyze and categorize text documents automatically, visualize the overall structure of their informational environment by visualizing each cluster and its sub-clusters, identify words or terms used to categorize each cluster and its sub-cluster and finally evaluate the quality of the text categorization based on the Cophenetic Correlation Coefficient measurement.

Cophenetic Correlation Coefficient is measured to evaluate the quality of clusters produced using three different inter-cluster distance measurements, namely MIN, MAX and Average Group Linkage. Based on the experimental results obtained, a better clustering result can be produced when MIN linkage is used. In addition to that, Euclidean Distance generally provides a better clustering solution because it produces a higher Cophenetic Correlation Coefficient value compared to using Cosine Similarity.

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Chapter 23
A Literature Review and Discussion of Malay Rule - Based Affix Elimination Algorithms

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Abstract Stemming is one of the techniques in natural language processing that is used to reduce a word to its root. Information retrieval and knowledge management can further be improved by improving the stemming process. There are four strategies that are being used widely in stemming that includes table lookup, rule-based affix elimination, successor variety and n-gram. However, not all of these strategies are being applied in Malay stemming algorithm. The well-known strategy used in stemming Malay text documents is called a rule-based affix elimination algorithm. In this paper, several Malay stemming algorithms will be discussed such as Othman's algorithm, Sembok's algorithm, Idris's algorithm, Rule Frequency Order Stemmer and Mangalam's algorithm. This paper also discusses some of the improvements made by researchers based on previous Malay stemming algorithm and this provides the current trend of Malay stemming algorithm. Different morphologies rules also being applied in different Malay stemming algorithms. Based on this review paper, it can be concluded that there are a lot of works related to the arrangement of the morphologies rules are conducted. However, this stemming process can still be improved by applying certain background knowledge such as root words dictionaries that can be used for checking the word during the process of eliminating affix words.

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23.1 Introduction

Stemming algorithm is a process that reduces a word to its root. For example, the words *conducts*, *conducted*, and *conducting* are stemmed to the word *conduct*. It is widely used in many areas such as computational linguistic and information retrieval (IR) and knowledge management [1]. The effectiveness of the IR or knowledge management systems can be improved by applying the stemming process that reduces the indexing file size and speeds up the performance of IR. Generally, there are four types of stemming strategies that are employed in the stemming process. These strategies include table lookup, rule-based affix elimination, successor variety and n-gram stemming.

In a table lookup strategy, Sharifloo and Shamsfard have suggested that all words and their corresponding stem are stored in some kind of predefined and structured form [2]. For each of the word stored, the root word is stored on the left side of it. A hash table is suitable for this strategy as each word is considered as the main key and the root word is considered as the associate value. However, there are disadvantages in this strategy as it requires a lot of space to store all the words and the table needs to be updated whenever there is a new word found.

Next, the most well-known stemming strategy is called a rule-based affix elimination. It has been used in stemming many languages such as English, Persian, Malay and many more. The first paper on this type of stemmer was published by Julie Beth Lovins [3]. It is a strategy that removes affixes from the word leaving the root word only. Different languages may have different methods on affix elimination [4]. Stemming documents in Malay language is more complex than stemming documents written in English language. The Malay language stemming algorithm does not only have to handle suffix rule as the English language stemming algorithm does, but it also handles prefix, circumfix and infix rules [5]. The advantage of this strategy is that it is able to produce semantically rich stems. On the other hand, different languages will require different methods to recognize different affixes rules. The details of the affixes used in Malay language stemming will be discussed in Sect. 23.2.

Successor variety is a purely syntactic approach to stem words [6]. The algorithm is based on the distribution of phonemes in a large body of utterances in order to determine the word and morpheme boundaries. The successor variety of a string is determined by the number of different characters that follow it in a word of some different text. Successor variety stemming consists of these three steps which are (1) Determine the successor varieties for a word (2) Invoke segmentation method to segment the word (3) Select one of the segment as stem.

There are four segmentation methods that can be used; cutoff method, peak and plateau method, complete word method and entropy method. One of the advantages of this strategy is that it does not require much knowledge of the language involved but it depends on the words used for computing the successor variety.

Finally, n-grams stemming algorithm splits word into groups of n letters and the similarity of two words is calculated from the number of unique n-grams in each words [7]. A certain number of equal n-grams will be produced if two of the words are from the same root. The n-grams stemming algorithm does not require prior knowledge about the language. It is entirely language-neutral. However, it requires a high computational complexity. The Dice's coefficient or Overlap Coefficient can be used to calculate the similarity between two words as shown below where, A and B are the numbers of unique digrams in both words C is the number of unique digrams shared by A and B [8].

$$Dice\ Coefficient = \frac{2C}{A + B} \tag{23.1}$$

$$Overlap\ Coefficient = \frac{C}{\min(A, B)} \tag{23.2}$$

The discussion above shows that the strategies used in the stemming process for each approaches have their own advantages and disadvantages. Currently, not all strategies are being applied in stemming words in Malay language. Most of the conducted researches have applied the rule-based affix elimination algorithm compared to other strategies. Section 23.2 will discuss about some of the algorithms implemented for stemming Malay language text using the rule-based affix elimination. Algorithms related to rule-based affix elimination process will be discussed in details in Sects. 23.3 and 23.4 concludes this paper.

23.2 Rule-Based Affix Elimination

In Malay rule-based affix elimination algorithm, it involves eliminating prefix, suffix, circumfix and infix. Prefix is the affix that is located at the left side of the root word. The affix that is located at the right side of the root word is known as suffix and the combination of prefix and suffix is known as circumfix. Infix is the affix that is inserted after the first consonant of the root word. In Malay language stemming, handling the prefixes rules is not as easy as handling the suffixes rule.

There are several spelling variation and exceptions that need to be made for prefix elimination. Spelling variation is determined by the first letter of the attached root. For example, the prefix 'men' is used when the root words start with the character *c*, *d*, *j*, *s*, *t*, *y*, and *z*. However, not all prefix rule handling can be handled by just eliminating the prefix. Prefixes also can cause the first character of a root word to be dropped. This is known as spelling exceptions. However, there are also exceptions where changes on the character is not applied with the same

prefix [9]. For instance, the word *mengolah* produces correct root with or without the spelling exception rule.

23.2.1 Othman's Algorithm

The first Malay stemming algorithm was developed by Othman as a M.Sc. dissertation project [10]. Othman's algorithm outlines 121 morphology rules that are arranged in alphabetical order. Besides using the morphology rules, Othman's algorithm also applies a dictionary of Malay words adopted from the Malaysian dictionary which is the Kamus Dewan (1991). The affixes of the word are removed by using the process of matching the affixes in the rules. The general algorithm of Othman's algorithm is shown below [10]:

Step 1 If there are no more words, then stop, otherwise set the next word
Step 2 If there are no more rules, then accept the word as a root word and go to step 1, otherwise get the next rule
Step 3 Check the given pattern of the rule with the word. If it matches, then apply the rule to the word to get a stem
Step 4 Check the stem against the dictionary. Perform any necessary recoding and recheck the dictionary
Step 5 If the stem appears in the dictionary, then the stem is the root of the word and go to step 1, otherwise go to step 2.

One of the main disadvantages of the Othman's algorithm is that the time complexity of Othman's algorithm is higher compared to Porter's algorithm. Not only that, it also causes some root words to be unnecessarily stemmed as this algorithm does not check the word with words stored in the dictionary. For instance, the word 'masalah' will be stemmed to 'masa' which produces an over-stemming error. This is due to the fact that the morphology rules used in Othman's algorithm are not sufficient to handle the modern Malay language [11].

There are four types of errors that can be produced by a Malay language stemming algorithm. They are under-stemming, over-stemming, unchanged and spelling exceptions. Over-stemming error occurs when two words from different root words are stemmed to the same root word [12]. Under-stemming error is a vice versa of over-stemming. Unchanged error is an error that is produced when no changes had being made when there should be one [11]. The first character of the word is not corrected after eliminating the prefixes will cause the spelling exceptions error. These errors will reduce the accuracy on precision and recall in IR [13].

23.2.2 Sembok's Algorithm

This algorithm is a modified version of Othman's algorithm [11]. It uses Othman's algorithm and the morphology rules with several changes on it. It improves Othman's algorithm by checking the word with dictionary before checking for the

affixes rule. This step avoids the root word such as 'mati' from being stemmed to 'mat' during the matching of affixes rule [4]. By doing this, over-stemming error can be reduced.

In Sembok's algorithm, additional rules were developed due to the fact that the morphologies rules used in Othman's algorithm are not sufficient to stem modern Malay text [11]. The additional rules were developed based on several resources as shown below:

- Exhaustive scanning of entry words in a Malay dictionary (DBP 1991)
- Exhaustive scanning of a book on Malay spelling (DBP 1987)
- Reference to a book on Malay morphology (Karim, Onn and Musa 1993)
- Reference of 10 chapters Malay translation of Quran (Hamidy and Fachruddin 1987) and 10 research abstracts on research done at UKM (SharifahMastura, UngkuMaimunah and Ramli 1989).

Sembok's algorithm had being tested with two datasets that consist of ten chapters of Malay translation of Quran (ancient dataset) and ten researches abstract (modern dataset). The results of empirical experiment conducted have shown some improvements compared to the Othman's algorithm. The results also show that some of the morphology rules used in the experiment are useful for ancient dataset but not for modern dataset and some of the morphology rules that can be used for modern dataset might not be useful for ancient dataset.

23.2.3 Idris's Algorithm

Idris's stemming algorithm is a modified version of Sembok's algorithm [4]. It reduces the number of affixes to be checked. Instead of checking for prefix, suffix, circumfix and infix, the proposed algorithm just checks for prefix and suffix. Circumfix and infix are ignored because circumfix is considered as a combination of prefix rule and suffix rules and infix is not used much in Malay language. A new rule called Rule 2 is used in their algorithm to handle prefix spelling variations and exception. The algorithm used by Idris is as shown below [4]:

Step 1 Check the word against a general dictionary. If the word found in the dictionary, then accept the word as the root word and exit, otherwise, proceed to the next step

Step 2 Check the word against the local dictionary. If the word found in the dictionary, then accept the word as the root word and exit, otherwise, proceed to the next step

Step 3 Check the word against the prefix rules. If the word matches the prefix rules, check the pattern of the prefix and the first letter of the stem word, otherwise, go to Step 8

Step 4 If the pattern of the prefix matches the prefix patterns in Rule 2, then apply the Rule 2 to the words, otherwise, remove the prefix and go to step 7

Step 5 Check the prefix of the word against the pattern of the Rule 2. If it matches the fourth rule (Rule 2(4)), then check the new stem word against the dictionary and proceed to the next step, otherwise, remove the prefix and go to Step 7
Step 6 If the word is not found in the dictionary, then go back to Step 5, otherwise remove the prefix and proceed to the next step
Step 7 Check the word against the dictionary. If the word found in the dictionary, then accept the word as the root word and exit, otherwise proceed to the next step
Step 8 Check the word against the suffix rules. If it matches with the suffix rules, then remove the suffix. Move to Step 1.

This algorithm shows a reduction in over-stemming errors by checking the prefix rules first then the suffix rule later.

23.2.4 Rules Frequency Order (RFO) Stemmer

The Rules Frequency Order (RFO) Stemmer algorithm is an improvement of a Malay language stemmer developed by Fatimah Ahmad and known as Rules Application Order (RAO) stemmer [14]. The RFO stemmer uses 418 rules and the spelling of variations rules that was developed by Ahmad, a list of 314 stop words developed by Ahmad and also a dictionary of root words from SISDOM98 which has 22429 root words [14]. In RFO stemmer, this algorithm rearranges the rules in decreasing order according to the frequency of each rule with some modification of Ahmad's algorithm. The RFO algorithm used is shown below [14]:

Step 1 Get the next word until the last word
Step 2 Check the word against the dictionary; if it appears in the dictionary, the word is the root word and goto Step 1
Step 3 Get the next rule; if no more rules available, the word is considered as a root word and goto Step 1
Step 4 Apply the rule on the word to get a stem;
Step 5 Perform recoding for prefix spelling exceptions and check the dictionary
Step 6 If the stem appears in the dictionary, the stem is the root of the word and goto Step 1; else goto Step 7
Step 7 Check the stem from Step 4 for spelling variations and check for the dictionary
Step 8 If the stem appears in the dictionary, the stem is the root of the word and goto Step 1; else goto Step 9
Step 9 Perform recoding for the suffix spelling exceptions and check the dictionary

Step 10 If the stem appears in the dictionary, the stem is the root of the word and goto Step 1; else goto Step 3.

The RFO stemmer algorithm has shown an improvement compared to the RAO stemmer algorithm in which the percentage of error produced by the RFO stemmer is lower by 3.0 % compared to the RAO stemmer [14].

23.2.5 Mangalam's Algorithm

This stemmer was developed by Mangalam Sankupellay and Subbu Vallippan [15]. It adopted the Porter stemming algorithm as the basis algorithm. The Porter stemming algorithm eliminates the commoner morphological and inflexional endings from words in English [16]. Porter stemming algorithm is a well-known stemming algorithm for English language. Although Porter Stemmer can be used in stemming Malay language, it needs some modification before it can be applied in stemming Malay language. The difference between English stemming and Malay stemming are as stated below [15]:

1. The combination of affixes attached to a word
2. The differences in syllables used to construct a word
3. The presence of infixes in Malay (which is not applied in English).

Hence, the algorithm of Porter stemming cannot be fully used in Malay language stemming. The modified algorithm that is suitable for Malay language stemming is as stated [15]:

Step 1 Check input word against the word dictionary. If the word is found in the dictionary, then output word as root word. Else go to Step 2

Step 2 Check input word for any prefix. If the word has a prefix, then remove the prefix and go to Step 1. Else go to Step 3

Step 3 Check input word for any suffix. If the word has a suffix, then remove the suffix and go to Step 1. Else go to Step 4

Step 4 Check input word for any infix. If the word has a infix, then remove the infix and go to Step 1. Else go to Step 5

Step 5 Check stemmed word for its first letter

If the first letter starts with 'm', then
Replace the first letter with 'p' or 'f' and go to Step 1

If the first letter starts with 'n', then
Replace the first letter with 't' and go to Step 1

If the first letter starts with 'y', then
Replace the first letter with 's' and go to Step 1

If the first letter starts with a vowel, then
Add 'k' as the first letter and go to Step 1

Else,
Root word could not be found and the program terminates.

The advantage in this stemming algorithm is that it is able to stem dual words. The algorithm will continue if there are any further affixes attached to the dual word. Besides that, it is also able to stem sentences instead of just stem for the words.

23.2.6 Ranaivo-Malançon's System

Ranaivo-Malançon introduced a morphological analyser that is able to process three types of word which are affixed, compound and reduplicated words [17]. It is a non-deterministic morphological analyser. This system does not only segment the affixed words but it also derives parts of speech and the sub-categorization of verbs based on the segmentation results. The major components of the analyser are as shown at Fig. 23.1 [17]. There are several processes involved before the words can be analyzed that includes filtering, segmentation, list of bases and interpretation. The filtering process filters non-affixed words. Besides that, it is also used to check on lexicalized affixed words, idiosyncrasies and affixed words built with an unproductive process. This is because these types of words will slow down the time for analyzing a long text and might cause error in the next step of processing these words. Hence, idiosyncrasies and affixed words built with an unproductive process had been listed in the exceptions lists and the lexicalized affixed words are listed in the list of bases. The words are checked for the hyphen before it can be segmented. If the words contain hyphen, the left and the right side of the words will be compared. These words only will be processed if the left and the right side of the words are equal.

If the left word is a substring of the word on the right side, then the word on the right side will be forwarded for the segmentation process and vice versa. If both words are not a substring of each other, both words will be processed for segmentation.

Prefixes and suffixes are searched from the left and the right side of the words. Next, morphotactic rules are used to eliminate incorrect segmentation and the morphographemic rules are then used to the correct segmentation as shown below [17]:

- *di–* and *me* never occur successively; exceptions: *dimengerti*
- *–i* and *–kan* never occur successively
- the order is *me–* and *ter–* but not *ter–* and *me–*
- the order is *me–* and *per–* but not *per–* and *me–*

- a prefixed word with *di–* cannot be affixed anymore. If the substring '*di*' is found after another prefix, it is not prefix. Without this rule, the word *mendiamkan* will be segmented into "me + di + am + kan" instead of "me + diam + kan".

The analyzer will then apply the segmentation rules (shown Table 23.1) before the morphographemic rules (shown in Table 23.2) are being applied to the segmented affixed word [17]. The segmented word will be run over with a list of bases which contains simple bases, infixed words, partial reduplicated words and blends. When the corrected segment is found, it will be passed to the interpretation process and the result of this process is the result for this analyser. Fig. 23.2 shows the flow of the segmentation process [17]. The symbol '#' indicates the frontier of the orthographic word, and the symbol '[]' indicates that the character at this position is one of the characters listed inside the brackets and finally the symbol '+' indicates the separation.

23.3 Discussion and Future Works

Based on the description of all the algorithms discussed in Sect. 23.2, the process of checking the existence of words in Malay dictionary and the process of checking the affixes rules are important steps in stemming words for Malay language using algorithms that apply rule-based affixes elimination.

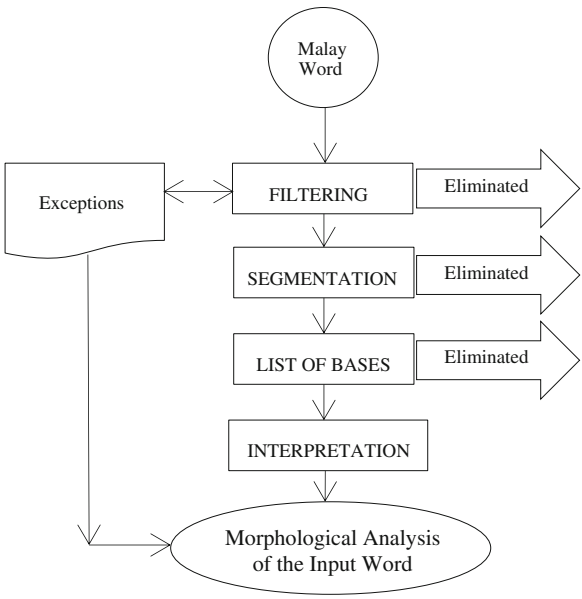

Fig. 23.1 Components of the analyzer

Table 23.1 Segmentation rules

	Context	Rewrite		Rule no.
From the left side of the word	# di	→	di +	1
	# [ks]e		[ks]e +	2
	# [bpt]er		[bpt]er +	3
	# [mp]eng[ghkqx]		[mp]e + [ghkqx]	4
	# [mp]en[gy][aeiou]		[mp]e + n[gy][aeiou]	5
	# [mp]en[cdjz]		[mp]e + [cdjz]	6
	# [mp]em[aeiou]		[mp]e + m[aeiou]	7
	# [mp]em[bfpv]		[mp]e + [bfpv]	8
	# [mp]e[lrwy]		[mp]e + [lrwy]	9
From the right side of the word	an #	→	+ an	10
	i #		+ i	11
	kan #		+ kan	12
	nya #		+ nya	13

Table 23.2 Morphographemic rules for analysis

Context	Rewrite	
[bpt]er + [aeiou]	→	(1) [bpt]er + [aeiou]
		(2) [bpt]er + r[aeiou]
[mp]e + ngeCVC	→	(1) [mp]e + ngeCVC
		(2) [mp]e + keCVC
		(3) [mp]e + eCVC
		(4) [mp]e + CVC
[mp]e + ng[aeiou]	→	(1) [mp]e + ng[aeiou]
		(2) [mp]e + k[aeiou]
		(3) [mp]e + [aeiou]
[mp]e + ny[aeiou]	→	(1) [mp]e + ny[aeiou]
		(2) [mp]e + s[aeiou]
[mp]e + n[aeiou]	→	(1) [mp]e + n[aeiou]
		(2) [mp]e + t[aeiou]
[mp]e + m[aeiou]	→	(1) [mp]e + m[aeiou]
		(2) [mp]e + p[aeiou]
[aeiou] + kan	→	(1) [aeiou] + kan
		(2) [aeiou]k + kan
[ao] + i	→	(1) [ao] + i
		(2) [ao]i (no suffix)

By checking the existence of words in the provided dictionary before running the affixes rule checking, it helps to reduce the over-stemming error. The arrangement of the affixes has been discussed [4] and it is concluded that the best affixes arrangement is performed by checking the prefixes first and then checking the suffixes [4]. However, Sembok concluded that the order of rules does not necessarily improve the stemming process [14]. The best arrangement for the affixes rule order is actually depended on the type of languages used (e.g., ancient

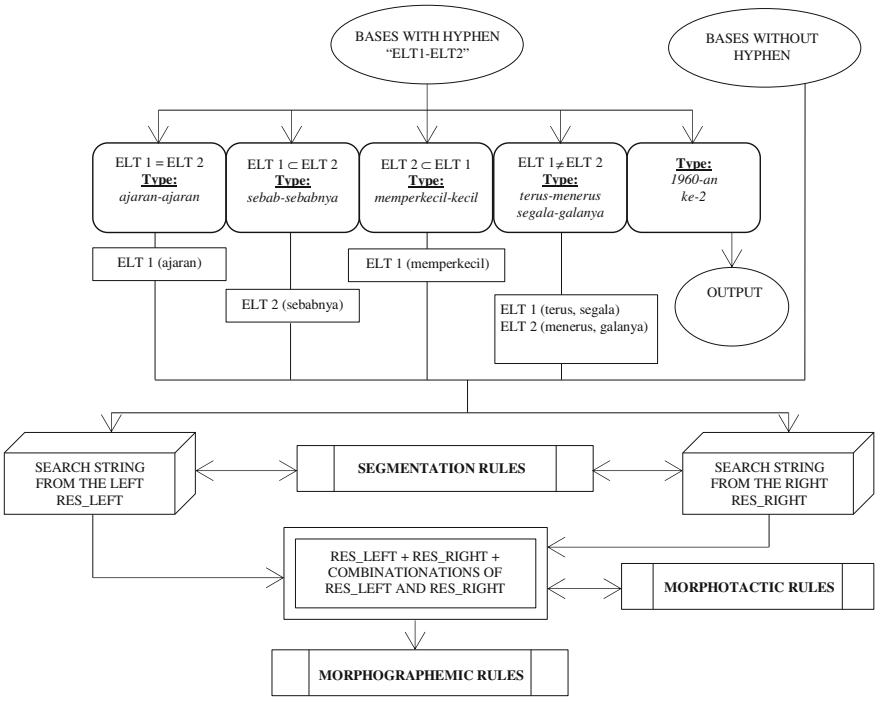

Fig. 23.2 Segmentation of affixed words in malay language

or modern languages). The morphology rules will also need to be changed based on the type of the language used. Hence some of the morphology rules used for ancient text will not be useful in modern text.

The Porter stemming algorithm can be applied to stem words in other languages with some modifications on the algorithm based on the rules of the language. Besides that, most algorithms also perform dictionary checking before and during the affixes elimination. However, not all the words stored in the dictionary are to be checked during the affixes elimination. It would be a waste of time to check every word that does not contain any affixes during the affixes elimination process. It might also produce error such as under-stemming or over-stemming. Hence, it is highly recommended that several different types of dictionaries should be used for checking the words during the affixes elimination process in order to stem Malay words with more effectively and efficiently.

Based on the review in this paper, most of the rule-based affix elimination algorithms implemented for documents written in Malay language also involve arranging rules and creating a new list of rules. However, Malay stemming algorithm might still be improved by using several different dictionaries. Hence, a new framework that applies several different types of dictionaries should be studied and proposed in order to improve the efficiency of Malay stemming algorithm.

23.4 Conclusion

It can be concluded that there are several researches conducted to improve the Malay stemming algorithms. Most of the stemming algorithms, for Malay language, are using the rule-based affixes elimination strategy compared to the other strategies due to the complexity of Malay language. Although the number of errors has been reduced, there are still a lot of ways that can be implemented to increase the efficiency of the Malay stemming algorithm. Several different types of dictionary can be used to improve the stemming algorithm for Malay language. A research will be conducted to investigate the effects of using a few dictionaries on the stemming accuracy for Malay texts.

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Chapter 24
Ontology-Based Query Expansion for Supporting Information Retrieval in Agriculture

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Abstract The demand for relevant knowledge related to effective and efficient agricultural development has increased tremendously recently in all over the world. The web can be considered as a distributed mass of simple hypertext pages and this gives rise not only to the redundancy of information but also difficulty in managing the relationship among the concepts of information. Thus, a formal way to represent knowledge on agricultural development is crucial. Information related to agricultural development can be represented using ontological modeling that enables the integration of knowledge obtained from heterogeneous sources. Despite this fact, the semantic interpretation of users' information needs become crucial in retrieval mechanisms. One of the successful techniques used to ensure relevant information is obtained, is to expand the input query by employing the query-related terms derived from the ontology in order to approximate the actual

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user's intention. This paper reviews various relevant researches conducted in ontology-based query expansion, particularly in agriculture domain.

Keywords Ontology · Query expansion · Information retrieval · Agriculture

24.1 Introduction

The information published on the web space is increasing at an enormous speed with the advanced development of information technology. Agricultural information and its related domains are now widely available in the internet. This information is very useful especially to farmers for them to improve their production with respect to changing circumstances and conditions [1]. This agriculture information is normally published on the internet in diverse formats such as Relational Databases, XML, RSS, webpages and others. Daily usage of searching information through search service providers also grow rapidly. Statistically, about 93 % of internet traffic is occupied by information searching services [2]. Information resources on the Internet are dynamic and heterogeneous, in which the web contents are unpredictable and formed from thousands of dialects [3], which not only causing difficulties in searching useful information but also decreasing the efficiency of searching for relevant information. Although there are various advanced keyword-queried web search engines (e.g., Google, Yahoo and Bing) which can be used to effectively retrieve the entire document from the web, the returned search results are considered appropriate only when the users perform the appropriate queries. Naturally, web user tends to post queries in their native languages and this may cause ambiguities of language [3]. Often, it led to the poor relevancy of returned results as the vocabularies used by the users might not recognizable by the system. Majority of the users prefer to query using a single and general keyword rather than using a unique keyword [4]. Only a small scale of expert users will query three or more keywords with the uses of Boolean operators (e.g., AND, OR and NOT). Web based information seeking turned out to be difficult for novice users who lacks of subject knowledge and most of the time novice users face insurmountable difficulty in manipulating the query language to formulate the right keyword queries [5]. These behaviors exhibit lacks of efficient human-computer interaction. The influences of a poor interaction are obvious when observing web expert and domain expert formulate domain-specific query in global space, in which domain experts usually achieve better results.

In order to deal with the problems studied, a relevant research regarding ontology based query expansion should be reviewed. The main purpose of having a query expansion is to improve the retrieval performance. A query expansion is used to disambiguate the natural language. The major process of query expansion is the modification of the original query with new relevant and meaningful terms, which results users' desired information to be retrieved. Query expansion can be

performed based on the corpus, or knowledge structures which includes thesauri [4], WordNet [6, 7] and ontologies [8–10]. Several query expansion methods have been studied since years ago that includes Relevant Feedback [11], Local Co-Occurrence [12, 13], Latent Semantic Indexing [14, 15] and Ontology-Based [10]. The last method is especially useful when user wants to search for domain specific information.

In this paper, we will concentrate on the ontology-based approach specifically in agriculture domain. In order to improve poor search results caused by vocabulary problem, a good way is to expand the original query with new terms. Ontology is one of the modeling techniques that possess the power of formally representing the domain knowledge. Thus, there is a need to develop such techniques to enrich information and also increase the accuracy performance to ensure that users obtain relevant information when searching for specific information. The system should be able to assist users by reducing agricultural inputs and shorten the response time while getting a satisfactory solution for their search queries. Section 24.2 will review some of the related works in query expansion. Services to access existing agriculture ontologies will also be detailed in Sects. 24.3 and 24.4 concludes this paper.

24.2 Related Works

An information retrieval system is specifically designed to retrieve a collection of documents that potentially matches the input query. Depending on the user's requirement, the purposes of a query can be classified into three classes. They are Navigational, Transactional and Informational queries. The navigational query is used to retrieve information from a website visited by the user. The returned results may be relevant but not desired by the user. This type of query is better performed on a single website or web page of a single entity, particularly homepages. In contrast, the transactional query is used to find a site where the user intents to perform a particular search action. The majority of these transaction queries are applied in an online purchasing and web media downloads. Finally, the informational query is used to collect available information from the web. This technique usually covers a broad topic in which there may be a large numbers of relevant results and a query expansion is best applied in this technique.

24.2.1 Query Expansion

Queries can be varies according to the nature of the employed query terms. These are either natural-language terms or terms which are derived from a controlled vocabulary such as ontology. The adoption of Boolean operators AND for the purpose of combining query terms can be illustrated as follows. In order to search

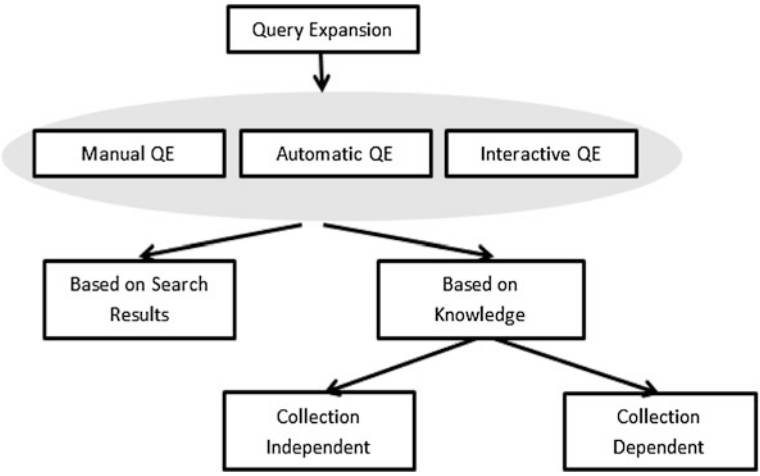

Fig. 24. 1 Classification of query expansion

for the topic of Michael Jackson's album, the relation of this topic is mapped to the entities Entertainer, Thriller in the ontology, and the following expended query can be defined as, "Michael Jackson" AND "Entertainer" AND "Album" AND "Thriller". Query expansion (QE) approaches are studied in many ways.

For instance, the classification of mainstream query expansion methods can be described as depicted in Fig. 24.1, which includes user manual QE (require user to decision which new term should be added without any influences from the system), automatic QE (the system autonomously extend the query despite of the awareness of the user; follows a set of pre-defined rules for terms selection criteria) and interactive QE (user can decide to, or not to adapt the new expansion terms that suggested by the system) [16].

With Query expansion, an input query is reformulated by adding additional terms and these terms can either be derived from the returned documents of original query or from the knowledge collections. In Fig. 24.1, there are two types of knowledge collections namely, knowledge independent collection and knowledge dependent collection. The knowledge independent collection contains a general-purpose knowledge and has been used for language understanding and most of the time it refers to external sources such as lexicons, glossaries, thesauri, dictionaries or ontologies. On the other hand, the knowledge dependent collection relies on the to-be-queried documents to represent the knowledge of a specific domain. In this paper, agriculture ontology is used as a domain specific dictionary that may assist us in deriving agriculture-related query expansion terms when searching for specific information.

Alternatively, most of the query expansion methods can be categorized into global and local techniques [3]. The global techniques are query-independent since all documents are examined for all queries. The expansion terms are then extracted

from the whole document collection. Conversely, the local techniques select the expansion terms based on the frequency of the terms obtained from the top-ranked documents. The frequency of a specific term specifies the indexing terms that are similar to the initial query terms and these terms can be used to extend the initial query. The similarity degree of a pair of terms can be measured using any similarity coefficients such as Cosine, Dice and Tanimoto [17]. These methods require fast response time as the calculations are mostly performed on-line.

24.2.2 Ontological Query Expansion

A concept represents a set of entities or things in universe, and ontology is a type of resource that semantically describes the relations of interconnected concepts such as synonym, hyponyms and other semantic relations. This resource is used to extend the coverage of the retrieval to the related documents that do not necessarily contain the same words as the query but sharing similar context [8]. Furthermore, ontology's semantic feature is not limited to text only, but it also can be used to interpret visual mediated information for the purpose of retrieving non-text documents. As mentioned previously, an ontological-based knowledge representation provides two types of applications in query expansion; a domain specific knowledge collection and a general knowledge collection. It is not sufficient to represent the knowledge needed by just applying a single domain specific ontology, especially when the application approach exceeds the capability of the ontology. Under some disambiguation cases, domain specific ontologies [18] will need support from domain-independent ontology. For example, in common sense, the term 'translate' means restating words from one language into another language. In biology domain, the term 'translate' means that synthesizing proteins that depend on mRNA. This kind of ambiguity intersects the domain knowledge with common sense [17].

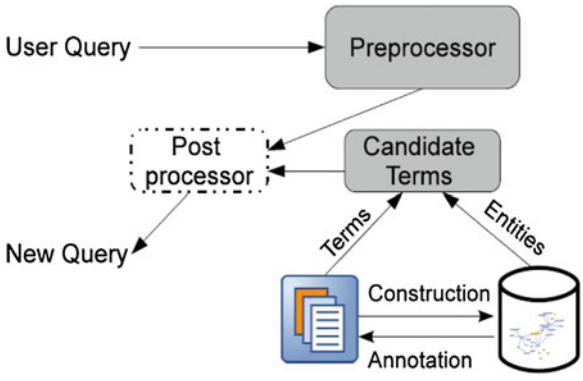

Fig. 24. 2 Synthesized plan for ontology-based query expansion

The core component of a query expansion is achieved in several phases. Figure 24.2 illustrates a synthesized plan for an ontology-based query expansion [19]. There are three major components which are preprocessor, query expansion and post-processor. Firstly, it is necessary to maintain a mapping between various expression of query and ontological entities, which will aid to the disambiguation of the language. Otherwise, the system will fail due to the mismatch between the query terms and ontological concepts [10]. The mapping can be obtained by constructing a corpus relevant ontology and annotating the corpus by utilizing the ontology. Both of these processes are called as Construction and Annotation, and it should be conducted before the actual query expansion taking part. In the pre-processing phase, a raw query accepted from the user can be pre-processed in order to identify important keywords that could express the intention of the query. In the main core query expansion phase, a post-processor will then optimize the set of candidate expansion terms while reformulating a new query. A successful expansion consequently depends on the way the candidate terms are arranged in order to expand the initial query.

24.2.3 Query Expansion Using WordNet

Wordnet is a special type of lexical database that combines features of dictionary and thesaurus [20]. Some researchers refer WordNet as ontology although it is more like thesaurus [21]. It contains general purpose terms in English. WordNet defines lexical and semantic relations between English terms into groups, known as synsets. Every paired synsets comprise semantic relations such as hyponymy, meronymy, synonymy and entailment. Wordnet has been widely implemented in the derivation of potential query expansion terms. Obviously noticed, there is a trend toward researches on extending user input query with the words that are lexically related to the original query words using WordNet [6, 7].

Some early works have made a comparison of the effectiveness of using different combination of relations obtained from the WordNet for the query expansion purpose [6]. In the process of expanding the query, key phrases are identified and extracted from the initial input query and mapped into the WordNet synsets. The synsets with most similarity will be selected as query expansion terms. The evaluation was performed based on the TREC corpus. The query expansion using WordNet synsets recorded an improvement of 15–20 % of precision, compared to the unexpanded query.

Zhen used query expansion technique in order to decrease the negative effect of ambiguity terms [17]. The project applies synonym and hyponym relations from the WordNet and variants of Unified Medical Language System (UMLS) lexicon to expand the original queries in biomedicine domain. The problem of query expansion in search activities which focused on Learning Object's search in specialized repositories has also been investigated and it has been proposed to use domain ontologies, linguistic processing and validation based on a general dictionary such as WordNet. Based on the experimental results, the contribution from

WordNet's relations is minimal in specific domain retrieval, because most of the specific terms do not have high hyponym level as common vocabulary have [17]. Therefore, the recent works conclude that a query expansion that applies lexical-semantic relations is hardly beneficial for detailed queries whereas increases in retrieval effectiveness can be obtained for less detailed query formulations.

24.2.4 Query Expansion Using Ontology

A study of analyzing Excite query logs revealed that 19 % of the user posted queries contained a geographic term such as place names, zip codes and geographic features [22]. Apart from the conventional term-based query expansion, [23] adopts an iterative footprint-based query expansion that comprises a fuzzy spatial expression in the query such as castles near Cardiff. This expansion mechanism was based on the interpretation of geographical expressions such as near, where, in, outside, north of and etc. Both domain ontology and geographical ontology are employed to support the retrieval of relevant documents within a spatial search space, footprint. In this case, degree of relevance is computed by analyzing the query footprint (geographical coverage of a specific location) and the document footprints (documents that fall in the coverage). The query footprint will be expanded when returned documents are not sufficient.

Recent research by [24] performs a query expansion on a Persian pseudo-ontology which is formed by using information extracted from Wikipedia articles and its associated page. In this approach, the existent concepts (or keywords) in the input query are mapped on to the ontology that transformed from Wikipedia. The experiment shows that queries based on Wikipedia potentially improve the precision of the information retrieval system [24]. A semantic query expansion on biomedical domain utilizes the Gene Ontology (GO) as domain knowledge [25]. In the experiments, the effectiveness of the information retrieval mechanism with and without query expansion is measured. The results showed an increase performance of 28 % on synonyms relations and a slightly decrease on other relations [25]. Popper proposed to use an ontology to bridge the mismatch of subjective knowledge and objective knowledge inspired from Popper's theory of knowledge [26]. The authors use the objective knowledge from the UMLS ontology to enrich queries semantics. The user query is reformulated by tracking related knowledge in ontologies. This semantically enriched query is able to deliver more information to search engine and bring positive results to the search performance [26]. Besides, a comprehensive review on earlier researches in ontological query expansion can also be found the paper written by [10].

24.3 Development and Application of Ontologies in Agriculture

Agriculture sector plays a fundamental role in creating food and raw materials for agro-based industries. The development of agro-based industries is crucial in generating wealth and economic growth of the country. It was the key development that led to rise of populations by creating food surpluses and ensuring food security for all. A standard agriculture repository for relevant information to be collected, organized, combined and aggregated enables effective delivery of agricultural information [1]. Ontologies have been used widely in domain-based applications to achieve interoperability between heterogeneous information systems. Ontologies are metadata schemas, providing a controlled vocabulary of concepts, each with an explicitly defined and machine process able semantics. By defining explicit specification of a shared conceptualization and common domain theories, ontologies improve the communication process between different agents (e.g., human and machines), supporting the exchange of semantics and not only syntax. Ontologies are standalone and software independent. This encourages reusability of the domain knowledge as it can be easily adapted by any other applications [27].

Taking into consideration the importance of the requirement for information service and its applications in the agricultural development, the lack of necessary progress on it may possibly cause the stagnancy of agricultural development. It is crucial to have continuous increase in knowledge through access to innovations, changes and the latest results of agricultural research. The collection of knowledge can be utilized effectively only when it is representing in a formal structured way. Many researches and projects have been implemented in the domain of agriculture in making the agricultural development information more easily accessible and sharable. The use of ontologies is vital and is widely viewed as the backbone to support multiple types of information management such as information retrieval [27].

24.3.1 Integrated Agriculture Information Framework

The Integrated Agriculture Information Framework (IAIF) is normally considered as a point of reference for farmers in such a way that appropriate corrective actions can be taken when the crops' production deviated from the normal scenario due to any natural or un-natural grounds. IAIF enables knowledge extraction from various domain related repositories. IAIF utilizes metadata and domain ontologies in order to combine, merge and aggregate the data in existing knowledge repositories.

The IAIF agricultural ontology consists of three sub ontologies namely Domain Ontology, Resource ontology and Linking Ontology. Triple based approach was used in creating the ontology where two concepts are linked together based on a specific property to generate a graph as directed. A Centralized Agriculture

Resource Ontology is created to relate the domain ontology with different resources. This ontology mapping schema is designed based on OWL specifications. The key role of this ontology is to ensure reusability of existing agricultural information and to establish common methodology for linking domain ontology with resources. The IAIF ontology has an advantage over other approaches where it includes domain-resources properties and constraints that capture the relations amongst different concepts of the application domain and resources. As an example, contain relation exists between concept Met-Office-Dataset and Weather which bring the meaning that weather information can be found in Met-Office-Dataset.

The framework produces an integrated knowledge of semantic and non-semantic agricultural identical knowledge resources by developing domain-resource ontology. It links non-semantically knowledge from World Wide Web with other resources of this domain which make it possible to build the relation among domain concepts and knowledge repositories metadata [1].

24.3.2 Scalable Service Oriented Agriculture Ontology for Precision Farming (ONTAgri)

A scalable service oriented agriculture ontology for precision farming (ONTAgri) was introduced with the intention to fulfill the context rich environment, dynamic

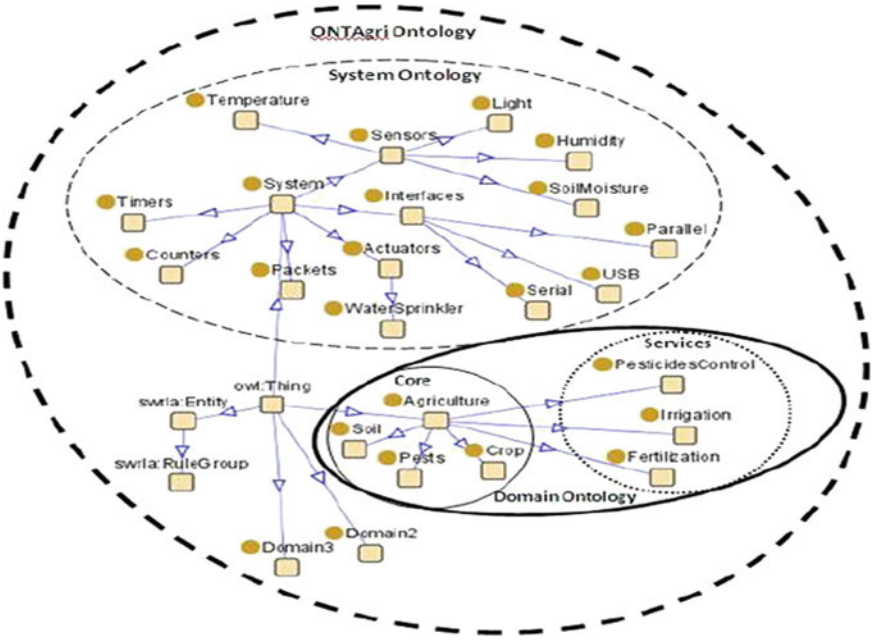

Fig. 24. 3 ONTAgri ontology [28]

and time variant attributes and variety of requisites for basic services, agriculture domain demands scalable, distributed and service oriented modeling [28]. This ontology is defined in order to support agriculture domain that includes several farming practices such as irrigation, fertilization and pesticides spraying. ONTAgri is modeled through service oriented ontology due to the diversified knowledge captured. It comprises of two major parts which are system ontology and domain ontology. The domain ontology contains description about major parts of a land, crops and their related objects and it is further divided into core and services group of concepts as shown in Fig. 24.3.

In core concept, description of several core concepts of agriculture such as plant, soil and pest is captured. Besides, the semantic description of each concept, detailed attributes and relationships are important in this core part as it could be used in different application requirements. On the other hand, services concepts are defined to enable service oriented scalability. The services group consists of basic farming services such as irrigation, fertilization, pest spraying and etc. Each of the service concepts utilizes core concepts for which the service is introduced. The system ontology is separated from the domain ontology to reduce dependency which makes it easier when a new service that utilizes the same system components is added. The proposed ontology offers ease in introducing new agricultural services without changing the structure of the former ontology.

24.3.3 AGROVOC

AGROVOC is a corporate, multilingual vocabulary of Food and Agriculture Organization (FAO) of the United Nations which contains more than 40000 terms in 21 languages [29]. It consists of topics related to agriculture, forestry, fisheries, environment and other domains. The AGROVOC thesaurus is designed to standardize the indexing process in improving the efficiency and effectiveness of the information searching process. AGROVOC utilizes Simple Knowledge Organization System (SKOS) as a concept scheme model for the representation of classification schemes, taxonomies, thesauri and every structured controlled vocabulary [29]. There are three levels of representation in AGROVOC concept scheme which are concepts, terms and term variants. Concepts represent the classes of entities. Each AGROVOC concept is uniquely identified by a URI and named a term. Variant of terms can be assigned as alternative term to a concept. Although the main authoring tool is VocBench, contributions to AGROVOC may also occasionally come from legacy formats such as spread sheets and SQL files. The RDF version of AGROVOC has been made available as a Linked Open Dataset at the address http://aims.fao.org/aos/agrovoc/ [29].

Table 24. 1 Review of existing application of ontologies

Ontology Apps	Ontologies	Ontology representation	Ontology storage	Advantages	Open access
IAIF	Domain, resource and linking Ontologies	RDF-OWL	Files	• Reusability • Cross domains relationship	No
ONTAgri	System and domain ontologies	OWL/SWRL	Files	• Flexibility to add • additional services	No
AGROVOC	AGROVOC Thesaurus	RDF/SKOS-XL	Files and DBMS	• Reusability • Multilingual • Provide indexing for efficient search	Yes
AOS	AGROVOC Thesaurus	RDF/SKOS-XL	Files and DBMS	• Accessibility in different systems • Web-based application	Yes

24.3.4 The Agricultural Ontology Service

The Food and Agriculture Organization (FAO) has been putting some efforts to establish an AOS. It is designed to serve as reference tool that standardizes the agricultural terminology in multiple languages for use by any number of different systems. Using the knowledge within AGROVOC, the Agricultural Ontology Server (AOS) will be able to develop specialized domain-specific terminologies and concepts which will provides better support to the information management in the web environment. By utilizing AGROVOC thesaurus as its core, the AOS is designed to serve as a common set of core terms and relationships as well as the richer relationship which can be shared among knowledge organization system [30].

24.4 Conclusion

One of the most natural and successful retrieval techniques is to expand the original query with other words that best capture the actual user intent. It is more likely to produce a useful query to retrieve relevant documents. The process of searching for information looks simple where users only need to enter a few words into a search box and then a long list of results will be returned. One of the challenges for a search engine is to translate user's simple and short queries into machine understandable language and then return relevant lists of documents that fulfill user's information needs. Delivering relevant results for information searching is a challenging task. One of the main challenges is query drift problem. This problem occurs when the words added to the original query are totally unrelated to the query topic. It may result in degrading the quality of information returned by the retrieval task.

Another challenge in information retrieval is the term mismatch problems. This term mismatch occurs when a user enters terms that do not match with the stored indexers. The vocabulary problem includes the synonymy and polysemy issues. Word inflections, such as a word with plural forms (e.g., 'television' versus'televisions'), may result in a failure to retrieve relevant information, hence decrease the recall score. On the other hand, polysemy may cause retrieval of irrelevant information which will cause decrease in precision. The vocabulary problem becomes worse if the paucity of query term reduces the possibility of handling synonymy while the different sources and sizes of data make the effect of polysemy harsh. Resolving term mismatch and vocabulary problem is crucial in order to deliver a comprehensive set of relevant documents.

To conclude, it is quite clear that ontology-based query expansion is an ad-hoc approach. In this paper, we have reviewed several works related to query expansion and the applications of agricultural ontology. Table 1 shows the comparison of several ontology applications that have been reviewed in the previous sections. Representing agricultural information with ontology enables the integration of information from heterogeneous source and thus enriches the domain knowledge. Searching agricultural information in a large collection of data is complex. Ontology-based query expansion is an alternative approach in information retrieval. It expands the input query by employing query-related terms derived from the ontology. Besides that, ontology provides not only terms matching but extended the concepts mapping features which can be utilized for retrieval of non-text documents. It has a great impact on the performance of information retrieval.

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Chapter 25
Metafrastes: A News Ontology-Based Information Querying Using Natural Language Processing

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Abstract. This paper presents Metafrastes, a system that provides users with the ability to retrieve information from Semantic Web knowledge bases through queries that are formulated in natural language. The Web system that we introduce is engineered based on several Semantic Web tools and techniques. Our contribution consists mainly of a Natural Language Processing engine, able to translate queries formulated in natural language to SPARQL queries that can be applied to existing knowledge bases. Additionally, we develop a user interface that captures the user interaction with the system. Last, we evaluate the system based on a number of pre-defined queries formulated in natural language. The proposed approach has been positively evaluated with respect to precision and for queries that are aware of the information structure from the knowledge base.

25.1 Introduction

Since the introduction of the World Wide Web, the amount of information that is available via this medium has steadily increased [1]. Nowadays, millions of Web pages provide enormous amounts of information to anyone with access to it. When dealing with such massive amounts of information, it is very important that the information is organised in a structured way in order to optimally serve the Web

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user's information needs. The Semantic Web [2] helps in addressing this issue. Designed as an extension of the current World Wide Web, the Semantic Web strives to assign proper meaning to the information, with the ultimate goal to present the information in such a way that both human users and machines can use and manipulate the information to better suit their wishes. To support this vision, numerous technologies have been developed, such as data representation languages RDF [3, 4], OWL [5], and tOWL [6, 7], and query language SPARQL [8]. RDF and OWL enable the representation of self-describing data, on which queries can be executed using SPARQL. The more recent tOWL language extends OWL with a temporal dimension, enabling representations of change and state transitions, in addition to static information.

In this paper we focus on user interaction with Semantic Web information systems. The Semantic Web brings numerous useful additions to the current World Wide Web, but these additions will only be of use if they enable human users or automated processes to interact with Web information systems. Various types of user interaction exist, including search term narrowing (which enables the user to start with a broad term, while narrowing it down to more specific terms by, e.g., expanding a taxonomy tree filled with search terms) and natural language input (which enables the user to start his search for information by formulating a question in natural language). Natural language input can be a convenient way for the user to retrieve information, because there is no need to summarise his thoughts in a single keyword; the user can merely type his information need in natural language in order to retrieve the desired information.

To clarify the usefulness of natural language input, we present an example. Suppose that a news ontology exists, that automatically collects news items about, e.g., companies. A user might then be interested in the news items on the competitors of Google. However, without knowing the structure of the underlying ontology, this user cannot know which companies are competing with Google. Being able to formulate a natural language query such as "In which news items does at least one of Google's competitors appear?'' would be a great feature for this user, as this user does not need to know exactly which companies compete with Google, yet he can still obtain relevant answers.

To be able to use natural language input, a natural language processing engine needs to be in place to convert the user's question to a format that can be processed by a computer. This is why we focus on user interaction by using and analysing some existing natural language processing engines, both designed for conventional use and for use in Semantic Web environments. Based on this analysis, a Semantic Web approach to natural language processing of user input is proposed.

The outline of this paper is as follows. In Sect. 29.2 we provide an overview of related work. In Sect. 29.3 we introduce the NLP engine that we develop for querying knowledge bases based on queries formulated in natural language. An evaluation of the system is presented in Sect. 29.4. Finally, we conclude in Sect. 29.5.

25.2 Related Work

Several systems have already been presented in literature that deal with queries based on natural language. In this Section we discuss CO-OP, Masque/SQL, AquaLog, and SemNews, as prolific examples of such systems.

Cooperative Query System (CO-OP) [9] is a portable natural language database query system which was developed in the mid-1980s and meant to work with a CODASYL database management system. It focuses on providing solutions for a number of long-recognised NLP issues, including ambiguity and vagueness. Additionally, it also aims to reduce the installation effort that is required whenever an NLP system is applied to a different domain.

Masque/SQL [10] is a portable natural language front-end, which answers English questions by generating and executing SQL code. It is a modification of the original Masque (Modular Answering System for Queries in English) system, which was focused on working with Prolog queries on Prolog databases. The Masque system, which was developed at the Artificial Intelligence Applications Institute and the Department of Artificial Intelligence of the University of Edinburgh, strives to combine extensive linguistic coverage, efficiency and portability. Moreover, it was also developed to be easily configurable for different knowledge domains.

AquaLog [11] is a question-answering tool that takes an ontology and a natural language query as input, after which it returns an answer from the ontology. The natural language queries are translated into logical queries, which are interpreted with respect to a given ontology and the corresponding semantic markup. Being an ontology-compatible system, AquaLog strives to work with Semantic Web technologies only, thereby trying to be as portable as possible by making use of the ontology standard representation languages.

SemNews [12, 13] is a semantic news service that monitors different RSS news feeds and provides structured representations of the meaning of the news items that originate from these news feeds. It strives to make more Semantic Web content on the Web available by extracting summaries from RSS descriptions of news items and by processing this natural language input using an underlying component called OntoSem.

In deciding the usefulness of previous approaches for our current endeavour, we define four criteria that these approaches should fulfil: (i) Semantic Web foundation or orientation, (ii) ability to answer natural language questions, (iii) ability to deal with news items, (iv) use of an intermediate representation.

Table 25.1 Overview of the related work and their scores on the four criteria

Criterium	CO-OP	Masque-SQL	AquaLog	SemNews
Semantic web	partial [16]	partial [16]	yes	yes
NL questions	yes	yes	yes	no
News items	no	no	no	yes
Intermediate	partial [17]	yes	yes	partial [17]

Table 25.1 provides an overview of the related work that was discussed in this section, along with the four criteria that we deem relevant. From this table, it follows quickly that AquaLog is the most suitable NLP system to consider. We apply AquaLog on our domain ontology (a news ontology) and the results were not adequate. In fact, none of the four complete NLP systems were able to address our needs, therefore we chose not to use an existing NLP system, but a partial one in the form of a linguistic parser. Using such a parser as a first step in our NLP engine provides us with flexibility, as the resulting parse tree can be altered whenever we deem necessary.

25.3 NLP Engine

The architecture of the NLP engine that we introduce is shown in Fig. 25.1. We use the remainder of this section to discuss the design of the architecture.

To start the process, the user formulates an English question and commands the NLP engine to process his question. The question is then parsed by a *parser*, which returns a parse tree. The parse tree is used as input for the *triple generator*, which then generates ontology triples based on its input. The ontology triples are then forwarded to the *query generator*, which constructs the correct SPARQL query. The SPARQL query is processed by the *query processor*, which interacts with the ontology to obtain the query results. An appropriate answer to the user question is generated by the *response generator*, which takes the raw query results and reformats them in a user-friendly format, as shown in Fig. 25.6.

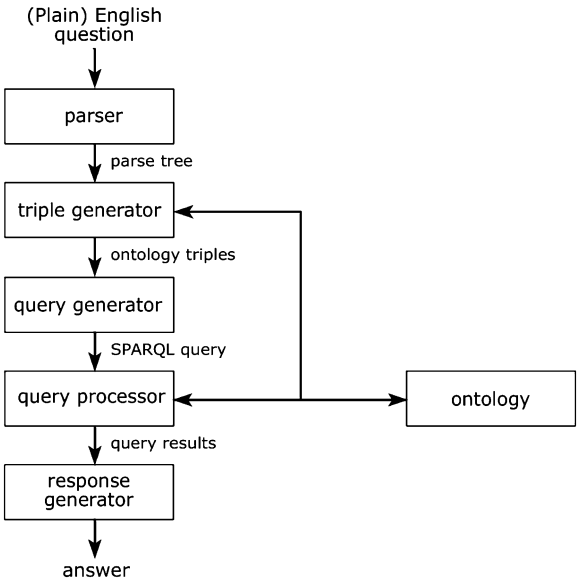

Fig. 25.1 The architecture of our NLP engine

Our architecture uses a sequential structure, an approach to systems design that is quite common in the field of natural language processing. This is because a sequential structure provides flexibility when it comes to the format of the final results, as the engine can be easily altered to work with a different query language, e.g., SPARQL 1.1 [14], by just altering two components of the total five that are involved in the whole process (for the RDQL example, only the query generator and the query processor would need to be altered). Apart from the sequential structure, the intermediate representations (the parse tree and the ontology triples) provide more possibilities to generate multiple types of output.

25.3.1 Implementation

This section describes the decisions that were made in order to come to a valid implementation. After describing shortly how the implementation was organised and set up, we discuss the implementation by focusing on every separate component of the engine, as displayed in Fig. 25.1.

25.3.1.1 Organisation and Setup

Our NLP engine is implemented as a Java program. We call the system 'Metafrastes' (original Greek word: $\mu\varepsilon\tau\alpha\varphi\rho\alpha\sigma\tau\eta\varsigma$), literally meaning 'translator' in Greek.

Tools and Languages To be able to implement the engine, a number of different tools and languages are used: (i) The Java Platform (Standard Edition 6 Release), (ii) Resource Description Framework for the Semantic Web (RDF), (iii) the Web Ontology Language (OWL), (iv) SPARQL (Query Language for RDF), (v) Jena (Semantic Web Framework for Java) [15], (vi) ARQ (SPARQL Processor for Jena) [16], (vii) Hermes (Semantic News Portal) [17], and (viii) Stanford Parser (Statistical Parser) [18].

25.3.1.2 Parsing

With most NLP engines, *parsing* is the first phase in the process of translating the user input. It is used to interpret the user input syntactically, so that the structure of the user input is made available to the NLP engine. The process of parsing results in a parse tree, which represents the user input in such a way that it can be handled by the NLP engine.

Stanford Parser The tool that we use for the parsing step is the Stanford Parser [18]. It consists of a Java implementation of probabilistic natural language parsers and can be used to produce the *most likely* analysis of a user inputted sentence. An example of a parse tree as it can be produced by the Stanford Parser is shown in

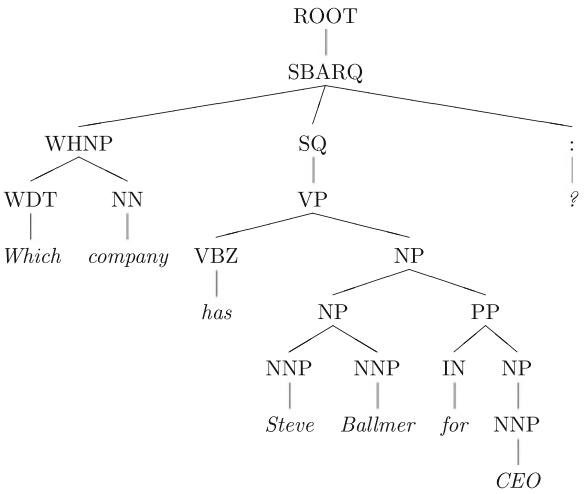

Fig. 25.2 "Which company has Steve Ballmer for CEO?": parse tree

Fig. 25.2. The example question we use is: "Which company has Steve Ballmer for CEO?''. This example will be used throughout the remainder of this paper to illustrate the workings of different system components.

The parse tree in Fig. 25.2 was generated by inputting the example user question in the lexicalized Probabilisty Context-Free Grammar (PCFG) parser, which uses various forms of probabilistics and statistics to annotate important words in the user input as phrasal nodes. These phrasal nodes are all assigned an annotation, specifying the type of the word or part of sentence.

25.3.1.3 Domain Ontology

The domain ontology was built by means of a wrapper application on Yahoo! Finance to extract information on the top-100 NASDAQ companies. The OntoClean approach [19] was used to validate the domain ontology composed of entities as companies, products, persons, currencies, CEOs, etc. Each concept has a number of lexical representations associated (some derived from the corresponding WordNet entries, where these are available).

25.3.1.4 Generating Triples

The most important step in the process is the generation of ontology triples. These triples are of the form (subject predicate object). In this section, we zoom in on how the ontology triples are generated and what is required in order to carry out this process. We start by first introducing the Jena tool in more detail. Next, we describe the heuristics that we developed for Metafrastes.

```
   input  : A parse tree parseTree which was returned by the Stanford Parser
   output: A list ontologyTriples which is filled with the ontology triples
 1 currentTerm ← "news items";
 2 keywords ← "mention, concern, related to";
 3 if parseTree.contains (currentTerm) then
 4     currentTerm.update ();
 5     ontologyTriples.add (rdfTypeTriple(?news, News);
 6     if hasLink (currentTerm, keywords) then
 7         currentTerm ← keywords;
 8         ontologyTriples.add (relationTriple(?news, hermes:relation, ?relation));
 9         ontologyTriples.add (rdfTypeTriple(?relation, Relation));
10         if hasLink (currentTerm, ontologyConcept) then
11             currentTerm ← ontologyConcept;
12             ontologyTriples.add (relationTriple(?relation, hermes:relatedTo,
               ?concept));
13             ontologyTriples.add (rdfTypeTriple(?concept,
               getOntologyClass(currentTerm)));
14             previousTerm ← currentTerm;
15             while more linked concepts exist do
16                 if hasLink (currentTerm, ontologyConcept) then
17                     currentTerm ← ontologyConcept;
18                     ontologyTriples.add (relationTriple(?concept,
                       getRelation(previousTerm, currentTerm),
                       ?anotherConcept));
19                     ontologyTriples.add (rdfTypeTriple(?concept,
                       getOntologyClass(currentTerm)));
20                 end
21             end
22         end
23     end
24 else
25     if parseTree.contains (ontologyConcept) then
26         currentTerm ← ontologyConcept;
27         ontologyTriples.add (rdfTypeTriple(?concept,
           getOntologyClass(currentTerm)));
28         previousTerm ← currentTerm;
29         while more linked concepts exist do
30             if hasLink (currentTerm, ontologyConcept) then
31                 currentTerm ← ontologyConcept;
32                 ontologyTriples.add (relationTriple(?concept,
                   getRelation(previousTerm, currentTerm), ?anotherConcept));
33                 ontologyTriples.add (rdfTypeTriple(?concept,
                   getOntologyClass(currentTerm)));
34             end
35         end
36     end
37 end
38 return ontologyTriples;
```

Fig. 25.3 Developed heuristics for generating the ontology triples from the parse tree

```
(?company rdf:type hermes:Company)
(?company hermes:hasCEO ?ceo)
(?ceo rdf:type hermes:Business_leaders)
(?ceo hermes:name "Steve Ballmer")
```

Fig. 25.4 "Which company has Steve Ballmer for CEO?": ontology triples

Jena Jena is a Semantic Web framework for Java. This tool provides functionality for communication with RDF data sets and ontologies. We use it in our NLP engine to query the ontology. Furthermore, Jena contains a separate query processor called ARQ, which is able to process SPARQL queries and return the results from the ontology. We use this part of Jena later on in the question translation process.

Developing Heuristics When a complex problem needs to be solved, it may prove very helpful to develop heuristics that describe how a solution to the problem may be obtained. Such heuristics aim to exploit the problem specifics and to produce a suboptimal solution for a complex problem. The heuristics developed for our system are shown in the algorithm depicted in Fig. 25.3.

The heuristics take the parse tree as input, which was the result of the previous step in the question translation process. Then, on lines one and two, two variables are assigned. The variable *currentTerm* keeps track of the current term in the parse tree, while *keywords* is used when a request for news items needs to be discovered.

From line three, we check whether the user asked for news items in his question. If so, the value of *currentTerm* is updated with the news item term. The *if* tag on line six determines whether there are relations linked to the news item term. If so, the *currentValue* variable is updated again and ontology triples are added for this relation. This step repeats itself, but now a link between the current term and an ontology concept is searched for. If this is found, the ontology triples are again added and next to updating *currentTerm*, the previous term is stored. After that, we check whether there are any links to ontology concepts in the remaining leaves of the parse tree. If this is so, ontology triples are added for every link to an ontology concept that exists. If no links are present, a final triple is added (the synonym triple), after which the ontology triples are returned.

If the user did not ask for news items, the algorithm skips to line 22, where we check whether the parse tree contains an ontology concept. If this is the case, an initial ontology triple on the concerned ontology concept is added, after which the while-loop is entered to search for more linked concepts. Again, they are added as ontology triples until no more linked concepts exist. The assembled ontology triples are returned at the end. Figure 25.4 shows the ontology triples for our example after they have been returned by the ontology triple generator.

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX news: <http://www.jborsje.nl/hermes/news.owl#>
PREFIX hermes: <http://www.jborsje.nl/hermes/news.owl#>
SELECT DISTINCT ?company
WHERE {
  ?company rdf:type hermes:Company .
  ?company hermes:hasCEO ?ceo .
  ?ceo rdf:type hermes:Business_leaders .
  ?ceo hermes:name "Steve Ballmer" .
}
```

Fig. 25.5 "Which company has Steve Ballmer for CEO?": SPARQL query

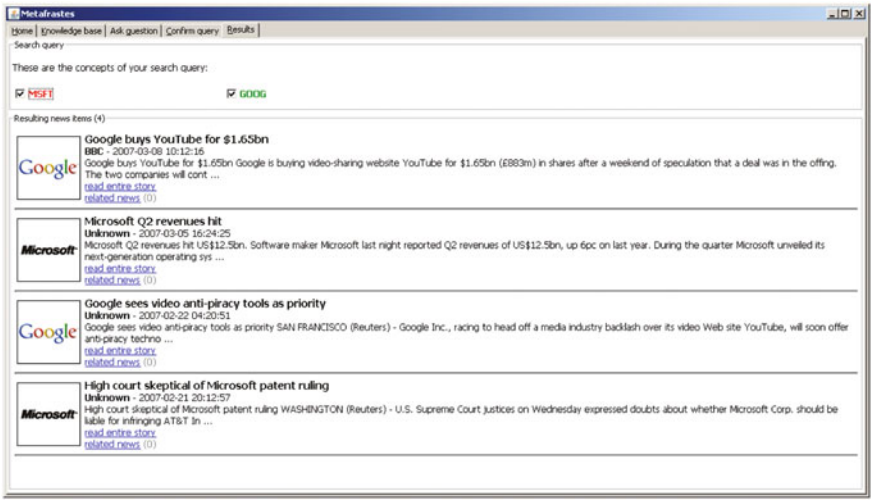

Fig. 25.6 Displaying the results in Metafrastes

25.3.1.5 Generating Query

The SPARQL query is generated based on the ontology triples. This is done by the QueryGenerator module, that combines constant values with the generated ontology triples in order to create the correct SPARQL query. These queries take the form shown in Fig. 25.5. The starting variables (for the generated pattern graph) are used in the SELECT clause of the SPARQL query.

25.3.1.6 Processing Query

After the query is generated, it needs to be processed in order to retrieve any results. We use ARQ to process the queries and retrieve the results from the

ontology. ARQ is a query processor for SPARQL that was developed to work with ontologies that are already loaded in Jena. The query processor returns a result set from the ontology, which our engine alters so that it represents a list of news items or a direct answer from the knowledge base.

The results of the processed query are displayed as a list of news items, where each news item is shown together with the concept that triggered the inclusion of that particular item in the results set. At the top of the screen, the user can again exclude or include concepts in order to restrict the results set. Figure 25.6 illustrates this step.

25.4 Evaluation

Evaluating the results that are produced by Metafrastes is equivalent to evaluating the generated SPARQL queries, as these queries ultimately provide the results. Thus, the quality of the results depends on the quality of the generated SPARQL query. The major part of the generated SPARQL query consists of the ontology triples that were generated earlier by the triple generator. Thus, the quality of the generated SPARQL query depends on the quality of the ontology triples that are produced by the triple generator. Consequently, we evaluate the performance of Metafrastes by evaluating the ontology triples that are produced in order to come to a conclusion on the quality of the results.

The evaluation of the generated SPARQL queries, as well as the quality of the generated results in terms of soundness and completeness, is done by the authors. It should be noted that this evaluation is objective, due to the crisp nature of the responses to the posed queries. At this stage we did not perform any evaluation of the system based on other criteria such as ease of use of the system/user experience.

25.4.1 Evaluating Example Questions

To get to the evaluation results as described in this section, we did one run in which we asked nine example questions (assuming that the ontology structure is

Table 25.2 Selected example user questions and their translation scores

Question	Translation
Which news items mention Google?	Correct.
Which companies are competitors of Google?	Correct.
In which news items does at least one of Google's competitors appear?	Incorrect.
Who is the CEO of Apple?	Correct.
Which news items mention the CEO of Apple?	Correct.
Which company produces iPhones?	Correct.
Which news items mention the company that produces iPhones?	Correct.
What is the name of the CEO of the company that produces iPhones?	Correct.
Which company has Steve Ballmer for CEO?	Correct.

Table 25.3 Some custom user questions and their translation scores

#	Question	Translation
C1	When was YouTube bought by Google?	Incorrect.
C2	Which companies have recently experienced a CEO switch?	Incorrect.
C3	Give me the names of all software companies.	Incorrect.
C4	Is Google situated in the Netherlands?	Incorrect.
C5	Does Larry Page work at Microsoft?	Incorrect.
C6	Which CEO works for Adobe?	Correct.
C7	iPhones are great. Where can I get one?	Incorrect.
C8	Who is the CEO of Motion in Research?	Correct [16].
C9	What does Apple do?	Incorrect.

knows). The resulting ontology triples were examined for correctness and, based on this, it was decided whether the NLP system produced an accurate translation of the question. We consider a query to be correctly translated when the results of the SPARQL query are sound and complete with respect to the original natural language query (completeness is considered in relation to the information stores in the ontology). The example questions are reproduced in Table 25.2, along with their translation scores.

We can see from this table that eight out of nine questions were translated correctly. We can conclude from this that our NLP engine performs quite well on the set of example questions.

25.5 Evaluating Custom Questions

When evaluating the system based on a set of custom questions, we applied the same procedure as the one we described in the previous section. Table 25.3 shows a list of nine custom questions. They are questions that we came up with, regardless of the structure of the ontology. Moreover, we tried to act a bit like 'layman users' ourselves, resulting in questions that are not always formulated in a clear way.

Table 25.3 shows that our NLP engine performs poorly when it comes to questions which are not as structured as our example questions. In some cases the incorrect translation followed from the fact that the question was formulated in a vague manner (such as question C7 and C9). Some questions were properly formulated, but just too complex for the NLP engine to translate properly.

25.6 Conclusions and Future Work

The work we present here enables us to draw some conclusions on ontology-based information querying using NLP. We conclude that as the use of Semantic Web technologies are becoming more popular, they are also used more frequently in

various NLP systems. Our work also shows that these technologies can greatly support NLP through their data representation capabilities. Moreover, our work shows that current technologies provide a good foundation for new systems that are able to bridge the gap between expert- and layman users.

As future work we will focus on improving the quality of the NLP process. Also, we will focus on enabling users of the system to use custom ontologies rather than the domain ontology provided by the system. In the evaluation we would like to consider more complex queries, such as, for example, queries containing constraints on the time frame of news items.

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Chapter 26
An Application for Recommender Systems in the Contents Industry

Giovanny Mauricio Tarazona Bermudez, Jordan Pascual Espada and Edward Rolando Nuñez-Valdez

Abstract This paper presents and describes the construction of a recommender system model that classifies input information to yield product recommendations. This model was applied within the contents industry [1] by using artificial neural networks (particularly adaptive resonance theory) as an intelligent agent. The Netflix Prize data base was used and the model's validation and simulation was written using Matlab®.

26.1 Background

The contents of this paper are organized as follows: First, theoretical background about Recommender Systems (RS), Adaptive Resonance and ART 1 is provided [2–4]; subsequently the model's construction is described—requirements, information parameters, and network architecture among other aspects; then an alternative algorithm is defined, the model is simulated and validated [5]; Finally, results are presented and analyzed.

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26.1.1 Recommender Systems

Recommender Systems (RS) are used in the field of electronic commerce as an effective technique to suggest the use of products (provided at a single outlet) that adapt to the needs and preferences of clients [6].

The use of Recommender Systems (RS) within e-commerce applications is growing more frequent due to their positive connection with sales growth and quality of service. This type of systems help people find goods they were unaware they needed, despite the interest such products may arise on users. A recommender System is commonly used to find closely related users or just people that share a particular interest [7].

The development of Recommender Systems is intended to reduce information overload on networks. Unlike other traditional assistive systems such as search engines (e.g. Google, Yahoo, etc.), RS is mostly based on a Collaborative Filtering process (CF), which offers personalized recommendations to web-site active users regarding various sorted (or not) items (e.g. goods, films, parties, etc.) [8]. Once these profiles have been separated, they serve to build independent models that predict client behaviour in specific contexts as well as within specific client segments. Such a contextual client segmentation is useful since it allows the creation of better prediction models implemented through different e-commerce applications [9]. The current generations of recommendation methods can be classified into the following three categories: content-based, collaborative, and hybrid recommendation approaches. Among the most commonly used RS techniques, those based on user profiles represent the basis for such systems. From the dawn of RS, a lot of work (within the academia as well as the industry) has been devoted to the construction of user profiles [10]. As a consequence, nowadays, various alternatives are being developed in order to improve these indicators by using tools such as the Semantic Web, which makes use of intelligent agents to provide a better response to user search requirements; and the Web 3.0, which readily integrates the Semantic Web concept so as to improve quality of the services provided by the Business to Business model (B2B) besides other services [11].

26.1.2 Adaptive Resonance Theory

This theory (put forward by Carpenter and S. Grossberg in 1987) presents a network-topology design aimed at meeting the need for a stable-enough model in order to preserve the most significant traits of past learning as well as being flexible and adaptable, acquiring new relevant information whenever it appears. This solves the so called plasticity-stability dilemma, where plasticity is conceived as the system's capacity to learn by establishing interactions between the inputs and outputs of a particular system, reaching a stable state; and stability refers to the system's capacity to remain stable and/or invariant to environment-associated disturbances or to unimportant inputs [12].

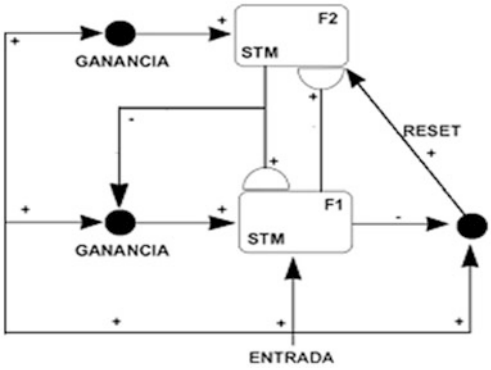


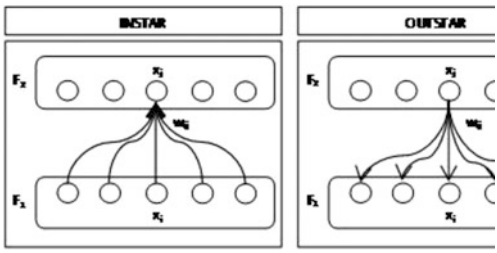
Fig. 26.1 ART1 network architecture

ART 1: network architecture (see Fig. 26.1) consists of an element called F1 together with N neurons. The number of neurons (N) should match the input-parameter dimension. The element called F2 is an on-center, off-surround multiplicative-competitive network, with a number of neurons that may grow with the amount of information being stored in the system. In this case, each neuron at a level represents a single category.

This network consists of to levels, which are connected to each other through instar and outstar modules. The instar module matches an F1-level activation state to an F2-level neuron activation, whereas the outstar module plays a dual-instar role. Thus, when an F2-level neuron is activated, the outstar module responds by activating certain stage at F1 within the pattern associated to that particular neuron. Therefore, for the instar module, the content accesses the memory, whereas for the outstar module, the memory accesses the content (Fig. 26.2).

ART 2: Algorithm ART2 is applied to this study due to its capabilities to deal with analog-input codes. Carpenter and Gross-berg (1987) proved that algorithm ART2 can solve the plasticity/stability dilemma, where the storage of new information does not destroy the previous information learnt in a systematic way.

Fig. 26.2 Instar and outstar modules



ART2 has various appealing features that are useful when modeling cognition at phenomena levels. Firstly, unlike many other neural-network models, ART2 is sensitive to the order in which data are presented. Secondly, ART2 networks start at a minimum size and grow as needed whenever a given task is to be leant. Thirdly, the disadvantage caused by plasticity/stability can be explicitly controlled or manipulated. ART2 belongs to an unsupervised-learning algorithm class; hence, this type of models can learn only the statistical regularities found in data. Despite being simple, unsupervised learning is powerful and plausible, and biological systems are known to learn from mere stimuli exposure [13].

26.2 Model Construction

It is important to consider that the model's application is limited to the contents industry, and in particular limited to the electronic film rental service provided by a company called Netflix (via web). The starting point is a filtered search on a film data base that then allows users to select one of the results from such initial search. This company developed a tool that predicts whether users will enjoy the film (or not) based on previous ratings (regarding other films). The main idea is to make personalized recommendations according to user likes and dislikes.

Since the focus of the company is based on user ratings about films, it is common that users do not take film rating seriously and objectively, it is even possible to have different rating from the same user for the same film, which introduces system errors. This is the reason why a contest called The Netflix Prize was launched in an attempt to find alternative methods. In this contest, user information is provided together with film titles, film release dates and film internal codes; the purpose is to allows research teams to validate their models and methods, thus obtaining useful tools for film rental forecasts [14].

26.2.1 Methods and Model Parameters

Information requirement definition according to scope Nowadays, films offer a vast variety of attributes. Such attributes may range from genre to a detailed description of the whole cast; however, not all this attributes are used when presenting a film for clients, neither in the selection processes of other existing recommender systems. For this reason, three (3) basic attributes were established; these attributes not only allow an improvement in the information available for users during the renting process but also offer a better description of the type of selection that clients themselves are performing at a particular time. Thus it is possible to carry out a finer classification process regarding user tendencies. The most important attributes that will help to yield a better (final) recommendation are as follows Genre (First Attribute): Film genre can be classified according to the

Table 26.1 Classification according to film genre

Action and adventure (01)	Faith and spirituality (08)	Special interests (15)
Animation and anime (02)	Foreign (09)	Health and sports (16)
Children and family (03)	Horror (10)	Mystery and suspense
Classics (04)	Independent (11)	TV (18)
Comedy (05)	Music and musicals (12)	Thrillers (19)
Documentaries (06)	Romance (13)	Premiere (20)
Drama (07)	Science fiction and fantasy	

common elements found in films, including aspects such as rhythm, style and the intended feelings on the target audience. Also, films can be defined in terms of their atmosphere or their format. Although there is no general consensus about what the official film classification is, the following genres are often used to establish sub-genres and also to establish hybrid genres by combining them. In order to perform a more user-friendly classification using the model, the following genres were chosen (Table 26.1).

Year (Second Attribute): Users of this kind of service search in order to find a specific film, using the year of release as a filter. For this reason, the world premiere year was chosen as one of the most important attributes when selecting a particular film. In order to present this information for the network, the following categories (regarding years) were proposed (Table 26.2).

As needed, new categories will be added for future decades (10-year period categories). Age-group classification (Third Attribute): Because there is a lot of material and also an easy access to all these products, creating a filtering classification becomes necessary when presenting the recommender results before users. For this reason, age-group classification was considered as one of the most important attributes when presenting information for the network. This classification is based on that of the MPAA ("What each rating means" Motion Picture Association, whose official website is available on: http://www.mpaa.org/ratings/what-each-rating-means.). Thus, the following categories are proposed (Table 26.3).

Definition of input information parameters: In order to facilitate insertion and extraction of information into the network, a type of coding that allows identifying a specific film according to the aforementioned attributes was created. This coding allows manipulating information in a simpler and more efficient way. Coding itself is shown in Fig. 26.3.

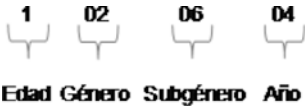
Table 26.2 Categories according to world premiere year

1950–1960 (1)	1980–1990 (4)	2010–20XX (7)
1960–1970 (2)	1990–2000 (5)	
1970–1980 (3)	2000–2010 (6)	

Table 26.3 Classification according to age-groups

G	All audiences (1)
PG	Some of the material is not intended for children (2)
PG13	Some of the material is not suitable for children under 13 (3)
R	Underage audiences must be accompanied by adults (4)
NC17	Not suitable for underage audiences, only for adults (5)

Fig. 26.3 Film-attribute coding



Thus, a particular classification coded 1020604 corresponds to a film with the following attributes: all audiences, Anime or Animation (main genre), Documentary (secondary genre), 1980–1990 (world premiere year).

For the ART1-type neural network, binary-digit information will be handled. This type of codes allows representing the location of element one (1) within a binary-input information vector. In order to clearly illustrate this representation, let us take as an example the aforementioned previous code (1020604). The corresponding vector is as follows:

Code: 1020604

$$C\grave{o}digo : [10000|0100010000000000000|000100]$$

Each category is represented as follows:

$$Edad : [10000]$$

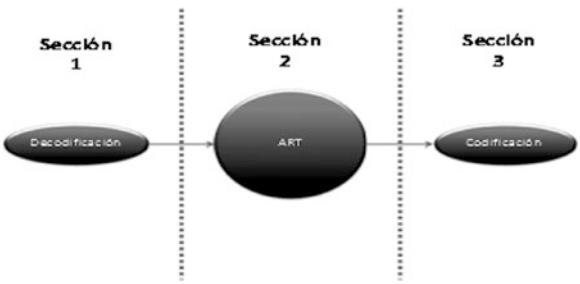
$$C\grave{o}digo : [0100010000000000000]$$

$$A\tilde{n}o : [000100]$$

Thus, the identification process becomes easier to handle by using the category model that will be created (or is already created) by the network.

Determining the necessary parameters according to the network: This type of network only requires specification of the comparison parameter that is utilized when creating the categories or when assigning input information to one of such

Fig. 26.4 Model-network architecture



categories; this parameter is also known as surveillance parameter. For the present model, and considering that the system's sensitivity (when creating new categories) is preferred not to be excessive, nor restrained, the surveillance parameter is assigned with a weight ranging from 60 to 100 % ($0.6 < \rho < 1.0$). This parameter will be accurately determined during model validation.

Establishing the network architecture: The basic network structure consists of (3) sections. Section one (1) includes one (1) node, which makes use of the code to transform input-information attributes into elements that can be chosen by the network. Subsequently, this information is sent to the next section. Section two (2) is an ART network that takes the information from the first node, processes such information, and sends it to section three (3). Section three consists of one (1) node that codifies output information once again according to the aforementioned coding parameters. Fig. 26.4 illustrates this architecture.

On the other hand, network ART includes a number of input neurons that is equal to the input-information vector's dimension, that is, the number of input neurons will be thirty-one (31). Additionally, the network makes use of a Reset neuron and also a Gain neuron, which are an essential part of this type of network. A more detailed description of the elements that constitute the network is provided in the following paragraphs.

Establishing network specifications: ART-type networks use synaptic weights at the junctions between neurons. These synaptic weights may vary as the network learns. This is where the learning storage of the network itself lies. The following is a description of each of the weights, also of how weights are determined and what the role of each weight is. In order to better illustrate weights, see Fig. 26.5

Upward connections: upward connections occur among all neurons that belong to input layer j and all neurons belonging to output layer i. These connections have a synaptic associated to them; the weight in question can be represented by an index and its initial values are given by:

$$W_{jt}(t = 0) = {}^{1}/_{1+N} \tag{26.1}$$

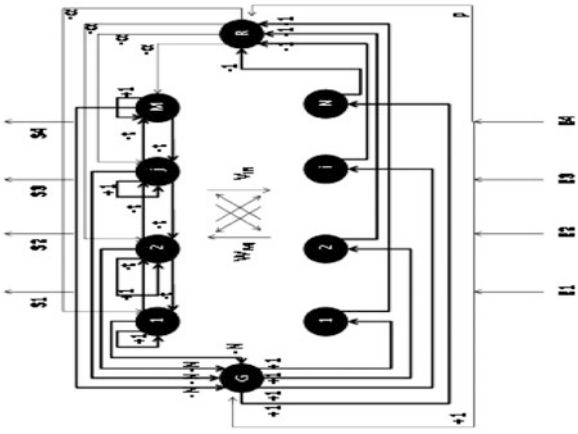


Fig. 26.5 ART network specifications

$$W_{ji}(t+1) = \frac{V_{ij}(t) \cdot e_i^k}{\gamma + \sum_{i=1}^{N} V_{ij}(t) \cdot e_i^{(k)}} \tag{26.2}$$

where N represents the number of neurons of the input layer, K represents the number associated to the input information and γ represents a normalization value, normally zero point five (0.5).

Downward connections: Similar to upward connections, these connections link all output neurons to the input neurons. The synaptic weights associated to these connections are represented with an index V_{ij} and their initial values are given by:

$$V_{ij}(t=0) = 1 \tag{26.3}$$

$$V_{ij}(t+1) = V_{ij}(t) \cdot e_i^{(k)} \tag{26.4}$$

Side connections: These connections only appear for output neurons. The connections allow a neuron to inhibit the activity of neighbor neurons, which ultimately allows the network to achieve the right classification. Each of such connections has an associated synaptic weight equal to:

$$It = {}^{1}/_{M} \tag{26.5}$$

where M represents the number of output neurons.

Self-recurrent connections: When the competition between output neurons occurs, attention must be paid to self-recurrent connections. These connections will back up the winning neuron by considering their own value; this value will always be equal to one (+1) since it represents the influence of a neuron on itself.

Connections from and to the Gain neuron: the value from the output layer neurons arrive at the gain neuron with an associated synaptic weight equal to −N, and the values of the input information arrive with an associated weight equal to (+1). At this point, the neuron compares input values to output values, and the resulting value will flow from the gain neuron towards the input neurons through connections that have synaptic weights equal to one (+1). This allows strengthening the activation of certain amount of input neurons according to the amount of output neurons that get activated by following the two-thirds (2/3) rule.

Connections from and to the Reset neuron: The values received by the Reset neuron come from the input layer neurons that are connected through an associated synaptic weight equal to negative one (−1), and also from the values of input information that are connected through an associated synaptic weight equal to the value of the surveillance parameter (ρ). The neuron compares these values (according to the similarity established by the parameter) and sends inhibiting signals with large negative weights ($-\alpha$) to the output-layer neurons that do not provide a correct representation of the input information.

Model algorithm formulation: In order to perform the construction of the model, the process characteristics and the development method must be established. To facilitate the understanding of such a process we have divided it into three modules, namely a reading-coding module, a classification module, and a

decoding-recommendation module. The following is a presentation of the process together with the dynamics that lead to the completion of the three proposed modules, which ultimately make up the recommender system.

Module 1: Information reading-and-coding: input information will be presented to the model when the user selects the film he/she wishes to rent. According to the coding presented above, the film attributes are identified and so the system proceeds to transform the codes into vectors (as previously specified).

Module 2: Information classification: once the coder receives the information, the model performs the corresponding classification process based on the aforementioned architecture. The detailed process is described next.

Flowchart description (Fig. 26.5):

- Establishing initial values: According to the characteristics of ART networks, the network must initiate its processing with specific initial values for the weights that are to go up and down between the input and output layers, and also for the inhibiting weights.
- Inserting input information: information from the reading-coding stage is inserted into the network through the received vector. This vector will be transmitted to the output layer neurons.
- Calculating output-neurons output: This is the point where output-neurons competition takes place. The corresponding simplified output will be determined by the following expression [15]

$$SN_{sj} = \begin{cases} 1 & MAX\left(\sum_{i=1}^{N} W_{ji} E_i^{(k)}\right) \\ 0 & \text{Re}sto \end{cases} \tag{26.6}$$

- Identifying the highest output value of all output neurons: The previous expression is what determines the neuron(s) that will have an output value equal to one (1), and also the neurons that are to yield an output value equal to zero (0), The neurons whose output value is equal to one (1) will be identified.
- Comparative evaluation of output values: if there is more than one output value equal to one (1), this means that the network is in the first classification; therefore, the network can be assigned any category. In this case, the rule of thumb will be to assign the first category. If, on the contrary, there is only one winning neuron, the system will proceed to calculate the corresponding similitude relationship.
- Calculating the similitude relationship: The similitude relationship allows evaluating whether the input information is being properly represented (according to the surveillance parameter) by the winning category. This relationship is given by the following expressions.

$$\text{Re}lacion\ de\ semejanza = \frac{\left\| E_k \cdot V_j \right\|}{\left\| E_k \right\|} \tag{26.7}$$

where:

$$\left\|E_k \cdot V_{j\cdot}\right\| = \sum_{i=1}^{N} e_i^{(k)} * x_i \tag{26.8}$$

$$\left\| E_k = \sum_{i=1}^{n} e_i^{(k)} \right\| \tag{27.9}$$

$$x_i = \sum_{j=1}^{M} V_{ij} \cdot SN_{sj} = V_{ij\cdot} \tag{26.10}$$

- Comparative evaluation between the similitude relationship and the surveillance parameter: For the input information to be sorted into a particular category, its similitude relationship must surpass the surveillance parameter.
- Assigning a neuron category of higher output value: If the similitude relationship surpasses the surveillance parameter, the input information will be stored into the category that corresponds to the output neuron that yielded the highest output value.
- Creating and assigning a new category: if, on the contrary, the similitude relationship does not surpass the surveillance parameter, the input information will be sorted into a single and newly created category.
- Identifying the category with the largest number of matches: The category with the largest number of elements assigned (matched) will be found. This information will be stored to be used in by the next module.

Module 3: Decoding and recommendation: Once the classification is obtained, the value stored is utilized. Such a value identifies the category that obtained the largest number of matches. Then the system proceeds to make the recommendation. In case there is more than one category with the same number of matches (elements assigned), the category that includes the most recent match will be chosen.

Once a category is chosen, the system continues to decode the output vector according to the coding guidelines. The result of this procedure represents he actual recommendation obtained form the model. This recommendation will be applied as an internal organizing search filter (by date). The net result is a set of film records associated to the recommended category. This is the point where the main goal of the present model lies.

26.3 Validation and Simulation of the Model

The validation of the model considered the characteristics mentioned above, the scope of this study, and also making use of the database provided by The Netflix Prize contest. The following section describes the database structure. Decision factors (already mentioned) are specified together with the model's validation and simulation results.

General Aspects of the Data Set: The database used for this study was obtained directly from the Netflix Prize contest. Permission was granted for research purposes only. This data set consists of the following elements:

- Number of rentals for a particular film (Qualifying): In this data set, the internal code associated to a film is specified together with its records, namely client codes and the dates such film was rented.
- Film title (Movie_titles): In this data set film titles are specified according to its associated internal code.

Based on these two data sets, enquiries were conducted, leading to a new data set that is compatible with the model. This new data set specified the following information:

- Code of the films rented per user, according to the model coding: the model code is specified in this data set. Such a code is associated to the films, and the records are represented by the number of the user that rented the film in question.

Based on this data set, the experiments continued to perform the necessary treatment to conduct a satisfactory simulation and validation of the model.

Treatment performed on the database: Due to the vast amount of records (more than two million—2,817,132) that were available in the NETFLIX database (particularly on a table called Qualifying that was provided for the contest), it was decided that a filter should be applied to the whole database. The filter required enquiries to be performed so as to show the records of films that had been rented more than eight (8) times. This value was chosen after consulting a panel of experts. It was recommended that cluster samples be taken regarding the number of times a film had been rented. In the end, two largest values were chosen and the results corresponded to the records of films that had been rented up to eight (8) or nine (9) times.

This decision was made in order to evaluate a significant amount of data, also allowing the establishment of a considerable (and manageable) number of categories for users. The number of resulting records, that is, the number of films that were rented more than eight times was eighty-six (86) out of more than seventeen thousand (17,770) films. The number of renting records that were obtained was over twenty nine thousand (29,171), and these records were stored after the enquiry called "Users" (rented = 9) that belongs to the class Films with a Code, within the NETFLIX database.

Selecting the simulation and validation tool: In order to sect the most appropriate tool for the simulation and validation of the model, the following elements were regarded as decisive factors:

- Capacity to handle data: The tool to be selected must be capable of handling data matrices in such a way that data can be used as input and output elements to (and from) the model.

- External-tools Integration Capacity: The tool to be selected must be capable of interacting with other tools in terms of data import and export, for the input and output information, respectively.
- Easy-to-use when programming the model: The tool to be selected must provide a friendly and simple environment for the development of the present model.

Regarding the decisive factors above, a decision was made on using MATLAB® version 7.8.0.347 (R2009a) as the simulation and validation tool. In addition to this software tool, it was decided that Microsoft Access® and Microsoft Excel® be the packages in charge of handling databases and the resulting records.

Simulation and validation parameters: During the development of the validation and simulation processes, the only parameter to be considered was the surveillance parameter (ρ), which represents input-information similitude according to the existing prototypes, and also determines the way categories are developed as well as the creation of the network itself.

In this particular case, the value considered for the surveillance parameter was equal to zero point six ($\rho = 0.6$). This value was established in order to verify the new-category creation process as well as the matching of existing categories. This is necessary since, as already explained, such a parameter defines the system's sensitivity when creating new categories.

Simulation and validation: The simulation process started by inserting the input data from database NETFLIX-Query Users (rented = 9), belonging to the class "Films with a Code", into the input matrix.

Once the input matrix was created, the process continued uploading the matrix onto the MATLAB® work space. Then an executable file "Ejecutable.m" was run. This file contains the code that is associated to the model.

Simulation and validation results: Simulation and validation results are sorted into four data sets. These data sets, containing relevant information for the present model, are detailed as follows:

- Matrix for weights V_{ij}: This matrix stores updated weights V_{ij} that are distributed for each user. Each row corresponds to the prototype for each category. Each column corresponds to the values associated to each characteristic according to category, using a row of zeros in between users.
- Matrix for weights W_{ji}: This matrix stores updated weights W_{ji} that are distributed for each user. Each row represents a competition vector for each category. Each column represents the values associated to each of the competition characteristics, using a row of zeros in between users.
- Matrix for Categories (C): This matrix stores the categories where the films rented by each fell into (were classified). Each row represents a rent-record for a particular film together with the category assigned to such record, using a row of zeros in between users.
- Matrix for recommendations: This matrix stores the recommendation category for each user. The rows represent the recommended category and the number of records assigned to such category, using a row of zeros in between users.

This data sets are to be exported onto a spreadsheet so as to create data record (backup) an also for future analysis.

Another important result that is worth considering for future analysis is the processing time that this model has, namely the time spent processing all the records included in the input matrix.

26.4 Discussion on Simulation and Validation Results

Once the results from the model were obtained, the resulting data set contained in the matrix (Recommendation—matrix R) was evaluated, since this matrix represents the output o the whole model.

In order to verify model effectiveness, a desktop test was performed, choosing a random record number. This record number referred to a specific user from whom records were taken o apply the model. Results obtained after the desktop tests are shown next:

$$n := \frac{z^2 \rho(\rho - q)}{\varepsilon^2} \tag{26.15}$$

In the expression above, represents the normal deviation that corresponds to the desired trust level, which in this particular case, was set to be 95 % (Z = 1.65). The probability of success (the right matching of categories and the right recommendation) was set at 80 %. The probability of failure (1) and, which is the maximum error tolerable (3 %) were also established. After performing calculations using Eq. (26.15), the sample size was equal to four hundred and eighty one (481). This calculation included a procedure with random sampling for the definition of users and the information to be evaluated. From this, records were taken and the model was applied.

This information was compared to the categories already assigned and also to the recommendation developed in Matrix C and Matrix R, respectively, which were conducted with the whole of the data. Thus, it was possible to confirm the independence condition between networks for each user, that is, a network is created for each user with its own categories and recommendations; as established. This allows personalizing the final recommendations according to the user's own historical rent records.

On the other hand, the processing time that was obtained from the model for the input matrix (previously mentioned), that is, for a number of records over twenty nine thousand (29,171), was about hundred and fifty seconds (454.64). This period of time does not include the time spent exporting the results, since such a process is external to the model itself and its time span depends on the type of management employed by the mathematical software package regarding memory (memory resources where the algorithm runs) as well as the external elements that are involved in the export process.

- On-line learning is one of the key aspects (that can be better used) of neural networks within the context of web applications, since most of the current intelligent agents require user supervision. This kind of supervision makes data analysis and data storage more complicated. On the other hand, the computational cost might be reduced since there are fewer variables to be store and also the processing speed for incoming information is reduced.
- Neural network models that include on-line learning allow implementing models (like the one proposed in this study) in other environments and/or markets only by making minor adjustments to the input parameters according to particular evaluation aspects.
- The development of tools that involve intelligent agents and business intelligence, and whose purpose is to analyze trends and/or forecast behaviors, offer competitive advantages for companies. This type of tools encourages loyal behavior in clients and may increase the number of potential clients significantly. Moreover, these tools allow obtaining real-time information, avoiding the costs associated to previous-records revision so as to meet the specified objectives.
- The model facilitates statistical treatment of variables since the prototypes constructed for each category represent user's preferences, gathering the relevant information from the historical renting record of that client. This reduces the number of records per variable, allowing the establishment of strategies and also accelerating the decision making process.

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Chapter 27
Design and Development of a Location-Based Advertising and Recommending System

Chien-Hsing Wu, Dong-Jyu Huang and Flora Peng

Abstract This paper designs and develops a prototype of Location-based Advertising and Recommending System (LBARS) system. The LBARS utilizes the techniques of GIS, GPS and location-based service to sense users' location and send advertising message to those who are within the defined area and/or time zone. A salient function of the system mechanism is to recommend advertising messages with priority according to parameters that include user defined preference, distance and time. An illustrated example is used to demonstrate the prototype system.

Keywords: Location-based service · Advertisement and recommendation system · Mobile value-added service

27.1 Background

Context-Aware has been seen an important research domain which claims that any system which can analyze who, what, when, where, and which within the ambient environment is regarded a context-aware system [1]. It is used in the recommending system [2] because in addition to his/her experiences when customers make decisions they will be usually influenced by the ambient he or she is in.

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Fig. 27.1 The conceptual framework of the LBARS

Location-based service has been seen an important mobile value-added service. Traditional channel to pass marketing messages generally is to hang posters and/or to publish on newspapers or magazines [4, 5, 8]. To date, this channel has been replaced by mobile marketing by utilizing location-based service (LBS). The LBS has four basic types of applications: (1) mobile banking, (2) mobile advertisement, and (3) position tracking [7]. In particular, the positioning tracking model has been used to sending message to customers in the domain of commerce.

Nowadays, there has been an LBA platform available called Vpon, but it has only LBSA without recommending system. The advertisement without recommending will be a kind of spam [3, 6], so the research designs and develops a LBA system which integrated LBA and recommending system. The research described in this paper basically is to design and develop the service system mentioned in [8] and add the function of recommendation (Location-based Advertising and Recommending System, LBARS). The conceptual framework of the LBARS is illustrated in Fig. 27.1. First, the service provider sets up the server of LBARS and 3G mobile phone users install the client side software. Sever provide a website for store marketer to type and send promotion (or commercial) information (such as

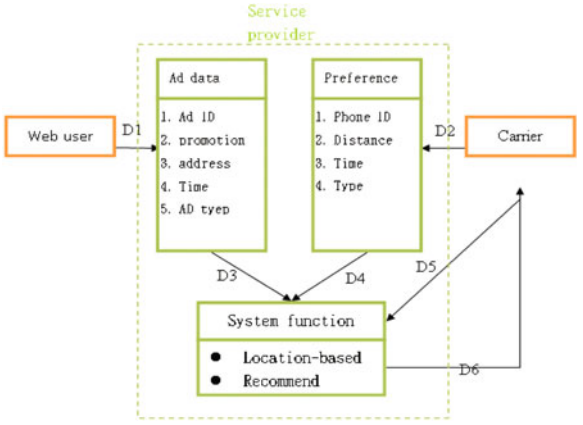

Fig. 27.2 The LABRS Framework

sales information, when to open and close, store address, target area), and save into the designed database. Finally LBARS on the server will frequently detect the location of users and send promotion information to those (target users) who are in the target zone. By using the developed prototype system of LBARS, the advertiser can enter a promotion message onto the web page, and the LBARS will recommend the best messages to the user according to the recommendation mechanism.

27.2 Method

The LBARS framework is presented in Fig. 27.2. The framework consists three parts: web users (e.g., advertiser), carriers (e.g., phone users), and service provider.

First, the Web users basically is the advertiser who can type the promotion messages to the LBARS's web, and through the data stream (D1) to the LBARS's database, including ad ids, promotion messages, the shop address, the advertising type, and promotion time. Before a user uses the system, the LBARS system will ask the user whether or not he or she allow location to be detected and returned information to the server. If yes, the system will get the user's location (D5), and the users will have to give the preference stored back to the LBARS's database, including phone ids, distance preference, time preference, time preference, type preference (D2).

Second, in service provider part the location-based function is designed for that when the advertiser types the promotion message to the server, the server will send the message to Google push notification cloud server. When the user comes in the defined area the cloud server will push the message to the user if he or she allows. The recommend function is designed to determine the message priority shown on the user's cell phone. In fact, before counting for the recommendation score, the ad dynamic properties are collected and used as the input of formula 1. The ad dynamic properties will depend on the distance between the user's and the shop's location or on the time between the user's time when he or she comes into the area and/or within the time between.

Moreover, the user preferences are collected as the input of formula 2. Generally, the LBARS needs to allow a user to pick one of preferences from distance or time. As the user uses the LBARS thereafter, his or her preferences will be stored in database every time a use occurs, and a learning mechanism will return the best preference according to the use profile.

Assume number of properties m, and every user's default are $U_1 \sim U_m$. Formula 2 as follow, k = 1, 2,…..m (number of properties).

We refer to [9]. In the information set, the dynamic properties of location-based A_i are $A_{i1} \sim A_{im}$, and the preference properties of user U_j are $U_{j1} \sim U_{jm}$. The recommend score formula 3 as follow.

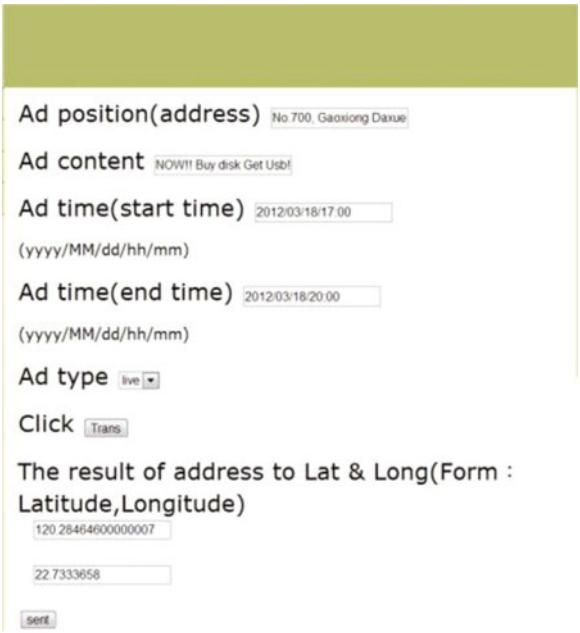

Fig. 27.3 The service provider's website

Because of the type filter, users will decide what ad type they want, so we fix the formula 3 to formula 4 as follow, T is the type what the user choice, the value either 1 or 0.The formula 1 and 2 are as follow.

$$D' = \frac{D - D_B}{D} \tag{27.1}$$

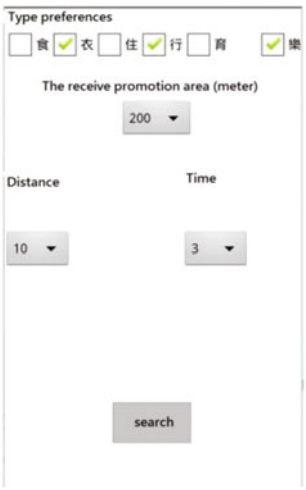

Fig. 27.4 The carrier page

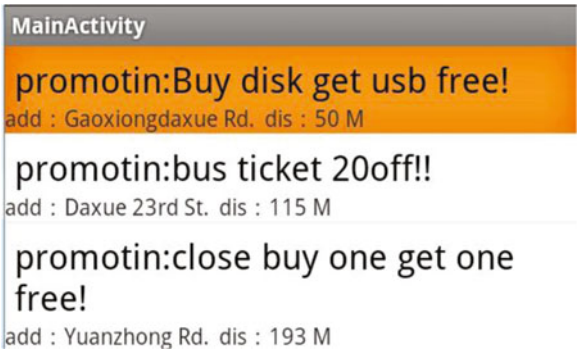

Fig. 27.5 The output from Fig. 27.4

$$w = \frac{U_k}{\sum_{v=1}^{m} U_v} \tag{27.2}$$

$$\sum_{k=1}^{m} A_{ik} U_{jk} \tag{27.3}$$

$$\sum_{k=1}^{m} A_{ik} U_{jk} \times T \tag{27.4}$$

27.3 An Illustrated Example

To demonstrate the LBARS prototype system, the paper presents an example. Figure 27.3 shows the web user typing the promotion message on the service provider's website, and after he submitted all the information, the information is stored in the server. Figure 27.4 shows the carrier side that a user starts using the system, so he or she has to choose preferences. It shows that the types chosen are closing, traffic, and amusement. The range is 200 m, the distance preference is 10, and the time preference is 3. When he click the "start searching" button, the system will start to find the shop location according to the user's location and the parameters the user defined. The recommendation function filters the type he defines to be pushed and counts for the recommendation score by the preference he had chosen. The Fig. 27.5 shows the results of Fig. 27.4.

27.4 Conclusion

The LBARS prototype is designed and developed in the research. It integrates the techniques of GIS, GPS, LBS to fulfill the need of mobile advertisement for advertisers in a real-time manner. The mechanism used to derive information

priority, recommend information, and send information to cell phone users is in particular important because previous studies in literature put emphases only on the position tracking and message delivery, without considering the issue of information loading. Although the prototype has been validated with respect to the feasibility and functionality evaluation and feedback from advertisers and 3G cell phone users needs to be conducted further.

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Chapter 28
Visualising Outliers in Nominal Data

Swee Chuan Tan

Abstract Scatter plot is a useful method for visualising clusters and outliers in continuous data. However, this method cannot be used directly on nominal data due to a lack of natural ordering and 'distance' in nominal values. One solution to this problem is to *map* the multi-dimensional nominal data to a numeric space, and then draw a scatter plot of the data points based on the first two principal components of the numeric space. This paper reports a study on how such plots can be generated using three types of mapping: (a) Binary Input Mapping (BImap), (b) Attribute Value Frequency Mapping (AVFmap), and (c) BImap combined with AVFmap. Results show that the combined method draws upon the complementary strengths of BImap and AVFmap, to generate meaningful scatter plots for visualising categorical outliers and achieve the highest information gain among the methods tested.

28.1 Introduction

In knowledge discovery process, data visualisation can be used to uncover new knowledge of a system, which forms the basis for deriving useful and actionable insights. Among existing data visualisation tools, scatter plot is a simple yet useful tool for understanding proximity and similarity of data points. By Gestalt principles [1], humans view spatially close objects as groups, and view objects of the same size, colour or shape as similar. Hence, we can use scatter plots to identify clusters of similar data points as well as differentiate data points that exist in different parts of the plot. We can also incorporate shapes, colours and sizes to highlight object similarity.

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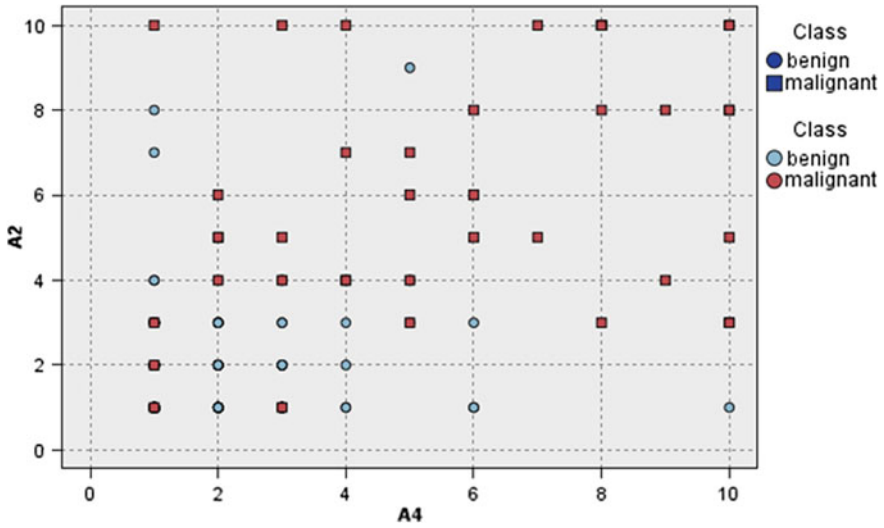

Fig. 28.1 A scatter plot of ordinal variables (*A2* Uniformity of cell size, *A4* Marginal adhesion) of the Wisconsin breast cancer dataset [2]

Assume that there is a certain process generating data points that cluster within certain data subspace(s). Usually, data points generated by another process are likely to have a different pattern, and are likely to occur in a different subspace. Using a topology-preserving dimension reduction method, a two-dimensional scatter plot can be used to portray these patterns, which allows users to gain insights into the underlying generating processes.

While scatter plots have commonly been used for analysis of continuous data, our work focuses on analysing outliers (from clusters) in multi-dimensional nominal data. At first sight, it appears counter-intuitive to apply scatter plots for analysis of multi-dimensional nominal data. This is because nominal values do not have natural ordering, let alone the notion of 'distance'. In addition, drawing a scatter plot based on categorical data may make little or no sense, such as the one shown in Fig. 28.1.

One solution to this problem is to map the nominal values to certain numeric space, and then project the numeric space to a lower dimensional space using Principal Component Analysis (PCA) [3], so that a scatter plot can be drawn using the first two principal components. PCA is useful here because it preserves the topology of the numeric data space.

Using the above approach, we explore three different ways of mapping nominal data to the numeric space, namely:

- **Map Nominal to Binary Inputs (BI) Attributes**: this method characterises the *magnitude of differences* in values between nominal instances.
- **Map Nominal to Attribute Value Frequency (AVF) Attributes**: this method characterises the *frequency of occurrences* of categorical values [4], which is known to be an important aspect of outlier analysis [5].

- **Map Nominal to BI and AVF Attributes**: this method combines BI and AVF data so as to draw upon their complementary strengths.

This study shows that scatter plots generated based on combined BI and AVF data are meaningful and retain important information captured by BI and AVF attributes. Unlike existing methods, the proposed method is designed for visualising outliers in multi-dimensional nominal data and does not require knowledge of the application domain [6] and knowledge of normal instances [7].

The rest of this paper is organised as follows. Section 28.2 reviews related work. Section 28.3 presents methods using scatter plots for visualising categorical outliers. Section 28.4 discusses experimental details and results, and Sect. 28.5 concludes this paper.

28.2 Related Work

Nominal Data Visualization: There have been several studies on visualisation of nominal data. Some example exploratory techniques include Sieve Diagrams and Mosaic Displays [8], Dimensional Stacking [9], and Parallel Sets [10]. Most of these techniques are limited to data sets that have a few attributes. Another useful technique is Multiple Correspondence Analysis [11], which provides a graphical display of distances among points in a contingency table, rather than the original data points. Shiraishi et al. proposed a display for groups of categorical data [12], but the positions of data points are not derived from the topology of the data space.

There are also approaches that map the nominal categorical values to numeric type. For example, Rabenhorst [13] mapped a list of character strings to integers, where each integer corresponds to the alphabetical order of a character string. This approach makes a strong assumption that categorical items are ordered alphabetically. Also, the method is not designed to view multi-dimensional data.

Rosario et al. [14] proposed Distance-Quantification-Classing (DQC) to preprocess nominal data into numeric form, so that visual exploration of data can be performed using a parallel coordinate plot. Unlike DQC, this paper focuses on mapping nominal data to numeric form for the purpose of outlier analysis using scatter plots.

Ma and Hellerstein [6] proposed a way to order categorical values based on domain semantics and apply this approach to scatter plots and parallel coordinate plots in the area of network management. Unlike this approach, our approach does not require domain knowledge to map categorical values; instead, we simply map the nominal data to continuous space using binary inputs or AVF, or both.

Chandola et. al [7] introduced the concept of separability statistics for mapping categorical data to continuous space. This is a semi-supervised approach because the proposed method requires a labelled reference data set to be available to generate the statistics. In contrast, the approach described in this paper does not require labelled data to perform mapping.

Attribute Value Frequency for Outlier Detection: Here we examine the idea of applying attribute-value frequencies for outlier detection. In the literature, outliers are commonly referred to as instances that are *few and different* [15].

Being ***few*** means that the outliers are the **minority** (i.e., rare) records in a data set, compared with most other data points that make up the majority pattern. This implies that the proportion of outlier records in a data set is relatively small. We refer this as the **minority property** of outliers.

Being ***different*** means that outliers exhibit **different** pattern(s) compared to the majority pattern(s) made up by most other data points. This implies that outliers contain attribute values that are different from most other data points. We refer this as the **dissimilar property** of outliers.

Based on these tacit assumptions of outlier properties, the "outlyingness" of outliers can be measured using attribute-value frequency (AVF) proposed by Koufakou et al. [5]. Let $f(x_{i\,j})$ be the number of times the jth attribute of instance x_i carrying a certain value, and the average AVF can be defined as follow: average $\text{AVF}(x_i) = 1/m \cdot \sum f(x_{ij})$. Given that m is number of categorical variables, the summation runs from $j = 1, 2, \ldots, m$.

Hence, outliers are expected to exhibit lower attribute-value frequency scores (i.e., lower AVF scores) than most other records with high attribute-value frequency scores. Koufakou et al. [5] showed that the average AVF is very effective for ranking outliers, despite its simplicity.

Inspired by Koufakou's work, this study will investigate how AVF can be incorporated into a scatter plot to give meaningful representation of outliers' positions within the data space. This can be achieved by drawing a two-dimensional scatter plot using the first two principal components of the AVF space. As long as the outliers possess the Minority and Dissimilar properties, the scatter plot will give a reasonable spatial separation between low-frequency outliers and high-frequency majority data points, facilitating outlier visualisation.

28.3 Using Scatter Plots for Visualising Categorical Outliers

As mentioned, a natural approach to visualising categorical outliers is to map the nominal data to a numeric space, and then reduce it to two principal dimensions for scatter plot visualisation. Here we present three methods for mapping nominal data to numeric space.

28.3.1 Scatter Plots of Categorical Data using Binary Input Data

The first mapping method is to convert nominal data to binary-input (BI) data. Let A be a nominal attribute with a finite set of k values, $A = \{a_1, a_2,\ldots, a_k\}$. We denote a binary input of A as $BI_{ai} = 1$ if $A = a_i$; and $BI_{ai} = 0$ otherwise. We also denote such a mapping to BI data as BI map.

When a nominal variable A with k values is converted into k binary input variables, there is a fixed distance between any two different values of A. Recall that outliers are usually few and different, so this approach provides a way to differentiate outliers from normal data points based on *magnitude of differences* in their values. A plot based on BI data will characterise the magnitude of differences between all possible pairs of data points in the data space.

However, BI data does not account for low-frequency (i.e., few) outliers, and may fail to detect less frequently occurring outliers having values not well differentiated from the majority data points. As an example, we consider Table 28.1. When using BI data, the distances among records $R1$, $R2$ and $R3$ have the following property: $d(R1, R2) = d(R1, R3) = d(R2, R3)$. Although the set of values observed in $R3$ also occurs in $R4$ (i.e., the frequency of occurrence for the set of values in $R3$ and $R4$ is two), this piece of information is not captured in distances computed using BI data. In other words, it fails to consider the fact that $R3$ occurs more frequently than $R1$ and $R2$.

28.3.2 Scatter Plots of Categorical Data using AVF Data

The second method is to draw a scatter plot using AVF data. Unlike using BI data, a distance computed using AVF data is good at characterising the *frequency of differences* between data points. Consider an example in Table 28.1, in which the Euclidean distance between $R1$ and $R2$ computed using AVF data is $d(R1, R2) = 0$, which is less than $d(R1, R3) = 0.354$. This suggests that AVF data is better at characterising the differences in data points based on their frequency of occurrences. We denote such a mapping as AVFmap.

Table 28.1 A set of simple records for illustrating the properties of binary input and AVF Data

Original data			Binary input data		AVF data	
Record	A1	A2	A1_C1C2C3	A2_C5C6C7	A1_AVF	A2_AVF
R1	C1	C5	100	100	0.25	0.25
R2	C2	C6	010	010	0.25	0.25
R3	C3	C7	001	001	0.5	0.5
R4	C3	C7	001	001	0.5	0.5

Table 28.2 Strengths and weaknesses of BImap, AVFmap and BIAVFmap

Mapping	Measure Magnitude of Differences	Measure Frequency of Differences
BImap	Yes	No
AVFmap	No	Yes
BIAVFmap	Yes	Yes

Note that AVF does not consider the magnitude of difference between records $R1$ and $R2$. Table 28.1 shows that although records $R1$ and $R2$ are different in terms of categorical values, they are mapped to the same set of AVF scores. This implies that scatter plots generated from AVF data may create overlaps of data points as it could map different data points having the same set of frequency values onto the same AVF point.

28.3.3 Scatter Plots of Categorical Data using Binary Input and AVF Data

The third mapping method is to draw upon the complementary strengths of BImap and AVFmap. This is achieved by simply combining the BI data and AVF data. More formally, let $d_{AVF}(p, q)$ and $d_{BI}(p, q)$ be the Euclidean distances of instances p and q computed using AVF data and BI data, respectively. Then, $d_{BIAVF}(p, q) = \sqrt{((d_{AVF}(p, q))^2 + (d_{BI}(p, q))^2)}$, which is the Euclidean distance of p and q using the combined data of BI and AVF. Since this approach uses more information, it is likely to portray the data distribution more meaningfully; compared to scatter plots generated using either BI or AVF data. We denote this approach as BIAVFmap.

While we expect BIAVFmap to work well in most cases, we also note that sometimes it may produce the same plot as BImap and AVFmap. For example, consider a subset of data in Table 28.1 that is made up of only records R3 and R4. In this case, the distance between R3 and R4 is the same using BI data or AVF data. In addition, the relative distance between R3 and R4 is also the same even when BI and AVF data are combined. More specifically, if $d_{AVF}(p, q) = k\, d_{BI}(p, q)$ for any pair of instances p and q in a data set, then $d_{BIAVF}(p, q) = \sqrt{(1 + k^2)}.\, d_{BI}(p, q)$, where k is a constant. This is when BIAVFmap may not enhance the scatter plot visualisation.

28.3.4 Summary of Strengths and Weakness of BImap, AVFmap and BIAVFmap

Table 28.2 gives a summary of the strengths and weaknesses of the three methods presented so far. BIAVFmap appears to be the most promising method since it measures both magnitude and frequency of differences.

Table 28.3 Data sets obtained from the UCI machine learning repository [2]. Wisconsin Breast Cancer data set has the number of malignant cases reduced (to 39 cases) based on the procedure described by Koufakou et al. [5]. All attributes are treated as nominal type

Data set	Number of instances	Number of attributes	Outlier class	Outlier (%)
Wisconsin Breast Cancer	483	10	Class 4 "malignant"	8
Hayes-Roth	160	5	Class 3	19
Lymphography	148	19	Class "fibrosis" and "normal"	4

28.4 Experimental Details and Results

We obtain three data sets from the UCI Machine Learning Repository [2]. These data sets are used to illustrate the strengths and weaknesses of the methods studied. The details of these data sets are provided in Table 28.3.

As for the tools used for the experiments, a Pentium PC with Windows 7 and IBM SPSS Modeller 15 installed was used for performing the PCA projection as well as generating scatter plots.

To perform objective evaluation of the scatter plot quality produced by the three mapping methods, we adopt the Information Gain measure. Let S be a set of all data points, Gain(S, P) is defined as the expected reduction in information entropy [16] due to the operation P. Let p and p^* be respectively the proportions of positive and negative examples in S, entropy is defined as $\text{Entropy}(S) = -p \log_2 p - p^* \log_2 p^*$. Then $\text{Gain}(S, P) = \text{Entropy}(S) - \sum |S_v| / |S| \cdot \text{Entropy}(S_v)$, where v is a subspace in the projected two-dimensional space produced by P. In our experiments, we partition the projected two-dimensional space (on the scatter plot) into 36 equally-sized subspaces. In short, we expect a better mapping method to achieve higher Information Gain.

Plots based on the Wisconsin Data Set: Fig. 28.2a shows a scatter plot of the Wisconsin data set based on AVF data only. The size of a plotted data point indicates the number of records occupying the same point. Some of the data points are labelled with numbers indicating the degree of outlyingness ranked using the average AVF, with smaller numbers representing more outlying points. The plot in Fig. 28.2a reveals that the benign and malignant cases are well differentiated across the horizontal axis (which is the first principal component), but a lot less so across the vertical axis (which is the second principal component). Based on what is already known about this data set, the benign cases are expected to be less scattered than the malignant cases. In this case, AVF is found to portray only part of the expected data profile because it only measures the frequency (but not the magnitude) of differences among observations.

Figure 28.2b shows the scatter plot of the Wisconsin data set based on BI data only. Recall that BI measures the magnitude of differences between instances, rather than how often the instances differ. This perspective of the data shows that

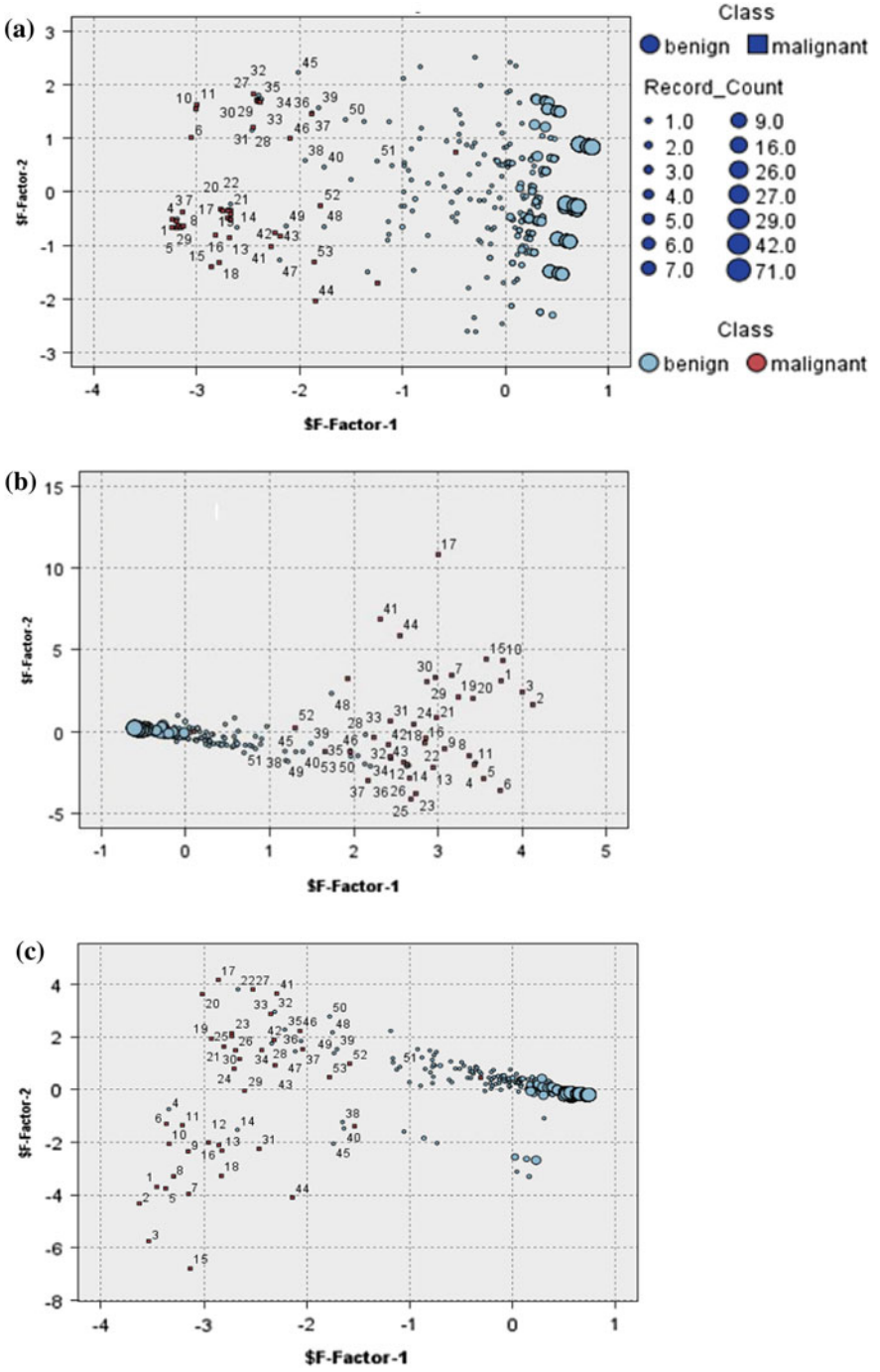

Fig. 28.2 A scatter plot of Wisconsin breast cancer data using the AVF, BI and BIAVF data, **a** Scatter plot of Wisconsin breast cancer data using AVF data, **b** Scatter plot of Wisconsin breast cancer data using the BI data, **c** Scatter plot of Wisconsin breast cancer data using the BIAVF data

benign cases are very similar and malignant cases tend to be disparate in characteristics, which conforms to the actual characteristics of this data set.

Finally, Fig. 28.2c shows the scatter plot generated based on combined BI and AVF data. This plot shows that the benign cases are densely populated and similar in characteristics, while the malignant cases are more scattered and markedly different from the benign cases. It is also interesting to note that the quality of Fig. 28.2c, which is generated with Wisconsin data set treated *nominally*, is very similar to the scatter plot generated by PCA on the original data set treated *numerically*. The latter plot is not shown here due to space constraint.

Plots based on the Lymphography Data Set. Figure 28.3 shows the scatter plot of the Lymphography data set based on the combined AVF and BI data. The plot shows a natural separation between the inliers and outliers, and users can identify most of the outliers by exploring the isolated data points. While it is also possible to generate a similar plot using a semi-supervised approach (e.g., [7]), one would need to obtain a sample of the inliers as the reference set, which may not be available in practice.

For this data set, the plots that are produced from the BI data alone or AVF data alone, are found to be very similar to the plot generated using both AVF and BI data. This is not surprising because we have shown that there are situations where BIAVFmap may even produce the same results as BImap and AVFmap. For simplicity, only the plot generated based on BIAVFmap is shown.

Plots based on the Hayes-Roth Data Set. Figure 28.4a shows the scatter plot of the Hayes-Roth data set based on the AVF data only. The plot reveals that the inliers and outliers are well separated, but there are too many overlapped inliers. Compared to Fig. 28.4b, which is the plot generated based on BI data, it is easy to see that the inliers are more scattered that those in Fig. 28.4a. However, the inliers

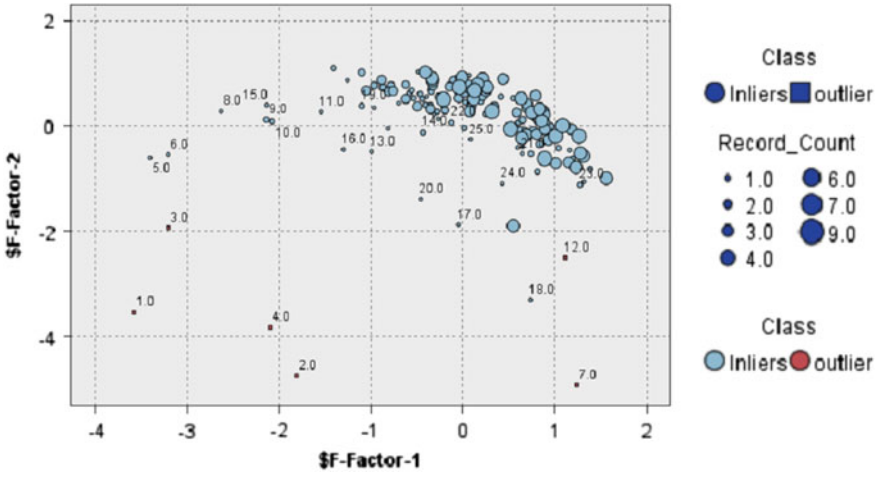

Fig. 28.3 A scatter plot of Lymphography data using the BIAVF data

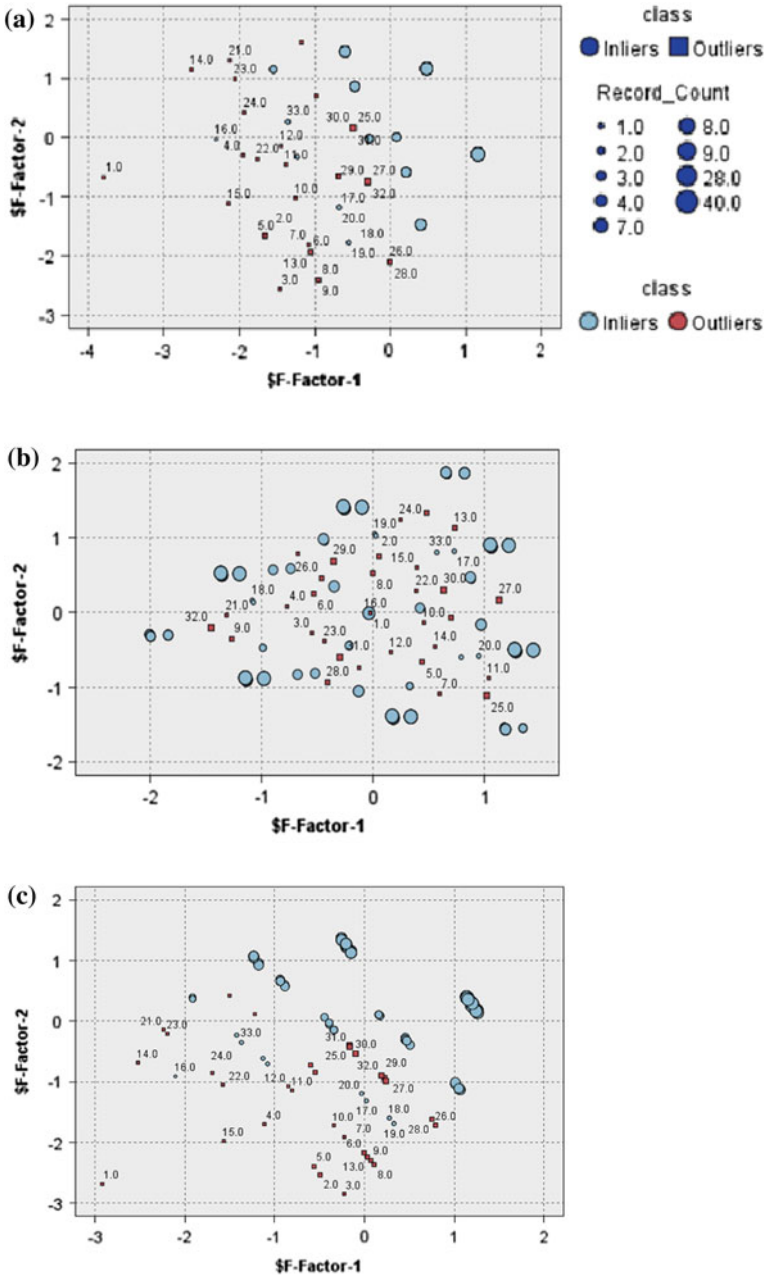

Fig. 28.4 A scatter plot of Hayes-Roth data using the AVF, BI and BIAVF data, **a** Scatter plot of Hayes-Roth data using the AVF data, **b** Scatter plot of Hayes-Roth data using the BI data, **c** Scatter plot of Hayes-Roth data using the combined BI and AVF data

Table 4 Results on the performance of the three mapping methods show that BIAVFmap gives the highest information gain in all the data sets

Data set	BImap	AVFmap	BIAVFmap
Wisconsin Breast Cancer	0.3267	0.3247	**0.3281**
Hayes-Roth	0.3275	0.5173	**0.5427**
Lymphography	0.2228	0.2262	**0.2448**

and outliers are not well separated in Fig. 28.4b. In this case, plot based on BI data is not a good characterisation of the outlying cases as most of these cases are enclosed by, and mixed with, the inliers.

Finally, Fig. 28.4c shows that the plot generated based on combined AVF and BI data gives a more balanced view with the inliers being well separated from the outliers, and the inliers are not as overlapped as those in Fig. 28.4a.

Further Evaluation of Scatter Plots. So far we have interpreted and discussed the quality the generated scatter plots. Here we provide an objective evaluation of these plots using Information Gain. In general, we expect a higher information gain for a better plot. Table 28.4 gives a summary of the results obtained from the plots. It shows that among the three mapping methods, BIAVFmap achieves the highest Information Gain in all the three data sets. This implies that BIAVFmap is able to produce scatter plots that contain subspaces with outliers that are better differentiated from most other data points.

Note that the Information Gain results also agree with our earlier interpretations of the generated plots. For example, on the Wisconsin data set, we considered BImap as producing a better scatter plot than that produced by AVFmap in the previous subsection. Notice that this rating is reflected in Table 28.4, with BImap achieving higher Information Gain than AVFmap. Similarly, we regarded BImap as producing the worst scatter plot for Hayes-Roth data set in the previous subsection, and this rating is also correctly reflected in Table 28.4 as well.

28.5 Concluding Remarks

This study shows that BImap captures the *magnitude of differences* between categorical data points; but cannot differentiate rare anomalies from most other data points that make up the majority pattern. On the other hand, AVFmap characterises the *few* property, but does not consider the magnitude of differences in values. This study shows that combining AVF and BI data effectively characterises both the few and difference properties of outliers, and usually results in higher quality scatter plots. The results also suggest that BIAVFmap achieve higher Information Gain and is likely to be more effective for outlier analysis.

One aspect that has not been considered in this paper is the use of *nonlinear* PCA [17] for analysing the data sets. Yet, our recent study shows that a scatter plot generated using nonlinear PCA on the Wisconsin Breast Cancer data (treated as nominal) is very similar to the scatter plot generated using BIAVFmap. On the

other hand, the scatter plot results based on the Hayes-Roth data suggest that BIAVFmap is better than nonlinear PCA. We will present a more detailed analysis of this finding in the near future.

Finally, details of data sets and methods will be available online to facilitate further research in this area.

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Part IV
Knowledge Management and Social Network

Chapter 29
Knowledge Management Model Supported by Social Networks. Case: University-Enterprise

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Abstract This paper presents a knowledge management model to strengthen the relations between the university and the enterprise, and to facilitate joint strategies and interaction with social networks support. The use of social networks in this model focuses on creating bidirectional links between the university and the enterprise, based on informal exchange of knowledge and sharing information of interest to both actors. The expectations the model use is analyzed through the application of a survey of a population sample of Colombian university students, where the results show the good attitude of these to use social networks in knowledge management to support the relations between the university and the enterprise.

Keywords Social networks · Knowledge management · Entrepreneurial · University · Knowledge management model

29.1 Introduction

The boom of social networks worldwide is a phenomenon that involves the whole society, one of the social networks that has grown is Facebook, that has over one billion users worldwide, and the numbers continue to grow day by day. Due to the

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DOI: 10.1007/978-94-007-7287-8_29,

proliferation in the use of these networks, there is a need to involve the university academic community (professors, teachers, researchers, managers, etc.) and the business community to interact with each other through the use of available networks, to support and enhance knowledge management within the university, the enterprise and research.

When in universities knowledge management is not done correctly because of the problem with organizational learning processes. As a result, it does not have the intellectual capital expected. Hence, to develop these processes, the universities must be able to focus on a team approach, adopting a network model. Currently universities are providing social networking facility that supports the exchange of information and communication, becoming a source of learning and continuous improvement.

For these reasons, the KM-U model (Model of Knowledge Management in University) was supplemented [1], adding a node entrepreneurial with the influence of social networks, to support a more easy and effective knowledge management within universities and interrelationships with the enterprises.

29.2 Conceptualization

Although knowledge management, today is a booming business, but in the university, members of the academic community at large number do not really know what it involves when managing knowledge. Most of them use the information that flows through processes that support activities such as learning, problem solving, strategic planning and decision making but do really understand, what is involved thereby, not adding value to the organization processes.

Man uses knowledge management to interact with others, for example the simple fact of how a father teaches his son the most basic things of life or a teacher teaches his students a particular topic, make implicitly in use [2].

Organizations today no matter what they are engaged in, they have realized that there are intangible assets that must be well managed in order to create competitive advantage and to compete in a globalized economy. Within these assets we can find the information and knowledge what we call knowledge management. This is defined [3] as the set of processes that direct the analysis, dissemination, use and transfer of experiences, information and knowledge among all members of an organization to generate value Tables 29.1, 29.2, 29.3, 29.4, 29.5, 29.6, 29.7.

Table 29.1 The active use of social networks

Questions	Answers	Percentage (%)
Yes	70	97
No	2	3

Table 29.2 Good know social networks

Social network	Answers	Percentage (%)
Facebook	71	99
Tuenti	2	3
MySpace	35	49
Twitter	58	81
eLearningSocial	0	0
Netlog	9	13
Flickr	8	11
OdioAMiCompi	0	0
Xculpture	0	0
LiveSpaces	7	10
Other	2	3

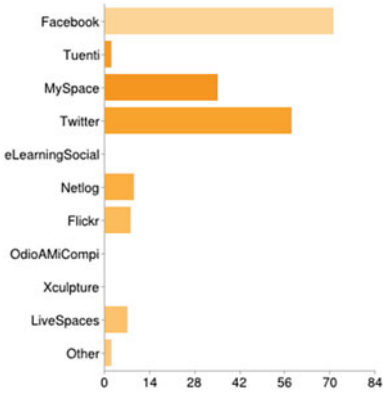


Table 29.3 Use of social networks academically

Questions	Answers	Percentage (%)
Yes	53	74
No	19	26

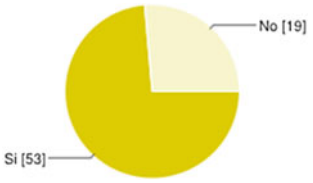


Table 29.4 Time on-line daily

Duration in hours	Answers	Percentage (%)
Menos de 1 hora	15	21
Entre 1 y 3 horas	38	53
Entre 3 y 5 horas	9	13
Más de 5 horas	10	14

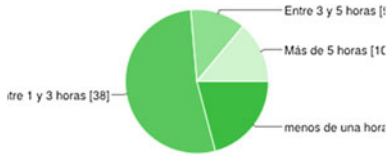


Table 29.5 Preferences in use of the social networks

Social network	Answers	Percentage (%)
Facebook	47	65
Tuenti	3	4
MySpace	7	10
Twitter	43	60
eLearningSocial	4	6
Netlog	6	8
Flickr	7	10
OdioAMiCompi	1	1
Xculpture	4	6
LiveSpaces	2	3
Other	1	1

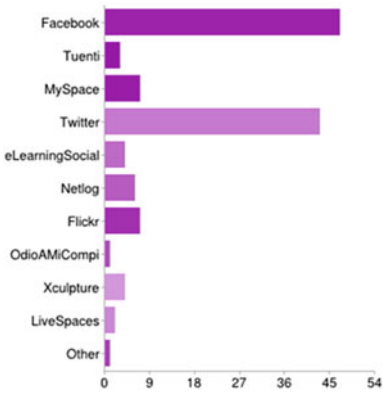


Table 29.6 Activities of knowledge management that can be carried out through the social networks

Activities	Answers	Percentage (%)
To share document	58	81
To share pictures	35	49
To foment the communication among enterprise-university	53	74
To share knowledge among educational	28	39
To share knowledge among students	36	50
To share knowledge among educational and students	57	79
To share knowledge among users	24	33
To foment the communication	35	49
To share the knowledge that is generated between university and company	28	39
Other	0	0

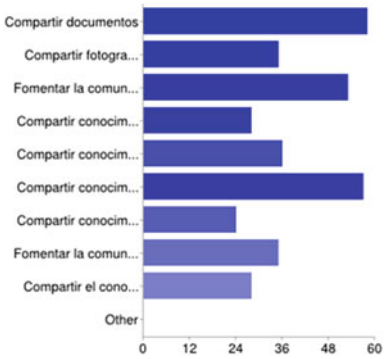
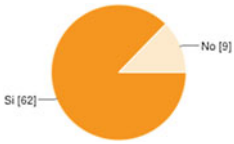


Table 29.7 Disposition in the use of the social networks

Questions	Answers	Percentage (%)
Yes	62	86
No	9	13



The use of social networks by the members of the academic community is a means of interaction among the academic community is known as digital culture. Certainly the role of social network in these virtual platforms between society and the possibilities they offer are many. Majority of them are only used as entertainment, fun and contact with friends and acquaintances. The question is why not using them as a support tool for managing knowledge within the university in a professional way.

To achieve this, we need a knowledge management model that links the academy, the research and the business sector with the support of ICT online with the use of social networks in order to manage information and knowledge to be generated as a result of the implementation of strategic plans in organizations.

29.2.1 Social Networks and Knowledge Management

Internet social networks are technological support tools for interactions between people who share a common interest. They are virtualization or the abstraction computing social networks previously built and maintained through face interaction. These social networking websites, represented through tools such as Facebook, MySpace, Twitter, LinkeId, Blogger and others are just very evolved expression with a significant technological component (Web 2.0) of previously existing social networks, which have revolutionized our old forms of interaction with sociocultural change in people and society.

Knowledge has been channeled in a particular manner either in restricted, centralized, maximizing initiatives aimed to codify explicit knowledge, the ideal of conventional enterprise because it is easier to transfer, knowledge is often viewed as a resource or object and not an act. However, today it is more important to have the flow and exchange, of knowledge because of the rapid obsolescence of knowledge in all fields. This phenomenon requires us to have an organizational change that allows the activation of more channels of exchange and creation of knowledge for University-Enterprise relationship, as well as finding a way of renewal and sustainability [2]. These new approaches require new knowledge best practices aligned to facilitate generating knowledge and innovation in organizations at the university. Socialization, collaboration, solidarity and culture are key collective decisions that must be taken into account for this purpose.

Knowledge management has critical factors that determine their success; these are related to having an organizational culture that values cooperation, collaboration, diversity and complementarity, good levels of trust and communication among employees or members of the academic community. A full understanding of that knowledge depends exclusively on people and how they are interrelated, and appropriate technology and infrastructure to facilitate the flow of information and knowledge. In a broader sense, not just organizational, social networks today provide societies forming relationships that increase confidence and improve communication schemes, an interdependence between the processes of learning, problem solving and knowledge acquisition; a review of social relationships rather than individual, ease of finding information, or who has knowledge, motivation to cooperate, recognition and collective collaboration, social reputation and sense of belonging, and diversity and complementarity in information, knowledge, the perspectives and experiences of both the university and the enterprise.

Connecting people individually or in groups using a variety of forms can be an important source of new ideas and help organizations to extend and develop their skills. Social networks can be used to store all the relevant information and highlight the necessary information for a specific need or unusual information. Some organizations provide “yellow pages” of who knows what, while other key personnel identified what is connected to the social network and part of the work is to provide the appropriate links.

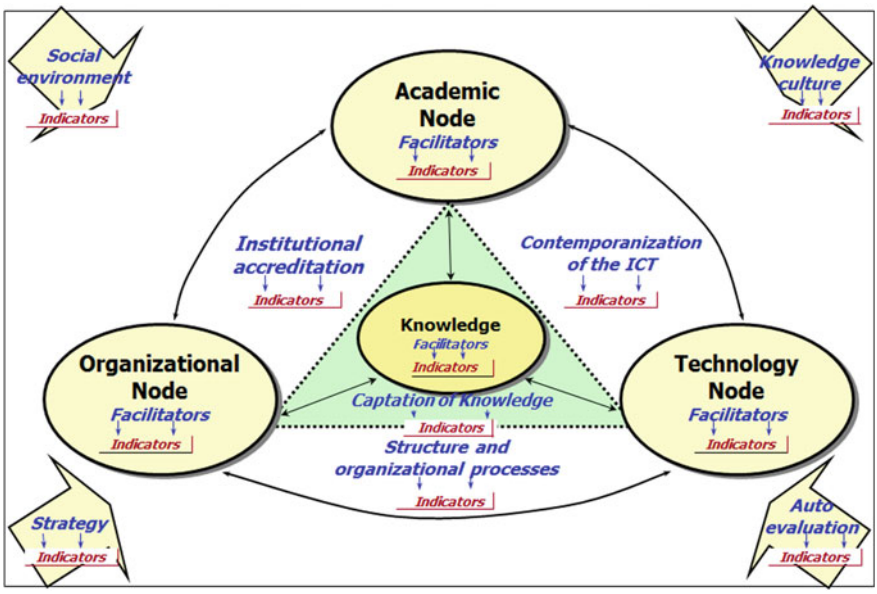


Fig. 29.1 Organizational model of knowledge management in university *Source* Medina [1]

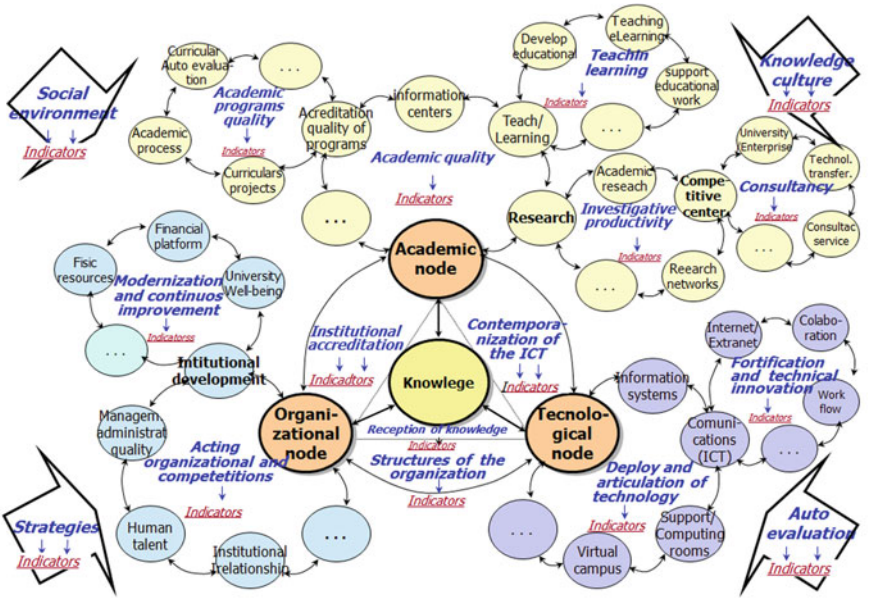


Fig. 29.2 Organizational model of knowledge management in university (view details structural with subnodes) *Source* Medina [1]

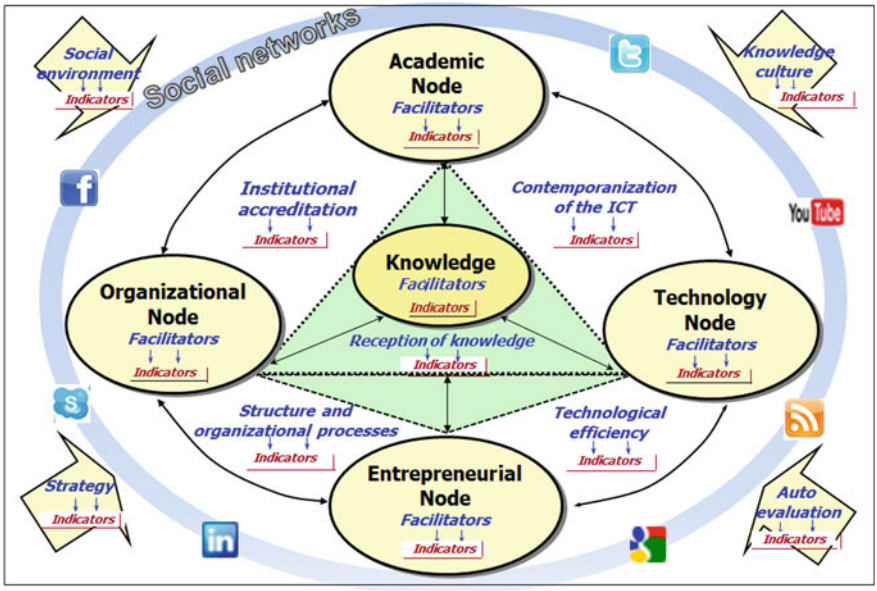


Fig. 29.3 Knowledge management model support by social networks as facilitator the relations University-Enterprise. *Source* Adaptation and extensión GC-U Model

29.2.2 Analysis of the Study Case

Given that research previously undertaken have dealt with the analysis of business cases where it have implemented knowledge management programs in the last years, this research focused on analyzing the Knowledge Management Model in University - KM-U (see Fig. 29.1 and more details in Fig. 29.2) [1, 4] and then based on that, develop a model that integrates the enterprise with social networks.

29.3 Knowledge Management Model Proposed

The proposed model is based on an extension of the KM-U model analyzed previously by using social network.

The model expresses the need to connect the external environment through the internal management process based *on knowledge*. The model is based on four interconnected nodes, which are supported by different types of social networks. The nodes identified are: Academic, Organizational, technological and entrepreneurial, with the latter node the proposal to strengthen relations between the university and Enterprise (see Fig. 29.3).

The core of the model is *the knowledge,* which will be enriched by the experience-based *knowledge* that can bring in the entrepreneurial node. The nodes are fed by both internal and external facilitators. External facilitators comprising: (*Social environment, cultural knowledge, strategies and self-assessment)* focus on developing strategic action policies of the university in its socio environment. Internal facilitators also kept, by creating an additional one, called *overcoming technological deficiencies.* These facilitators are aimed at developing operational tactics and actions to achieve the principles and purposes of the educational projection specific to each university.

The characteristics of each of the elements contained in the model are described below.

29.3.1 Nodes and Subnodes

The nodes are knowledge-based resources, which generates, transfers knowledge and can perform various processing functions that required treatment internally or through network links. The *nodes* of the model are:

- *Knowledge Node or Core*: This is the main axis model since this node serves as a repository of knowledge. It shows how to generate and disseminate knowledge at the university and the enterprise.
- *Academic Node*: Refers to the activities of the academic area such as: the production of knowledge, professional training, and social culture. The teaching and research are part of these activities usually seek training in the service of human society and the expansion of human knowledge.
- *Organizational Node*: this node functions involve guidance and support to enable university activities and relate specifically to the leadership, direction, supervision and control of the financial and administrative affairs of the university and all its dependencies.

Knowledge and organization are two central aspects of the necessary transformation of the university, although theoretically these two aspects should be inextricably linked, the current situation shows that it is not. Therefore it is necessary to create new relationships between the different actors of the university as well as a different concept for the administration of resources, where knowledge is part of this vital, new ways to learn and to link with the surroundings.

- *Technology Node*: Is the infrastructure available that creates, access, and disseminate knowledge. This includes standard programs developed to measure access to telecommunications, intranet, extranet and user support and all locally or remotely. Using these tools and participating employees share the content on their daily work processes. They also facilitate the learning process by allowing the organization and storage of knowledge.

- *Entrepreneurial Node*: Universities and enterprises are primary actors in innovation processes and both possess skills and fundamental scientific and technological capabilities to generate knowledge that are often complementary. The knowledge generated in one area can be different and, therefore, complementary, in respect of what takes place in other business institutions. In order to develop science and technology, both universities and businesses require financial resources, infrastructure and human capital which often do not have partners or whose costs can′t be afforded. In general, the research and development projects are very long term activities with uncertain results and involve large sums of money. Moreover, despite the need to share to develop and use capabilities to generate scientific and technological knowledge, the university and the company carried out this task with responsibility, goals and criteria very different and sometimes difficult to reconcile.

Generally, universities are dedicated to training and knowledge generation in science and technology through basic research, therefore establishing a virtuous synergy between these functions and financed with equity. The purpose and use of the results of such research are typically academics, which encourages its dissemination in the scientific community for evaluation and development of further research.

Enterprises, on the contrary, need to pursue innovation processes to increase productivity and competitiveness, especially in dynamic sectors, which are motivated by other interests. Most of the time, the market is the main incentive mechanism to the introduction of innovations originating in the results of applied research, and the appropriateness and cost-effectiveness of such innovations are the main criteria for evaluation.

The *subnodes* or detailed knowledge resources initial model described in Fig. 29.2, but the subnodes that could be implemented in the proposed *Entrepreneurial* N*ode* can be summarized in:

- Services.
- Innovation.
- University-Enterprise projects.
- Research projects.
- Other that consider the organization.

For those nodes and subnodes facilitators agents and indicators are explained below.

29.3.2 Agents Facilitators and Indicators

Organizations need to obtain results that are coming through the behavior of their agents facilitators, that is to say, their personnel's performances and the operation of their processes [5].

In higher education institutions the agents facilitators are the elements that will promote activities that allowed the university organizational policy and management or compliance with actions that evaluated according to the behavior of a number of indicators that facilitate the identification, development and retention of knowledge and ultimately help sustain and fulfill the mission of the organization.

Because the entrepreneurial node was added to the model, some facilitators that arise for this node are:

- Flow of human resources.
- Informal contacts between professionals.
- Popularization activities and diffusion of the knowledge.
- Joint Projects.
- Technology-based companies.

29.3.3 Interaction Model with Social Networks

Informal networks of work, such as creating informal contacts between professionals, teachers, researchers, students and other members of the academic community involve bidirectional links between universities and industry, based on informal exchange of knowledge, information sharing. In these networks, the flow of knowledge is tacit and poorly coded and is incorporated in people, enabling knowledge sharing in a relationship, however, is less formalized in research projects and long-term development. Companies often use and positively assess these informal networks of professionals. Besides facilitating contact with qualified human resources, these channels are used to obtain information on trends in research and development and access to scientific and technological knowledge to develop professionals in universities. On the side of universities, these networks represent a way of circulating the progress of investigations and submit them for evaluation by professionals who are users of the applications of this knowledge. In this sense, informal networks and professionals can be a way to begin to articulate the range of scientific and technological knowledge built on experience of professionals with business requirements, constituting good channels to identify collaborative projects or future scientific joint research [6].

29.4 Attitudes and Expectations of the Use of Knowledge Management Model Supported by Social Networks

Social networks can be used in education to help learning. It is particularly useful for collaborative work, understood as the exchange and development of knowledge on the part of small groups, aimed at achieving academic purposes, it can used as a platform for consolidation of certain communities, which in our case would be a community made up of the academy and university. Using social networks in collaborative work

promotes motivation, higher levels of academic performance, enables individual learning and group feedback, improves retention of learning, critical thinking power, multiply the diversity of knowledge and experience acquired [7].

29.4.1 Research Context

This research was carried out to study the attitudes of students from different semesters at the School of Engineering at the University Sergio Árboleda, on social networks and their use in the context of knowledge management model supported by social networks. In this study, we sought to examine the degree of knowledge and use of social networks of our students, using a questionnaire sent by e-mail account to each student, designed specifically for this research. We want to and which in indicate the attitude of our students in the didactic use of these platforms for interaction.

29.4.2 Data Analysis

Of all students enrolled in the School of Engineering, a sample of 72 students was involved in the survey. Data analysis results were obtained from in the following questions:

- Is there any social network activity currently in use? The following information was obtained:
- What social networks do you know at the moment?
- Do you use the social network from your own initiative or from the professors? To the question it has used the social networks academically, for a professor's suggestion or for own initiative?
- How long do you connected to the social networks daily?
- What you would like to use for practical academic and managerial?
- What is the possibility that social networks can be used day by day in the academic processes?
- Are you willing to use the social nets to negotiate the knowledge generated by the daily activities of the university?

29.4.3 Analysis of Results

Analysis of the data from the answers received from the survey provides us the following results. On one hand, students have a good attitude about the use of social networks and many were users. Knowledge and use social networks by some of

students were especially high. This shows that there is an absence of mistrust for t using them. In analyzing the use of social networks academically, it is clear that a very high percentage has been used for this purpose, either on students' own initiative or on the recommendation of teachers. As for the time spent online the highest percentage was in the range between one and three hours days it indicates that the time spent likely to suggested that knowledge management was indeed happened through this medium. The use of social networks was preference for more than 50 %. Of the people surveyed. To share knowledge regardless of where it is generated, it is necessary to use a social network to make this process efficient and effective.

The published form is available at the following link:

https://docs.google.com/spreadsheet/viewform?formkey=dg9szzbzcvrxmxhfznk5vwpia01mnke6mq

29.5 Conclusions

It is important to understand that knowledge management will establish a knowledge center (brain) based on technology (hardware and software), rather it serves as the necessary routes (nervous system based on conversational networks) to the natural flow of knowledge within institutions. As we know the main goal of knowledge management resides in the creation of value (survival of the system).

The model has been developed thinking of the general requirement for organizations to create value and the disposition of the resource 'knowledge' as the key factor for generating of sustainable competitive advantages.

From the hypothesis outlined in this research we can reaffirm that, in implementing the model at any university and specifically in Colombia, one can overcome the gap between academia and business, using social networks to share information, knowledge and experiences obtained, in order to provide the country with better social and economic benefits. This is because any country that wants to incentives the cooperation of universities with industry must move simultaneously in the definition of productive structures that require a higher level of knowledge.

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Chapter 30
Social-Technology Fit: A Conceptual Model

Hsin-Yi Liao, Chien-Hsing Wu, Didi Sundiman and Flora Peng

Abstract Literature has paid limited attention to the explanation model of social networking performance. It is argued that a healthy social networking should have a fitting structure among the technology characteristics (e.g., communication and cooperation), social characteristics (e.g., demands of privacy and trust), and individual characteristics (e.g., the tendency of self-realization) to develop its social values in a stable manner. In consequence, this study proposes a conceptual explanation model for social networking performance, which is called Social-Technology Fit Model (STFM). The STFM is based on the theories of technology-performance model and technology-task fit model. The STFM with theoretical arguments and instrument for variables is presented in this paper.

Keywords Online social network · Information technology · TPF · TTF

30.1 Background

Over the last decade, the information and communication technology (ICT) innovations make social software (e.g., FaceBook and Weblog) gradually develop a new operating model for the modern society, which is called Online Social Networking

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(OSN). From the research development aspect, there are three facets to facilitate the development of OSN: technology, management, and behavior. The technology facet enhances the usefulness, ease of use, and entertainment. For example, Vavpotic and Bajec [36] presents the method of software development from the aspect of societal appropriateness. The management facet finds its application values. For example, Keng and Ting [25] investigates the application mode of Internet blogs from the viewpoint of customer value, while Fuller et al. [14] integrates the customers' conception to develop medical equipment products by using the social software (e.g., networked virtual environments). The behavior facet focuses on how to apply social networking software effectively based on the social relavance. For example, Haefliger et al. [16] analyzed the strategy of using social networking media based on the consideration of both internal and external environment, and behavior as well. Recently, Yu, Duan and Cao [42] compares social networking media (e.g., blog and online forum) with traditional media (e.g., TV) to examine the impact on values and performances of an enterprise, and suggests that social networking media has a great impact on the performance of an enterprise. Carpenter et al. [4] and other researchers emphasize the problems deserved discussing in depth that whether social networking provides valuable social relationships or disperse the valuable relationships in a human's real life [3, 32].

The development of social networks not only is a technical problem of ICT, but also involves related issues of the values of both individual and social development [31], such as motivations of using social networking software, interactive mechanism of virtual society, and impacts of virtual trust as well as virtual privacy. For example, Social Cognitive Theory (SCT) proposed by Bandura [2] indicates that human behavior could not only be controlled by others, but also be influenced by the environment and external social factors. In consequence, network of information society on the one hand can reflect the development of society and community; on the other hand it also brings positive efficacy as well as negative effects. The positive efficacy can be improving efficiency of interaction, promoting creative ideas, accelerating the speed of information and knowledge sharing, and enriching daily lives. The negative effects can be the problems of privacy, various kinds of business disputes, worries of virtual trust, lack of loyalty, increase of energy consumption, cybercrime, and smart phone addicts.

To develop a fit model that explains the facet interaction, among theories in literature are technology-performance model [9] and technology-task fit model [15, 23, 24, 27, 30, 34]. As a result, from the viewpoint of the characteristics of social network participation factors, it can be seen that there are three main roles that play for the social networking performance: individual characteristics (e.g., cognitive characteristics and psychological behavior of members of society participating in a group.), ICT characteristics (e.g., functional characteristics of ICT supporting the operation of society, such as mobile interactive functions), and social characteristics (such as expectations, interaction, values, and norms).

Therefore, the main objective of the current study is to propose a conceptual explanation model, called Technology-Social Fit Model (TSFM), to explain the OSN performance. In other words, this study considers that when social software

develops a positive and healthy virtual society, the definitions of the individual characteristics, social characteristics, and ICT characteristics should be defined a good fit, so as to increase social networking performance. The Technology-Social Fit Model with theoretical arguments and instrument for variables is presented in this paper.

30.2 Literature Review and Hypotheses

30.2.1 OSN Performance

There are many kinds of methods to measure the social networking performance; however, no unique measurable index is used. Usually, the measure is set based on a specific context [21, 38], which include tangible index and intangible index. Satisfaction, cognitive convenience, perceived usefulness are examples of intangible index, while frequency of use, ratio of efficiency, ratio of reducing costs, ratio of performance improvement are the tangible index. Moreover, from a macroscopic aspect, OSN is developed somehow according to the economic theory. For example, Allen [1] points out that the reason why information and knowledge have economic values is that information and knowledge can help people to make valuable decisions. Therefore, people who gain useful information and knowledge would have potential of economic values as well. That is to say, performance of the OSN can be viewed based on the social network users' satisfaction in sharing with the information and knowledge provided by that OSN. It can be also seen that after the introduction of Web2.0, the information/knowledge economic rapidly combines with the participation economics (called Parecon) [17]. This formation of economic type is basically analyzed from the viewpoint of psychology. In other words, almost everyone naturally has the tendency to desire participating in affairs they are interested in, in particular those in online communities. Through this participation requirement mechanism, the participants not only collaborate to create ideas or solve the problems, but also satisfy the sense of participation. Hence, members of society in social network interaction rapidly form a participatory economics. It means people who have the ability to attract online users to participate will be having the economic values, such as Twitter and FaceBook, but at the same time, this pattern also brings some negative impacts as described above.

To assess the OSN performance is in fact not easy. As mentioned previously, the current study is an exploratory research, and would observe the ONS performance from a macroscopic aspect. In consequence, based on the arguments by Hartmann et al. [18], Enders et al. [12], and Hsu and Tsou [21], this study uses two indicators to measure OSN performance. One is the satisfaction of participation and another is satisfaction of information and knowledge sharing. Therefore, the study considers two indicators as the measure elements: participating satisfaction

Table 30.1 Research Questionnaire

Code	Concept of variable	Measure items
TC	Technology characteristics: social network users believe that OSN needs to consider the technological characteristics [26, 31, 40, 41]	TC1: When participating in OSN, I often use ICT to analyze and present the contents
		TC2: When participating in OSN, I often use ICT to store and manage the contents
		TC3: When participating in OSN, I often use ICT to link and communicate for contents
		TC4: When participating in OSN, I often use ICT to help interaction and collaboration for contents
		TC5: Overall, ICT helps a lot when I participate in an OSN
SC	Social characteristics: social network users believe that an OSN needs to meet the social characteristics [15, 23, 27, 30, 34]	SC1:When I participate in OSN, I feel self-realization
		SC2:When I participate in OSN, I have sense of belonging
		SC3:When I participate in OSN, I feel I get helps
		SC4:Overall, I feel that it is valuable to participate in OSN
IC	Individual characteristics: social network users believe that an OSN needs to meet the individual characteristics [4, 29, 35]	IC1:When I participate in OSN, I have perception of personal privacy
		IC2:When I participate in OSN, I have perception of equality to members
		IC3:When I participate in OSN, I have perception of virtual trust
		IC4:When I participate in OSN, I have perception of diversity of social values
		IC5: Overall, I have enough perception to participate in OSN
STF	Society-technology fit: social network users believe that an OSN needs a certain degree of association among technological characteristics, social characteristics, and individual characteristics [15, 23, 27, 30, 34]	STF1: I think social software (e.g., FB) is very suitable to help participate in OSN activities
		STF2: I participate in OSN by using social software
		STF3:I think social software meets my social behavior
		STF4:Overall, I think social software is suitable for social development

(continued)

and sharing satisfaction. Items are presented in Table 30.1. For example, "I am satisfied with the information and knowledge obtained from OSN" is one of the measure items for sharing satisfaction.

Table 30.1 (continued)

Code	Concept of variable	Measure items
ITU	Intention of technology use: social network users believe that an OSN requires intention of technology use [8, 22].	ITU1:I often use the Internet technology ITU2:I often encourage people to use the Internet technology ITU3:Overall, I am willing to use the Internet technology
SNP	OSN performance: social network users believe that the performance of an OSN has social values [12, 18, 21].	SNP1:I feel very satisfied with the information and knowledge obtained from OSN SNP2:I am very satisfied with participating in OSN to increase social values SNP3:I feel very happy when interacting with others in OSN SNP4:Overall, I am willing to participate in OSN
Do you have any comments or suggestions about the online social networking?		

30.2.2 Fit Analysis and ICT Adoption

The fit analysis has been long studied for more than 20 years, such as individual-task fit model (ITFM) [11], personal-environment fit model (PEFM) [33], personal-team fit model (PTFM) [28, 39], task-technology fit model (TTFM)[9, 23, 30, 34], and tasks-individual-technology fit model (TITFM) [15, 23, 30]. Importantly, these theories have shown the importance of fit analysis toward performance. In fact, the result of operational effectiveness or consequence (e.g., social network performance, and product design performance) is a fitting outcome of systematization. However, any imbalance will affect the overall performance, which means that it must fit through major participation elements in order to have a better performance. With respect to the fit analysis, DeLone and McLean [9] proposed and confirmed the task-technology fit model to explain organization performance. Goodhue and Thompson [15] extended the model by adding the personal characteristics and use intention of technology to explain performance appropriately, and the research findings also support this argument. Extension of this TTFM can be seen in literature in various domains (e.g., [23]). The research results suggested that adaptation model can be indeed used to explain the performance. However, their study did not consider individual cognitive behavioral characteristics. On the other hand, Koo et al. [27] proposed and validated a TTF fit model for the use intention of social communication technology (SCT). The research finding confirmed that task characteristics and the relationship among network members have an impact on intention of using SCT. From these, the factors influencing performance should consider both personal characteristics and technological applications problems and their fit.

In fact, the focus of fit analysis theory is based on a causal model. The current argues that OSN performance can be explained by a fit model that involves various

factors. Therefore, this study considers that personal characteristics, social characteristics, technology application characteristics, and their fit are the main facets that influence the OSN performance. The model proposed is named social-technology fit model (STFM). Moreover, the utilization of ICT will also increase OSN performance [15]. Accordingly, three research hypotheses are defined as follows.

H1: Social-technology fit is significantly related to online social networking performance.
H2: Social-technology fit has a significant impact on intention of technology use.
H3: Intention of technology use is significantly related to social networking performance.

30.2.3 ICT Characteristics

ICT has two phases to form social network. One is technical comprehensiveness structure, and another is the combination with demand aspect of the behavior. In the first phase, the aim is to construct a rapid information flow pipeline, especially which can carry multimedia contents. In the second phase, members of the society based on their behavioral characteristics proceed with social activities under this structure (e.g., ideas and experiences sharing). At the same time, these activities can satisfy the users' participation needs. When it reaches a certain size, participation economy forms and starts new social values which includes both positive and negative consequences. There are four main ICT functions used in the process of forming social network [31, 40, 41]. They are: (1) analysis & presentation: used to support the presentation of information and knowledge contents and behavior profile; (2) storage & management: used to store and manage information and knowledge contents and behavior profile; (3) networking & communication: used to support the circulation of information and knowledge to enrich the psychological satisfaction; and (4) interaction & collaboration: used to support interaction and cooperation of members in network to strengthen the community cohesion.

Generally, it is believed that environment characteristics (physical or virtual) will affect operating mode of network and thereafter its performance. Hoegl and Schulze [19] concluded from their research findings that practice communities and knowledge map are the common and frequent applications of ICT tools for knowledge learning. Therefore, it is believed quite complex when putting ICT into people's social thinking behavior or behaving people's social thinking in the ICT-mediated environment. However, just like Mumford [32] mentioned, the ultimate goal is to find the way toward the real values for now and future. When people are being in the immersion status, they are within a situation in which they are very concentrating on processing the information obtained from ICT-mediated environment. The result may have positive values (e.g., learning effectiveness) or negative problems (e.g., deviation from the current situation) [7, 20, 28, 39]. Therefore, this study argues that ICT characteristics has an impact on social-technology fit model, and will therefore

affect social networking performance. Accordingly, the forth hypothesis is defined as follow.

H4: ICT characteristic is significantly related to society-technology fit model.

30.2.4 Social Characteristics

Among social theory is the exchange theory that members of community expect to enhance the social status, reputation, social belonging, and information and knowledge sharing. This expectation will be increasing willingness to participate in the network. Literature indicates that the exchange theory has been widely used to explain social performance for virtual network. However, it is realized that OSN is a changing environment that may develop a new operating model from time to time. From a macro point of view, among the formation factors, it is believed that the consideration of a functional theory would be able to explain the main activities and motivations that the community can be cultivated toward social values. For example, Castelfranchi [5] emphasizes that both unplanned cooperation and information sharing can be a kind of social functions to help value development. In other words, OSN should be developed into a function of new social values (e.g., information symmetry), so as to evaluate how social characteristics rely on ICT.

Based on the functional theory, the social characteristics (e.g., members' self-achievement) may affect the benefits that members' interactions produce. For example, self-achievement in a social network will be very possibly resulting in a thought willing to give contribution to the community. In this case, members of the society will also sense positive, and therefore enhance the cohesion of that community. If this function can be achieved and enhanced by ICT, it will be able to give social characteristics a better definition for the social networks, and thereafter can find suitable development characteristics for ICT as well. As a result, at this stage, the current study mainly discuss the functional theory, and believes that these social characteristics have the impact on social-technology fit toward OSN performance as well. The current study starts at the theoretical basis of the social function, and explore the relationship between its characteristics and social-technology fit toward OSN performance. Accordingly, the fifth hypothesis is defined as follow.

H5: Social characteristic is significantly related to the society-technology fit.

30.2.5 Individual Characteristics

Technology-performance model has demonstrated that personal characteristic is one of the important factors affecting the fitness [10]. In other words, the fitting degree is affected by individual's working ability and characteristics reflected by

the use of technology. From the perspective of social network performance, due to the fact that individual in general can control the use of social software because of the willingness, instead of the need of task performance, current study considers the personal characteristics with cognition that is compatible to the participation willingness of OSN. In other words, if a person's personal characteristics are more inclined to activity of socialization whether it is for work or daily life, he or she would have more willingness (or tendency) to enter into the online society. In this case, he or she will be likely to find possible ways (e.g., learning) to do so, and therefore will be more likely to provide contribution, such as the support for Internet fundraising to help disadvantaged people and the help to establish a natural disaster message dissemination network. More importantly, this concept is supported by the research finding of Carpenter et al. [4] showing that the behavior of using Facebook is related to the personal mass tendencies and motivations.

Relationship analysis between personal characteristics and social network compatibility cognition can begin with the concept of privacy, equality of members of society, virtual trust, and values of diversity [6, 29, 35]. For example, research finding by Kwon et al. [29] showed that both internet psychology and ethical issues of privacy and trust are the main reasons of the willingness to use GPS which can bring new location-based networking values for online social network. This implies that both online society networks and realistic social networks need a higher perceived value in terms of privacy and trust. Moreover, research finding by Tassier and Menczer [35] pointed out that members' work inequality can be reduced in the dynamic online social network structure by enhancing information symmetry. In consequence, this study believes that individual characteristics will have an impact on society-technology fit toward OSN performance. Accordingly, the sixth hypothesis is defined as follow.

H6: Individual characteristic is significantly related to the society-technology fit.

30.3 Method

30.3.1 Research Model

According to the hypotheses defined above, the research model is illustrated in Fig. 30.1. It includes independent variables and dependent variables. In the first layer, the independent variables are technology characteristic, social characteristic, and individual characteristic; the dependent variable is society-technology fit (H4, H5, and H6). In the second layer, the independent variable is society-technology fit model and the dependent variables are intention of technology use (H2) and OSN performance (H1). At the same time, the study also investigates the relationship between intention of technology use and OSN performance (H3).

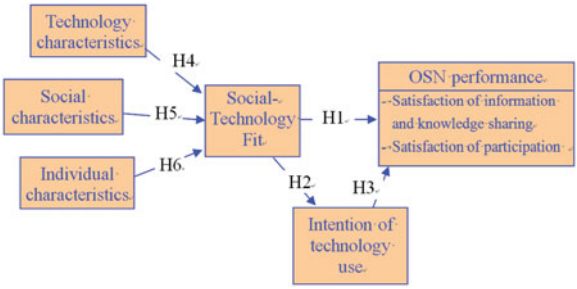

Fig. 30.1 Research model

30.3.2 Measure and Data Analysis

The questionnaire is designed and developed based on the literature review described in the second section (Table 30.1). The measure level adopts the five-digit Likert scale from "strongly disagree" to "strongly agree". The questionnaire is presented in Table 30.1 containing 26 items for variables. Before questionnaire is sent out, the pre-test will be carried out to increase its readability, understandability, and reliability. The operation definition for variables is defined as follows. **Technology characteristics**: It is the perception of ICT characteristics supporting social interaction behavior in the operation of OSN [26, 31]. **Social characteristics**: It is the perception of social functions in the operation of OSN [5, 13, 37]. **Individual characteristics**: It is the cognition and perception of individual characteristics compatible with virtual society in operation of OSN [4, 29, 35]. **Society-technology fit**: It is the perception of integration relevance of social characteristics, individual characteristics, and technology characteristics. **Intention of technology use**: It is the perception of intention of ICT use in the operation of OSN [8, 22]. **OSN performance**: It is the perception of OSN performance with respect to satisfaction of participation and satisfaction of information and knowledge sharing in the operation of OSN [12, 18, 21].

For sample population, the study will select 3G mobile phone users as our subjects, and their activities are on the OSN to a certain extent. Moreover, considering the amount of a large number of questionnaires, this study will use the convenient sampling technique. To gather information more efficiently, the questionnaires will be the online questionnaire along with the meaning of each variable. The connotation of OSN is in fact abstract for some users. The study at the same time will also collect the comments and suggestions from the subjects who are using any OSN. To determine the sample size, the study will set the 95 % confidence level, sampling error of 5 %, maximum variance of pre-trial, and the return rate of approximately 70 %. The number of returned samples will not be less than 300 as the basic requirement. The data analysis will have three parts: descriptive statistics, factor analysis and reliability and validity analysis, and path analysis (e.g., hypothesis testing). Descriptive statistics aggregate the basic information of returned samples. It will also present sample characteristics

relationship from different perspective when necessary. Factor analysis and reliability and validity analysis are to confirm the internal consistency and reliability of research model of variables. Path analysis will obtain the results by using the structural equation model.

30.4 Conclusion

The issue related to OSN is one of the important tasks for government (e.g., technology education performance), enterprise (e.g., customer relationship management performance and technology development performance), and society operators (e.g., social performance) to seek for the solutions effectively. Based on the theories of personal-task fit model, personal-environment fit model, personal-team fit model, technology-task fit model, and task-personal- technology fit model, the current study proposes a social-technology fit model to help explain the OSN performance. The study is a new attempt different from previous studies in the field of social function theory. However, the study presents only a conceptual model, without conducting an empirical examination, which is one of the future focuses. The various applications derived from social software have demonstrated the effectiveness of social development for both real and virtual world. The mobile social network services and the behavior of the users of mobile devices (e.g., 3G mobile phones, tablet PCs, e-books) will influence the operation of the dynamic social networking. While trying to find a solution for the OSN with better health and quality, it is believed that future outcome of this study will be helpful for the development of OSN.

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Chapter 31
The Use of Blogs as Knowledge Sharing in MBA

Eric Kin-Wai Lau

Abstract Blogging is becoming imperative in today's Internet world. A literature review on blogging was presented in order to understand the importance of blogging in the action research approach. The present study, therefore, performs a more detailed investigation into the basic elements of action research in blogs and presents a case study, with a view to filling some gaps in the research concerning this topic. This paper addresses how blogs could be used for MBA education. The present study is an exploratory attempt to analyze the influence of blogs on MBA education. The process of action research offers a promising approach to achieving this objective. In the collaborative processes of action research, including context analysis, planned actions, and reflections on the lived experience, it develops the students' own knowledge of complicated consumer behaviors. The study challenges practices that separate the students' knowledge from the tacit knowledge and recognizes the importance of experience in MBA applied learning environment.

Keywords Blogs · Action research · Knowledge sharing

31.1 Introduction

The MBA program emphasizes the sharing of experiences, and in an e-environment academic staff members retain their traditional role of being 'facilitators'. It is commonly delivered through competency-based education, with a clear picture of what the students will be able to learn. However, the question of whether these competencies are being taught in the classroom is yet to be answered. The ultimate

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goal in MBA is to apply business knowledge in real life situation. Students should acquire and apply knowledge in the program. The dominant discourse discussed in the education literature often avoids addressing the importance of the tacit knowledge of consumers. The wisdom of MBA intellectuals is grounded in personal experience, rather than formal academic settings.

Modern notions of business education emphasize autonomous learning, independent critical thinking, analytical capacity, and excellence of teaching. In contrast to the traditional 'one-to-all' teaching mode, increasing emphasis is being placed on interactions among students and lecturers with a view to discovering the 'best option', rather than the 'right solution'. Learning communities are therefore becoming an important aspect in the MBA education.

Learning communities have traditionally operated through social interaction; collaboration is important in learning. According to Pedlar [18], learning communities consist of the following components: mutual interdependence; acceptance of differing learning needs among members of the group; equality in terms of knowledge, skills, status, and power; sharing; and offering. McFadzean and McKenzie [14] suggested that the essence of online learning is the collaborative process among the learners in the same group—thus facilitating team sharing. In this regard, advances in technology, especially advances in computer networking, make it possible for students to work and collaborate via the Internet after class, and thus build a lively interactive case-sharing community. Moreover, lecturers have more channels, time, and space available to communicate with individual students.

The purpose of this paper is to demonstrate the experience of the author by using blogs for part-time MBA evening class in consumer behaviors. In the paper, the intention of using action research and content analysis to understand how knowledge in terms of tacit and explicit knowledge exchange and transfer among students in the class is recognized. The investigation may help schools to develop their e-learning portals more effectively. It offers an alternative to other explanations of e-learning adoption decision among those adult learners.

31.2 An Overview of Blogging

In the 1990s, when the Internet began to be commonly used by the general public, it was used mainly in the form of e-mail communication. Afterwards, as broadband Internet connection became widespread, companies began to use websites to communicate with their customers. The Internet has provided many benefits to consumers, the most well known of which is the speeding up of the communication process, including the consumer-to-consumer information flow. Online communities are the product of Internet applications [13]. The term "blog" is a shortened version of "Web-log" [23], and refers to individuals' online diaries. People organize their contents into smaller sections and display them in reverse chronological order [8]. More than 112 million blogs were available in 2008 and

over 175,000 new blogs are created every day [21]. Rather than traditional static Web contents, people update their blogs frequently and add new articles daily. These attract readers to visit their preferred blogs daily to read their new articles.

Blogs can be either personal or commercial. A personal blog is referred as to as an online diary, which may contain personal opinions regarding a specified topic or factual information [8]. Blogs consist of a person's opinions and feelings and their own views. Most articles in personal blogs are written by one person, but there are blogs that have several authors, which are named group blogs or community blogs. A commercial blog can be used internally or for marketing purposes. Most personal blogs and commercial blogs are complementary; visitors are allowed to comment on their articles. Direct offline interaction among people is possible through blogs. The importance of conducting action research focuses primarily on the ability to visualize the level of collaboration and the sharing of knowledge. Blogs tend to be transparent and are available for everyone on the Internet to view, comment on, and share.

31.3 Action Research in Blogging

Qualitative research emphasizes heavily the collection and interpretation of the available data. According to Denzin and Lincoln [5], qualitative research is "multimethod in focus, involving an interpretive, naturalistic approach to its subject matter. This means that qualitative researchers study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them" (1994, p. 2). Blogging, therefore, provides rich qualitative data for research.

Blogging is full of knowledge. Davenport and Prusak [4] defined knowledge as "a fluid mix of framed experience, contextual information, values and expert insight that provides a framework for evaluating and incorporating new experiences and information" (1998, p. 5). Knowledge can be either tacit or explicit [20]. Tacit knowledge represents knowledge that cannot be codified and is inexpressible. Tacit knowledge always refers to knowledge that people acquire from experience and practice. Alternatively, knowledge that can be expressed in a written form is called explicit knowledge. Alternatively, Nelson and Winter [16] suggested that explicit knowledge is technological knowledge that can be defined well in a book or other media. Two issues associated with tacit knowledge were identified by Gourlay [6], i.e. whether tacit knowledge is an individual trait or shared by others and whether tacit knowledge can be converted into explicit knowledge. People can freely drop by others' blogs and make comments. In other words, it is an ideal that blogging enables researchers to capture explicit knowledge from people's blogs, as well as gaining tacit knowledge from the actual participation in blogging.

The importance of blogging originates from the fact that people sometimes do not know what they are supposed to learn. Action research is possible in blogging. As suggested by Vignali and Zundel [22], action research enables researchers to

build knowledge or theory from actual participation in the problem-solving process. As stated by Greenwood and Levin [7], action research is "carried out by a team encompassing a professional action researcher and members of an organization or community seeking to improve their situation. Action research promotes blog participation in the research process and supports action leading to a more just or satisfying situation for the stakeholders" (1998, p. 4). With blogs, people can read existing articles, join the discussion, comment, and even add their personal remarks or create articles. They provide a platform that makes action research possible and easy.

Coghlan [3] addressed three main managerial issues in action research for practitioners. First, it is ideal for action research that the research subjects are real events that are managed in real time. Second, research provides effective action and learning. Last, the findings can contribute to the development of the theory of organization. Again, the actual participation in blogs could be expected to be a suitable method for action research, i.e. the research takes place with the subject matter. It is a continuous process and all the parties in the community should be involved.

Blogging brings all people on the Internet together to act collectively. Action research in blogging can be undertaken in free interactions continuously. The process is people-centered. Lewin [12] classified action research as the process of action, research, and training. Chein et al. [2] further added the essence of cyclicality in action research. It begins with the problems the people in the community are currently facing. In the course of executing action research in blogs, there is a need to incorporate real problems into the cyclical process, which can be viewed as consisting of five components: diagnosing, action planning, action taking, evaluating, and specifying learning. Berger and Luckmann [1] named this relationship "action-reflection-theorising." It allows students to be involved in meaningful ways.

Given the fact that many elements of action research have been developed, blogs can facilitate the following:

1. identification of the real problem as the topic of blogs;
2. intervention in the real problem situation as the commentaries in blogs.

31.4 Case Studies

The MBA program emphasizes the sharing of experiences, and in an e-environment academic staff members retain their traditional role as "facilitators." The course "Consumer Behavior" was selected for a pilot test of the use of blogs for marketing education. It was tried initially in the academic year 2008–2009. The course ran in a 6-week cycle, in parallel with other MBA elective courses, with 6.5 h' class contact per week. In total 50 MBA students registered for this particular course. Most of them were studying part-time, with two full-time exchange students. The course examines the psychological processes underlying consumer

buying behavior. With the use of qualitative data in blogs, the students can develop personal critical reflections on the theoretical and analytical implications in the consumer buying process. For example, what makes a consumer choose one product/brand over another? Do social effects and advertising really change their perceptions of certain brand names? The students are assessed individually on their participation in blogging. They are told to share their real consumption experience in blogs and share their own views on others' articles (i.e. peer review).

The course emphasizes the sharing of experiences, and in an e-environment academic staff members retain their traditional role as "facilitators." In particular, the course examiner can make use of the blog (see above) by posting discussion questions on particular topics. The student participants are notified of the posting of these topics. Suggestions and experiences can be sent back directly. The blog can thus provide a rich environment for case studies and feedback from participants. Because it can be accessed at any time from any place, it is a convenient and effective method of stimulating learning.

The blog-based platform employed for the course is named "Journal LX" and is hosted by the university. Students can simply select the title they want to read or comment on. They can also submit their own blog articles in electronic format through the Web connection. The blogger provides five main features for students:

1. "New entry" – where students can create their entries (i.e. articles) as easily as clicking "new entry"; they can compose their articles by using a simple text editor provided system. They can still edit those articles they have published previously
2. "Recent posts" – where students can obtain the latest articles posted in the blogger
3. "Comment" – where students can comment on others' articles by a simple click
4. "Archives" – where students can acquire articles posted earlier
5. "Export" – where students can download all the articles as a compressed file for content analysis.

31.5 The Action Research Process in Blogs

Building on the preliminary qualitative data obtained above, the theoretical model presented here posits the student as an active agent within the context of his or her social environment. This paper investigates students' buying experience from their case-sharing in the blogs. The students engaged in a collaborative writing exercise as blogging. They could gain five points for each new entry and two points for each follow-up comment as the assessment. At the end of the course, they needed to submit a final write-up on the topic of "consumerism" based on their own insights developed and earned from the blogging exercise. Therefore, the students were actively involved in the cyclical research process. The students did raise

some questions concerning the experience and ideas shared by others in the blogs. Problematic discussion then turned to the research process. It was consistent with the qualitative research methodology named "Netnographic," suggested by Kozinets [11], i.e. ethnography on the Internet. The students were assumed to be independent of what they observed in the blogs. As with most action research projects, the inquiry was developed in a series of cycles that consisted of real experience shared, critique, and identification. The students created a new entry as a starting point. The entries typically comprised a mix of personal experience, opinions from others, self-reflections, and actions.

The main objective of the study was to examine systematically the content of statements offered by the students, and to sort them according to the message they posted in their blogs. All messages posted in their blogs were unobtrusively downloaded and screened for references to the student ID. Contents of the blog messages were classified according to the topic (i.e. meaningful variables) written by the students. An emphasis was placed on capturing the students' feelings and perceptions in the course. We seek to develop analytic interpretations of the qualitative data. Once collected and organized according to this dichotomy, line-by-line analysis of these online messages was done.

31.6 Findings and Discussions

The main objective of the study was to examine systematically the content of statements offered by part-time evening MBA students, and to sort them according to the topic discussed. Once collected and organized according to this dichotomy, the verbatim transcripts of the messages were content analyzed using the software package "Nudist," a computer program for qualitative research. Some phrases that appeared frequently in the message were identified by the computer program. These phrases were identified as content analysis variables. Analysis of the sample revealed four main factors, or recurring themes, that appeared in the 345 cases (i.e. blog articles created by students) and 1,045 comments (i.e. follow-up comments on the blog articles from students other than the original author). The discussion themes, together with the frequency of occurrence, are shown in Table 31.1.

The importance of assessing the use of blogs in MBA education focuses primarily on the ability to visualize the level of collaboration and the sharing of

Table 31.1 Content Analysis Variables

	Meaningful variables	Frequency of blog articles	Percentage (%)
1	New case related to the topic discussed in class	215	62.319
2	New case not relevant to the topic discussed in class	84	24.348
3	Follow-up on the in-class case discussion	32	9.275
4	Asking questions about the subject matter	14	4.058
Total		345	100

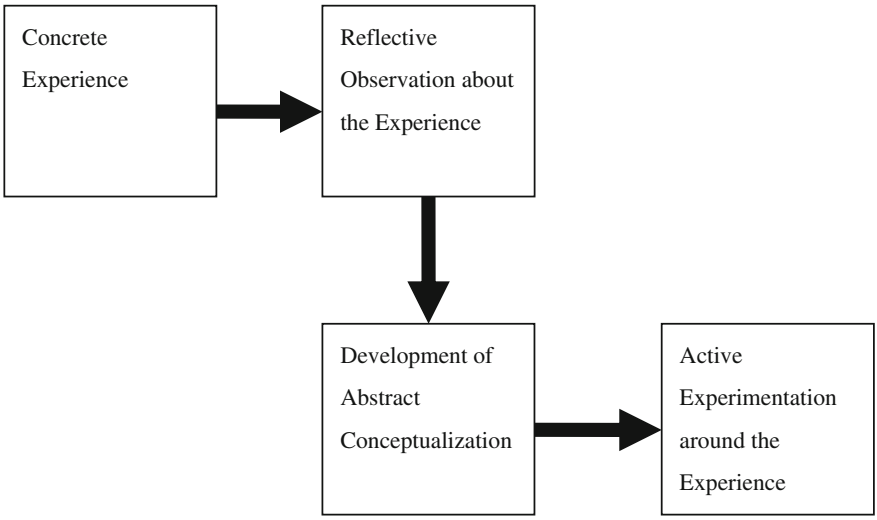

Fig. 31.1 Kolb's Learning Knowledge Cycle [9]

knowledge in the learning community. The common characteristic of all the blog messages contributed by students in the study is that they spent time reflecting on their own experience with other classmates in order to apply the concepts they had learnt to real-life marketing cases. We can evaluate whether the discussion in the blogs met its original objectives. It was noted that new cases dominated the blog discussion (in total, 86.667 % of all the messages discussed in the blog).

Kolb [9 p. 38] observed that learning is "… a process whereby knowledge is created through the transformation of experience." To achieve this, Kolb and Fry [10] argued that effective learning requires four distinct abilities: (i) concrete experience abilities; (ii) reflective observation abilities; (iii) abstract conceptualization abilities; and (iv) active experimentation abilities. According to Kolb [9], a complete model of a learning cycle therefore entails all of these elements, as illustrated in Fig. 31.1.

Blog discussion stimulates student reactions. With 345 blog articles there were 1,045 follow-up comments received, on average 3.03 follow-up comments for each blog article, which suggested that peer-led discussion in blogs enables Kolb's [9] learning cycle.

Knowledge can be either tacit or explicit [20]. Tacit knowledge always refers to knowledge that people learn from experience and practice. Alternatively, knowledge that can be expressed in a written form is called explicit knowledge. "Knowledge conversion" is a process that makes tacit knowledge explicit and codified. As suggested by Nonaka and Takeuchi [17], tacit knowledge is not easily converted into explicit knowledge because of the nature of tacit knowledge, and social interaction is the key in knowledge conversion.

Blog discussion also enables students to present their concepts visually. In the following example, a student posted his photo taken in the street to illustrate his case.

Original blog article titled "Be the first mover—According to the traditional culture, people purchase these products non-rationally." Six comments received from other students on the photo posted in the blogs.

This example shows that students can make good use of blog technology in sharing the marketing concepts in which they have personal experience. This was in line with the four different categories of knowledge transfer defined by Nonaka and Takeuchi [17]. They are:

1. tacit to tacit (the knowledge transfer happens during socialization, e.g. mentoring, learning by doing);
2. tacit to explicit (the knowledge transfer happens in externalization, where the knowledge is written or communicated in some permanent or semi-permanent way, e.g. stories, narrative, presentation);
3. explicit to explicit (the knowledge transfer happens in a systematic procedure, e.g. computer database, expert system);
4. explicit to tacit (the knowledge transfer happens in the internalization process, e.g. active participation and repetition).

Blogs, therefore, can be the tool for knowledge conversion in MBA education. In addition, students can even apply their knowledge learnt in class in real business cases in which they are involved.

31.7 Conclusion

MBA education has undergone dramatic changes in the last decades. Online learning is a hotly debated educational issue. The importance of MBA education originates from the fact that people sometimes do not know what they are supposed to learn. Moller [15] applied social reinforcement with the help of the Internet, and found that asynchronous distance learning was enhanced through an online community. Piccoli et al. [19] also investigated the effectiveness of a Web-based learning environment. They postulated that higher-level learning online would be correlated with higher test scores and greater satisfaction with the online learning environment. In terms of social interaction, traditional collaboration with fellow students and academic staff is often cited as being an important feature of traditional learning. However, with the help of technology, interaction and collaboration are made possible without personal physical direct contact.

The demonstration in this paper provides rich evidence to support the concept. The study focuses on marketing education from participatory action research in blogging. It uses a collaborative inquiry approach. As a result, blog discussions should be in place in order to protect intellectual assets and help students to acquire, store, and utilize knowledge in a flexible and effective way. It is generally accepted in modern education that the learning processes of individuals are facilitated by interactive communication with fellow students and academic staff. Indeed, this interaction and this collaboration are, in many ways, more flexible and extensive than traditional learning. They provide another alternative for people who are looking for high-quality learning opportunities while still conducting other aspects of their ongoing lives and careers. Flexibility is thus one of the major advantages for people who choose online courses. For these reasons, it is likely that traditional teaching and executive training will increasingly shift to online distance learning using the Internet.

Traditionally, an MBA participant must physically attend the university campus for mass lectures and tutorials. Students enjoy learning with blogs and it promotes after-class discussion. The continuous postings from students in the blog create an ongoing discussion to extend their learning process and act as a resource for others. A blog opens up personal opinions, ideas, and feelings to other classmates in the free-form writing space. It enables students to become independent learners in the action research approach. This framework also provides some directions for future research on the assessment of knowledge exchange in blogs.

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Chapter 32
Top-X Querying in Online Social Networks with MapReduce Solution

Zheng Jianya, Li Weigang and Lorna Uden

Abstract Social Media offer golden opportunity for information mining. However, it is a challenge to find useful knowledge from these massive data. This paper describes a solution for a common problem using top-x querying in Online Social Networks (OSNs). Seventy-five GB data were collected from Twitter, reorganized into dataset in a distributed computing platform with Hadoop. By adopting Aggregate-Rank-Delete algorithm, we used MapReduce solution to develop an algorithm, called *MapFollowee & ReduceFollower* to query the Top-X members who retweet and that have largest number of followers. This proposed approach is to effectively accelerate the querying process, in which not only the performance is faster than the matrix algorithm but also faster than the original algorithm in the stand-alone version. It also reduced the data storage from the original dataset. This result is important because it provides a new parallel paradigm as an application of MapReduce with an efficient way to resolve the practical problem in OSNs.

Keywords Hadoop · MapReduce · Online social networks · Query · Top-X

32.1 Introduction

Big data relies on the ability to gather and sort massive amounts of diverse information. A key source of such varied and diverse information is on line social media. From YouTube videos to tweets, users are feeding trillions of pieces of data

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every day. Companies are beginning to understand and predict consumer behaviour through the use of data from online social media. Data gathered from other business activities is structured, but social media data is unstructured and, therefore preventing regular business intelligence tools from working effectively.

McKinsey & Company found that the value of big data recovered from social media activity has a number of values. It can help boost productivity, it can reduce costs and it can help businesses to make better, more well-informed decisions. Online Social Networks (OSNs) have become important social activities on the web. They provide high potential to get relevant information for both business marketing and academic research. While companies focus on promoting their brand and products, the science community is interested in user interactions and evolution of networks. Although the data has great value, how to abstract valuable knowledge from the massive data, sometimes within a certain time limitation, is still a great challenge.

One of the problems in OSNs is to execute the queries of specific information, for example, to query a users' Top-X followers who have more followers in Twitter or Weibo. To solve this problem, Sandes et al. [1] have developed a logical *model (Follow Model*) and *Aggregate-Rank-Delete* algorithm with successful implementation using the conventional computation environment. In some situations, it may be necessary to query more sophisticated information, for example, within a group of 100 thousand retweets, we want to know the users' Top-X who retweeted and with more followers. As the scale of OSNs increases, it is necessary to develop a new computing paradigm to process the massive data.

The Google research group developed MapReduce model [2] to simplify data processing on clusters. This technique allows performing large-scale computation in a parallelized computing and distributed storage environment, accelerates the data processing with commodity computers to resolve real-world tasks. Capturing the business value of big data requires transforming raw data into usable products that offer new insights to the business. As an application of MapReduce, a research group originally from Yahoo developed a pioneer system call Hadoop, which is unique in its ability to simultaneously process and analyze complex and disparate types of data.

By adopting *Aggregate-Rank-Delete* algorithm, MapReduce is used in an algorithm to query the Top-X members who retweet and also the largest number of followers. This new approach is called as *MapFollowee & ReduceFollower*, which is implemented in the Hadoop system. Seventy-five GB network and message data were collected from Twitter and presented in the distributed platforms. This approach effectively accelerates the querying process, in which not only the performance is faster than the matrix algorithm but also faster than the original algorithm in the stand-alone version. It also reduced the data storage from the original dataset. This result is important because it provides a new parallel paradigm as an application of MapReduce with an efficient way to resolve the practical problem in OSNs.

Next section of the paper describes related work. This is followed by Sect. 32.3 describing the *Follow Model* and *Aggregate-Rank-Delete* algorithm that was proposed for OSNs. In Sect. 32.4, we describe *MapFollowee & ReduceFollower*

algorithm to execute the Top-X user query in the Hadoop distributed platform. The case study with the analysis of the experiment is demonstrated in Sect. 32.5. The paper concludes with suggestions for further research.

32.2 Related Works

This section discusses the methods of measuring influence in social network followed by the study of the Top-X query and MapReduce models.

32.2.1 Influence Measurement in OSN

Influence measurement is a hot research topic in social network. The TFG model is based on the theory of factor graph by Tang et al. [3], which proposed to incorporate the information of topic and social relationship into a unified probabilistic model. Goyal et al. [4] proposed a framework based on the General Threshold Model to measure probabilities of influence by neighbours of a user. The time was considered as a factor in their models which can make the computation incrementally and efficiently. The contribution of Anagnostopoulos et al. [5] distinguishes the social influence from various factors such as hemophily or unobserved confounding variables that can induce statistical correlation. The authors conducted a series of tests and prove that the social influence can be extracted with the help of action time series.

The research by Chen et al. [6] focuses on influence maximization within the social network. To reduce the large running time of greedy algorithm these authors proposed degree discount heuristics to select the proper user as seed to propagate the information. This work give an idea to locate the users who have more influence (promote the information propagation). Cha et al. [7] collected a large scale of data from twitter to study user's influence by indegree, retweets and mentions. Their research produces some interesting observations such as popular users who have high indegree are not necessarily influential. This provides us the challenge to measure the influence within a special community.

32.2.2 Top-X Querying Problem

Today the Web contains huge pile of documents that are not only heterogeneous in their content, but also in the level of annotation and structure they provide. Combining effective and efficient search over such heterogeneous collections within a single search engine would be problematic especially when the structure of documents, like in XML with potentially diverse schemata, hierarchical embeddings, and semantic annotations, should be exploited by queries and be taken into account for result ranking.

XQuery was devised primarily as a query language for data stored in XML form. So its main role is to get information out of XML databases—this includes relational databases that store XML data, or that present an XML view of the data they hold. Top-X is a novel engine, coined for efficient ranked retrieval of XML documents over semistructured but nonschematic data collections.

According to Theobald and others [8], Top-X is a search engine for ranked retrieval of XML data. It is a comprehensive framework for unified indexing and querying large collections of unstructured, semistructured, and structured data, comprising a full-fledged solution for ranked retrieval on desktops or intranets with annotated text or semistructured data, and, ultimately, the Web. It comes with a flexible, yet powerful and self-throttling query relaxation and/or expansion technique as an adequate means for coping with the inevitable diversity when merging various data sources that provides a controlled influence on the result ranking.

Top-X supports a probabilistic-IR scoring model for full-text content conditions and tag-term combinations, path conditions for all XPath axes as exact or relaxable constraints, and ontology-based relaxation of terms and tag names as similarity conditions for ranked retrieval. These authors argued that Top-X has an improved scoring model for better precision and recall, and a radically different architecture which makes it much more efficient and scalable. It has been stress-tested and experimentally evaluated on a variety of datasets including the TREC.

In this paper, Top-X querying means to find the first X's influential members (X may equal 10, 100 or 1,000 etc.) from a certain community. This community was formed dynamically from Twitter or other OSNs.

32.2.3 Related Works of MapReduce in OSNs

The Google Files System (GFS) is a scalable distributed file system [9] that was designed and implemented for Google. The concept of MapReduce was initially introduced by the same group of researchers who developed the GFS [2, 10]. A comprehensive review is provided in [11], which is presented with various study cases. Among these applications, the most widely used implementation is Hadoop system, which was originally developed by a group of researchers from Yahoo. An overview of its architecture and design can found in [12].

Apache Hadoop has been the driving force behind the growth of the big data industry. Hadoop is an open-source distributed file system that allows for the collection and analysis of massive volumes of unstructured data. Data from any number of sources and in any range of formats can be processed quickly and cost effectively. It is highly scalable, which is an essential additional attribute for businesses that want their data analysis solution to grow with them.

32.3 Aggregate-Rank-Delete Algorithm

The *Aggregate-Rank-Delete* algorithm was developed by Sandes et al. [1] to find Top-X members by considering time and other property restrictions in OSNs. It consists of two processes, *indexation* and *aggregate-rank-delete*.

32.3.1 Indexation

For a more general representation, the set $S = \{(e_a, t_1), (e_b, t_2), \ldots (e_n, t_m)\}$ represents a series of events, such as retweet or mention. The subscript of *e* means a user and the *t* is the time when the event occurs. The set $C(e_k)$ represents all the events of user *k* in the set S, and $|C(e_k)|$ is the number of occurrences. $S[t_i \ldots t_j]$ means the event set during the time span t_i and t_j.

For example, a tweet of user *A* was retweeted at time t_1 and t_2 by his followers; a tweet of another user, *B*, was retweeted at time t_3. There is the event set $S = \{(e_A,t_1), (e_A,t_2), (e_B,t_3)\}$. We use C to mark the event set of a particular user. The event of user *A* can be represented as $C(e_A) = \{t_1, t_2\}$ and $|C(e_A)| = 2$ while user *B* represented as $C(e_B) = \{t_3\}$ and $|C(e_B)| = 1$.

To query of the number of occurrences of event e_K during the time span $[t_a, t_b]$ became inefficient when the user and event dataset is very large. A simple manner of optimization is to maintain an independent list for every user e_k in time order, as $C(e_K) = \{t_1, t_2, \ldots, t_m\}$ where $t_1 < t_2 < \ldots < t_m$. With this list, it can be more efficient when querying the number of events during a time span.

Figure 32.1 is an example of application of indexation. The event of e_k occurs 13 times in the time line. If we want to know the number of occurrences of this event during t_a and t_b, all we need to do is subtract the ordinal of first occurrence after t_a from ordinal of the first occurrence after t_b.

32.3.2 Aggregate-Rank-Delete

Indexation is first step in the Top-X querying. The second step, the *Aggregate-Rank-Delete* algorithm can be used to query the Top-X members in

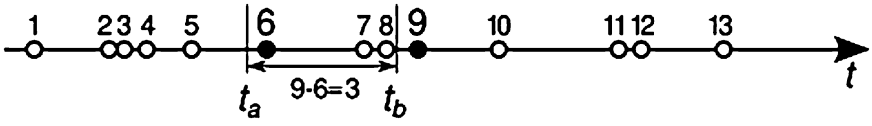

Fig. 32.1 Indexation step

OSN effectively. As the name shows, this algorithm consists of three steps: aggregation, ranking and deletion.

Aggregation. A time span, is defined, which is the interval of time restriction in the query condition, $[t_a \ldots t_b]$, it can be 1 h, 1 day or 1 year. Using time interval Δt, we can split the timeline into continuous slices. Δt may be 10 min or half an hour, etc. The principle is to choose a length of slice that is shorter than the slice. With this the computation may cost more time, but the query time span can be limit into a shorter interval as needed. Note that the time slice is always shorter than time span.

In every time slice $S[t_s, t_{s+\Delta t}]$, we can get two numbers about event e_k, $\min(e_k, t_s)$ and $\max(e_k, t_s)$. For a given time span $[ti \ldots t_j]$, $\min(e_k, t_s)$ is the minimum number of occurrences during this time slice, while $t_j \in [t_s, t_{s+\Delta t}]$. Likewise $\max(e_k, t_s)$ is the maximum number of occurrences during this time slice.

Figure 32.2 demonstrates the step of aggregation. Time span was represented at the top of the figure, and each slice in the time line is a predefined time slice. We take the fifth time slice which marked "Time Slice" as an example. In this slice, the $\min(e_k, t_s)$ is 1 because from the beginning of the slice until the occurrence 7 happens, the time span only has one event which is occurrence 6. The $\max(e_k, t_s)$ is 3 by the reason that after occurrence 8, in the time span there are 3 occurrences such as 6, 7 and 8.

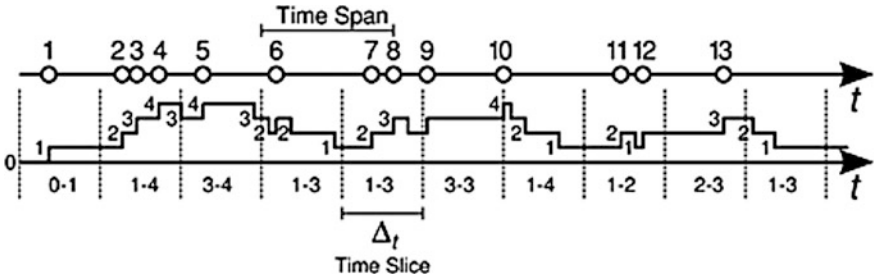

Fig. 32.2 Aggregation step

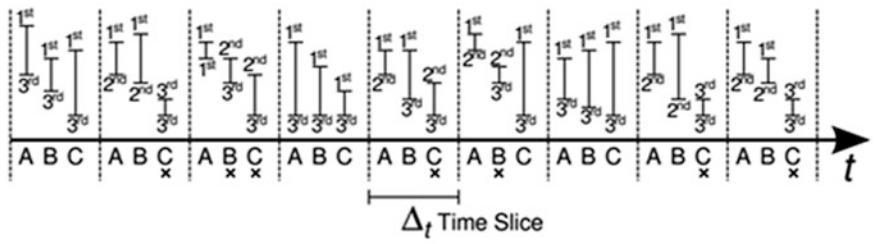

Fig. 32.3 Delete step

Ranking. In the aggregation step, we get all users' information in every time slice. This will require great storage space. According to our requirements of querying Top-X members, it is unnecessary. So the ranking step is proposed to eliminate the useless data.

For every time slice, we order all the users by the value of $\min(e_k, t_s)$ then get a list of $(e_1, e_2, \ldots, e_X, e_{X+1}, \ldots, e_n)$. The X is the top number we need to query. Note that, excepting the Top-X $\min(e_k, t_s)$, we also need to keep the elements whose $\max(e_k, t_s)$ is more than the X-th $\min(e_k, t_s)$. This extension can guarantee the accuracy of this algorithm.

Delete. In the delete step, we reduce data except for the data collected in the ranking step. With this step, we can significantly reduce the data size and further make the query more efficiently.

Figure 32.3 shows an example in the delete step, where we appointed X is 1. For every slice we store the biggest number of $\min(ek, t_s)$. Also take the fifth time slice which marked by Δt, A is with the biggest $\min(e_A, t_s)$ among A, B and C, so the A will be reserved. For B, its $\max(e_B, t_s)$ is bigger than $\min(e_A, t_s)$ which will be reserved as we mentioned in the ranking step. For C, its $\min(e_C, t_s)$ is not the No.1 and the $\max(e_C, t_s)$ is smaller than the $\min(e_A, t_s)$, as a result, we can delete this element in this time slice.

It should be noted that, there are various restrictions of the time span (1 h, 1 month or 1 year), it should maintain a list for every time span according to a certain time slice. This makes the query result more accurate. With the aggregation result, it doesn't need a lot of work to do this.

32.4 MapReduce Solution for OSNs

In this section, we specificity Top-X query problem in OSNs and develop a new algorithm *MapFollowee & ReduceFollower* using MapReduce solution.

32.4.1 Problem of Top-X query

More and more companies have become involved in promoting their brands in Online Social Networks (OSNs). Consequently, it is necessary to discover who the most influential people in the information propagation are. Some researchers have successfully resolved the problem by using social relationship network, see Sect. 32.2. We propose a new paradigm to find Top-X queries to support the process of finding dynamically who is the most influential in a community.

The Top-X query is to find out the most influential person by their behavior and activity in OSNs, using the number of the followers or retweets. Suppose one user in Twitter publishes a tweet, and their followers see this tweet and are interested

then retweet it. This retweeting mechanism makes the information diffusion go much further. Our objective is to find out who make the most contribution during this diffusion. The original tweet writer may be not the person who contributes the vast broadcast of the information, however, who retweets this tweet and with more connections may contribute much more in this process within OSNs. To better describe this querying, we first introduce the *Follow Model* [1] to represent the relationship networks in OSNs.

Suppose the social network described as a directed graph $G = (V, E)$ where the vertice set V represents the users and the directed edges $E: V*V$ represents the followship relations among the users, where (a, b) in E means that user a follows user b. The original *Follow Mode*l includes three functions which are:

- $f_{out}(a) = \{b|(a,b) \in E\}$: is the set of all followees of user a.
- $f_{in}(a) = \{b|(b,a) \in E\}$: is the set of all followers of user a.
- $f_r(a) = f_{out}(a) \cap f_{in}(a)$: is the set of all friends of user a.

For the functions above, Follow-Mode also defines its reverse functions

$$f' = \begin{matrix} f_{in} & if\, f = f_{out} \\ f_{out} & if\, f = f_{in} \\ f_r & if\, f = f_r \end{matrix}$$

and combination methods.

$$f_1 f_2(a) = f_1(f_2(a))$$

Let $Z = \{u_1, u_2, \ldots, u_n\}$ is a set of the users who retweet a message (include the original writer). With the formal description of followee f_{out} and follower f_{in}, $|f_{out}|$ means the number of followees, also as $|f_{in}|$ is the number of followers. We can mathematically this problem as

$$|f_{in}(u_K)| = f_{in}(u_K) \cap Z(u_k \in Z)$$

Our target is find out the who have the largest $|f_{in}(u_K)|$ in the set Z.

32.4.2 Algorithm to Find Top-X using MapReduce

The basic idea of MapReduce solution is to specify the map and reduce functions, parallelize the computation across large-scale clusters underlying runtime system automatically, handle the machine failures and schedule inter-machine communication.

This model hides the messy details of parallelization, fault tolerance, data distribution and load balancing in a library; it makes programmers job easy to use. Researchers only need to express the simple computation by the map and reduce functions. With the efficient use of network and disks, a distributed environment is

easily extensible. In this sense, MapReduce is developed for large-scale data processing.

Twitter, Weibo and other OSNs have been used by large number of people in our society. The functions of activities of users in these platforms are dynamically changing. Besides the traditional actions such as *retweeting*, *mentioning* and *commenting*, the new action *liking* (recommending) add one more latitude in the relationship between the users. The refinement of the relationship requires more specialization demand in the query. The most common case is query the Top-X users in a particular community (usually with the same tag or do the same action) with a time restriction in the period $[t_a, t_b]$.

Suppose in a time span $[t_a, t_b]$ a tweet was retweeted by a set of m users $Z = \{A, B, C, \ldots, P, Q, R, \ldots\}$. This set dynamic changes by other users doing the action retweeting this tweet. The dynamically variation is a great challenge for traditional computation. We introduce an algorithm called *MapFollowee & ReduceFollower*, using MapReduce model to resolve the problem. This technique is suitable for these kinds of tasks, i.e. to find the couples of (Follower, Followee) from the dynamically changing set Z (this can refer as the Map step), and then to rank Top-X members (this can refer the Reduce step). The parallelization computation by Hadoop brings the efficiency in these steps.

Table 32.1 *MapFollowee & ReduceFollower* algorithm in Top-X querying

Follower (key 1)	Followee (value 1)	MAP=>	Set Z (key 2)	$f_{in}(.)$ list(m)	REDUCE=>	Set Z (key 2)	$\lvert f_{in}(.)\rvert$ (value 2)
User A	User P		P	A		P	1
User A	User Q		Q	A, B		Q	2
User B	User Q		R	B, C		R	2
User B	User R		–	–		S	–
User C	User R		A	–		A	–
–	–		–	–		–	–
Top-2							Q, R

```
// Class Mapper, Find the relationship in the scope of the community/group
method map (followerid, followeeid)
  for all followerid ∈ S
    if(followeeid ∈ S )
      emit pair(followeeid, followerid)
// Class Reducer
method reduce(followeeid, pairs<followeeid, followerid>)
  for all pairs ∈ pairs<followeeid, followerid>
    C_followee <--- C_followee + 1
  sort(C_followee)
  emit (followeeid, C_followee)
```

Fig. 32.4 Implementation of *MapFollowee* & *ReduceFollower* program

The new proposed Top-X querying algorithm, *MapFollowee & ReduceFollower* is basically divided in four steps and described as:

(1) **Collecting step.** This step is to construct the correlation of users in the set Z. Usually we can get the following relations between the users from the social network data. For each user, there are various pairs to present his following relation, namely, $f_{out}(.)$, see Sect. 32.3. In Table 32.1, the first two lines <*User A, User P*> means user *A* follows user *P*.
(2) **Mapping step.** With the following pairs between the users, we use the map function to get the followed relation $f_{in}(.)$. This function can get a set for every user in the set Z, which is dynamically formed and with significant scale in OSNs. As Table 32.1, user *Q* has two followers: User *A* and *B* (in the second part of Table 32.1).
(3) **Reducing step.** With the follower set of everyone in set Z, we calculate the follower number in this step. For example, user *P* has one follower and user *Q* has two followers.
(4) **Ranking step.** In this step, we order the users by the number of their followers, then the result is what we wanted: Top-X, in Table 32.1, it is Top-2. In fact, the ranking function is an inherent in the reduce function. We listed this here to explain our algorithm more clearly.

32.4.3 Implementation of the Algorithm to Find Top-X

It is obvious that *MapFollowee & ReduceFollower* model is effective to achieve parallel computing by the implementation of Hadoop. The reason is that Hadoop includes the MapReduce solution which hides the details of failure handling, schedule communications etc. For the unstructured user relationship network data from Twitter, the step of mapping the couples of (Follower, Followee) is with the complexity of $O(n^3)$, Hadoop is ideal for doing that.

Figure 32.4 presents the implementation of *MapFollowee & ReduceFollower* algorithm to find Top-X using MapReduce in Haddop.

32.5 Case Study

This section describes the data from Twitter, experimental settings and results.

32.5.1 Data Description

The experimental dataset of OSNs is collected by Yang and Leskovec [13] from Twitter. There are nearly 580 million twitter posts from 20 million users covering an 8-month period from June 2009 to February 2010. It consists of about 20–30 %

of all posts published on Twitter during that time frame. Almost 71 out of 580 million twitter posts are retweets. Moreover, 66,935,426 events (word starting with #) are referred to in the dataset. Once the redundant records were removed when the same guy referred to the same event several times, 4,086,161 of them were unique. For detail information of the data, see [13], which were used to evaluate our computation model.

The social graph crawled by Haewoon Kwak et al. [14] has 41.7 million users and 1.47 billion relationships. We obtain the relationship of follower and/or followee from this social graph.

32.5.2 Hadoop System Setup

The Apache Hadoop software library is a framework that allows for the distributed processing of large datasets across clusters of computers using MapReduce programming models. In addition, it provides a distributed file system that stores data on the compute nodes, providing very high aggregate bandwidth across the cluster. Both MapReduce and the distributed file systems are designed so that node failures are automatically handled by the framework.

In our case, the cluster was constructed by four computers whose performance parameter is listed in Table 32.2. There were two kinds of computers used, HP with Ubuntu OS and iMac with Mac OS.

The cluster was connected by an 8-port Gigabit Ethernet Switch with category six cables. This connection guarantees maximum transmission rate between any two computers reaches almost 100 M/s. This high-speed connection can make the cluster work more efficiently.

Computer 1 plays two roles in this cluster. First it is the master machine, which manages the running of the cluster. On the other hand, it is also a slave machine to execute the computation as computers 2, 3 and 4. For our small scale cluster, we need to maximize the computational performance.

Table 32.2 Hadoop implementation with four computers

Computer	OS	Processor (GHz)	Memory	HD (TB)	Network card (G bit/s)
1	Ubuntu 12.04	Intel Core i5 2.80	4 G	1	1
2	Ubuntu 12.04	Intel Core i5 2.80	4 G	1	1
3	Mac OS 10.7.3	Intel Core i5 2.80	4 G	1	1
4	Mac OS 10.7.3	Intel Core i5 2.80	4 G	1	1

Table 32.3 The storage reduce using the *aggregate-rank-delete* algorithm

Top-X	1 h/20 min (%)	1 day/1 h (%)	1 month/1 day (%)
10	4.3	5.7	5.3
50	8.6	11.2	12.0
100	11.5	14.5	17.9

32.5.3 Performance Analysis of Aggregate-Rank-Delete Algorithm

With the *Aggregation-Ranking-Delete* algorithm, we investigated the retweet action in the Twitter with Yang's data set. The parameters of the timespan/time-slice were chosen as: 1 h/20 min, 1 day/1 h and 1 month/1 day respectively. For Top-X querying, we selected X = 10, 50, 100. With these parameters, the result of storage information is listed in the Table 32.3.

As shown in Table 32.3, when the time span is set as 1 day and time slice is set as 1 h, the storage of the information for querying about the retweeted users is reduced to 5.7 % of the total information. This improvement of *Aggregate-Rank-Delete* algorithm is significant for a great quantity of the original data. The percentage can changed according to the parameters setting. As the number X of Top-X query is always is a fixed constant, as the data set is getting huge, the performance of the storage saving is much improved for the frequency of online querying in OSNs.

32.5.4 Results and Performance Using MapFollowee & ReduceFollower Algorithm

When finding the Top-X influential users within a particular group in OSNs, *MapFollowee & ReduceFollower* algorithm is tested with the same data from Twitter. Top-X may be the users who retweeted a tweet and also have more followers.

To simplify the problem, we took the people who referred to the same event to form a community. In this case, we choose the users who mentioned the topic **#musicmonday**, about music, as a group which involved with 150,545 users. In this group, there were 55,115 user's relations available from the dataset; we only focused on these users with complete information. There were a total of 18,580,632 relations related to these users in the whole relation network of Twitter at that time. Our research was to find out who has the most followers within this group.

Table 32.4 Top 5 in the group with event **#musicmonday** in twitter (June/2009–Dec/2009)

User name	@Twitter	Location	Job	Followers	Event followers
Souja Boy Tell'Em	@soujaboytellem	US/Illinois	Rapper	1,241,331	4,572
Pete Cashmore	@mashable	US/	CEO	1,210,996	4,222
Hayley Williams	@yelyahwilliams	US/Tennesse	Singer	179,700	4,167
Jimmy eat world	@jimmyeatworld	America/ Arizona	Rock band	920,556	2,534
PostSecret	@postsecret	Website	Community	179,000	2,180

As mentioned in Sect. 32.4, *MapFollowee & ReduceFollower* algorithm adopts the concept of MapReduce and is implemented in Hadoop. With different configurations of the machines in cluster as shown in Table 32.2, we tested the *MapFollowee & ReduceFollower* algorithm in the Top-X querying from Twitter [13.14]. In Table 32.4, for saving the space, X equals 5. For example, Souja Boy Tell'Em is a rapper, record producer, actor and entrepreneur. He was with 1,241,331 followers in Twitter and 4,572 followers in the group of the event of **#musicmonday**, who was considered on Top of this group by means of the number of the followers.

In analyzing the performance, we observe that the cluster is efficient for the same task for a stand-alone computer. When the computation task with 26 GB data is processed by one machine, the CPU time is 80 min 30 s. When used by two machines in Hadoop system, it costs 58 min 46 s; and by four, 41 min 22 s. The percentage of the improvement didn't match the increment of the cluster, because with the more computers in the cluster, the communication between the nodes cost more system overhead. For large scale computation with more nodes, this scenario will be improved adequately.

32.6 Conclusions

With the application of *Aggregation-Ranking-Delete* algorithm, we can reduce the scale of storage significantly. From our case study, even the most complicate task as Top-100 query from Twitter, the size of information only occupies at most 18 % of the original data. As we mentioned above, the data reduction not only benefits the storage, but also improve the efficiency of the querying process. With less information, the query will be executed more efficiently. Besides, in the real situation, we take the time slice as the unit to organize the data. Since all the records have already been sorted when they stored, we can exploit the advantage of the ordered records frequently in succeeding step.

The *MapFollowee & ReduceFollower* algorithm can also be used to improve the execution of the computer tasks with parallel paradigms supplied by Hadoop. With this advantage, we can easily handle the massive without concern about the implementation details.

In future work, we will apply the proposed algorithms for more sophisticated queries. We will also connect more computers as nodes for the Hadoop system to test more data.

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Chapter 33
SMEs: Social Media Marketing Performance

Hilary Berger and Chris Thomas

Abstract In today's hyper-connected globalized world, social media and online customer interactions are changing the way companies do business from the outside in. Our investigation concerns the monitoring of social media performance within SMEs and more particularly within Wales. The continuous expansion of social media (marketing) and the concomitant growth of innovative new platforms have driven businesses to embrace new strategies presenting new challenges for current and future practice. This has led to a sustained need for organizations to engage in performance monitoring of social media. We found, however, that the timing of implementation of social media marketing into an SME is not the most important factor, rather it is more important to consider how well social media marketing can be utilized to have the best possible effect.

Keywords SMEs, Social Media · Social Media Marketing · Web 2.0

33.1 Introduction

Approximately once a decade, a pioneering new technology emerges that fundamentally changes the business landscape. In the 1970s it was main frame computing. In the 1980s, it was the Personal Computer (PC). In the 1990s, it was the internet. Today, it is the online social media innovation [1]. The ever increasing growth of social media services provides a communication platform for

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marketers to step onto and exploit. However, such engagement has the potential to create significant risk that many businesses, and SMEs in particular, might not be prepared to take. The emergence of contemporary social media services allow companies of all sizes to communicate with their audiences in a direct, instant and economical way known as Social Media Marketing (SMM). Indeed, large scale global organizations such as Nike, Hewett Packard and GlaxoSmithKline are all using SMM as a method of promoting their products or services. However, our research study concerns small to medium size enterprises (SMEs) that are also exploiting the power that social media services offer. Although there is no one universal definition of an SME, we adopt the definition put forward by the European Union (EU) who define an SME as an organization which has less than 250 employees [2].

Web 2.0, the second generation of web services and communities, emphasizes online collaboration, networking and user-generated content that enable people to directly contribute to the 'Information Superhighway' through forums, blogs, pod casts, wikis and so forth. Thus, companies are no longer in control of the information associated to them such that social media (SM) has caused changes in the way they manage and create relationships with their customers and stakeholders [3].

The accelerating rates of change of the globalized marketplace requires organizations to engage in social media and social media marketing that have become the gateway communication channels to connect with customers employees, clients, customers and suppliers to sustain competitive advantage [4]. Integrating SMM that enable direct communication with consumers and one-to-one participation calls for measures to monitor their performance and effectiveness [5, 6]. However, for SMEs such two-way communication with target audiences proves more difficult due to poor marketing communications that constrain successful implementation and utilization of social media. Although benefits of social media use can be substantial, this is still a relatively novel and unexplored area with few established specific theoretical models [7].

We respond to Bell and Loane [3] who report that there is only limited empirical enquiry relating to 'SMEs and Web 2.0' stressing the need for further investigation. Our research focus is centered upon Wales where there are 200,000+ SMEs (South Wales Chamber of Commerce 2012). Utilizing ten SMEs across South Wales we determine the level of SM activity, then identify which platform(s) were being used, examine the degree of awareness of performance monitoring and finally, determine the extent to which social media marketing performance is monitored and the identified associated benefits (if any).

33.2 Theoretical Context

We position our theoretical context by first briefly defining both social media (SM) and social media marketing (SMM). We next explore how SMEs use SM and their

preferred SMM platforms/services. To inform current and future practice we further consider whether and/or how SMEs monitor and measure the effectiveness of their SMM activities and potential benefits.

Although the term "Web 2.0" was first used in 1999 by Darcy DiNucci, since 2005 it is more commonly associated with O'Reilly [8] who defined it to mean the next generation web services that utilize new collaborative and dynamic information sharing tools, technologies and practices. He describes the Web 2.0 as 'a set of economic, social and technology trends that collectively form the basis for the next generation of the Internet' [8], p. 6.

Indeed, Web 2.0 has created a platform where the 'public' now have easy access to reading, creating and sending information to each other across the world instantaneously. Thus, the balance of power has shifted in favour of the 'public' and companies are increasingly utilizing social media channels, such as Facebook, blogs and twitter to stay close to their customers in an effort to govern their reputation [9]. Grunig [10] states that "Excellent organizations 'stay close' to their customers, employees, and other strategic constituencies" (p. 16). In todays current uncertain economic climate and competitive global market 'reputation' is considered to be a company's biggest asset as it has the ability to provide competitive advantage that is critical to its survival and success [9, 10]. This has challenged the former traditional 'top-down' marketing approach to a bottom-up approach obliging organizations to rethink their marketing strategies [11]. The indication is for greater focus to be placed upon interactive consumer contact and communication with the public.

33.2.1 Social Media and Social Media Marketing

Although social media is typically considered to be a new form of communication, Lapsley reveals that it has actually existed in one form or another since the 1950s. SM is an umbrella term that refers to a set of tools, services and applications that allow people to interact with others using an electronic network. There are many differing definitions for social media. Mangold and Faulds [6] describe it as a set of online word-of-mouth mediums that includes blogs, discussion boards, forums or social networks (to name a few) which generate vastly interactive platforms by bringing together individuals and creating communities. For example, 'Friendster' in 2002, followed by 'MySpace' [12] and then 'Facebook' [12]. People and organizations use social media at an increasingly exponential rate to share, co-create, and discuss user-generated content [5]. Such SM media services are now globally utilized and integrated as a daily activity among the diversity of populations [13]. According to Evans [7] social media services allow people to stay connected in what some would claim is an extension of the physical world. For this research study the concept of social media will be defined as an online interactive communication system where organizations (and individuals) use Web 2.0 tools to

collaborate with consumers on product development, service enhancement and promotion.

However, there is no universal definition of SMM due to its status as a comparatively new discipline that is in continual development and expansion. However, a general view is that it is a form of Internet marketing that uses social networking as a marketing tool. The goal of SMM is to produce content that users will share with their social network to help a company increase brand exposure and broaden customer reach [7].

It is accepted as one of the fastest growing areas of the Internet and a major factor for the adoption of SMM is the growth in social networking [14]. A recent study into use of SM by marketers to grow and promote their businesses found that Twitter, blogs, LinkedIn and Facebook, in that order, are the top four social media tools used [15]. Using Facebook as an example, the platform has generated an interest amongst marketers as it provides the prospect of reaching millions. Using social media can promote organizations instantly in ways previous tools could not [7]. In a recent report, "46 % of the surveyed companies have already used social networking as a successful tool to build and promote business, improve collaboration and communication, and increase consumer engagement" [16].

33.2.2 Welsh SMEs: Social Media, Social Media Marketing

From the perspective of the contemporary SME landscape the Internet is presenting global challenges and opportunities which increase their business potency via SM and SMM [17, 18]. Indeed of the 200,000 SMEs in Wales 70 % aim to grow their business over the next 2–3 years and 59 % aim to do this by exploiting new markets to create competitive advantage [19]. However, the extent of Internet use continues to vary widely among SMEs because their website adoption may be limited to the use of the Internet as a tool for email and web surfing rather than Internet based e-commerce [20]. Also challenges of Website adoption across Wales is tempered by a lack of brand recognition, lack of advertising resources, and limited website development and maintenance making it more difficult for SMEs to attract visitors and convert them into customers [21, 22].

Nonetheless, research suggests that around "one in three SME's are using social media on a daily basis" promoting their business to the online community [23]. In corroboration a survey [24] covering 862 respondents found that "62 % of the respondents now use social networking in everyday business" and that "92 % of those using it do so to keep in touch with existing customers, while 78 % are using it to find new customers". However, the survey also reports that although 84 % of Welsh SMEs say they use the Internet in some way this is below the comparable UK figure of 90 %. Although only a small difference, what is significant is that the number of Welsh SMEs that operate an ecommerce web presence stands at 60 % restricting the potential of the remaining 40 % to engage in Internet marketing opportunities. Nonetheless of the 200,000 + SMEs in

Wales, 70 % aim to grow their business over the next 2–3 years and 59 % aim to do this by exploiting new markets utilizing SMM [25].

33.2.3 Monitoring SMM Performance and Effectiveness

In an increasingly competitive environment, measurement of practice is an integral part of any organization. According to Fraser [26], p. 10 "effectiveness is a measure of match between stated goals and their achievement". Erlendsson [27] defines effectiveness as the extent to which a company's objectives are met. Due to the exponential growth of SM and SMM the monitoring and tracking of marketing goals is particularly important for SMEs striving to maintain competitive advantage across the global divide. Indeed, measurement of online communications had increased from 29 % in 2008 to 41 % in 2009 [28]. In response, third party tools and technology have been developed to monitor companies' specific performance and effectiveness. Examples include Google Alerts and eBuzz however, there is no one 'fix all tool' for monitoring performance out there [29]. However, not all SMEs are wholly convinced of the value and effectiveness of using such tools. There is also some misconception about the effort required to perform effective SMM monitoring. Croll and Power [30] state "The percentage of visitors that your site converts to contributors, buyers, or users is the most important metric you can track" (p. 16) but the perception is that measuring the ROI takes too much time and effort because it is far more complex than the usual cost versus increase in sales equation. In fact, it is believed that over 70 % of online businesses utilizing SM as part of their marketing drive do not bother to measure their ROI. Identifying if SM is positively impacting on a business is possible it is difficult, however, to know the full effect as it takes time to convert visitors into paid customers [4].

Table 33.1 Case study by business sector, Website and SMM monitoring

SME ID	Business sector	Year Website	Awareness of performance monitoring
A	ICT	1996	No
B	Leisure and Tourism	1998	No
C	Construction	2000	No
D	Education and Training	2002	No
E	ICT	2002	No
F	Sport	2004	No
G	Food and Drink	2006	No
H	ICT	2009	Yes
I	Financial & Professional	2009	Yes
J	Sport	2010	No

33.3 Research Approach

For this research study a mixed method approach was adopted. Primary data collection involved quantitative data utilizing a questionnaire aimed at facilitating statistical analysis [31, 32]. Qualitative data was gathered through subsequent interviews intended to extend, clarify and underpin the questionnaire responses to provide broad and rich insights [33, 34]. The use of questionnaires and interviews fits comfortably with the interpretive philosophy chosen.

Key individuals with professional experience of using SMM techniques from ten Welsh SMEs engaged in social media activities were selected randomly across different business sectors located in Cardiff and targeted for the questionnaire (see Table 33.1). Semi-structured questions organized around the research objectives involved standardized, closed questions to facilitate statistical analysis (yes/no) and to simplify the analysis process [32]. Three 'probing' questions gave respondents an opportunity to expand their answers, opinions and add additional information [34]. Five participants were further selected for semi-structured interviews to explore issues arising from the questionnaire for deeper analysis and understanding [35, 36]. Initial analysis involved organizing data into themes relevant to the research objectives. An inductive approach was applied to identify emergent patterns and sub-themes such that deeper analysis facilitated data to be compiled and statistically analyzed to draw out findings and formulate conclusions that could potentially contribute to existing theory [37]. All data were treated as confidential, stored securely and password protected. Anonymity was applied throughout the study [32, 38].

In this way it was possible to generate specific data relevant to the research aim and objectives [39, 40]. Secondary data collection involved a critical and systematic review of extant literature that facilitated triangulation aimed at yielding a stronger substantiation of analysis and the conclusions drawn [35].

33.4 Findings and Discussion

Our study responds to Bell and Loane's [3] call for further empirical enquiry relating to 'SMEs and Web 2.0'. Focusing on ten SME case studies located in South Wales our objectives were firstly to determine their level of social media activity and the preferred platform(s) being utilized. Secondly, we sought to examine the degree of the SMEs' awareness of performance monitoring for SMM activity and, thirdly to determine the actual extent to which social media marketing performance is monitored in practice.

33.4.1 Use of Social Media and Preferred Platform(s)

Using data collated from the questionnaire (100 % response rate) to provide some initial context for our first objective we determined the business sector and year of website development for each SME. To maintain anonymity alphabetical identifiers (A-J) were used (Table 33.1). We found that the majority (70 %) of the SMEs had developed their websites prior to 2009, the remaining 30 % were post 2009. All those developed post 2009 reported implementing at least one social media application into their website during development confirming that "one in three SMEs are using social media on a daily basis" [23] as previously discussed.

Next we sought to identify the level of SM applications and preferred platform(s) per SME. Using a control question, (Have you implemented social media into your website?) to which we already knew the right answer, we were able to verify that data being gathered was accurate in terms of respondents providing 'correct' responses. The results returned a 100 % positive response and we were able to further confirm that all participants had currently at least one social media application on their website.

We found that all participants used Facebook as a SM tool, with use of Twitter and YouTube at 60 and 50 % respectfully. LinkedIn accounted for 30 %, MySpace at 20 % and Delicious at 10 %. Interestingly Flickr, Digg and Reddit had a null return which when examined further through the subsequent interviews suggested they were not considered suited for business use. Thus, it is possible to confirm that the top three platforms used by the SME case study firms correlate to the top three most popular platforms in the world with over 964 m active users between them.

Further analysis implies a correlation between business sector and social media platform used. LinkedIn is commonly known for its professional service and as shown the three business sectors using the platform LinkedIn are ICT, Financial and Professional Services and Education and Training (see Fig. 33.1 below). The business sector ICT has the highest usage of different social media platforms.

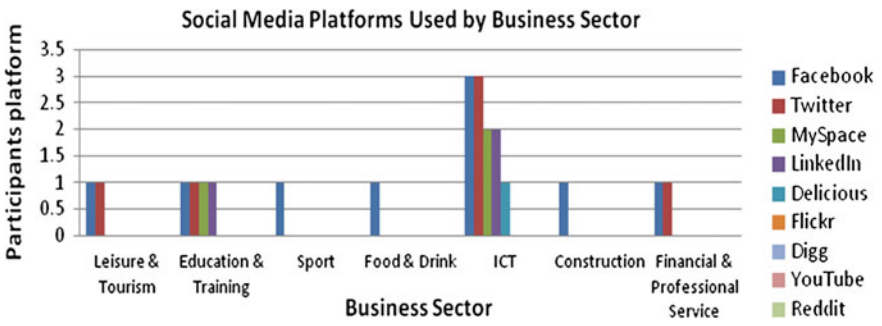

Fig. 33.1 Social media platform used by different business sectors

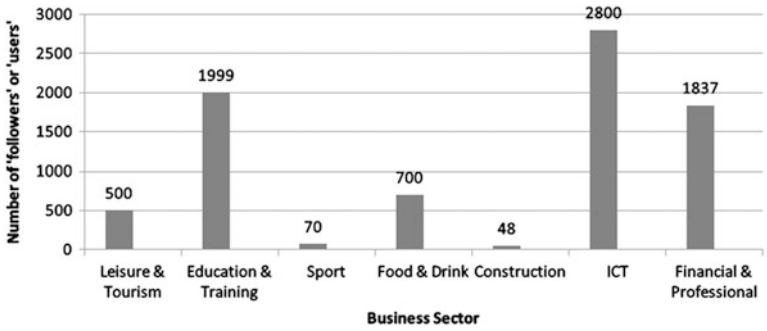

Fig. 33.2 'Followers' or 'Users' Per social media platforms used

33.4.2 SMEs Awareness of SMM Performance Monitoring Activities

The literature reviewed has established the importance of monitoring and tracking SMEs social media marketing activity in parallel to the ever-increasing rate at which social media is growing [41]. We asked the SMEs whether they had been aware at time of the website development of the concept of 'performance monitoring'. As shown in Table 33.1, only 20 % confirmed this to be the case. As would be expected these represented SMEs who had implemented social media applications i.e. post 2009. Although this demonstrates an acute lack of awareness we must also consider the fact that SM monitoring was not at the forefront of web development prior to 2009 when the majority of the sites were developed. As previously discussed "SMM is a comparatively new discipline" [7] therefore it would not have been probable that the SMEs with earlier developed websites would have had the same degree of awareness of SMM performance monitoring. Interestingly, those businesses with such awareness are considered to be within the ICT sector. This would indicate that not only is the year of development an important factor, but seemingly the business sector within which the organization operates has an impact on its awareness and monitoring of performance.

33.4.3 Extent that SMM Performance is Monitored in Practice

When asked to verify if they monitored their SMM performance, 60 % of the SMEs confirmed some level of monitoring but did not have any dedicated strategy in place. The remaining 40 % reported they did not even attempt to monitor their social media platform(s) despite use of multiple platforms. However, 100 % stated they do not feel they had a high level understanding of how such monitoring

actually works. Indeed, interviewee three comments "In general we believe there is lack of consensus about how or when we should measure the performance of our social media strategy. Currently we monitor by approximately counting the number of 'users', 'followers' and comments." We found that the base of 'users/followers' ranged between 48 and 2800 (Fig. 33.2) with an average of 975.5 and a standard deviation of 1073.9148 indicating that the range of values provided is wide.

Although evidence posits that the SMEs were concerned about measuring their SMM performance our findings suggest that it is perceived to be a too time consuming and complex activity. One reason put forward was the lack of a common tool that could be exploited across the different platforms [1].

33.5 Discussion

In this section we discuss briefly the empirical data drawn from the interviews to support the above findings. We found that SME participants were either unable to monitor their social media platform(s) or did not have the knowledge to measure the performance effectively. SMEs are implementing social media to source new business and facilitate a connection with existing customers. Therefore, monitoring or tracking organization marketing goals are more important than ever. In order for SMEs to tackle the monitoring of SMM performance a number of different technologies exist, however, these tools do not cover all platforms and are bespoke to fit one platform [29]. In practice one Interviewee commented that SMM was done "…in a very basic way" using the various tools provided by the different platforms. Indeed interviewee four explains "In essence the tools depend on which social media platform you use". We found that there was little awareness of any external tools outside those provided. Others criticized that "There isn't a one tool quick fix that caters for all" agreeing with Shih [1].

It is clear that SMEs should have a good working knowledge of their social media strategy to be able to benefit from maintaining a significant amount of 'users' or 'followers' to effectively increase business interest [42]. However, it becomes more poignant when considering that "Social media… should be viewed more as an extension of good business ethics—which, if done properly, will harvest sales down the line" [43], (p. 203). A corollary of SMEs not evaluating SMM performance is the obvious lack of data that prevents marketers/managers from collating sufficient data to illustrate its importance—hence perpetuating the skepticism held [42].

33.6 Conclusions

It is evidenced that social media is growing at an exponential rate and evolution of digital technologies throughout the last decade has generated a period of significant social, business and cultural change. The development of Web 2.0 has

provided an easily accessible mechanism for citizens to communicate socially with each other, in groups and as consumers. This study has gone some way towards enhancing an understanding of whether social media marketing is being used within Welsh SMEs, additionally establishing what preferred platform(s) are being used by SMEs. The results of this research support the idea that the platforms selected can be dependent on two instances. Firstly, the business sector in which the SME is placed, Secondly, The popularity of the platform—in relation to the number of users associated with the relevant business sector.

In conclusion it is evident that this continually evolving marketing channel highlights the need for SMEs to constantly monitor their social media marketing performance. We posit that although some participants are able to monitor their platform(s), they feel the process is too time consuming and complex acting as a result of there being no 'one tool fits all'. Nonetheless, SMEs should recognize the need to specifically define a clear strategy to engage in performance monitoring to optimize their social media marketing activities.

33.6.1 Limitations

Due to the relatively small size of the sample the statistical significant is limited. Therefore areas of future research would include conducting a similar study with a larger sample population across other Welsh regions.

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Part V
Knowledge Management in Business and Organization

Chapter 34
Knowledge Extraction of Consumers' Attitude and Behavior: A Case Study of Private Medical Insurance Policy in Japan

Yoko Ishino

Abstract Decision making in the marketing field requires the efficient acquisition and interpretation of consumers' behavior from questionnaire data. However, the data are usually full of noise, and attributes in the questionnaire data may have a high association with one another. The problem of a domain expert (or analyst) lies in determining a method to acquire accurate and useful knowledge about consumers' attitude and behavior from the noisy data. This study describes a novel method of extracting useful knowledge from questionnaire data by performing Bayesian network modeling, accompanied by feature selection, which incorporates Cramer's coefficient of association as an indicator. This method is capable of treating multiple objective variables in one model, handling nonlinear covariation between variables, and solving a feature selection problem. The proposed method was verified by a case study of private medical insurance products in Japan, using real data on health consciousness and private medical insurance.

Keywords Bayesian network · Feature selection · Marketing

34.1 Introduction

Extracting useful knowledge from consumers' survey data is a very important process in marketing. Although various types of knowledge exist, knowledge about the relationship between product features and consumer behavior (consumer behavior knowledge) is crucial for reaching target markets. This knowledge can help a marketer make decisions when developing new products or revising existing products.

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Traditionally, various statistical methods have been used for marketing analyses, which lead to consumer behavior knowledge. Multivariate analysis techniques, such as multi-regression analysis, principal component analysis, factor analysis, and Hayashi's quantification methods, have been the main statistical tools used to analyze quantitative data, including questionnaire data [1, 2]. However, these conventional statistical methods have a common weakness: that they usually assume linearity in the models. Moreover, questionnaire data used for assessing the consumers' behavior and attitude have a fluctuating nature; therefore, we call it noisy data. Conventional statistical methods are weak against such noisy data.

On the other hand, some machine learning techniques for obtaining consumer behavior knowledge need not assume linearity in the models and are robust for noisy data. However, they still include a combinatorial feature selection problem. Feature selection is the problem of choosing a small subset of relevant dimensions while holding desired properties. Successful feature selection provides many benefits: (i) interpretation of the data to execute a marketing task becomes significantly more tractable; (ii) the risk of overfitting, which occurs in statistics and machine learning when a model describes random error or noise instead of the underlying relationship, is largely avoided; and (iii) noisy features are eliminated. The question is which features should be retained or discarded. For the field of marketing, the evolutionary computation method, including genetic algorithms and inductive learning, was proposed [3]. This is an effective method when the only objective variable to be explained has already been defined before the analysis. However, it is often the case that some variables in marketing data have the potential to become both an objective variable and an explanatory variable. In this case, the type of the variable is decided through a trial-and-error process. In certain cases, the marketing data contains more than one objective variable.

This paper proposes a novel method of analyzing questionnaire data to solve the feature selection problem and to treat multiple objective variables in one model. This method is based on Bayesian network modeling, which is capable of handling nonlinear covariation between features, and Cramer's coefficient of association, which is used as a criterion for feature selection. This paper describes how the method extracts consumer behavior knowledge from consumer survey data. Achievable performance was evaluated with real questionnaire data on both health awareness and private medical insurance in Japan, collected over the Internet in 2010.

34.2 Knowledge Extraction from Questionnaire Data

34.2.1 Bayesian Networks

The proposed method of modeling consumers' attitude and behavior is based on Bayesian network modeling. A Bayesian network is a machine learning technique for empirically identifying associations in complex and high-dimensional data.

A Bayesian network graphically models probabilistic relationships among a set of variables. Over the last decade, Bayesian networks have become a popular representation for encoding uncertain expert knowledge in expert systems [4]. More recently, researchers have developed methods for deriving Bayesian networks from data [5–10]. When used in conjunction with statistical techniques, a Bayesian network has several advantages for data analysis. The greatest advantage is that a Bayesian network can be used to determine causal relationships from data and, hence, can be used to gain an understanding about a problem domain and to predict the consequences of intervention.

A Bayesian network consists of nodes, edges, and conditional probability tables (CPT). Nodes and edges represent events and conditional dependencies, respectively. In this paper, nodes represent discrete variables, which are questionnaire items related to consumers' attitude and behavior. Since these variables have causal relationships, edges in this paper are directed arrows. This paper considers only a directed acyclic graph, since it is mathematically manageable.

A Bayesian network can represent nonlinear covariation between features and does not assume a Gaussian distribution of variables, since the relation between features is given in the CPT. The model's structure can be learned from the data based on information criteria such as Akaike's Information Criterion (AIC) and Minimum Description Length (MDL) [11]. In addition, prior knowledge of a model designer can be embedded in the model in advance, as model constraints. The Bayesian network structure obtained from learning enables us to compute the posterior distribution of variables when other variables (the evidence variables) are observed. This process is called probabilistic inference, in which some efficient computational algorithms have been proposed, such as loopy belief propagation [12, 13]. Because of these convenient features Bayesian networks have recently begun to be applied to express complex human behavior in marketing [14].

34.2.2 Cramer's Coefficient of Association

Although a Bayesian network is a powerful tool, it provides an incorrect structure as a consequence of the structure learning process when the dataset contains too many attributes that are highly dependent on each other. This problem often occurs when a Bayesian network is used to describe complex human behavior, as in marketing area, when similar features are used as explanatory variables.

To overcome the problem, the current study uses Cramer's coefficient of association as a feature selection criterion before starting to learn a Bayesian network structure from the data. Cramer's coefficient of association, also called Cramer's V, is a popular measure of association between two nominal variables.

Before using Cramer's V, the Pearson's Chi squared statistic should be explained, since Cramer's V is based on the Pearson's Chi squared statistic [15]. A contingency table is useful when examining the association between two nominal variables, which relates to CPT. Based on the contingency table, Pearson's Chi

squared statistic is usually calculated to test the independence of two variables. The Chi squared statistic is defined as

$$\chi^2 = \sum_i \frac{(O_i - E_i)^2}{E_i}$$

where O_i is the observed number of cases in category i, and E_i is the expected number of cases in category i. Obviously the Chi squared statistic is affected by sample size.

On the other hand, although Cramer's V is based on the Chi squared statistic, Cramer's V is not affected by sample size and is normalized to the range between 0 (corresponding to no association between the variables) and 1 (perfect association). Cramer's V is given by the following formula:

$$V = \sqrt{\frac{\chi^2}{n(k-1)}}$$

where χ^2 is the Pearson's Chi-squared statistic, n is the total number of samples (observations), and k is the smaller number of rows and columns.

Calculating the value of Cramer's V for all combinations of two variables would help find redundant variables that have a high association with other variables. This enables us to discard the redundant variables, before starting to learn the Bayesian network structure from the questionnaire data.

34.2.3 Proposed Approach

The procedure of the proposed approach is as follows.

Step 1. Calculate the value of Cramer's V for all combinations of the two variables.

Step 2. Select variables that should be eliminated from the dataset.

(2.1) The variable combinations in which Cramer's V value is higher than a threshold (decided beforehand, e.g., more than 0.5) automatically denote the candidates to be considered.

(2.2) An analyst who has domain knowledge of the problem selects variables to be eliminated by examining each value of Cramer's V while focusing on the essential significance of each variable in the relevant field. When the analyst decides that the variables in a candidate combination are semantically redundant, one of them is eliminated. When the analyst decides that the variables in a candidate combination are both important, they are left in the dataset. This process is repeated until there are no further candidate combinations to be considered.

Step 3. Learn a Bayesian network structure using the remaining variables.

Step 4. Extract useful knowledge from the data by applying probabilistic inference to the obtained Bayesian network structure.

34.3 Analysis of Private Medical Insurance in Japan

34.3.1 Social Background of Private Medical Insurance in Japan

Consumers' attitude towards insurance products has changed significantly. Economic growth has recently slowed as a consequence of the current world economic crisis. In addition, the labor force in Japan is shrinking because of the decreasing birthrate and the aging population. Accordingly, Japanese consumers have begun to place a higher value on the security of enhanced medical treatment, pensions, and nursing, rather than the expensive life insurance against death.

In addition, Japan has its own history in the insurance industry. The Japanese insurance industry used to be heavily regulated. However, the situation changed after the mid-1990s. The insurance industry has undergone drastic changes since the new Insurance Business Law came into effect in 1996, aiming to loosen regulations on insurance companies. This law established the new Sector III Medical Insurance, the third field of insurance services, including medical insurance and nursing insurance [16]. The already existing insurance fields were Sector I Life Insurance, including whole-life insurance and ordinary-term insurance, and Sector II Property and Casualty Insurance, including automobile insurance and fire insurance. Before the law was implemented, foreign companies had monopolized the insurance services now classified into Sector III. However, the law allowed both life insurers and non-life insurers to enter Sector III, so that a variety of medical insurance products can be launched in the market.

The number of medical insurance contracts belonging to Sector III has increased continuously since 2001. However, the way of adding a special medical contract to a Sector I life insurance product still constitutes a significant share of the medical service coverage in Japan. The medical coverage market is very competitive and complicated, and it is still unclear how and why consumers choose insurance products.

This study explores customers' perceptions and behavior about these commercial products and services by focusing on private medical insurance products that contain both an insurance product of Sector III Medical Insurance and a special medical contract attached to Sector I Life Insurance.

34.3.2 Consumer Surveys

We used the following two sets of Internet survey data collected by a private research company in Japan.

- Survey on Health Awareness (survey period: May 1–5, 2010).
- Survey on Medical Insurance Enrollment (survey period: December 1–5, 2010).

Of the 2,002 respondents who participated in both surveys, we analyzed data from 1,631 respondents who clearly indicated their medical insurance enrollment status. These respondents included only those who selected "I have a stand-alone medical insurance (Sector III)," "I have medical service coverage as part of a special life insurance contract (Sector I)," "I have both stand-alone medical insurance and medical service coverage as part of a special life insurance contract," or "I do not have medical insurance." The respondents were from across Japan, without any specific regional variation.

34.3.3 Method of Analysis

Analysis Data. We extracted attributes from the survey questionnaires that fell into one of the following seven major categories that are likely to be related to customer values on medical insurance. Then, we conducted a Bayesian network analysis by using 67 attributes. The categories and the attributes within each category are as follows.

- Demographic attributes (DE: 5 attributes): These are answers to questions relating to gender, age group, marital status, presence of children, and household income levels.
- Action attributes on health consciousness (AC: 21 attributes): These are yes or no answers to questions on 21 behavioral attributes about maintaining and improving health, such as "play sport," "walk as much as possible," and "eat breakfast every day."
- Consciousness attributes about their own health (CO: 9 attributes): These are yes or no answers to questions on a respondent's perception about nine health awareness attributes, including "want to live longer," and "don't want to be sick."
- Benefits sought from medical insurance products (BE: 15 attributes): These are yes or no answers to questions on 15 medical insurance attributes to determine whether the product benefit would be a decisive factor in a respondent selecting a product, including "inexpensive monthly premiums," and "lifetime premium payment period."
- Information sources about health (IN: 9 attributes): These are yes or no answers to questions on nine information sources, including television, radio,

newspapers, and the Internet, to determine whether a respondent obtained health information from these sources.

- Purchase channel attributes of medical insurance products (PA: 5 attributes): These are yes or no answers to questions that determine whether a respondent used one of five channels to enroll in their insurance, including "acquaintance or referral," "sales visits," and "direct mail or flyer."
- Evaluation attributes of medical insurance products (EV: 3 attributes): Answers to the following three questions were used as evaluation attributes: "medical insurance enrollment status," "satisfaction with your current medical insurance," and "considerations about renewing medical insurance in the future."

Analysis Method. Two Bayesian network structures were learned (or inferred) from the survey data. First, all attributes were considered as stochastic variables constituting a Bayesian network, and one network structure was inferred. Then, the feature selection was performed by following the procedure stated in Sect. 34.2.3. Cramer's V values were used to extract candidate features for elimination, and an analyst used her domain knowledge to choose those features that should be deleted. Subsequently, the remaining features were considered as stochastic variables constituting a Bayesian network, and the second network structure was inferred. These two network structures were compared during the next step after extracting consumer behavior knowledge by performing probabilistic inference for each structure.

The method for learning (or inferring) a Bayesian network structure is the same for the two structures. Once a set of variables was designated, a standard method for learning a Bayesian network structure was used, as described below. The software package BayoNet version 5.0 was used in this study.

Learning a Bayesian network structure from data

Step 1. Prior knowledge is employed toward model constraints. In this study, some hypotheses about rough parent–child relationships among the seven attribute groups were employed. For example, the variables belonging to the demographic group have no parent variables that belong to other attribute groups.

Step 2. The structure learning process starts. This study used the Greedy Search Algorithm as the search algorithm, and AIC and MDL were used as information criteria.

Step 3. The resulting multiple graphs are evaluated using the information criteria, so that a best directed acyclic graph is selected. This study used AIC as the indicator and selected the model with the lowest AIC value.

Step 4. Once a best Bayesian network structure is obtained, the probabilistic inference is performed to evaluate each attribute's effect. The Loopy Belief Propagation algorithm was used in this study.

34.3.4 Results and Discussion

Graph Structure. For feature selection, Cramer's V values were calculated in all 2,211 $\left(= \binom{67}{2}\right)$ combinations of attributes. Attribute pairs with a value higher than 0.4 became candidates to be eliminated. Finally, 20 attributes were discarded according to the decision of the analyst. The breakdown of the eliminated attributes was 1 from the DE group, 11 from the BE group, 6 from the CO group, 1 from the AC group, and 1 from the IN group.

Figure 34.1 illustrates a best model obtained using all 67 attributes, where the AIC value is 107040.7. Figure 34.2 shows a best model obtained using the 47 remaining attributes after the feature selection. Here, the AIC value is 84834.1.

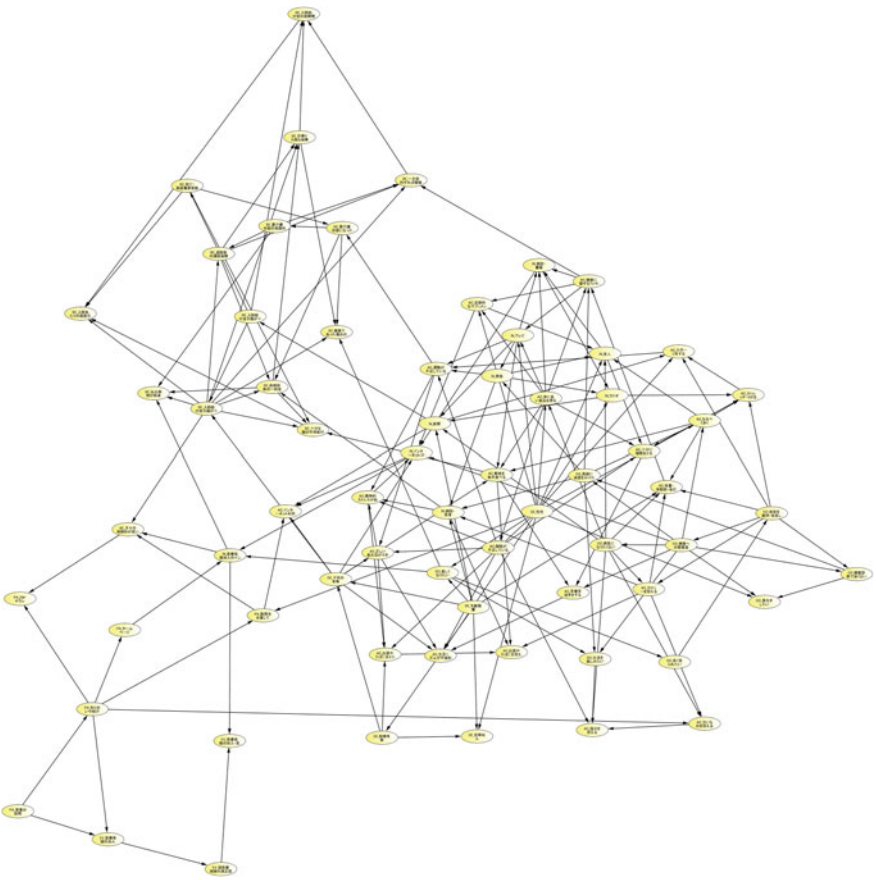

Fig. 34.1 A best Bayesian network structure obtained using all 67 attributes

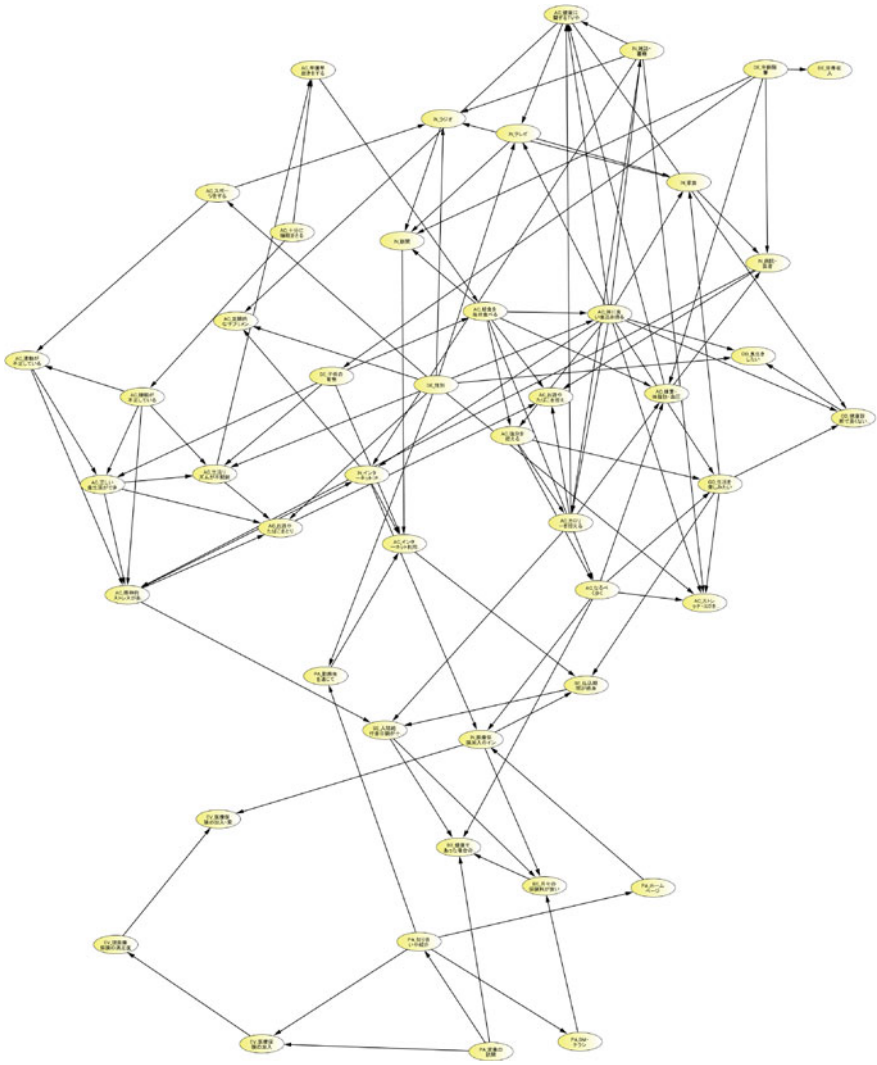

Fig. 34.2 A best Bayesian network structure obtained using selected 47 attributes

Based on these graph structures, we arrived at the following findings. The substructure relating to medical insurance evaluation attributes is similar between the two structures, as described below, although the rest is different.

- The attribute directly related to "satisfaction with medical insurance" is "medical insurance enrollment status." None of the attributes in the BE group (benefits sought from medical insurance products) is directly related to "satisfaction with medical insurance."

- The attributes directly related to "medical insurance enrollment status" were the two enrollment channels, "sales person/agent's visit" and "acquaintance or referral."
- The attributes directly related to "considerations about renewing medical insurance in the future" were the evaluation attribute, "satisfaction with medical insurance" and the information source attribute, "preferred method of using the Internet when selecting medical insurance."

Findings from Probabilistic Inference. We obtained the consumer behavior knowledge from the sub-structure shared by two Bayesian network structures related to medical insurance evaluation attributes, as shown in Fig. 34.3. The most effective way to increase the satisfaction indicator was to set the medical insurance enrollment status to "A stand-alone medical insurance (Sector III)," which increased the satisfaction indicator from 42.0 to 56.5 %. When customers purchase medical coverage as part of a special life insurance contract (Sector I), their satisfaction indicator slightly improves (44.3 %). However, this is a lower satisfaction level than when "stand-alone medical insurance" was used. The next effective way was to determine the purchase channel: "Purchase through acquaintance or referral" and "Purchase through a sales person's visit" are heavily linked to the satisfaction level, regardless of a "yes" or "no" answer. This result occurred because many of the respondents do not have any medical insurance policy. If currently uninsured people purchase a medical insurance product, they will be satisfied with the product, regardless of the purchase channel. The opinions about the purchase channel are split: some prefer face-to-face interaction with a sales-person or agent, some prefer word-of-mouth from an acquaintance or referral, and others do not have a preference.

In the case of the structure inferred by using all 67 attributes, useful consumer behavior knowledge relating to "Benefits sought from medical insurance products" could not be found. In contrast, the structure inferred by using the selected 47 attributes provided the following knowledge.

- Two attributes, "having mental stress" and "reducing the amount of calorie intake," are directly connected to the BE attribute "enough daily insurance benefits when people are hospitalized." When both "having mental stress" and

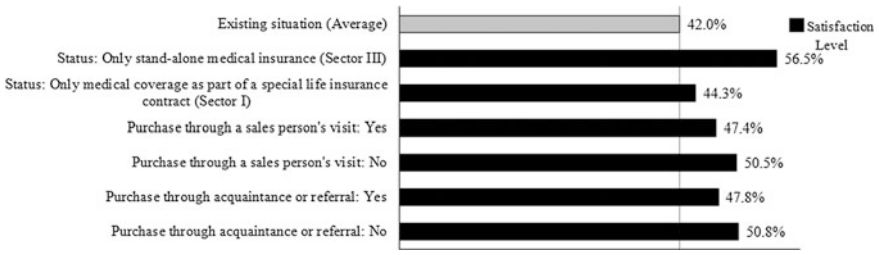

Fig. 34.3 Result of knowledge extraction concerning medical insurance evaluation

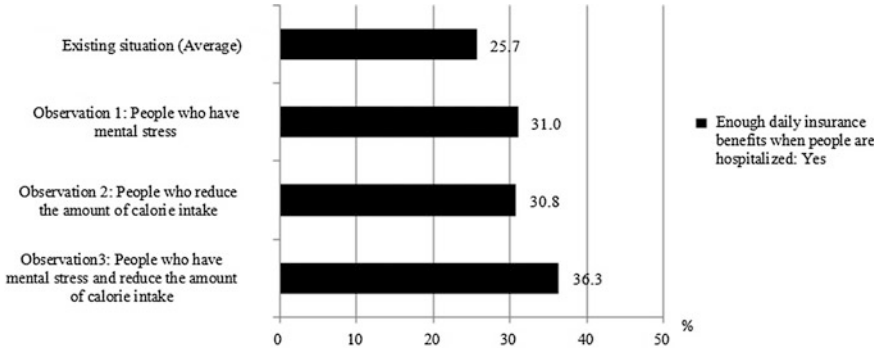

Fig. 34.4 Result of knowledge extraction concerning the benefit attribute

"reducing the amount of calorie intake" are set to yes, this increases the probability of this BE attribute from 25.7 to 36.3 %, as shown in Fig. 34.4. It is shown that people who feel stressed and go on a diet tend to be sensitive to the amount of the daily insurance benefit that would be paid, should they be hospitalized later.

- The answer to "how do you want to use the Internet when you purchase medical insurance?" is heavily linked to other insurance benefit attributes, as shown in Fig. 34.5. When the answer "I want to do everything over the Internet with regard to medical insurance" is observed, the probability of each of the following events increases, "lifetime premium payment period: no," "inexpensive monthly premiums: yes," and "walking as much as possible for good health: no." On the other hand, when the answer "I want to collect medical insurance information over the Internet, but have a face-to-face consultation with a salesperson before making decision" is observed, the probability of each of the following events decreases, "lifetime premium payment period: no" and "walking as much as possible for good health: no." This can be interpreted as follows. People who want to use the Internet in all aspects tend to be very sensitive to the price of monthly premiums, prefer to shorten the term of payment, and avoid walking, even though they know walking is good for health. On the other hand, people who want to use the Internet partially tend to be more generous: they have a tendency to accept the lifetime premium payment period and work on routine health maintenance by walking as much as possible. However, they do prefer inexpensive monthly premiums.

The above results clearly demonstrate that consumers belonging to the different segments demand different product benefits from medical insurance products. In other words, it turned out that benefit segmentation, that is, segmenting buyers by the benefits they want from products, is effective in the medical insurance market.

Discussion. We found several useful results for the marketing of medical insurance products. First, we obtained consumer behavior knowledge related to medical insurance product satisfaction. Being enrolled in a Sector III stand-alone

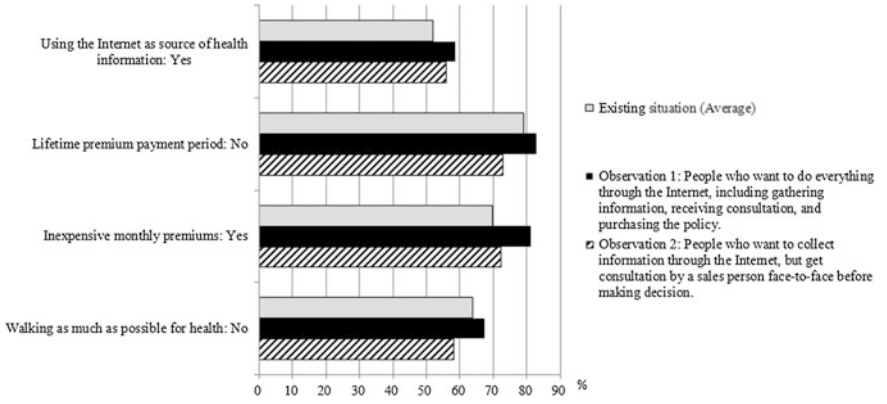

Fig. 34.5 Result of knowledge extraction concerning the consumers' behavior

medical insurance was associated with a higher level of satisfaction than being enrolled in Sector I medical service coverage as part of a life assurance policy. At the same time, we found that the effect of purchase channels could not be discounted. Although customers prefer to collect information by using information and communication technologies (ICTs), it is word-of-mouth, such as referrals from acquaintances, that has the largest effect on satisfaction levels. The relationship among satisfaction level, type of medical insurance products, and purchase channel can be reflected in marketing strategies, especially, the promotion strategy of products.

The consumer behavior knowledge mentioned above was obtained from both Bayesian network structures: one was inferred without feature selection, and the other was inferred after the feature selection. However, only the Bayesian network structure to which the feature selection was applied provided consumer behavior knowledge about the product benefit attributes. The relationship between the consumers' action attributes and the product benefit attributes proposed the effectiveness of benefit segmentation. This knowledge about benefit segmentation can also be reflected in the marketing strategies, particularly, product development and promotion strategies.

These results show that our proposed method is effective in extracting consumer behavior knowledge from questionnaire data. Originally, Bayesian network modeling was one of the best methods of extracting knowledge from questionnaire data, since this modeling method is capable of handling nonlinear covariation between features and requires no designation of the objective variable and the explanatory variables in advance. However, this study demonstrated that appropriate feature selection is indispensable before starting to learn the Bayesian network structure in order to extract useful knowledge. Without proper feature selection, the knowledge obtained will be insufficient. This occurs when many attributes are highly associated with one another in a dataset, and some seem to form a cluster. Consequently, an excessive number of edges are inferred within

such a cluster. This hampers the appropriate structure inference, since the inference (or learning) outcome is evaluated by using information criteria that restrict the number of edges, and many redundant but strong connections impede the weak appropriate connections. Therefore, proper feature selection is needed.

The proposed method based on Cramer's V values showed quite good performance. Since Cramer's V is a popular measure of association between two nominal variables, it is appropriate when analyzing categorical data in the marketing field. However, this method has a limitation that Cramer's V values cannot be used for continuous-valued attribute. In the case study of Japanese medical insurance, the feature selection using Cramer's V values revealed useful knowledge together with a Bayesian network. This knowledge could not be extracted without the feature selection.

34.4 Conclusion

In this study, we proposed a novel method of extracting useful knowledge from questionnaire data by performing Bayesian network modeling with feature selection, which incorporates Cramer's coefficient of association as an indicator. The main contributions of the research are: (i) that the combinatorial feature selection problem in a Bayesian network modeling can be solved by performing feature selection that uses Cramer's V values as indicators; and (ii) that the effectiveness of the proposed method was verified by a case study using practical questionnaire data.

The pre-requisites of the proposed method are quite simple and the solution strategy is straightforward. Therefore, we conclude that the proposed method is applicable to other domain problems as well. In the case study, the analyst is able to understand the meaning of the results of the probabilistic inference. However, organizing the outcome information into a more easily understandable format will help people in the business field. This is an area in which the proposed method can be further improved.

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Chapter 35
Product Information Retrieval on the Web: An Empirical Study

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Abstract In this paper, we investigate the consumers' perception of on-line product search using a questionnaire-based survey. We identify that the information retrieval activity of the purchase process can be performed with three Web applications: a search engine, a price comparison service, and a Web shop. The study underlines the need for linked product data as proposed by the Semantic Web. We argue that linked data will result in easier product search on the Web for the consumer.

35.1 Introduction

The Web makes it easier for consumers to find information on products compared to traditional product information sources. More and more users search on-line for products [14], whether it is to make a purchase, obtain information, or for pleasure [4]. Without the Web, it has become almost impossible to properly orient yourself for a product purchase. Everything one needs can be found on-line, usually with lots of information and against competitive prices. This luxury also brings some issues with it. For example, from which of the dozens stores will one order, should one visit a particular store, use a price comparison site, or use Google, and what should one do to explore the available products.

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The most common activity on the Web is searching for information [8]. Besides search types related to fact-finding and research-based searches, there is also a significant share of search sessions which are related to product search. On-line shoppers are faced with a multitude of choices: search engines (e.g., Google, Yahoo!, Bing, etc.), price comparators (e.g., PriceGrabber, BizRate, Google Shopping, etc.), and Web shops (e.g., Amazon, eBay, Books-A-Million, etc.). This study aims to understand how these searches take place, in order to identify the current bottlenecks. The hypothesis that we are testing in this paper is that the lack of linked data makes the current search for products suboptimal.

Each store and comparison service operates its own database with product information. Executing a sophisticated query against such a dataset often does not lead to desired results. The current lack of linked data for product information makes it difficult to compare and to find relevant products on the Web. A linked data approach to product information would allow one to navigate to the desired information at Web-wide level [3]. In this way, it becomes easy to find missing or complementary information about a product. There are three possible benefits of this improvement:

1. The availability of the product information increases due to replicating and complementary product data;
2. It makes possible to use complex queries based on product metadata;
3. The search costs will decrease as it will cost less time and effort to locate products.

The paper is organized as follows. Section 35.2 discusses the conceptual framework for on-line product search and the potential benefit that linked data can bring for the Web activity. Section 35.3 describes the survey that we carried out with respect to the current product search experiences on the Web. Section 35.4 presents and discusses the results of the survey. Last, Sect. 35.5 gives our conclusion and identifies future work.

35.2 Conceptual Framework

This section presents our conceptual framework for product (information) search. First, we define information retrieval in the context of product (information) search. Then, we discuss the search process and the need specificity of a consumer. Then, the Semantic Web data model for products is conceptualized. The identification of the need for linked data for product search will be examined by considering the way customers search for products on the current Web.

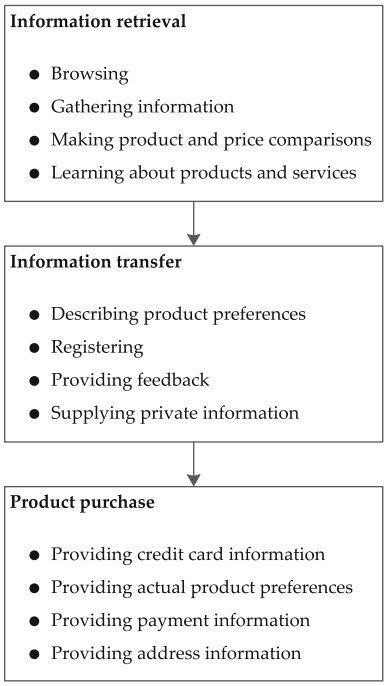

Fig. 35.1 On-line purchase process, adopted from [15]. This is the entire process for making purchases on the Web. Our study focuses on the first stage. This is because at stages 2 and 3, consumers already found their desired product and Web shop, and thus will no longer search for product information and Web shops

35.2.1 Information Retrieval

On-line shopping can be divided into three stages: information retrieval, information transfer, and the actual product purchase [15]. In this study we focus on the first stage, because at this stage the consumer is searching for product information. This is important for us, because the consumer can then specify whether the search task is difficult or easy. An overview of the purchase process is presented in Fig. 35.1. The first stage, the information retrieval activity, represents basic data exchange between any product related Web site and consumers. The last two stages are not considered in this study, because the consumers in these stages already found their desired product. This study solely focuses on how consumers find products on-line, as outlined in the previous section.

Information retrieval tools We argue that the search outcomes strongly depend on the used tool. The activities in the information retrieval stage can be performed with several tools. There are three types of tools available: a search engine, a price comparison service, and a Web shop. When it comes to general information search, the most common way to do this is by using a search engine [16]. Looking at the most visited websites we find a majority of search engines, e.g., Google, Yahoo!, Bing, etc. [9]. Besides search engines, consumers also use the so-called price comparison services. A price comparison service enables individuals to find the many prices that exist for specific products [19]. An example of such a

comparison service is Google Shopping, which is used world-wide, and Kieskeurig.nl, which is used in the Netherlands. Also, consumers can go directly to a Web shop, e.g., BestBuy. Most web shops aim to build a relationship with a customer, which should result in customers that prefer a particular Web store and come back for another purchase [13].

Search strategiesThe search strategy is dependent on the purpose of the search. When one knows what their desired product is, it will require a different way of searching than when the desired product is not known. This is also referred to as need specificity. The task type that is related to a low need specificity (i.e., we do not know what we are looking for) is known as product search. Product search aims to find a product candidate that was previously unknown [10]. In contrast, the task type that is related to high need specificity (i.e., we exactly know what we are looking for) is known as consumer information search. Consumer information search aims to find product information [10]. This distinction has important implications for the search process, because it affects consumer behaviour. In case of high need specificity, the consumer is more likely to use non-value-added search mechanisms [13], which is defined as objective information which is publicity available. For example, when searching for a smart-phone, this can be the brand and model. In case of low need specificity, the consumer is more likely to use value-added search mechanisms, this is defined as subjective information which is not publicity available. In the smart-phones example, this would include product reviews. When consumers have high need specificity, they would like to go directly to the product without having to go through subjective information. In contrast, consumers with low need specificity would like the subjective information, since that can help them better define their needs.

On-line information search has often been studied using micro-economic and decision-making theory. Accordingly, previous studies have determined that people search for information taking into account the trade-off between costs (e.g., time and effort) required to obtain relevant information, and the benefits obtained from the search outcome [1]. Furthermore, it is has been shown that individual factors, such as experience and cognitive skills, have a significant impact on the on-line search behaviour of a user [20].

In Detlor et al. [7] the distinction between searching and browsing is examined. The research results suggest that searching requires more detailed product information, while browsing places greater emphasis on information from a retailer. Furthermore, consumers spend more time on searching when the product is higher priced, more visible, and more complex [2]. In addition, consumers search differently because of individual factors, such as the perceived benefits of search (e.g., enjoyment, self-confidence, etc.), demographic aspects, and product knowledge possessed [2].

In order to identify the motives of searching for products, we distinguish between pre-purchase search and ongoing search [4]. The ongoing searchers are consumers that gather product information, even if they do not plan to buy anything. The motives for this activity are to experience pleasure, and to obtain information for future use. The outcome of ongoing search is an increased product

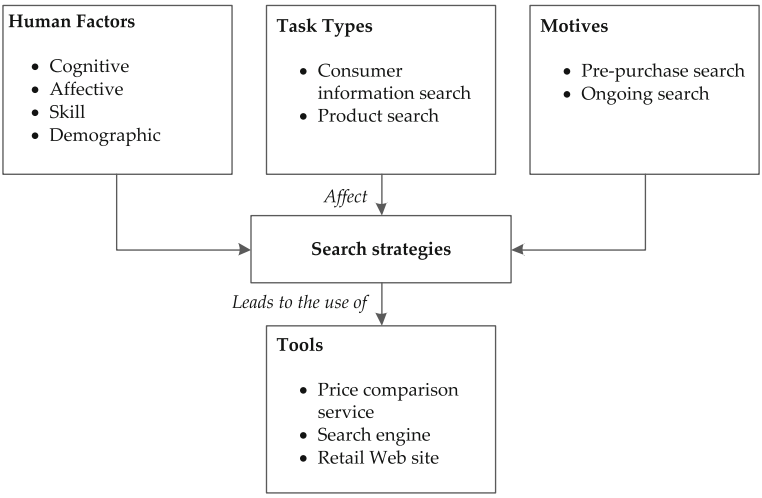

Fig. 35.2 Factors that affect the search strategies. The human factors are adopted from [8], the task types are adopted from [10], and the motives are adopted from [4]. We argue that the search strategy leads to the use of different tools

and market knowledge, which leads to less time and effort needed for searching, and an increased impulse of buying products [4]. Pre-purchase searchers are consumers who search in order to make a better purchase decision. The main outcome of the pre-purchase activity is also an increased product and market knowledge, and an increased satisfaction with the found product.

In Fig. 35.2 the factors that affect the consumers' search strategy are shown. The human factors adopted from [8], task types adopted from [10], and the motives adopted from [4] are important factors that affect the search strategies. The focus of this study is on the relation between the task type and the used tool, with respect to the difficulty of finding products in the perception of the consumer.

35.2.2 Semantic Web: Linking Product Data

The Semantic Web makes it possible to find information based on its meaning, not just its text [5]. When employing semantics for products, consumers can use a system that can find products with more ease. Such a system can also determine which products relate to each other. An important issue the Semantic technology can cover is the information provision, and the ability to deal with missing and complementary information. The Semantic Web has been developed to cope with incomplete, possibly inconsistent information, and product data is no exception. Price comparison services are early examples of the Semantic Web [18]. Most comparison services get their data from data feeds generated by retailers. Such a

service only centralizes data; it does not link this data, making it difficult to use queries through product-related information. Linking product data with semantics is yet in an early stage. To our knowledge, the only system that links product data is ProductDB [6]. ProductDB claims to create a page for every product in the world, for the purpose of connecting underlying structured data into one interlinked dataset. However, the project seems to have been discontinued.

We believe that using linked data for products can have benefits for consumers. The quality of the product information increases when the data is linked, as missing and complementary information can be corrected. Also, the use of linked data makes possible to use sophisticated queries, as the user has access to product metadata over large product information datasets. The advantage of linked data is that it becomes easier to find the right information. The search costs will decrease for the consumer, as it will cost less time and effort to locate information. Linked data can facilitate aggregators of product information by means of a shared product ontology [17]. A popular high level ontology to describe product information is GoodRelations [11]. This ontology has been refined for various product domains. GoodRelations is being used by more than 10,000 small and large shops world-wide, including Google, Yahoo!, and Best Buy [11].

35.3 Empirical Study

We conduct an empirical study to investigate the perception of consumers with respect to product search on the Web. The results of the survey are aimed at underlining the need for linked product data. The survey has the following objectives:

1. To determine the ease-of-search for product information, with low need specificity;
2. To determine the ease-of-search for product information, with high need specificity;
3. To determine the ease-of-search for Web shops;
4. To examine the relationship between the ease-of-search and the used information retrieval tool.

35.3.1 Product Classes Studied

The primary criteria for choosing products are their availability on the Web. In addition, the products must belong to ‘search goods’. Search goods are defined as goods for which the most important attributes for assessing product quality are discoverable without the consumer interacting with the product [12]. Also, the price of the products must not be too low, since consumers engage in more search

when the price is higher [2]. Based on these considerations, three product classes were chosen:

- Clothing;
- Smart-phones;
- Vacations.

These product groups have the similarity that information, and sale points are available on the Web. They have attributes which can be compared with each other. Linked data can be of value to these product groups, because of the large amount of information currently unorganized for these products on the Web. With linked data this information can be extracted and presented to the user by making use of queries.

35.3.2 Participants

In our research we use a field experiment. In order to control the sample we contacted responders. Participants could only participate if they declare that they have consulted the Web to search for the three product groups for their latest purchases. Eventually 32 responses are obtained. The demographic statistics are shown in in Table 35.1. Most responders are male, between the ages of 19 and 35, and indicated to have a professional education.

In order to determine the sample power, we perform a power analysis. This analysis is done with the software package IBM SPSS SamplePower. The results of the analysis show that with a sample size of 32 subjects, the means of the answers to the questions have a margin error of plus/minus 0.25 points from the true value. In computing the sample size we assume that we want to be 95 % certain that the observed value falls within the margin of error.

35.3.3 Evaluation Measures

In order to measure our research objectives, we used an excerpt from the questionnaire presented in [15]. The questions from the 'perceived ease-of-use' are adapted, so that the search process on Web-wide level is examined for the three product groups. For the questionnaire details we refer to the Appendix. We ask the

Table 35.1 Participants. This table contains the characteristics of the participants

Gender		Age			Education		
Female	Male	0−18	19−35	36−50	High school	Professional	University
9	23	4	22	6	8	16	8

respondents how easy they locate product information in case of high and low need specificity. Also, how easy it is to find Web shops in case of high need specificity. A five-point Likert-scale is used, where the item 'strongly disagree' means that it is very hard to locate a product, and the item 'strongly agree' means that it is very easy to locate a product. The second measurement examines which of information retrieval tools are used for each product group. A five-point Likert-scale is used, where the item 'strongly disagree' means that the tool is never used, and the item 'strongly agree' means that the tool is always used.

The reliability of the measures is tested by using the Cronbach's alpha method. With IBM SPSS Statistics, nine variables are combined, i.e., ease-of-search for information with high and low need specificity, and ease-of-search for Web shops, for the three product groups. The result shows that Cronbach's Alpha is 0.94, therefore the measures are reliable. The measures are assumed also to be valid, because they are adapted from other studies.

35.4 Analysis and Results

Table 35.2 shows the descriptive statistics of the items used in this study. The means shows that for all three product groups, finding information is perceived as an easy-to-medium task, since the means are between 3 and 4. Finding in- formation that has high need specificity is perceived as slightly easier than low need specificity, but the standard deviation is higher. This can be explained by the fact, that with high need specificity there are better terms on which the user can search. For example, entering a specific product in a search engine often gives good search outcomes, however, the user has to master the search engine query language well. Overall, finding Web shops is perceived as an easier task than finding information, since the means on locating stores are higher than the means of locating information.

Table 35.2 Descriptive statistics. This table contains the means and standard deviations of the responses to the questions about the ease-of-search and the use of information retrieval tools. The scale used is from 1 to 5, with 1 being 'very hard to find' or 'never used', and 5 being 'very easy to find' or 'always used'

	Clothing		Smart-phones		Vacation	
	μ	σ	μ	σ	μ	σ
Ease of search						
Product information(low need specificity)	3.31	1.03	3.41	0.98	3.28	1.08
Product information (high need specificity)	3.75	0.76	3.84	0.68	3.75	0.88
Web shops	3.81	0.78	3.91	0.69	3.78	0.79
Information retrieval tools used						
Search engines	4.31	0.59	4.25	0.72	4.38	0.55
Price comparison services	2.41	0.84	3.25	1.22	2.44	0.98
Web shops	3.56	1.16	2.69	1.09	3.06	1.22

Table 35.3 Correlations between ease-of-search and product information retrieval tools.

Product group	Perceived ease of search	Search engine	Price comparison	Web shop
Clothing	Product information(low)	0.522[b]	0.147	0.28
	Product information(high)	0.536[b]	−0.038	0.091
	Web Shops	0.480[b]	−0.028	–
Smart-phones	Product information(low)	0.493[b]	0.561[b]	0.244
	Product information(high)	0.547[b]	0.518[b]	0.063
	Web shops	0.505[b]	0.528[b]	
Vacations	Product information(low)	0.517[b]	−0.028	0.451[b]
	Product information(high)	0.464[b]	−0.243	0.377[b]
	Web shops	0.414[a]	−0.205	–

[a] Correlation is significant at the 0.05 level (2-tailed)
[b] Correlation is significant at the 0.01 level (2-tailed)
The correlations are calculated using the Pearson method in the software package IBM SPSS Statistics

Based on our study, search engines are most commonly used as product information tool. The price comparison service for clothing and vacations are less used than for smart-phones. This can be explained by the fact that smart-phones are more present on comparison services than the other groups, which are usually less present. The Web shop is used more for clothing and vacations, and less often for smart-phones. However, the average is close to 'neutral' for Web shops. When ease-of-search has four points or higher, then the search task is defined as easy. As shown in Table 35.2, the means of locating information and locating shops is lower than four. This implies that the first part of our hypothesis is supported, that is that the current search of products on the Web is suboptimal.

Table 35.3 shows significant Pearson correlations between search engines, and both the ease-of-search for Web shops, as well as product information. Price comparison services are correlated with the search for smart-phones; this applies both for information as to Web shops. As for the use of Web shops for information, we observe that this is only correlated with vacations. This can be explained by the fact that vacations are not as common products as clothes and smart-phones, so for convenience users prefer the travelling agency Web site.

In this section, we have analysed the outcomes of the survey, first by comparing the means of the answers to the questions, followed by the computations of the correlations between the ease of search and the information retrieval tools. The analysis shows that the subjects experience searching for products and product information on the Web as an easy-to-medium task. Smart-phones seem to be less difficult to find than clothing and vacations. We find this an indication of a good potential for linked product data, especially for the latter categories. In conclusion, we see opportunities for linked product data, because in the perception of consumers finding products and product information on the Web is not as easy as it can be with linked product data.

35.5 Conclusion

This study examines the way consumers search on the Web for products. We identified that the information retrieval activity can be performed using three tools: search engines, price comparison services, and Web shops. The tools are used in the search strategy of consumers in order to browse products, gather information, and make product and price comparisons. In addition, we discussed literature that investigates the factors that affect the search strategy of a consumer, which are human factors, task types, and motives.

With our empirical study we found that locating products and Web shops is perceived by the consumers as an easy-to-medium task. With regard to the product groups, the smart-phones are found with more ease than vacations and clothing. Smart-phones is the only group that has a significant correlation with price comparison services. The other groups, vacations and clothing, often lack of a comparison service, therefore these groups would benefit most from linked data. Linked product data can support consumers to make the task of searching product information on the Web more efficient, allowing navigation over Wide-wide product information. The perceived ease-of-search will improve, when more parties link their data, such as retailers, manufactures, review sites, comparison services, etc.

Future studies can focus on possibilities to encourage third parties to make use of linked data. For example, one can investigate how an incentive can be created for third parties to join the project. Linked product data would also be beneficial for consumers, as they will have customizable access to product information and offers on a Web-wide level.

Appendix

Questionnaire

The table below contains the questions from the survey. For questions 1−6, for each product group the subjects indicate whether they agree with the statement on a five-point Likert-scale, with 1 being 'strongly disagree', 3 being 'neutral', and 5 represents 'strongly agree'. The questions 1−3 refer to the ease-of-search, while questions of 4−6 relate to the use of the information retrieval tools. Questions 7−9 are intended for the identification of characteristics of the respondents.

Questions		Variable
1.	When i dont know exactly what to buy, i find it easy to locate the relvant product information when searching for:	Clothing(locate product information, low need specificity) Smart –phone(locate product information, low need specificity)

(continued)

		Vacations(locate product information, low need specificity)
2.	When i do know what product to buy, i find it easy to locate the relevant product information when searching for:	Clothing(locate product information, low need specificity) Smart –phone(locate product information, low need specificity) Vacations(locate product information, low need specificity)
3.	When i do know what product to buy, i find it easy to locate the shops that sell it when searching for:	Clothing(locate shops) Smart-phones(locate shops) Vacations(locate shops)
4.	I use a search engine(e.g., Google) when searching for:	Clothing(Search engine) Smart-phone(Search engine) Vacations(Search engine)
5.	I use a price comparison service (e.g.,Google shopping)when searching for:	Clothing(price comparison service) Smart-phone(price comparison service) Vacations(price comparison service)
6.	I use a specific web store that i know of when searching for	Clothing (Web shop) Smart-phone(Web shop) Vacations(Web shop)
7.	Your gender	Gender
8.	Your age	Age
9.	Your education level	Education

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Chapter 36
Japanese Students' Perception of B2C

Takashi Okamoto

Abstract Business-to-consumer sales of electronic commerce are commonly used worldwide as an important element of the consumer market. In relation to e-business, management of customer knowledge is an important asset for online shops. However, it is difficult for online shops to deal with customer management, collect data, and translate them into basic customer knowledge. This study examines university students' behavior and perceptions toward online shopping to provide basic customer knowledge. We used a questionnaire-based research method to elucidate students' perceptions of the advantages and disadvantages of online shopping. It was found that lesser is the availability and variety of goods in nearby actual shops, higher is the motivation to shop online, and that the availability of goods is a stronger incentive than cheapness in relation to the use of online shops. Conjoint analysis revealed students' priorities with respect to several attributes of online shopping. They gave higher priority to the perception of online shops' websites than other attributes. Surprisingly, this analysis also indicated that for students postage is a more important criterion than the price of goods. These analyses examined differences with respect to students' living environment or experiences of online shopping. The study will contribute to the development of understanding customer knowledge and suggest effective marketing strategies regarding online shopping.

36.1 Introduction

The expansion of ICT affects our daily lives, giving us new options for purchasing goods and services from online shops, use of which has become common. Even people with little knowledge of ICT find it easy to purchase desired goods at online

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malls and auction sites. In the ICT environment, business-to-consumer (B2C) sales are a common electronic commerce service.

In 2011, Japan's B2C market was worth 8.5 trillion yen, up 8.6 % from the previous year, and 60.1 % of Internet users in Japan used B2C [1]. The estimate of U.S. retail e-commerce sales for the third quarter of 2012 was $57.0 billion, an increase of 17.3 % from the third quarter of 2011 [2]. These data show that B2C is commonly used as an important element of the consumer market worldwide.

B2C shops are not always profitable, although their number has been increasing. The business problems of many online shops should not be attributed to technological complexities but to the lack of knowledge and know-how of their management. The managers of many online shops do not understand the online behavior and perceptions of consumers, i.e., customer knowledge regarding online shopping.

Management of customer knowledge is an important asset for e-businesses. Understanding customers' needs, aims, and perceptions is essential for building customer relationships, and of course, for business success. Customer knowledge includes knowledge about customers and that possessed by customers, which may include knowledge about potential customers and market segments as well as knowledge about individual customers. Management of customer knowledge is concerned with the management and exploitation of customer knowledge [3].

Many online shops may not use or understand customer knowledge, albeit this is essential for the online shopping business. They cannot afford to manage customer knowledge effectively because of the lack of capital or the location being rural. In many cases, they are even unable to deal with customer management, collect data, and translate them into basic customer knowledge such as consumer behavior and the perceptions toward online shopping.

Many studies have profiled consumer behavior and perceptions toward online shopping. Atchariyachanvanich et al. explain the effect of differing factors on a consumer's attitude towards using online shopping in Japan [4]. JADMA has reported the state of Japanese consumer's behavior and perceptions of online shopping for these four years [5]. Many studies, including marketing and management, examine consumer perceptions of B2C market [6, 7].

This study examines young people's behavior and perceptions toward online shopping. In particular, it reports the characteristics of university students' use of online shopping. The study may provide basic customer knowledge. It reports the students' distinction between online and actual shopping and the perception of advantages and disadvantages of online shopping, including differences regarding their living environment and the experiences of online shopping. Conjoint analysis revealed the students' priorities with respect to several attributes of online shopping. Our study will contribute to the development of customer knowledge and suggest effective marketing strategies for online shops.

36.2 Research Methods and Overview of Questionnaire

To examine young people's behavior and perceptions toward online shopping, we conducted a questionnaire-based research. We chose university students, around the age of 20, as representatives of young people. To compare the behavior and perceptions of rural and urban students, our research was conducted at Ehime University (EU) and Kanagawa University (KU). Rural and urban people live in different environments, which vary in factors such as public transportation and the number and variety of actual shops. Such differences may affect people's behavior and perceptions toward online shopping. EU is located in Matsuyama city, a rural prefecture of Ehime distant from Tokyo. KU is located in Yokohama city, an urban area very close to Tokyo. EU students were representatives of rural young people, while KU students were representatives of urban young people. As both sets of students were majoring in social sciences, we could reduce the number of demographic attributes other than the location of their university. We used a self-administered questionnaire and collected all data in class (Tables 36.1 and 36.2).

Our questionnaire comprised three sections. The first section gathered data about students' demographic attributes such as sex, possession of smart phones, and their transportation to school. The second section gathered information about their experience and behavior of using online shops. It also asked about their perceptions of the advantages and disadvantages of online shopping. These two questions offered multiple response options, which are listed in Tables 36.3 and 36.4 below. These choices were taken from the study of JADMA [5] so that the results of the two studies could be compared. The third section gathered data about their perceptions toward online shopping using conjoint analysis, as explained below.

Table 36.1 Respondents' demographic details

	Sex	Possession of smart phone	Transportation to school
EU	Female: 105	Smart phone: 186	Public transport: 15
	Male: 111	Other mobile phone: 35	Other means: 196
	No answer: 5		No answer: 10
KU	Female: 69	Smart phone: 138	Public transport: 98
	Male: 83	Other mobile phone: 18	Other means: 40
	No answer: 4		No answer: 18

Table 36.2 Means of gathering information about goods and purchasing them

Means		EU	KU
Information gathered from	Goods finally purchased from		
Internet	Internet	67	25
Internet	Actual shops	79	70
Actual shops	Actual shops	68	52
Actual shops	Internet	5	9

36.3 Compositions of Respondents and Behavior Regarding the Online Shopping

The study was conducted in January 2013. The respondents were 221 EU students and 156 KU students. Table 36.1 shows their demographic details. There were only minor deviations in gender. The details of possession of smart phones were common; over 84 % of the students in both universities possessed smart phones. However, there was a statistically significant difference (at the 1 % level) in the transportation to school; approximately two thirds of the KU students used public transport to get to school, but only 7 % of the EU students used public transport, most traveled to school by bicycle or on foot.

Over 85 % of the students at both universities had an experience of online shopping. Sixty-five percent of them mainly accessed online shops from PCs. Only 17 % of them used smart phones or other mobile phones for online shopping. The difference between the universities was not statistically significant: using online shops was independent of the students' location. Students did not use mobile devices but PCs to utilize online shops, although most students had smart phones. Many online shops or online malls expected consumers to use smart phones to purchase items, but many students still used PCs. They may need the convenience of a wider screen than that available on a mobile.

Some consumers may use online shops not for purchasing goods but only for gathering information about them. Such behavior is often called "showrooming" and bricks and mortar stores may be bothered by this behavior. The means used by students to purchase and gather information about goods are shown in Table 36.2. Seventy-one percent of the students used actual shops for purchasing; however, 68 % of them used the Internet to gather information about goods. Only 4 % of them used "showrooming." It appears that actual stores may still be the primary channels of purchasing for students.

Many KU students used actual shops, including those who used the Internet to search for information about goods. Significantly more EU students (at the 1 % level) purchased through the Internet after gathering information about goods from the Internet. Local bricks and mortar stores in rural areas often have a lesser availability and variety of goods compared to urban areas.

36.4 Perceived Advantages and Disadvantages of Online Shopping

36.4.1 Differences Between Locations

Understanding users' and potential users' perceptions of the advantages and disadvantages of online shopping will contribute to the market development of online shopping. Table 36.3 shows students' priorities for the advantages of online

Table 36.3 Students perceived advantages of online shopping Percentages in brackets indicate the rate of choice by students at each university

Advantages of online shopping	EU	KU	$\chi^2(1)$	P -value
Shopping at home	175 (79 %)	121 (78 %)	0.143	0.706
Purchasing goods not sold at nearby actual shops	171 (77 %)	94 (60 %)	12.834	0.000
Open 24 h	136 (62 %)	81 (52 %)	3.461	0.063
Cheapness/Collecting reward points	116 (52 %)	82 (53 %)	0.000	0.988
Large variety of items and information	113 (51 %)	57 (37 %)	7.865	0.005
Reference to reviews and reputations	95 (43 %)	67 (43 %)	0.000	0.994
Easy searching of goods	86 (39 %)	70 (45 %)	1.338	0.247
Easy comparison of goods	90 (41 %)	60 (38 %)	0.195	0.658
Delivery by other people	69 (31 %)	59 (38 %)	1.776	0.183
Purchasing at one's own pace	73 (33 %)	45 (29 %)	0.745	0.388
Rich information about other goods	35 (16 %)	26 (17 %)	0.046	0.829
Acceptable waiting time for delivery	34 (15 %)	17 (11 %)	1.574	0.210
Speedy purchasing	28 (14 %)	18 (10 %)	0.109	0.741
Easy purchasing procedures	30 (13 %)	15 (12 %)	1.364	0.243
Availability of rare goods	25 (11 %)	19 (12 %)	0.067	0.796
Rich information about goods	15 (7 %)	8 (5 %)	0.439	0.507
Other	1 (0 %)	3 (2 %)	1.884	0.170
No advantage of online shopping	0 (0 %)	1 (1 %)	1.420	0.233

shopping. Seventy-nine percent of the students selected "shopping at home," which makes it the highest priority feature. Seventy percent of the students selected "purchasing good not sold at nearby actual shops" as the second priority.

There was a statistically significant difference (at the 1 % level) between urban and local students in relation to two of the perceived advantages, "purchasing goods not sold at nearby actual shops" and "large variety of items and information": EU students gave higher priority to both these advantages than KU students. A similar study conducted over the past two years reported that almost the same results were found last year, while the difference in "purchasing goods not sold at nearby actual shops" was significant two years ago [8].

The results imply that local students give higher priority than urban students to the availability and variety of goods or services. The goods sold in local bricks and mortar stores often offer less variety than those in urban stores, although actual stores are the primary channels of purchasing for students. Local students may shop online if the products are unavailable from nearby actual shops. They feel these advantages strongly and may regard online shops as complementary to actual stores. Surprisingly, cheaper pricing was not the primary reason for shopping online: the student market clearly prioritizes availability and convenience. Therefore, small or local online shops do not need to engage in price competition; instead, they can focus on product differentiation.

Table 36.4 shows the students' perceptions of disadvantages and anxieties of online shopping. Eighty-seven percent of the students indicated that "purchasing without seeing actual goods" was an unattractive feature of online shopping.

Table 36.4 Students perceived disadvantages of online shopping Percentages in brackets indicate the rate of choice by students at each university

Disadvantages of online shopping	EU	KU	$\chi^2(1)$	P-value
Purchasing without seeing actual goods	190 (86 %)	139 (89 %)	0.806	0.369
Risk of difference between the appearance of goods online and that of the actual goods	121 (55 %)	83 (53 %)	0.088	0.767
Risk of receiving inferior goods	105 (48 %)	74 (47 %)	0.000	0.988
Annoying advertisements after purchasing	75 (34 %)	53 (34 %)	0.000	0.994
Insufficient explanation of goods	80 (36 %)	40 (26 %)	4.698	0.030
Risk of theft of personal information	68 (31 %)	47 (30 %)	0.018	0.894
Difficulty in canceling purchase orders	63 (29 %)	50 (32 %)	0.547	0.459
No supply of goods in stock at many online shops	45 (20 %)	34 (22 %)	0.113	0.736
Risk of purchased goods not being delivered	36 (16 %)	40 (26 %)	4.969	0.026
Too long from purchase to delivery	31 (14 %)	24 (15 %)	0.135	0.713
Insufficient reliability of shops or online malls	27 (12 %)	24 (15 %)	0.784	0.376
Complex purchasing procedures	19 (9 %)	22 (14 %)	2.860	0.091
Too many items to recognize what I want	26 (12 %)	10 (6 %)	3.036	0.081
Other	4 (2 %)	1 (1 %)	0.955	0.328
No anxiety about online shopping	1 (0 %)	1 (1 %)	0.062	0.804

Because approximately 90 % of the students selected this choice as the primary disadvantage of online shopping, online shops require ingenuity, such as displaying more information about product specifications and many product pictures from several angles, with the capability of zooming into see the details. Such efforts may ease customers' anxieties about the fundamental and technical characteristics of online shopping.

Focusing on differences relating to location, there were statistically significant differences in "insufficient explanation of goods" and "risk of purchased goods not being undelivered." More local students complained about the insufficient explanation of goods, while more urban students feared the risk of items not being delivered. The lesser availability and variety of goods in local areas are related to dependence on online shopping. These differences may arise from local students' greater need to use online shopping.

36.4.2 Differences in Experiences of Online Shopping

Experiences of online shopping may strongly affect students' attitudes and perceptions toward online shopping. Students who used online shops indicated all factors as priorities for online shopping more than those who had never shopped online. For priorities such as "open 24 h," "large variety of items and information," "reference to reviews and reputations," "easy comparison of goods," "easy purchasing procedures" and "speedy purchasing," differences between experienced and inexperienced students were statistically significant at the 5 % level.

These results demonstrate that experiences of online shopping improve students' perceptions toward online shopping. Before using online shops, students were not aware of their advantages or had only heard of their reputations, especially the technical ones. After experiencing online shopping, however, students had positive perceptions toward online shopping, because they enjoyed their many functional advantages.

In the case of disadvantages such as "risk of purchased goods not being delivered" and "complex purchasing procedures," students who never used online shops ranked these disadvantages more highly than those who had used them, and these differences were statistically significant at the 1 % level. In contrast, students who used online shops ranked the disadvantages of "annoying advertisements after purchasing," "no supply of goods in stock at many online shops," and "too long from purchase to delivery," more highly than those who never used them, and these differences were statistically significant at 5 % level.

These results indicate that students who never used online shops will often overestimate the risks of online shopping. These students are aware of such technical risks, but they may not understand them sufficiently; hence, they may avoid using online shops because of their incorrect risk estimation. To expand the online shopping market, we should inform potential users of the actual risks and show them simple methods to avoid these risks. Students who used online shops indicated that the inconveniences of online shopping included extremely complex user interfaces or poor distribution systems. To stimulate the use of online shops, we should develop more convenient systems in these two areas.

36.5 Students' Perceptions Toward and Priorities for Online Shopping

36.5.1 Conjoint Analysis and Questionnaire

To examine how students valued different features of online shopping, conjoint analysis was conducted via an experiment that presented respondents with choices to select the most desirable one by ranking their preferences. This analysis reveals the priorities of each attribute of online shopping.

Table 36.5 Varieties and levels of attributes

Attribute	Level 1	Level 2	Level 3
Availability of goods at nearby actual shops	Yes	No	–
Perception of the online shopping site	High	Low	–
Level of security of the online shopping site	Reliable	Average	–
Postage	Free	500 yen	–
Price of goods	3000 yen	4000 yen	5000 yen

Our questionnaire set the following situation: "You want to buy goods that cost 5000 yen. You consider purchasing the goods at either of the two online shops that have different conditions. Which online shop would you choose? If you have complaints about both online shops, you can choose not to purchase at either." We applied a mixed logit model to conduct a conjoint analysis because it has a preference from which an individual differs [9]. To conduct the analysis we referred to the research applying a similar approach [10]. Our questionnaire assumed that the condition of each online shop was composed of five attributes. The varieties of attributes and their levels were set up as shown in Table 36.5. Eight profiles were created from the levels of each attribute, using an orthogonal array design. Two profiles were combined at random, and a choice set with the added option "use neither online shop" was created. Each respondent answered eight choice sets per questionnaire. An alternative specific constant (ASC) was added to the analysis, which was introduced into "use neither online shop." This could be interpreted as affirmative for the purchase of goods from an online shop if the ASC was estimated as significantly negative.

36.5.2 Differences Between Locations

The results with regards to difference between locations are shown in Table 36.6. To examine the effect of urban or local location, a KU dummy variable, which had a value of 1 for a KU student, was added. The coefficient estimated in conjoint analysis indicates marginal utility, i.e., the increment of utility. Willingness to pay (WTP), which evaluates preference in terms of monetary value, can be used to compare respondents' weighting of each attribute. The variables underlined in Table 36.6 (also in Table 36.7) are estimated nonrandom parameters, while the other variables are estimated random parameters. A nonrandom parameter shows that most respondents' preferences are homogeneously distributed. Standard deviations of parameters indicate the diversity of respondents' perceptions, i.e., statistically significant variables indicate the diversity of respondents for the attribute.

From the results shown in Table 36.6, ASC was estimated as significantly negative, and respondents were considered to be positive about the use of online shops. This result is consistent with the diffusion of online shopping among students, as previously shown, and implies that online shopping may be a common means of shopping for students.

Positive and significant (at the 5 % level) estimated results were obtained for availability, perception, and security. It is considered that if the goods are hardly available in nearby actual stores, a respondent's utility increases, the perception of the site becomes high, or the level of security of the site becomes reliable. The WTP of perception was about five times higher than that of availability and security. This means that the perceptions of the online shop site were much more important for students than the availability goods at nearby actual shops and the

Table 36.6 Estimated results including differences in location

Variable	Coefficient	t-value	P-value	WTP
Availability is low	0.246	2.162	0.031	138.452
KU dummy of availability	−0.206	−1.167	0.243	−116.002
Perception is high	1.123	6.385	0.000	631.929
KU dummy of perception	0.326	1.253	0.210	183.192
Security is reliable	0.241	2.063	0.039	135.468
KU dummy of security	0.323	1.778	0.076	181.921
Postage	−0.005	−11.329	0.000	−2.612
KU dummy of postage	0.000	0.759	0.448	0.231
Price	−0.002	−17.598	0.000	−1.000
KU dummy of price	0.000	−2.439	0.015	−0.121
ASC	−9.791	−21.930	0.000	
Derived parameters for standard deviations of distributions				
Availability is low	1.042	9.885	0.000	
Perception is high	1.390	11.339	0.000	
Security is reliable	0.919	7.641	0.000	
Postage	0.003	6.590	0.000	
Price	0.000	6.576	0.000	
KU dummy of perception	0.586	2.340	0.019	
KU dummy of price	0.000	0.380	0.704	
ASC	2.816	13.091	0.000	

Table 36.7 Estimated results including differences regarding experiences of online shopping

Variable	Coefficient	t-value	P-value	WTP
Availability is low	0.456	1.990	0.047	216.918
Exp. dummy of availability	−0.385	−1.562	0.118	−183.003
Perception is high	1.749	5.470	0.000	831.314
Exp. dummy of perception	−0.640	−1.916	0.055	−304.321
Security is reliable	0.308	1.400	0.161	146.376
Exp. dummy of security	0.090	0.381	0.703	43.012
Postage	−0.002	−3.409	0.001	−0.958
Exp. dummy of postage	−0.003	−3.880	0.000	−1.267
Price	−0.002	−14.054	0.000	−1.000
Exp. dummy of price	0.000	2.596	0.009	0.162
ASC	−9.844	−20.715	0.000	
Derived parameters for standard deviations of distributions				
Availability is low	1.004	9.341	0.000	
Perception is high	1.214	7.827	0.000	
Security is reliable	0.774	5.062	0.000	
Postage	0.001	1.944	0.052	
Price	0.000	5.002	0.000	
Exp. dummy of availability	0.167	0.685	0.494	
Exp. dummy of perception	0.830	4.547	0.000	
Exp. dummy of postage	0.003	5.793	0.000	
Exp. dummy of price	0.000	3.295	0.001	
ASC	2.909	11.339	0.000	

level of security of the online shop. This implies that students may strongly avoid some risks regarding the lesser known online shops.

Negative and significant estimated results were obtained for the price of goods and postage; that is, if the price of the product and postage increased, the respondent's utility decreased. Of course, students do not like expensive goods and postage. From WTP, one yen of postage was equivalent to 2.6 yen of price. Postage was a more significant charge than the price of goods for students.

Focusing on the differences between locations, urban and local, other than for price, the KU dummy variable was not significant at the 5 % level, suggesting that there may not be differences between the two locations. Only the KU dummy variable for price was significant and negative. In comparison to EU students, KU students estimated the price of goods as more important. A tough competition environment among stores in urban areas may affect KU students' estimation of the price of goods.

36.5.3 Differences in Experiences of Online Shopping

Experiences of online shopping may affect perceptions toward online shopping, i.e., students who purchased goods or services from online shops may prioritize attributes differently. Table 36.7 shows the results when dummy variables relating to experience were introduced.

Security and the experience-of-security dummy variable were not estimated as significant; neither experienced nor inexperienced students considered security important among the five attributes. Availability and perception were significant and positive. Students who never used online shops prioritized perceptions higher than availability, because the WTP of perception was about four times that of availability. The experience dummy variables for availability and perception were not estimated as significant; that is, no difference resulted from the experience of using online shopping.

Postage, price, and the experience-of-postage dummy variable were estimated as negative and significant. The WTP of postage was −0.958, while that of the experience-of-postage dummy variable was −1.267. This result indicates that students who experienced online shopping feel twice charge of postage than inexperienced students. Experienced students strongly disliked postage compared to inexperienced students. As the experience-of-price dummy variable was estimated as positive and significant, experienced students were more tolerant of the increasing price of goods. Experienced students may become tolerant to the price of goods that they own, as they know the advantages of online shopping. They strictly distinguish postage from the price of goods because postage is not charged for goods that are owned. As the WTP of postage is smaller than that of the price of goods, inexperienced students may accept postage charges more than experienced students.

36.6 Conclusions and Discussions

In this study, we have examined university students' behavior and perceptions toward online shopping. Our research suggested certain important features that will support the maturation of the online shopping market. As online shopping becomes a common channel for purchasing goods and services, actual shops may be affected. Some bricks and mortar stores often consider "showrooming" to decreasing their sales. Only a few our respondents did this. Actual stores may still be the primary channels of purchasing, while online shops may become substitutes for actual stores.

Consumers' living environments, such as urban or local, may affect their behavior. The lesser availability and variety of goods at nearby actual shops, about which local consumers often complain, will motivate to use online shopping. Surprisingly, the availability of goods is a stronger incentive than cheapness for using online shops. Online shops do not need to engage in price competition; instead, they can focus on differentiation of their goods or developing their website more transparently. Consumers' experiences of online shopping may also affect their priorities or anxieties of online shops. Online shops could adopt different sales strategies or promotions for potential customers and repeaters.

Students give higher priority to the perception of online shops' websites than other attributes. Not only the use of a famous online mall but also support from the public sector may increase consumers' comfort. Surprisingly, postage is a bigger imposition for students, by more than twofold, than the price of goods. From this result, free postage may be a better pricing tactic, but it would impose a substantial burden on online shops. Cooperative delivery systems could ease the logistical costs, especially for the managers of small or local online shops.

From the perspective of local economy, online shops could become a means of revitalizing it. Many local online shops suffer from the lack of know-how or capital to improve their perceptions toward their online shop, but perception is the most important attribute of a site. The local government could support the perception of small shops' sites, and local online shops could cooperate to lower their postage costs.

There are many unknown or implicit aspects of online shopping. Research institutions such as universities could cooperate with local online shops to research consumer behavior and perceptions. If online shops became aware of differences derived from consumer features, collate this knowledge and share it with other online shops, they would be able to develop effective sales strategies for individual customers.

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Chapter 37
Bank Stock Leading Indicators and Extraction of Trigger Points

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Abstract Financial crises are typically cause by a chain of credit contractions, which in turns could be caused by the rapid worsening of indexes that indicate people's psychology, such as bank stock prices. Therefore, the prediction of bank stocks is especially important. The purpose of this analysis is to identify trigger points where bank stocks rise or fall by extracting what common points existed in financial economic indicators immediately before significant fluctuations of bank stocks occurred in the past. To conduct discriminant analysis, we used the logistic regression analysis, Support Vector Machine, J48, and the random forest. Comparison of discriminant error rates by using each analysis method confirmed that the random forest method showed the highest precision level. We also tried to extract highly important variables. This attempt showed that the following financial economic indicators are important indicators that could have an influence on bank stock movements: Money multiplier, 10-year yield of government bonds, current bank deposits, M2/nominal GDP, and repayment years for corporation borrowing.

Keywords Logistic regression analysis · Support vector machine · J48 · Random forest

37.1 Introduction

Financial crises, as typified by economic bubble burst of Japan in the beginning of the 1990s and the global financial crisis triggered by Lehman Brothers fall, cause not only capital market turbulence due to plunge of asset prices such as shares and real estate, but also the drastic economic deterioration of the real economy due to a chain of credit contractions. These situations significantly affect the lives of

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individual people. Therefore, it is important to conduct studies for clarifying and predicting the mechanisms of financial crisis occurrence. Many related studies have been made previously. A chain of credit contractions could be caused by the rapid worsening of indexes that indicate people's psychology, such as stock prices. The movements of bank stocks are especially important. There are many preceding studies that define a time point where bank stocks plunge as the beginning point of a financial crisis. If signs for significant fluctuations of bank stocks can be identified, we can make measures for predicting and averting financial crises. In this research, we aimed to identify trigger points where bank stocks rise or fall by extracting the common points that existed as financial economic indicators immediately before significant fluctuations of bank stocks that have occurred in the past.

As for the explanatory variables used in this research, we created a total of 94 different kinds of financial economic indicators, such as market indicators including long-term interest rates and exchange rates, those indicators regarded as bank performance or factors such as long-term interest rates by surveying the Bank of Japan, and indicators used by the Cabinet Office to determine whether the economy is moving forward or synchronizing. These indicators included financial data of corporations such as ROE and capital-asset ratios, along with macroscopic data such as the money supply and GDP, in addition to financial data of banks such as loans and advances, and deposits. From a vast number of factors, we identified the factors that have a significant influence on stock price movements.

As for the analysis methods, we used the following four methods: Logistic regression analysis that assumes normal distribution of logit regression errors, the Support Vector Machine (hereafter, SVM) that separates data on a hyperplane after mapping, J48 that is a decision-tree generation algorithm based on the GINI coefficient, and the random forest that is a group learning algorithm with J48 as the learner. Based on these analysis methods, we conducted precise analysis on stock price movements and their indicators even though a non-linear or non-continuous relationship existed.

37.2 Preceding Studies

The preceding studies for predicting stock prices are classified based on the following perspective as factors of stock price movements or methodologies of prediction, (1) economic fundamentals, (2) dividend discount model, (3) time-series model, and (4) non-parametric model.

There exist many preceding studies for predicting stock prices using economic fundamentals as factors of stock price movements. One of the representative studies is the one conducted by Chen et al. [1], where they showed the relationship between the economic fundamentals and stock prices of the United States by utilizing the Arbitrage Pricing Theory. In this study, they demonstrated that interest rates, inflation rates, exchange rates, government bond yields, and industrial production have a significant influence on stock prices.

The discount dividend model was a common methodology in the preceding studies for predicting stock prices until early 1980s as typified by Shiller [2]. However, according to LeRoy and Richard [3], stock price movements are so large that the dividend discount model cannot predict stock price well. Also Cambell [4] showed that the large part of stock movements derives from the correction of the expectation of the future stock return, not from the expectation of future dividend growth.

Since ARMA model or ARCH model was developed in early 1980s, the time-series analysis has been commonly used as a methodology of predicting stock prices. While many time-series analysis models assumes the normal probability distribution, the stock returns are pointed out not to be normally distributed.

As an analysis method based on a certain distribution assumption has such a disadvantage, some preceding studies such as Isogai [5] or Hidar and Hita [6] use a non-parametric analysis method such as neural network or Bayesian network for predicting stock returns.

As above, challenges of the preceding studies include (1) that it is not clear how the variables used as a leading indicator for stock prices are chosen, (2) that the number of variables used as a leading indicator is limited to $5 \sim 7$, (3) that an analysis method used is based on a certain distribution assumption, and (4) factors of stock price movements are not necessarily a leading indicator of stock prices. Therefore, this study in intended to extract key leading indicator of stock prices by using non-parametric method.

37.3 Data and Methods

37.3.1 Data

The purpose of this research was to clarify relationships that existed with the different kinds of financial economic indicators against the backdrop of bank stock movements. In this research we extracted common points in financial economic indicators that existed just prior to several past scenes where bank stocks rose (fell). Therefore, the data necessary for our study included a number of financial economic indicators that can become the leading indicators for bank stocks and their performance.

First, when it comes to all of the leading indicators of bank stocks and their performance, we created 94 different kinds of financial economic indicators. In order to create these indicators, we referred to market related indicators such as long-term interest rates and exchange rates, Possible Financial Related Indicators of the Working Paper of the Bank of Japan, Description of Financial Activity Indicators, Financial Sector Variables of Overview of Financial Macro-Econometric Model, and Explanatory Variables of Factors of Long-Term Interest Rate Movements. We also used the leading series and the coincident series from the indicators that compose the diffusion index created by the Cabinet Office. In

addition to financial data of banks such as loans and advances, and deposits, we also used financial data of corporations such as ROE and capital-asset ratios, along with macroscopic data such as the money supply and GDP (Table 37.1).

Table 37.1 Possible leading indicators of bank stocks

v1	LIBOR-OIS (Japan)	Month end	v48	M2/nominal GDP	Month end
v2	LIBOR-OIS (US)	Month end	v49	M2/base money	Month end
v3	JGB 10 year yield	Month end	v50	M2/foreign resere	MoM
v4	LIBOR-OIS (Japan)	MoM	v51	M2/nominal GDP	MoM
v5	LIBOR-OIS (US)	MoM	v52	M2/base money	MoM
v6	JGB 10 year yield	MoM	v53	Core CPI	MoM
v7	Lending growth rate	MoM	v54	Core core CPI	MoM
v8	Deposit growth rate	MoM	v55	Nominal Effective Currency Rate	MoM
v9	Loan/deposit	Month end	v56	Real effective currency rate	MoM
v10	Cash researve/asset(Banks)	Month end	v57	Machinary order	MoM
v11	Market financing/asset (Banks)	Month end	v58	Machinery tool order	MoM
v12	Liquid ratio (Banks)	Month end	v59	Net export	MoM
v13	ROA (Banks)	Month	v60	Gross export	MoM
v14	Lending yield (Nominal)	Month	v61	Nominal GDP growth	MoM
v15	Deposit yield (Nominal)	Month	v62	Real GDP growth	MoM
v16	Lending yield (Real)	Month	v63	Buncruptcy case	MoM
v17	Deposit yield (Real)	Month	v64	Buncruptcy debt	MoM
v18	Loan/deposit	Month	v65	Base money ratio (JP/US)	Month end
v19	Cash Researve/asset(Banks)	Month	v66	Money supply ratio(JP/US)	Month end
v20	Market financing/asset (Banks)	Month	v67	Base money ratio (JP/US)	MoM
v21	Liquid ratio (Banks)	Month	v68	Money supply ratio (JP/US)	MoM
v22	ROA (Banks)	Month	v69	Producer's inventory (Final demand)	MoM
v23	Lending yield (Nominal)	Month	v70	Producer's inventory(Manufacturing)	MoM
v24	Deposit yield (Nominal)	Month	v71	New job offers	MoM
v25	Lending yield (Real)	Month	v72	Machinary order	MoM
v26	Deposit yield (Real)	Month	v73	Housing construction started	MoM
v27	Funding dificulty (Industries)	Quarter	v74	Consumer confidence	MoM
v28	Lending attitude (Industries)	Quarter	v75	Nikkei commodity price	MoM
v29	Borrowing rate (Industries)	Quarter	v76	Interest rate spread	MoM
v30	Interest coverage ratio (Industries)	Quarter	v77	JGB10 year yield(Newly Issued)	MoM

(continued)

Table 37.1 (continued)

v31	Debt/recuring profit (Industries)	Quarter	v78	3 M TIBOR	MoM
v32	Capital ratio (Industries)	Quarter	v79	TPOIX price	MoM
v33	Current ratio (Industries)	Quarter	v80	Investment climate (Manufacturing)	MoM
v34	Fixed ratio (Industries)	Quarter	v81	Operating profits/asset (Manufacturing)	MoM
v35	ROE (Industries)	Quarter	v82	JGB10Year Yield	MoM
v36	Funding dificulty (Industries)	QoQ	v83	Sales forecast D.I of small business	MoM
v37	Lending attitude (Industries)	QoQ	v84	Industrial production(Manufacturing)	MoM
v38	Borrowing rate (Industries)	QoQ	v85	Producer's shipments(Manufacturing)	MoM
v39	Interest coverage ratio (Industries)	QoQ	v86	Large industrial power consumption	MoM
v40	Debt/recuring profit (Industries)	QoQ	v87	Producer's shipment (Durable goods)	MoM
v41	Capital ratio (Industries)	QoQ	v88	Non-scheduled worked hours	MoM
v42	Current ratio (Industries)	QoQ	v89	Producer's shipment(Investment goods)	MoM
v43	Fixed ratio (Industries)	QoQ	v90	Retail sales value	YoY
v44	ROE (Industries)	QoQ	v91	Wholesale sales value	Yoy
v45	M 2 growth rate	MoM	v92	Operating profits(Industries)	MoM
v46	Base money growth rate	MoM	v93	Producer's shipment(SME)	MoM
v47	M 2/foreign reserve	Month end	v94	Job offer rate	MoM

In order to examine what kind of influence these indicators had on subsequent bank stocks, we measured the variability rate of TOPIX comparisons of bank stocks (bank stock relative performance) during a 180-day period starting from the beginning of the next month following the month indicated by the financial economic indicators. Positive bank stock relative performance was considered to be in the rise group, while negative performance to be in the fall group. We set the measurement period to 180 days. This is because we considered that with this period the trends of bank stock relative performance could be clarified, so that the standards for classifying the rise group and the fall group could also be considered highly universal.

In this research, for the objective variables, we used not continuous variables such as increase/decrease rates of stock prices, but discrete variables as described above. This is because using a binary discrete variable for an objective variable enables us to use a wide variety of discriminant analysis methods such as SVM and neural networks.

After creating possible leading indicators of bank stock for the period from April 1991 to March 2012, we calculated bank stock relative performance during the period from May 1991 to April 2012. From a total of 252 months

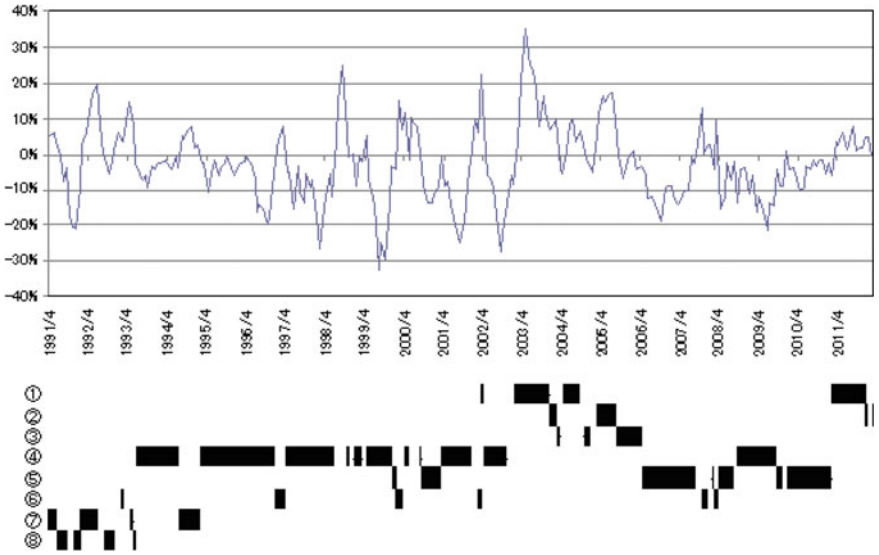

Fig. 37.1 Transitions of bank stock relative performance

(12 months × 21 years), 87 months (34.5 %) were included in the rise group and 165 months (65.5 %) were included in the fall group. Figure 37.1 shows the bank stock relative performance for 180 days from the beginning of the month.

37.3.2 Analysis Methods

As mentioned earlier, the purpose of this research was to clarify what kind of relationships with the different kinds of financial economic indicators that existed, against the backdrop of bank stock movements. For this reason, using the data created in the previous section, we extracted indicators that had significantly different standards within sample sets of financial economic indicators that correspond to the rise group and the fall group. We did so because these indicators could be the leading indicators for the classifying of each group.

In order to extract these indicators, we used the following four methods: Logistic regression analysis that assumes normal distributions for logit regression errors, the Support Vector Machine that separates data on a hyperplane after mapping, J48 that is a decision-tree generation algorithm based on the GINI coefficient, and the random forest that is a group learning algorithm with J48 as the learner.

Table 37.2 Comparison of discriminant precision levels based on each analysis method

	Training data			10-fold CV		
	Precision (%)	Recall (%)	F (%)	Precision (%)	Recall (%)	F (%)
Logistic regression	93.3	93.3	93.2	64.9	63.1	63.7
SVM	76.6	77.0	75.7	66.0	67.5	66.3
J48	88.0	88.1	88.0	74.9	75.4	75.0
Random Forest	99.2	99.2	99.2	76.4	76.6	76.5

37.4 Comparison of Discriminant Precision Level by Each Analysis Method

Comparison of discriminant error rates by using each analysis method confirmed that the random forest showed the highest precision (Table 37.2) in each case when training data was used along with the 10-fold cross validation method.

Logistic regression analysis showed a comparatively high recession level with a 6.7 % discriminant error rate when training data was used. On the other hand, the discriminant error rate got worse by 35.1 % when the 10-fold cross validation method was used. Logistic regression analysis has a characteristic where it easily causes over-training since all explanatory variables contribute to discrimination of objective variables. We consider that the results of this present research reflect this characteristic. Discriminant analysis performed by logistic regression analysis demonstrated that it is difficult to predict rise and fall of bank stocks by using the parametric method that assumes error variance as a normal distribution.

SVM showed the worst results of all of these four methods, with 23.4 % of the discriminant error rate when training data was used. On the other hand, when the 10-fold cross validation method was used, SVM's discriminant error rate was 34.0 %, showing the smallest deterioration of the discriminant precision level of all four methods. However, most discriminant precision levels were comparatively low when compared to these four methods. SVM is required to maximize margins from samples that are adjacent to the separating hyperplane. Whereas SVM has a sophisticated generalizing capability, it does not use all samples; therefore, the discriminant precision level when training data is used could deteriorate. We considered that the results of this present research reflect this characteristic of SVM. It was demonstrated that the high-dimensional mapping of SVM has difficulty in separating rise and fall of bank stocks.

J48 showed a comparatively high discriminant precision level with a 12.0 % of discriminant error rate when training data was used. The discriminant error became 25.1 % when the 10-fold cross validation methods was used. This result showed that J48 has a high universal capability. Generally speaking, whereas the discriminant precision level of J48 is enhanced with the use of training data when the lower limit of the number of samples included in the final node is lowered, the decision tree becomes bigger. This lessens the universal capability of J48. Since the purpose of this research is to identify factors of bank stock movements, a

smaller number of classification tree nodes is desirable. Therefore, we increased the lower limit of the number in final node samples within the range where the discriminant error rate based on the 10-fold cross validation method does not become significantly lower. Where the number of final node samples was set to 2, the number of branches became 19, and the discriminant error rate based on the 10-fold cross validation method was 23.0 %. Where this number was set to 10, the number of branches also decreased by 10 and the discriminant error rate became 24.6 %. The lessening of universal capability was limited.

As for the random forest method, the discriminant error rate became 0.8 % when training data was used, and this rate also became 23.6 % where the 10-fold cross validation method was used. The discriminant precision level for this method was the highest of all four methods. J48 showed a high precision level when using the 10-fold cross validation method. This lead us to consider that non-linear relationship due to multiple factors had an influence on rise and fall of bank stocks.

37.5 Extraction of Bank Stock Movement Factors

The random forest analysis method has an additional method to measure how much prediction precision falls where a certain explanatory variable is not used in order to evaluate the important level of the variable. By using this method, we extracted variables that are important for bank stock movements. Figure 37.2 shows how much the GINI coefficient lowers when that explanatory variable is removed.

According to Fig. 37.3, the following financial economic indicators that could have influence on bank stock movements were extracted: Base money ratio of the US and Japan (v65), money multiplier (v49), 10-year yield of government bonds (v3), current bank deposits (v10), M2/nominal GDP (v48), repayment years for corporation borrowing (v31), money supply ratio between the US and Japan (v66),

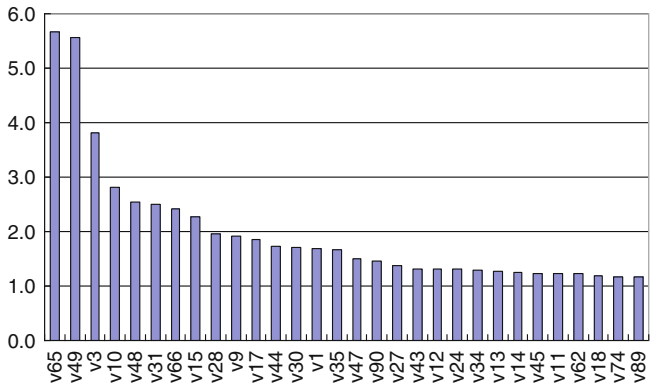

Fig. 37.2 Variable selection by the random forest method

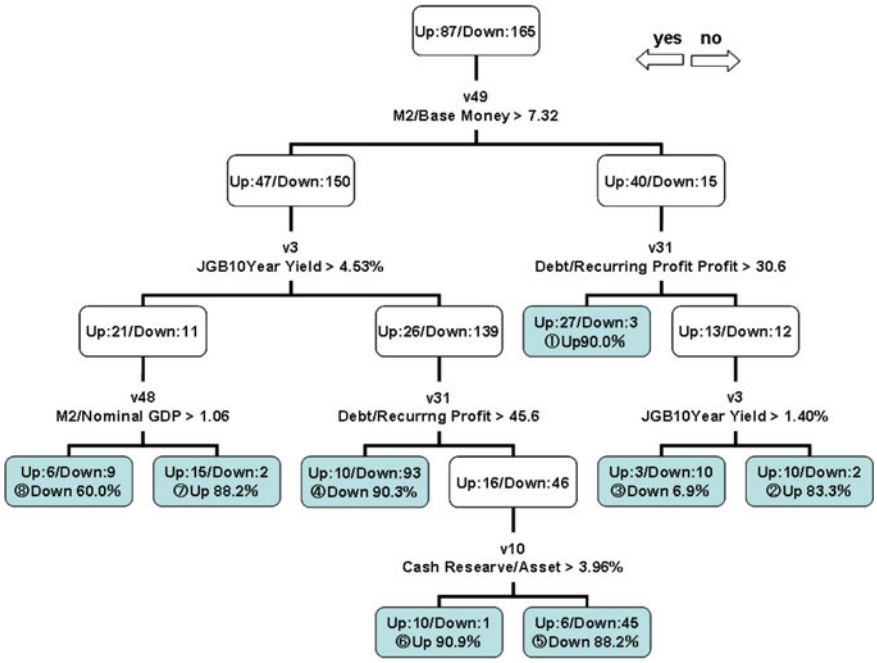

Fig. 37.3 Classification tree based on variables selected

and practical loan rate yields (v15). Of all eight variables, five variables are related to money.

37.6 Interpretation of Extracted Leading Indicators

As mentioned earlier, the random forest method creates a lot of classification trees by using J48 based on multiple samples generated by using the boot strap method. This method obtains estimated values by majority voting. However, this method does not determine any unique classification tree, so that the relationship of each explanatory variable is unclear. To indicate the relationship between each explanatory variable, we created the classification tree based on J48 by using variables selected by the random forest method. Figure 37.1 show samples classified in the final node in chronological order.

In Fig. 37.3, v65 (Base money proportion of the US and Japan, at the end of the month) was selected as the most important variable; however, v65 is not included in the classification standards. This is because in the variable selection conducted by the random forest method, different types of variables are included in multiple samples created by the boot strap method and the important variable is selected from each sample set. Therefore, variables with high correlations could finally be

extracted. Actually, the correlation coefficient between v65 and v49 (M2/base money, in the end of the month) shows a high value of 0.89. On the other hand, when a classification tree is created with J48 by using both variables, only one important variable is selected as the classification standard.

Figure 37.3 shows the money multiplier (M2/base money, v49) as the most important factor of bank stock movements. Where this value falls below 7.32 times from the previous quarter at the end of the month, bank stocks tend to rise during the next month. The money multiplier is probably regarded as the velocity of the money being distributed in the market. When the money multiplier declines, normally, bank stocks tend to fall. However, the money multiplier actually fell below 7.32 during the period set by this research from 2002 to 2006, and after 2011. In these periods, base money expanded rapidly due to quantitative easing. Therefore, quantitative easing showed that this policy had a certain level of effectiveness on the rise of bank stocks.

Where the money multiplier fell below 7.32, the repayment years for corporation borrowing (v31) based on the current earnings of corporations became the next important classification standard for the factors of bank stock movements. When this value exceeded 30.6 years at the end of the month, during 180 days following the next month, bank stocks rose in a relative manner at a rate of 90.0 %. A total of 27 months of 2003, 2004, and 2001 actually corresponded to this case, where a number of months belong to this classification. When the repayment years for corporation borrowing rose, normally, bank stocks tended to fall. However, it was shown that if the Bank of Japan performs the quantitative easing policy under the state of low profitability for outstanding borrowing of corporations, bank stocks tended to rise.

Where the money multiplier exceeded 7.32 (in a period without quantitative easing), JGB 10-year yield (v3) was the important factor of bank stock movements. Where this value fell below 4.53 % at the end of the month (from 1993 to 2013), again, the repayment years of corporation borrowing (v31) based on the current earnings of corporations became the important classification standard for the factors of bank stock movements. Where this value exceeds 45.6 years at the end of the month, during 180 days following the next month, bank stocks rose in a relative manner at a rate of 90.3 %. A total of 93 months during the period between 1993 and 2002, along with 2008 and 2009 corresponded to this case, where a number of months belong to this classification. It was shown that during the normal period without quantitative easing, excessive debt of corporations was the most significant factor of bank stock fall.

37.7 Conclusion

If we can extract phenomena that were commonly observed immediately before stocks rise or fall by comparing them with the past Tokyo bank stock price index (bank stocks) and Tokyo Stock Price Index (TOPIX), we can identify the

environments where future bank stocks easily rise or fall when compared to TOPIX. The purpose of this analysis is to identify trigger points where bank stocks rise or fall by extracting what common points existed in financial economic indicators immediately before significant fluctuations of bank stocks occurred in the past.

As the explanatory variables used in this research, we created a total of 94 different kinds of financial economic indicators, such as those indicators regarded as bank performance or factors of long-term interest rates by surveys of the Bank of Japan, and indicators used by the Cabinet Office to determine whether the economy is moving forward or synchronizing. These indicators included financial data of corporations such as ROE and capital-asset ratios, along with macroscopic data such as the money supply and GDP, in addition to financial data of banks such as loans and advances, and deposits. We created monthly-based indicators for 21 years (252 months), from April 1991 to March 2012.

To conduct discriminant analysis, we used the following four methods: Logistic regression analysis that assumes normal distributions for logit regression errors, the Support Vector Machine (hereafter, SVM) that separates data on a hyperplane after mapping, J48 that is a decision-tree generation algorithm based on the GINI coefficient, and the random forest that is a group learning algorithm with J48 as the learner. By using these analysis methods, we identified the best discriminant analysis method in this research.

Comparison of discriminant error rates by using each analysis method confirmed that the random forest method showed the highest precision level in the case of using training data. Logistic regression analysis also showed a high precision level. With the use of the 10-fold cross validation method, the discriminant error rate of logistic regression analysis showed the highest value of these four methods, which was 36.9 %. This result actually shows that training data caused over-training. This is because parametric methods such as logistic regression analysis is not appropriate for handling data not based on normal distribution, such as similar to stock prices. On the other hand, the random forest method showed the lowest discriminant error rate, which was 23.4 %, of the four methods. This result shows that the random forest method has a high universal capability.

However, the random forest method has the disadvantage where it does not clarify the relationship between each explanatory variable. To complement this disadvantage, we tried to extract highly important variables by using the random forest method in order to create a classification tree with J48 based on the variables extracted. By so doing, we identified the relationship of each variable.

This attempt showed that the following financial economic indicators are important indicators that could have an influence on bank stock movements: Money multiplier (v49), 10-year yield of government bonds (v3), current bank deposits (v10), M2/nominal GDP (v48), and repayment years for corporation borrowing (v31). In particular, where the money multiplier exceeded 7.32 (in a period without quantitative easing), the repayment years of corporation borrowing based on the current earnings of corporations became the important classification standard for the factors of bank stock movements. Where this value exceeds 45.6 years at the

end of the month, bank stocks are highly likely to fall, that could be regarded as a trigger of a financial crises.

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Chapter 38
Empowering Leadership in R&D Teams: A Closer Look at the Process and Outcomes

Yu-Qian Zhu and Houn-Gee Chen

Abstract Recent research suggests that there are two distinct behavioral components of leadership: (1) those targeted at influencing the group as a whole (group-focused); and (2) those aimed at individual group members (individual-focused). Differentiated individual-focused leadership occurs when leader exhibits varying levels of individual-focused leadership behavior across different group members. This research examines the unique influences of group-focused empowering leadership and differentiated individual-focused empowering leadership on R&D team's processes and team effectiveness.

Keywords Empowering leadership · R&D teams · Group-focused leadership · Individual focused leadership · Differentiated leadership

38.1 Introduction

Recent research points out that leaders can attend to both team and individual members [1, 2]. Thus, there are two distinct behavioral components of leadership: (1) those targeted at influencing the group as a whole (e.g., setting goals for the whole group, and provide inspiration for the whole group); and (2) those aimed at individual group members (e.g., setting goals for individual members, and providing individualized coaching). The former is called group-focused leadership, while the latter is termed individual-focused leadership [2]. Differentiated individual-focused leadership occurs when leader exhibits varying levels of

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individual-focused leadership behavior across different group members, for example, treating some members better than others; or providing more support to some members than others [2]. A critique question concerning differentiated leadership is whether it is beneficial or detrimental to team effectiveness. Wu et al. [2] reported that differentiated individual-focused transformational leadership harms group effectiveness through self-efficacy divergence. However, much is still left unexplored. For example, what are the effects of differentiated individual focused empowering leadership on other team outcomes, such as performance and creativity, and through what mechanism?

The introduction of group-focused, individual-focused, and differentiated leadership addresses "the dynamic interplay between the individuals within a team and the team as a whole" [1], and provides a unique lens to examine leadership behavior and new insights for the leadership literature [2]. To advance this line of research, the current research aims to investigate empowering leadership in R&D teams through the lens of group-focused and differentiated individual focused leadership, and the mechanism through which they affect team effectiveness in the forms of team creativity and performance. We examine how group-focused and differentiated individual focused leadership influence team creativity and performance through internal team processes, i.e. intra-team competition and collaboration. We contribute to existing literature in two ways. First, we add to the empowering leadership literature by examining the behavior components and characteristics of empowering leadership: group-focused, and differentiated individual focused leadership. Instead of treating empowering leadership as an overall concept, we look into the components of empowering leadership, and explore each component's unique contribution/effects to team effectiveness. Thus, we're able to provide more targeted and fine-tuned advices to R&D managers regarding their management concerns. Second, this research extends our understanding of how R&D team leaders influence team creativity and performance through creativity-enabling or hindering group processes. We investigate how leadership behaviors, although unintended, may lead to unwanted group processes as an outcome.

38.2 Theory and Hypotheses

Based on the heuristic model of team effectiveness, we propose empowering leadership behavior as the contextual factor in our model. An empowering leader consults with and makes joint decisions with team members and delegates responsibilities to team members, encourages team members' active participation and self-leadership, and encourages followers to actively provide input, participate in team decisions, and display initiative [3]. Extending prior work by Pearce and Sims [4], Faraj and Sambamurthy [3] defined empowering leadership in the R&D context to consist of three dimensions: encouraging teamwork, encouraging self-development, and participative goal setting. These three dimensions can be then categorized into two types: group-focused empowering leadership, and

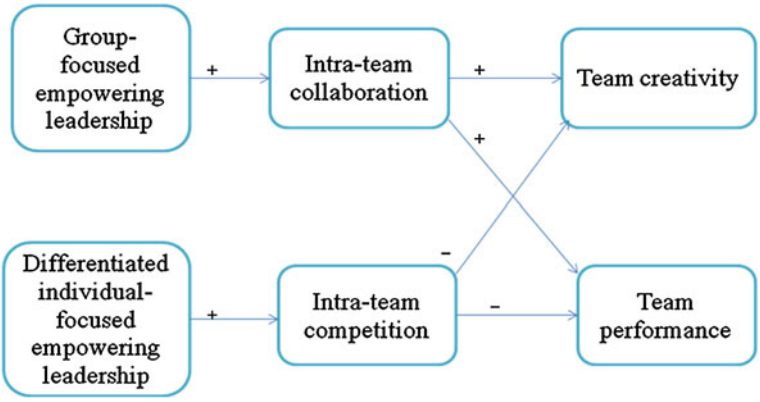

Fig. 38.1 Proposed research model

differentiated individual-focused empowering leadership. Group-focused empowering leadership refers to activities that are aimed at influencing the team as a whole. For example, encouraging teamwork and providing vision for the whole team. Differentiated individual-focused empowering leadership, however, describes leader treating members differently in individual-focused activities such as providing resources/support, and encouraging individual learning. The contextual factor of empowering leadership induces team processes, defined as the interaction pattern among team members [5]. In this research, we focus on two specific forms of team processes: intra-team competition and collaboration. These processes, accordingly, lead to different team outcomes, such as team creativity and performance. Figure 38.1 below delineates the proposed research model.

Specifically, this model links group-focused empowering leadership with intra-team collaboration, as it forms an environment conducive to collaboration. On the other hand, differentiated individual-focused empowering leadership involves within-team variability of member experiences with leadership, and may hurt team outcomes by igniting intra-team competition. Below we explicate the logic underlying our arguments.

38.2.1 Group-Focused Empowering Leadership

Group-focused leadership sets its influence target as a whole group, rather than individual members within the group. For the team as a group, leaders can direct the team as a whole and influence team outcomes by leadership activities such as setting shared team goals and providing team rules and guidance. Empowering leadership focuses on member participation and self-management [6], and encouraging teamwork is an important aspect of empowering leadership as closer teamwork enhances the ability of a team's self-management [4]. Encouraging

teamwork, as one dimension of empowering leadership is likely to influence a team as a whole because of its emphasis on common ground, shared values, and ideology. Empowering leaders encourage teamwork by urging the whole team to work together as a team and coordinate efforts with each other [4]. Thus, in this study, we refer to encouraging team work as group-focused empowering leadership.

Theory of Reasoned Action suggests that subjective norms and attitudes can influence one's behavioral intentions, and subsequently, the actual behavior [7], the need for social connection and intimacy, is one of the three core psychological need of human being [8]. Collaboration with other team members can provide fulfillment of the need of relatedness. Therefore, it is likely that people have initial positive attitudes toward collaboration. Moreover, as group-focused empowering leadership emphasizes the importance of the team to work together as an entity and coordinate efforts with each other, team members likely embrace teamwork as a subjective norm, i.e. a perceived expectations to perform what is expected from relevant individuals or groups [7]. For group-focused empowering leadership that promotes team members working together as a team, team members are likely to form positive interaction with each other and collaborate with each other to achieve common team goals. Drawing on the above reasoning, we predict:

Hypothesis 1 Group-focused empowering leadership is positively related to intra-team collaboration.

38.2.2 Differentiated Individual-Focused Empowering Leadership

Differentiated individual-focused empowering leadership describes leader treating members differently in individual-focused activities such as providing resources/support, and encouraging individual learning. Individual-focused leadership has its roots in situational leadership theories, which suggest that effective leaders should vary their behavior on the basis of follower's individual characteristics (i.e., capabilities) as well as contextual factors [2]. For the three dimensions of R&D empowering leadership proposed by Faraj and Sambamurthy [3], encouraging self-development and participative goal setting appear to focus more on individuals needs and capabilities. Self-development refers to leadership behaviors that encourage team members to learn new things, develop new skills, and seek new opportunities, while participative goal setting emphasizes leader and individual member setting performance goals together [3]. Thus, these two dimensions are considered individual-focused empowering leadership.

Differentiated individual-focused empowering leadership, however, captures the variation of individual-focused leadership among team members [2]. A high level of differentiated leadership signifies that the leader treat different members differently. For example, instead of treating all members as the same, the leader

may encourage some members to seek new opportunities to grow more often than other members. Or, the leader may sit with some members and discuss their performance goals with them, but give directive orders to others as far as performance goals are concerned. Low levels of differentiated leadership, on the contrary, suggest that the leader provides similar level of participation and support for development for each team member.

Prior research on leader-member-exchange (LMX) has demonstrated some detrimental effects of differentiated leadership on team member relationship. Sherony and Green [9] found that coworker relationship quality increased as coworkers' similarity in leader-member-exchange (LMX) quality grew and decreased as similarity in LMX diminished. Within-team differentiated leadership results in the formation of sub-groups in teams: an in-group and an out-group, with the former enjoying a better relationship with the leader. Social psychologists argue that the in-group may seek positive distinctiveness through direct competition with the out-group; while the out-group may try to reverse the relative positions of the in-group on salient dimensions [10]. On a broader scale, when leaders do not treat every member equally, members also compete with each other for supervisor attention [11], and scarce resources such as opportunities to learn new things, skills, and abilities etc. [12]. As a result, higher differentiated individual-focused empowering leadership may lead to higher levels of intra-team competition. Thus, we predict the following:

Hypothesis 2a Differentiated individual-focused empowering leadership in encouraging self-development is positively related to intra-team competition.

Hypothesis 2b Differentiated individual-focused empowering leadership in participative goal setting is positively related to intra-team competition.

38.2.3 Intra-Team Collaboration and Team Effectiveness

We focus on team creativity and team performance as two measures of team effectiveness in the R&D context. A collaboration support all three components of creativity: expertise, creative-thinking skill and intrinsic task motivation [13]. The more often people exchange ideas and thoughts by working together, the more knowledge they will have, and the more expertise they will have. In fact, one way to enhance the creative thinking of employees is to expose them to various approaches to problem solving. In addition, insights and lessons learned by one member are shared so that all can benefit vicariously from others' experiences. Creativity is spurred when diverse ideas are united or when creative material in one domain inspires or forces fresh thinking in another [14]. These structural preconditions suggest that creativity is the consequence of a social system of actors that amplify or stifle one another's creativity. Dividing creativity into three phases: variation, selection and retention, Singh and Fleming [15] report that joint work

reduces the probability of very poor outcomes—because of more rigorous selection processes—while simultaneously increasing the probability of extremely successful outcomes—because of greater recombinant opportunity in creative search. We thus expect that intra-team collaboration directly enhances team creativity.

The whole team's performance also benefits as in a collaborative team environment. When team members collaborate toward a common goal, perceptions of shared fate is created and supportive behavior is promoted, whereby each group member looks out for the interests of the others. Members in a collaborative team will consider a task from a greater variety of viewpoints, and such broader consideration is more likely to uncover problems. As team members share valuable information and lesson-learned with each other, so some similar mistakes are avoided and pitfalls are shunned. Allen, Lee, and Tushman [16] found that overall technical performance of engineers working on developing new products or processes obtained great benefit from technical communication within the lab. We thus hypothesize:

Hypothesis 3a Intra-team collaboration is positively related to team creativity
Hypothesis 3b Intra-team collaboration is positively related to team performance.

38.2.4 Intra-Team Competition and Team Effectiveness

R&D work is often-times systemic and continuous, and may consist of multiple, con-current work flows that influence each other, i.e. highly interdependent [17]. In R&D teams, each member's work is dependent on the others. For overall performance and successful project integration, both intra-team and inter-team collaboration are vital [18, 19]. Intra-team competition, on the contrary, may be detrimental to R&D team effectiveness. Rather than share information and experience, people in competitive teams tend to keep valuable information proprietary. Moreover, rather than supporting each other, people in competitive environments may be motivated to impair the progress of others in an effort to gain positive advantage. Teammates are likely to remain indifferent to one another and avoid interacting for fear that doing so will result in exploitation [20]. The possibility also exists for teammates to interfere, obstruct, or in some other way make the behavior of another less effective [20]. Thus, intra-team competition may have negative influences on team effectiveness in both creativity and performance:

Hypothesis 4a Intra-team competition is negatively related to team creativity
Hypothesis 4b Intra-team competition is negatively related to team performance.

38.3 Methods

38.3.1 Sample and Procedures

We will test the model and hypotheses with data collected from a cross-sectional field study of employees in R&D departments from a system integration company headquartered in Taiwan.

38.3.1.1 Measures

Group-focused empowering leadership. Group-focused empowering leadership measurements are from Faraj and Sambamurthy [3]'s empowering leadership measurement of encouraging teamwork with 5 items. Wording of the items was adjusted to reflect team referent (e.g., "My team leader encourages us to work together with each other who are part of the team"). Measures use a scale anchored at 1 ("strongly disagree") and 7 ("Strongly agree"). Because intra-team collaboration is a group-level variable, individual level data need to be aggregated to the group level for analysis [21, 22]. Before aggregation is performed, individual level responses should be assessed whether satisfactory levels of intra-group agreement, inter-group variances, and reliability at the group level are achieved to justify aggregation [21, 22]. Three indices are calculated: First, average interrater agreement, Rwg, measures the amount of agreement among a single group of judges (employees, team members) [23]. Second, ICC1 (intraclass correlation 1) measures between group variances [21], and third, ICC2 (intraclass correlation 2) estimates the reliability at the group level [22]. These indexes ensure that the data has adequate within-group agreements and between-group variances, and thus fit for aggregation to the group level.

Differentiated individual-focused empowering leadership. Differentiated individual-focused empowering leadership has two dimensions: differentiation in encouraging self-development and differentiation in participative goal setting. Encouraging self-development (5-items) and participative goal setting (3-items) were from Faraj and Sambamurthy [3]'s empowering leadership measurement. Measures use a scale anchored at 1 ("strongly disagree") and 7 ("Strongly agree"). Differentiated leadership falls into Chan's [24]'s dispersion composition model, where within-group variation conveys the substantive meaning of a construct. Following Wu et al. [2]., we operationalize differentiated leadership with the coefficient of variation [25]. It is calculated by dividing the within-group standard deviation of the individual-focused leadership measure by the within-group mean of the same variable [3]. A large value of this coefficient indicates more variation in the group member's perceptions of leader behavior, given adjustment for mean differences between groups. Because there are two dimensions: encouraging self-development and participative goal setting, two scores were calculated for each team.

Intra-team competition. Intra-team competition is measured using within school competition scale from Mael and Ashford [26]. The original scale was developed to measure perceived competition among students attending the same school, and some items may not be readily applied in the work setting. Thus, the wording of the scale was modified to fit the working context. Because I intend to measure the climate of competition, not the causes of intra-team competition, one item addressing the source of competition: "My manager does not encourage competition among team members" was removed. During factor analysis, another item from the original scale "The climate of my team makes people try to be better than everyone else" was moved due to low factor loading in the work setting for this analysis. The final six-item scale focuses on perceived rivalry and social comparisons. Group-level variables are measured using individual respondents and aggregated to the group level after satisfactory ICC1 and ICC2 are achieved.

Intra-team collaboration. As collaboration has been studied mostly at the organizational or business unit level, measures of collaboration at the functional team level have been very limited. Thus, the measures of intra-team collaboration blended prior research from several scholars into one scale. It synthesizes scale items used in Aram and Morgan [27] for collective problem solving, Singh and Avital [28] and Baggs [29] for information sharing, Aram and Morgan [27] for help and support, Lin et al. [30] for collaborative working, and last, Singh and Avital [28] for task coordination. The scale reflects the willful contribution of personal effort, knowledge and resources to the completion of tasks of other team members towards common goals.

Team performance. Team performance was from Faraj and Sambamurthy [3]. We use a 1–5 scale, ranging from well below average to well above average. We asked team managers to assess the performance of their own team and compare their team with other R&D teams with which they were familiar on dimensions such as: budget performance, schedule performance, and the extent of meeting design objectives.

Team creativity. Team creativity was measured with Lovelace, Shapiro and Weingart [31]'s 4 items with a 1–5 scale from well below average to well above average. This too, was assessed by team managers of their own teams against other R&D teams with which they were familiar with. We ask about the innovativeness of the team's product, the number of innovations or new ideas introduced by the team, the team's overall technical performance, and the team's adaptability to changes.

Control variables. We controlled for major contextual factors that could be expected to influence team performance and creativity. Reward structure (the percentage of the reward that is individual-based vs. team-based) is believed to be part of the team contextual factors and motivations [32]. In line with prior research that measures pay mix as a ratio [33], I control for team reward structure with a single measurement reported by the manager "In my team, _____ % (a number between 1 and 100) of compensation is determined by individual performance, and _____ % (a number between 1 and 100, and should add to 100 with the previous number) of compensation is determined by team performance". Manager tenure,

history with the team (how long has the manager worked with the team) and team size are also controlled for.

38.4 Analysis and Results

To be added.

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Chapter 39
Distribution of Roles in Virtual Organization of Agents

Juan F. De Paz, Carolina Zato, Gabriel Villarubia, Javier Bajo and Juan M. Corchado

Abstract Agent-based virtual organizations have acquired growing relevance during the last years. While these systems can be used to model human societies, there are still some open issues to be solved when working with agent-based virtual organizations, including conflict resolution. In a virtual organization it is possible to find different conflictive situations among which is the task of assigning roles to the agents in the organization. The number of agents can vary dynamically in an organization, which has produced the need to define automatic self-adaptive mechanisms for role assignment. This paper presents an innovative linear programming mechanism for role assignment in virtual organizations of agents. With the use of linear programming it is possible to determine the roles that will be assigned to each agent based on the agent's specific capabilities. The proposed mechanism was tested in a case study in geriatric residences and the results obtained are presented in this paper.

Keywords Virtual organizations · Lineal programming · Distribution of roles

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39.1 Introduction

Nowadays, the inclusion of organizational aspects is achieving more importance in the research of multi-agent systems. The evolution of multi-agent systems to virtual organizations of agents introduced concepts derived from social organizations, such as, roles, groups and norms. One of the first attempts to include organizational concepts in multi-agent systems occurs in [1]. As one of the earlier systems, MACE, introduced the concept of role to describe multi-agent systems [2]. Other examples of early works on the use of organizational concepts in MAS come from [3] and [4] but they do not tackle the problem of how to design such organizations. Work on organizational theories started within the context of the CommonKADS effort, but has since focused on human organizations models [5].

An exception is found in [6] which describes an analysis method for MAS in organizational terms.

Once the concept of organization and role was established, the next challenge was the organization itself in such structures. The agent concept has evolved from an autonomous entity that behaves individually, almost selfishly, to a collaborative entity that is part of a society, group or organization. Thus, interaction, coordination and adaptation are key points of an agent society and are closely related to organization and reorganization, which can determine behaviors and, clearly, communications channels.

The organization of agents can be considered from different perspectives, although the most common is by grouping organizations with common interests. An interest can be the desire or need to share resources and competencies, or to solve a common goal. Comparing artificial agents to those from the real-world, an agent can have different roles and be part of various organizations. The reorganization of an agent organization can be motivated by the desire to reduce conflicts within inter-agent cooperation and to increase the efficiency in achieving goals [1]. The process of reorganization must take roles into account since a role reflects the competencies that an agent either has or should provide to other agents [7].

The real world is highly dynamic and quick, which is why computer applications should be adaptable and able to follow automatic and efficient methods. Multi-Agent Systems (MAS) are often cited as one of the most promising approaches to create open systems. However, these open MAS themselves and their environments are not static; they change, disappear or grow. Agents can migrate, organizational objectives can change, and operational behavior can evolve [8]. Continuous change requires continuous reorganization and/or restructuring, and since the VO paradigm is based on human societies, it is logical that it should also perform efficient reorganizations. The problem is when and how. A high dynamicity involves a high need of reorganization, which in turn makes it necessary to find an effective, automatic and formal way to order the societies.

In this paper, an organization is considered solely on the basis of its structure, i.e. by the way groups and roles are arranged to form a whole, without being concerned with the way agents actually behave. Additionally, multi-agent systems

will be analyzed from the "outside", as a set of interaction modes [7]. Therefore, no issues regarding the architecture of agents or the way agents act will be addressed. Agents will only be defined by their functions in an organization, i.e. by their roles, and by the sets of norms, which they must follow to play those roles.

This paper presents a role distribution model for agents of an organization. The model is based on minimizing a certain parameter. The model uses linear programming to search for the optimal solution. This ensures that the best solution can be found when we are working with linear restrictions and objective function. The system has been integrated into the PANGEA [9] architecture, allowing a distribution of roles among the available agents by following a structure of organization, constraints, capabilities and costs of the agents. The system was validated in a case study to verify the correct operation of the proposal.

This article is divided as follows: Sect. 39.2 describes the state of the art; Sect. 39.3 presents the proposed model; Sect. 39.4 describes the results obtained and the conclusions respectively.

39.2 Background

An organizational structure can be defined as the set of group structures expressing the design of a multi-agent organization scheme [7]. The principles of reorganization are clearly explained in [8]. The most popular implementations of organizational adaptation include approaches based on load balancing [10, 11] or dynamic task allocation [12, 13]. The latter is often the case in organizational self-design in emergent systems that, for example, include composition and decomposition primitives that allow for dynamic variation of the organizational structure (macro-architecture) while the system population (micro-architecture) remains the same [14]. Another common approach is dynamic participation, where agent interaction with the organization is modelled with roles, and adaptation occurs as agents move in and out of those roles [15–17]. However, few of these systems allow agents to change the problem-solving framework of the system itself [18]. Based on the above considerations, two reorganization situations can be identified: the behavioural change related to roles; and the structural change related to interaction between agents, dependencies and norms.

This study is interested in how organizations change, and how reorganization can occur dynamically, with minimal interference from the system designer. From our point of view behavioural changes are strongly closed to structural changes.

One concern is the starting point in generating an organization. To create an organization it is necessary to have an efficient distribution of roles among the available agents. The topologies represented in Fig. 39.1 illustrate different types of organization and communication that can exist for agents, including [19]:

- Hierarchies: agents are arranged in a tree-like structure in which the lower levels have basic functionalities and higher levels have decision making and control.

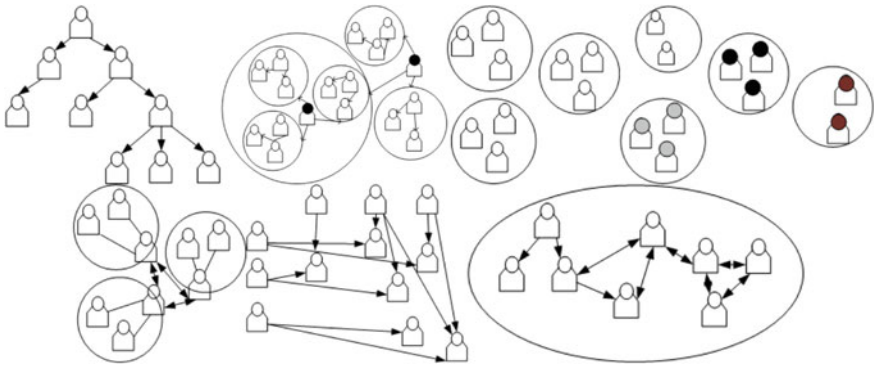


Fig. 39.1 *Top* row, *left* to *right*: hierarchy, holarchy, coalition, congregation, *Bottom* row, *left* to *right*: federation, matrix organization y group

- Holarchies are nested and hierarchical structures of holons [20]. A holon is a part of larger entity, and is the result of an association of subordinated entities. This type of topology is usually applied in domains where the objectives are recursively broken down into subtasks.
- Coalitions are temporal associations of agents that are created to achieve a particular goal, often generating benefits and reducing costs. Coalitions are dissolved once the objective is achieved. Internally they are usually represented as a flat structure or with a leader, while externally they are represented as a single and atomic entity.
- Groups are sets of cooperative agents working together towards a common goal. Thus, they maximize the usefulness and efficiency of the equipment. The representation of goals, beliefs and plans is made at a team level. The groups are usually created when solving problems can be best achieved by working together. While the groups lend themselves to greater redundancy, they are more flexible. However, greater flexibility leads to more communication and increased difficulty to coordinate.
- Congregations are groups of agents with similar or complementary characteristics. In this case, they do not work to achieve a specific goal, instead they facilitate the process of finding suitable partners to achieve that goal. For this reason, this type of topology is usually intended for long-term goals.
- Federations are groups of agents with a representative. The other members of the organization interact only with the representative, giving up part of their autonomy. This agent "representative" also acts as an intermediary between the group and the outside world, taking on various functions such as (i) Broker: distributes tasks among group members (ii) Mediator: facilitates interactions between different actors (makes contacts) (iii) Monitor: controls states of agents and reports on events (iv) Embassy: controls communication between external agents and agents of the federation (translator).

- Matrix Organizations: in this type of topology organization, an agent can be controlled by more than one agent supervisor. For this reason, it is necessary to use mechanisms for evaluating commitments and local conflict resolution. It is like a grid-like structure in which the manager agents surround other agents.

The presented method allows reorganization of any topology and can be easily adapted to personalized topologies.

39.3 Proposed Reasoning System

The reorganization mechanism has been included as a behaviour inside the agent that plays the role of OrganizationAgent in the PANGEA platform. PANGEA [9] is a multi-agent platform to develop open multiagent systems, specifically those including organizational aspects such as virtual agent organizations. This platform allows the integral management of organizations and offers different tools to the end user. Additionally, it includes a communication protocol based on the IRC standard, which facilitates communication and remains robust even with a large number of connections.

PANGEA provides the following pre-determined roles that must be fulfilled by at least one agent to ensure the proper functioning:

- OrganizationManager: responsible for the actual management of organizations and suborganizations. It is responsible for verifying the entry and exit of agents, and for assigning roles when an agent enters the organization for first time. To carry out these tasks, it works with the OrganizationAgent, which is a specialized version of this agent.
- OrganizationAgent: works closely with the OrganizationManager in charge of performing organization issues.
- InformationAgent: responsible for accessing the database containing all pertinent system information.
- ServiceAgent: responsible for recording and controlling the operation of services offered by the agents.
- NormAgent: ensures compliance with all the refined norms in the organization.
- CommunicationAgent: responsible for controlling communication among agents, and for recording the interaction between agents and organizations.
- Sniffer: manages the message history and filters information by controlling communication initiated by queries.

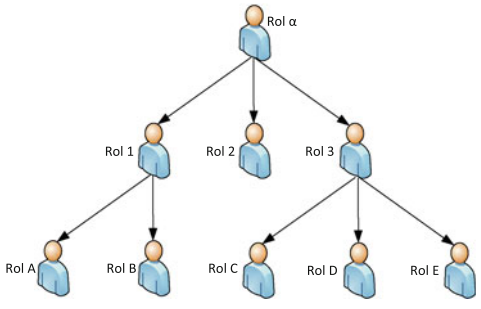
39.3.1 OrganizationAgent

The creation process of the virtual organizations and the distribution of roles among the agents may be carried out in a distributed or centralized way. This process becomes more complicated when an initial organization is not available and the system needs to assign an initial distribution of roles among the agents.

This distribution can be carried out using agreement technologies, allowing the agents to exchange messages and negotiate the distribution of roles. This process can take place when the virtual organization requires small modifications. However, it would become very difficult to establish an initial distribution or create a new distribution when a lot of changes are necessary, as this situation would require many messages. An innovative solution to solve this problem consists of applying linear programming when the first distribution of roles is created, or when there are many changes with regard to the number of agents or the roles that need to be assigned.

For each of the organization types, we define a different graphical representation. For example, Fig. 39.2a represents a virtual organization with a hierarchical structure. The organizational structure is stored in an XML file similar to the one shown in Fig. 39.2b. The system has to fill out the identifiers of the agents responsible for the roles. A specific role is assigned to one agent, although one agent may have several roles and the same role may be assigned to different agents.

In addition to the information associated with the required structure, it is necessary to define the information associated with each of the agents, taking into account their ability to perform certain roles. According to these characteristics and to a series of restrictions, it is possible to establish a linear programming problem to assign each tag agent to an agent identifier. The information stored for each of the agents varies according to the case study taken into consideration.



(a)

```
<hierarchical>
    <child rol="alpha" agent="">
        <child rol="1" agent="">
            <leaf rol="A" agent=""/>
            <leaf rol="B" agent=""/>
        </child>
        <leaf rol="2" agent=""/>
        <child rol="3" agent="">
            <leaf rol="C" agent=""/>
            <leaf rol="D" agent=""/>
            <leaf rol="E" agent=""/>
        </child>
    </child>
</hierarchical>
```

(b)

Fig. 39.2 **a** Graphical representation of the organization. **b** XML with the information of the organization

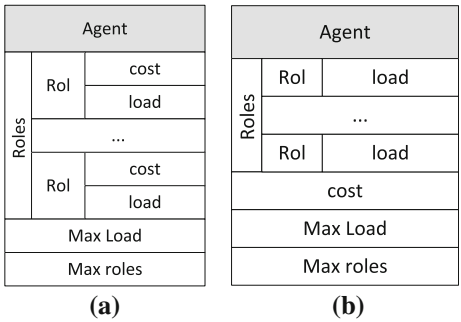


Fig. 39.3 **a** Restrictions with costs per roles. **b** restrictions with costs per blocks

An example of restriction for the organizational structure shown in Fig. 39.2 can be seen in Fig. 39.3a. In addition to the information stating the ability of an agent to play a specific role, and the corresponding work load, we have included information which will apply restrictions for the maximum number of roles that an agent can handle at one time. Figure 39.3a contains information about the cost and load of carrying out a role, in addition to some variables that limit the maximum load of the agent and the number of assigned roles. Figure 39.3b is similar to 39.3a although it additionally contains a cost value associated to the maximum load. For example a block of time can represent a working day.

Once the information of the structure and the restrictions is available, the optimization problem can be resolved. In this case, a minimization problem is formulated. The next subsection formulates the integer linear programing problem used to resolve the optimization problem.

39.3.1.1 Optimization Problem

To explain the problem simply, it is necessary to create a network containing all the Information about abilities and maximum load for the agents. The assignation problems represent the information in a graph in order to facilitate the formulation of the optimization problem. The graph contains values that are situated over the connecting lines and contain information about the cost and capacity of carrying out a task. Based on this information and the values it is easy to represent the optimization problem. Figure 39.4a shows the information previously presented in Fig. 39.3a. The roles are labeled with the name r_i where i represents the role. The agents are labeled with the name a_i. The nodes 0 and f are incorporated to establish the start and end points. The values v_{ij} establish the cost of the agent j to carry out role i. The values c_{ij} represent the load of role i over the agent j. The values l_i indicate the max load of the agent i. Figure 39.4b shows the restrictions according to Fig. 39.3b.

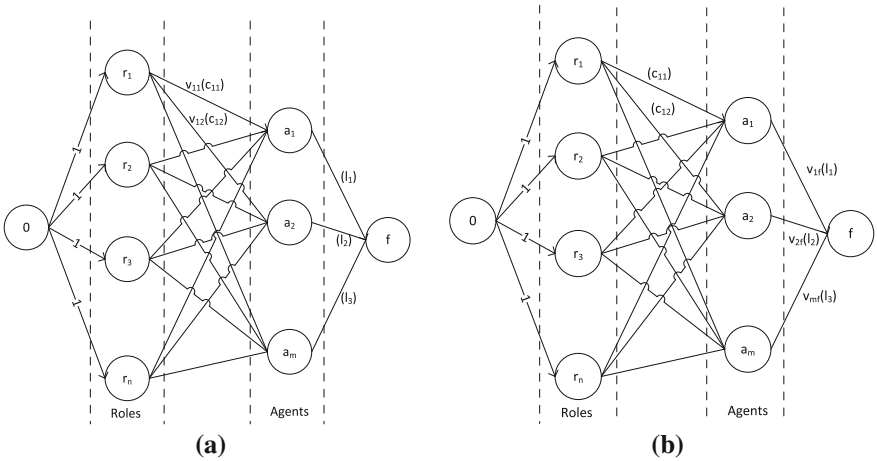


Fig. 39.4 **a** Representation of the information and restrictions according to the cost for each role. **b** representation of the information and restrictions according to the cost for max load

The optimization problem represented in Fig. 39.4a is resolved according to the optimization problem formulated in the following lines. The Branch and Bound and simplex formula [21] is used to resolve the optimization problem. The variable x_{ij} represents a connection between role i and agent j, the other variables are defined at the beginning of this section.

$$
\begin{aligned}
&Min\, v_{11}x_{11} + v_{12}x_{12} + \ldots + v_{nm}x_{nm} \\
&\qquad st \\
&c_{11}x_{11} + \ldots + c_{n1}x_{n1} \leq l_1 \\
&\qquad \ldots \\
&c_{1m}x_{1m} + \ldots + c_{nm}x_{nm} \leq l_m \\
&x_{11} + \ldots + x_{1m} \geq 1 \\
&\qquad \ldots \\
&x_{n1} + \ldots + x_{nm} \geq 1 \\
&0 \leq x_{ij} \leq 1 \\
&x_{ij}\ hold\ number
\end{aligned}
$$

The optimization problem associated with the Fig. 39.4b is different, and will be revised in the case study presented in Sect. 39.4.

39.4 Results and Conclusions

The system was applied to a previously analyzed case study to test the performance of role distribution among the medical personnel of a geriatric residence. In this residence, the personnel needed for a working day is composed of the following specializations (roles): Three attendants, 15 nurses, three floor supervisors, 15 caregivers, and one manager. The geriatric residence has a total of 50 employees (agents) that can be used to carry out the working day tasks. The proposed system has to assign the roles to these individuals. Each employee is capable of carrying out several tasks according to the abilities required for the task, the load of each task, and the max load of the person. Table 39.1 shows the information available about each individual and the roles previously identified. That information is then used to assign the roles. As an example, Table 39.1 shows one role per specialty and five agents that have been represented. However, all personnel are taken into account and represented in the table. The information in the table follows the model represented in Fig. 39.3b. The maximum number of roles per agent has not been limited because it is indirectly limited by the max load parameter. The information from Table 39.1 is represented as follows: cost of the working day | necessary time to carry out the role | time of the working day | maximum number of roles. The cost is a function of the working day; that is, if an agent carries out two roles in the working day, the price will be the same as if the agent carries out only one role. As can be seen in Table 39.1, a role can imply a different workload for each of the agents, even if the role requires the same capacities. The loads are assigned according to the experience of each employee in the residence. For example when considering the assignment of role floor supervisor, it is possible to observe that agent 3 requires 3 h while the agent 2 would need only 2 h to carry out the job. Additionally, as can be seen, agents 2 and 3 receive a different salary. Agent 5 is qualified to act as manager, which requires 2 h. That leaves agent 5 with 6 additional hours to perform any other compatible role.

Using the information presented in the Table 39.1, the optimization problem can be formulated as shown below:

Table 39.1 Table of indexes for each of the agents and each of the roles. The information is represented in the following format: working day cost (v_{ij}) | role load time (c_{ij}) | maximum load of the agent l_j | maximum number of roles

	Agent1	Agent2	Agent3	Agent4	Agent5	…
Order1	80|8|8|∞					…
Nurse1		120|6|8|∞	110|7|8|∞			…
Supervisor1		120|2|8|∞	110|3|8|∞		150|2|8|∞	…
Carer1		120|6|8|∞	110|6|8|∞	100|6|8|∞		…
Manager1					150|2|8|∞	…
…	…	…	…	…	…	…

$$Min\ 80x_{1f} + 120x_{2f} + 110x_{3f} + 100x_{4f} + 150x_{5f}$$

st

$$8x_{11} \leq 88$$

$$x_{1f} - x_{11} \geq 0$$

$$6x_{22} + 2x_{32} + 6x_{42} \leq 8$$

$$x_{2f} - x_{22} \geq 0$$

$$x_{2f} - x_{32} \geq 0$$

$$x_{2f} - x_{42} \geq 0$$

$$7x_{23} + 3x_{33} + 6x_{43} \leq 8$$

$$x_{3f} - x_{23} \geq 0$$

$$x_{3f} - x_{33} \geq 0$$

$$x_{3f} - x_{43} \geq 0$$

$$6x_{44} \leq 8$$

$$x_{4f} - x_{44} \geq 0$$

$$2x_{35} + 2x_{55} \leq 8$$

$$x_{5f} - x_{35} \geq 0$$

$$x_{5f} - x_{55} \geq 0$$

$$x_{11} \geq 1$$

$$x_{22} + x_{23} \geq 1$$

$$x_{32} + x_{33} + x_{35} \geq 1$$

$$x_{42} + x_{43} + x_{44} \geq 1$$

$$x_{55} \geq 1$$

$$x_{11} + x_{22} + x_{32} + x_{42} + x_{23} + x_{33} + x_{43} + x_{44} + x_{35} + x_{55} = 5$$

$$0 \leq x_{ij} \leq 1$$

x_{ij} *Integer number*

The variable x_{ij}, where i and j are numbers, represents a connection between role i and agent j. x_{if} represents a connection between agent i and final node f of the network represented in Fig. 39.4b. The variables x_{ij} and x_{if} are integers and the value may be 0 or 1 according to the restrictions. The other variables are defined above in Sect. 39.3.1.1

The generic assignation problem is defined as follows. The first of the restrictions implies that the max load is not greater than the maximum hours an agent can work, while the second restriction implies that the cost of the working day of the agent is active if a role has been assigned to the agent. For example, in the previous example $x_{2f} - x_{32} \geq 0$ if the role 3 is assigned to agent 2 then $x_{32} = 1$ and then $x_{2f} = 1$. The third restriction implies that each role is assigned to at least one agent, and the last restriction represents that each role is assigned to only one agent.

Table 39.2 Final costs obtained with the different proposals

Algorithm	Test 1	Test 2	Test 3	Test 4	Test 5
Manual	3430	4110	3200	3380	3580
Genetic algorithm	3380	3720	3340	3350	3410
Linear programming	3220	3580	3200	3280	3410

$$
\begin{aligned}
&Min \sum_i v_{if} x_{if} \\
&st \\
&\forall j \quad \sum_i c_{ij} x_{ij} \leq l_j \\
&\forall i,j \quad x_{jf} - x_{ij} \geq 0 \\
&\forall i \quad \sum_j b_{ij} x_{ij} \geq 1 \\
&\sum_{i,j} b_{ij} x_{ij} = n \\
&0 \leq x_{ij} \leq 1
\end{aligned}
$$

$c_{ij} = 0 y b_{ij} = 0$ when there is no link between role i and agent j, or the cell row i col c_{ij} is empty in Table 39.1. Otherwise value is the cost and $b_{ij} = 1$, where n is the number of roles to assign.

The assignation of the roles and tasks would be defined as the values of the variables x_{ij}. A value of 1 indicates that role i is assigned to agent j, 0 if it is not assigned. The result of the problem shown above is as follows: agent 1 performs the role of attendant, agent 2 has no roles, agent 3 performs the role of nurse, agent 4 is assigned to a caregiver, agent 5 performs the role of floor supervisor and manager, and the cost is 440€.

To evaluate the performance of the system, the total cost of the assignation problem using the 50 workers and the 37 roles was compared to both a manual planner and a generic automatic planner. The manual plan is carried out by a staff member who distributes the roles among the available personal according to the restrictions, while the automatic plan is based on a genetic algorithm. During the test, the number of agents and capacities of the personnel were modified, while the number of the roles remained constant. The results of the test are shown in Table 39.2. As can be seen, the proposed approach reduces the costs in personnel and in all cases the total cost is equal to or lower than the other two approaches.

The planning model of the agent OrganizationAgent in the PANGEA architecture [9] allows the reduction of costs and the simplification and increased efficiency of the process for assigning roles. Figure 39.3a and b represent two different problems with two of the more common situations in this kind of system. These models could be easily extended to other problems if all the restrictions and the objective functions are linear. In other cases, the optimization problem should

be resolved with heuristics. The case study was applied to the model presented in Fig. 39.3b. In future works, new organization models and restrictions will be analyzed to incorporate them into the agent OrganizationAgent in the PANGEA architecture.

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Chapter 40
Uncovering Hidden Characteristics of Your Business Leaders

Measuring the Difference between the Ideal the Real Through Persona Design Method

Yasuhiro Sasaki, Masaaki Kunigami, Atsushi Yoshikawa and Takao Terano

Abstract We propose a novel method of through which employees can identify and rank the images of the ideal leaders of an organization. In many companies, despite discussion of the images of leaders, it is difficult to hide differences in how different individuals recognize those images. Past research on leaders has not answered these questions. To clarify differences in recognition, we apply the persona technique. The persona technique was started in the user interface field of computer software development, and has spread to the product development field. The proposed method uses the following procedure: (1) set persona characters with various attributes, (2) assign the attribute values by the orthogonal design technique, (3) design questionnaires, (4) get questionnaire data on the personas from subjects, (5) evaluate the data recorded on respondent questionnaires. Using the proposed method, we successfully detected the ordering of different employee images of organization leaders.

Keywords: Personas · Competency · Leadership · Personal requirements · Human developments

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40.1 Introduction

40.1.1 Necessity and Difficulty of the Research on Leader images

According to Bennis [1], leaders are made, not born, and moreover are primarily self-made. We also support this view that leaders can be cultivated.

Leaders play very important roles in business organizations, and their capabilities influence the rise and fall of their organizations. Leaders guide and inspire subordinates. Excellent leaders can give their organizations a competitive advantage. Therefore, it is essential for business organizations to cultivate excellent leaders [2].

However, research on leader training is incomplete. The capabilities leaders require are not uniform, and leaders must also be well versed in the operations of their organizations. Moreover, leaders must maintain smooth relations between bosses and subordinates. Furthermore, they need to learn the conceptual capabilities necessary to understand and map enterprises. Since business conditions differ among organizations, it is impossible to uniformly define the capabilities leaders require. This is one reason that research on leader image is difficult.

40.1.2 Cooper's Concept of "Personas"

In marketing and user-centered design, personas are virtual characters created to represent different user types within a targeted demographic, attitude or behavior set that might use a site, brand or product in similar ways [4]. Personas are useful in considering the goals, desires, and limitations of brand buyers and users to help guide supplier decisions about a service, product or interaction space, such as the features, interactions, and visual design of a website. Personas may also be used in a user-centered design process for software design, and are also considered a part of interaction design, having been used in industrial design and more recently for online marketing. A user persona represents the goals and behavior of a hypothesized group of users. Generally, personas are synthesized from data collected through interviews with users, and are presented in one-page descriptions that include behavior patterns, goals, skills, attitudes, and environment, with a few fictional personal details to make the persona a realistic character.

Alan Cooper, a noted pioneer software developer, developed the concept of personas. From 1995 he became interested in how specific, rather than generalized, users would use and interface with software. The persona concept was popularized for the online business and technology community in Cooper's 1999 book "The Inmates are running the Asylum" [3]. In this book, Cooper outlined the general characteristics, uses and best practices for creating personas, and recommended that developers design software for single archetypal users.

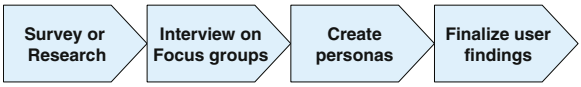

Fig. 40.1 Usual persona generation and measure examination process

In this paper, we applied the persona technique to draw images of corporate leaders. Usually, minute fixed-quantity investigation and close qualitative investigation are required for "persona" creation [5]. In fact, this level of expense, time and effort is unnecessary for "persona" creation. We demonstrate this in this research, which devises a simple technique that collateralizes fixed rationality and probability (Fig. 40.1).

40.2 Purpose of the Research

Identification of desirable leader characteristics is a central concern in the knowledge management literature. However, different business environments require different types of business leaders. Business environments that change too fast make it difficult to achieve agreement about desirable leader characteristics. This paper proposes a novel method to identify desirable leader images using virtual characters. We use personas to research leader characteristics [8].

By application of an experimental design, we aim to minimize the number of questionnaire items that subjects must select from. We aim to obtain high-precision results with a small sample by utilizing conjoint analysis [7].

The proposed method is summarized as follows: (1) set persona characters with various attributes, (2) assign the attribute values by orthogonal design techniques, (3) set virtual business situations, (4) obtain questionnaire data on the personas from subjects based on the business situations, and (5) evaluate the data to get the leader images for the corresponding business situations.

40.3 Brief Description of the Proposed Method

40.3.1 Assigning Leaders Based on Capability Requirements

Previous research [6] on the leader image of ICT organizations probed 25 competencies as capabilities required for leaders. The paper identified nine core competencies by systematic examination as the most important capability requirements, as summarized in Table 40.1.

Of course, a person who excels in all capabilities is ideal. However, there are few such business leaders and expecting young leaders to have such capabilities is unrealistic. We thus created the orthogonal array listed in Table 40.2 to prompt experimental subjects to choose talented people who were suitable business

Table 40.1 Main capability requirements expected of business leaders

No.	Competency	The example of action
1	Practical skill	The thing required for mind and logic composition for which it has deep knowledge broadly and moderately
2	Positiveness	The subject of a high level is set up actively and the best is always concentrated towards achievement.
3	Judgment	It can judge [whether while there is an uncertain element, a project can be promoted and it can lead to a success, and] by itself.
4	Cultivating human resource	Advice according to the feature and characteristic of a place of work and the member of a project is performed.
5	Visio	Business planning, such as a development project which can promote two or more proposal affair efficiently, is drawn up.
6	Communication	A confidential relation with a partner can be built through "hearing it" and "talking."
7	Negotiation	The merit to the company by developing a system is recognized, and in-company adjustment can be carried out.

Table 40.2 Combination of capabilities of business leaders

	Practical skill	Positiveness	Judgment	Cultivating HR	Vision	Communication	Negotiation
typeA	–	–	–	–	–	–	–
typeB	–	–	–	○	○	○	○
typeC	–	○	○	–	–	○	○
typeD	–	○	○	○	○	–	–
typeE	○	–	○	–	○	–	○
typeF	○	–	○	○	–	○	–
typeG	○	○	–	–	○	○	–
typeH	○	○	–	○	–	–	○

(L8 array)

leaders. Using the orthogonal array listed in Table 40.2, we could perform many comparisons despite few selections.

In this array, Type A denotes a leader with average performance in all capabilities, while Types B to H denote leaders who excel in different sets of four capabilities.

40.3.2 Experiment Setup

The experiment was designed as follows. We prepared the questionnaire vote. Respondents individually answered questions about the following three cases. To ensure conformity of responses to the case, we asked respondents to attach leader type rankings to their responses (Table 40.3).

Table 40.3 Setup of each case

	The situation of organizations
Case 1	The achievements of this organization tend to descend. If the leader does not take bold measures, this organization does not have the future.
Case 2	The achievements of this organization are upward. The atmosphere of this organization is bright.
Case 3	The achievements of this organization are safe for the time being. However, the future of this organization is slightly opaque.

We printed eight personas (from Type A to Type H) on small pieces of paper, and arranged them on the desk. We put such papers in order at random for every respondents. We then asked respondents to rearrange those papers in descending order of the degree to which they described the ideal leadership of the organization in the subject case. Respondents rearranged the papers into order suitable as a leader of the case. Respondents repeated this examination three times. Respondents entered ranking in the answer sheet for every case (Fig. 40.2).

We administered the questionnaire, and collected reply data from 25 respondents, at the following three locations:

(1) A Tokyo Institute of Technology graduate school seminar: 13 respondents
(2) The Mitsubishi study group: 5 respondents
(3) A specific society seminar hall: 7 respondents (Table 40.4).

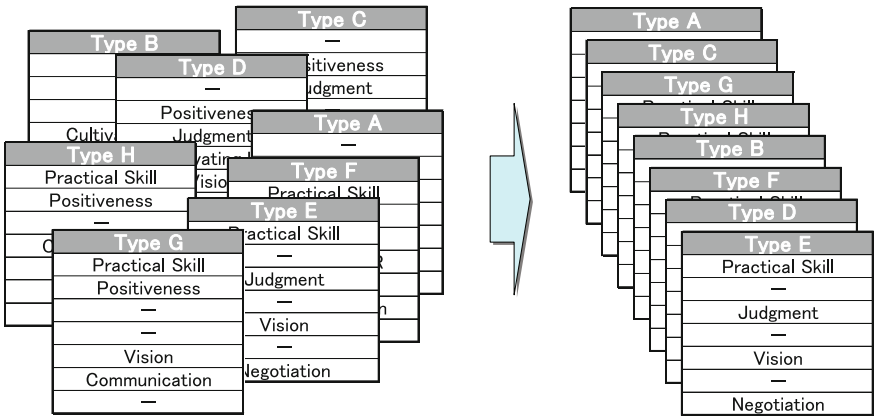

Fig. 40.2 Rearrangement of cards by respondents (image)

Table 40.4 The collection result of answer sheets

Place	All	Male	Female	Business persons			Postgraduate student (not in service)
				more than 20 years in service	11- 20 years in service	no more than 10 years in service	
(1)	13	11	2	6	2	2	3
(2)	5	5		1	4		
(3)	7	6	1	1	2	4	
Total	25	22	3	8	8	6	3

40.4 Results and Discussion

40.4.1 Results of Respondent Assessments of Leader Capability Requirements

Below we analyze the questionnaire results using the orthogonal array. The seven competencies were allocated to each persona by the L-8 orthogonal array. We analyzed which of the leader competencies respondents considered important when they ranked (the best: 1st—the worst: 8th) the leader personas. Subsequently, besides conjoint-analysis, we applied multiple regression analysis to determine the sensitivity of the respondents' evaluations. In the multiple regression analysis, the response variable is "score (= 8—rank, the best: 7—the worst: 0)" and the explanatory variables are the existence of the seven competencies (0–1 data, absence: 0, existence: 1). The multiple regression analysis under the three cases of organizational situation (sample size 25each) illustrates how the seven competencies contribute to the score. Each of the regression coefficients of the seven competencies illustrates how the existence of each competency contributes to the score of rank. We call these coefficients "score contribution". The set of the score contribution is expected to change reflecting the difference of the organizational situations or the difference of the subjects' expectation to their leaders (Table 40.5).

40.4.1.1 Case 1 (An Organization with Declining Achievements)

The most important capability requirements needed for the business leader in this organization are "imagination and vision", followed by "judgment" and "positive attitude and drive to succeed". Clearly different from both cases 2 and 3, the outcome shows that the relatively short range competencies become clearly

Table 40.5 (Case 1) Capability requirements

Category		Practical skill	Positiveness	Judgment	Cultivating HR	Vision	Communication	Negotiation
All	N = 25	0.7	1.2	1.1	-0.3	2.0	0.1	0.4
Businesspeople more than 20 years in service	N = 8	0.3	0.5	1.2	-0.5	1.8	0.1	0.6
Businesspeople 11-20 years in service	N = 8	1.2	1.3	0.9	-0.6	2.2	-0.1	0.7
Businesspeople no more than 10 years in service	N = 5	0.0	1.3	1.1	0.2	2.6	0.9	0.1
Postgraduate Student (not in service)	N = 4	1.1	2.1	1.3	0.3	1.4	-0.6	0.0

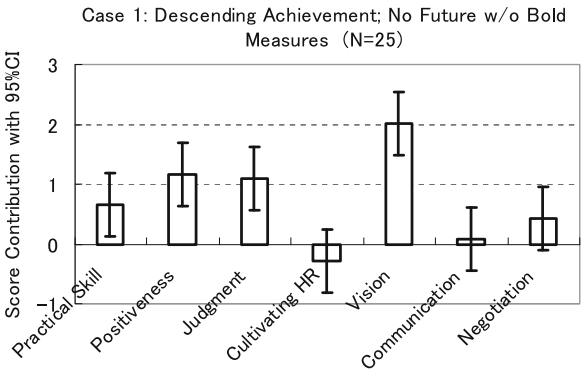

Fig. 40.3 (Case 1) Capability requirements in low performance organization

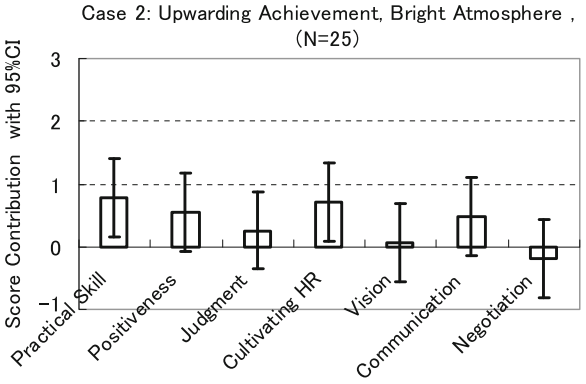

Fig. 40.4 (Case 2) Capability requirements in a high performance organization

significant instead of the relatively long range one (Cultivating HR). The effect-size: r2 (coefficient of determination) = 0.35.[1] (Fig. 40.3).

40.4.1.2 Case 2 (An Organization with Increasing Achievements)

The most important capability requirement for the business leader in this organization is "subordinate training" capability. There was no significant difference between the seven competencies, and the effect-size: r2 (coefficient of determination) = 0.08 (Fig. 40.4).

The null hypothesis "capability elements do not influence selection of leaders" was not disposed in this Case 2.

[1] Cohen [10] shows that Cohen's delta of 0.08 (equivalent to r-squared of 0.138) suggests big difference (as large as the difference of average IQ between PhD students and undergraduate students). Therefore, our outcomes (r-squared of 0.35 and 0.29) show considerably strong effect on the subjects' preference of the leaders' competency.

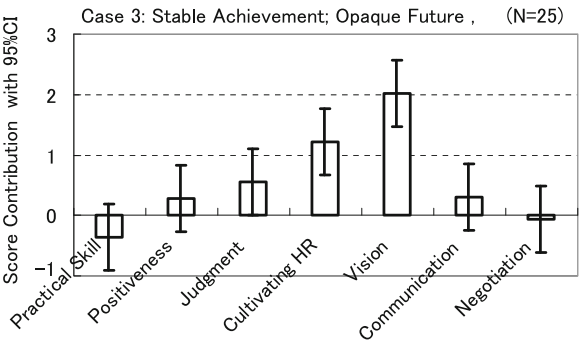

Fig. 40.5 (Case 3) Capability requirements in a poor performance organization

40.4.1.3 Case 3 (An Organization with Stable Achievements)

The most important capability requirements for business leaders in this organization are "imagination and vision", and "subordinate training." Clearly different from Case 2, the outcome shows that the middle—long range (Vision, Cultivating HR) competencies are clearly significant. The effect-size: r2 (coefficient of determination) = 0.29.[1] (Fig. 40.5).

The null hypothesis "capability elements do not influence selection of leaders" was disposed in this Case 3.

40.4.2 Influence of Respondent Years of Service on Recognition of Leader Capability Requirements

The previous subsection confirmed that leaders' capability requirements change with organizational situation. The confirmation involved checking respondent recognition of leaders' capability requirements using the persona technique and orthogonal array. This method of confirmation raises the question of whether respondent recognition of leader capability requirements differed based on respondent attributes such as years of service.

In this section, we describe the results of checking for differences in responses arising from respondents' attributes. We divided respondents according to years of service, and conducted multiple linear regression analysis. A thin shading cell indicates a coefficient of one or more, while a deep shading cell indicates a coefficient of two or more. Certain items influence respondent ranking of leader capability requirements.

40.4.2.1 Case 1 (An organization with Declining Achievements)

Every group of respondents identify "Vision" as a significant capability requirement for leaders. However, other capability requirements vary among different groups of respondents. For example, employees with a medium level of experience (defined as 11–20 years of service), and students recognize "Practical Skills" as important, while employees with a high level of experience do not.

40.4.2.2 Case 2 (An Organization with Growing Achievements)

In case 2, there is no significant difference in the overall capability requirements. Recognition of the capability requirements varies among every category of respondents. In the senior category (businesspeople with more than 20 years of service), "Practical Skills" are recognized as important. In the junior category (Businesspeople with less than 10 years of service), "Judgment" is recognized as important (Table 40.6).

40.4.2.3 Case 3 (An Organization with Stable Achievements)

In case 3, "Vision" is most important to leaders' capability requirements, followed by "Cultivating HR". Recognition of the capability requirements for leaders varies among every category of respondents. Respondents who were senior employees did not consider "Cultivating HR" important. Meanwhile, junior employees and students considered "Judgment" to rank next in importance (Table 40.7).

40.5 Conclusion and Future Work

The previous literature on competency research explored leaders' capability requirements by decomposing leaders' behavioral traits. This approach could not easily distinguish the strengths of different capability elements. In contrast, the present study identified the requirements for business leaders using a simple questionnaire.

Unlike conventional research methods, the proposed technique is based on questionnaire design using an orthogonal array. Rearrangement of eight types is equal to performing paired comparison 28 times. This technique successfully eliminated prejudice and identified respondents' probable opinions.

It is a strong point of this method that size can take out "the preference about their leader" from at least about 25 sample according to a situation.

We observed statistical difference using a simple situational setup. The results suggested that the images of the desired leader, as expressed in the attributes of the designed characters clearly differ with the business situations.

Table 40.6 (Case 2) Capability requirements

Category		Practical skill	Positiveness	Judgment	Cultivating HR	Vision	Communication	Negotiation
All	N = 25	0.8	0.6	0.3	0.7	0.1	0.5	−0.2
Businesspeople more than 20 years in service	N = 8	1.1	0.0	−0.1	0.8	−0.1	0.9	0.6
Businesspeople 11–20 years in service	N = 8	−0.1	1.3	0.0	0.9	0.1	0.6	0.1
Businesspeople no more than 10 years in service	N = 5	0.9	0.6	1.3	−0.5	0.0	−0.3	−1.8
Postgraduate student(not in service)	N = 4	1.6	0.1	0.3	1.6	0.3	0.3	−0.1

Table 40.7 (Case 3) Capability requirements

Category		Practical skill	Positiveness	Judgment	Cultivating HR	Vision	Communication	Negotiation
All	N = 25	−0.4	0.3	0.6	1.2	2.0	0.3	−0.1
Businesspeople more than 20 years in service	N = 8	−0.4	0.4	0.5	0.9	1.9	0.3	−0.3
Businesspeople 11-20 years in service	N = 8	−0.7	0.3	−0.3	1.4	2.7	0.4	−0.2
Businesspeople no more than 10 years in service	N = 5	0.1	0.9	1.4	1.3	1.2	0.4	0.5
Postgraduate student(not in service)	N = 4	−0.1	−0.8	1.4	1.4	2.0	0.1	0.0

In this experiment, some competencies (communication or negotiation) have not significant contribution under all situations. These factors can be pooled into the error factor under the analysis of variance, and can be regarded as controlled data to the others. However, to clarify what are the controlled data, we will use a bigger orthogonal array with dummy factor in some columns as controlled data in the next experiment.

The capabilities respondents identify as required in leaders differ with respondents' years of service. This demonstrates differences in recognition based on gaps in respondents' experiences.

Viitala [9] has been looking at how the subordinates and the leaders look at the need to develop their competences. The culture may also have effect on which kind of leaders are seen as good ones. This time, we investigated the influence of respondents' years of service. The influence of culture is also a future subject.

In future work, we plan to conduct interview sessions with excellent corporate leaders. Future work can examine the following questions:

- How are appropriate items incorporated in an orthogonal array?
- What is the most suitable method of analyzing the collected data?
- Is the simple persona used in the technique presented here appropriate compared with an originator persona?

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Chapter 41
Enterprise Knowledge Management Under Cloud Computing Environment

Liang Huo, Dapeng Ji, Zhenling Liu and Yu Yu

Abstract With the coming information economy age, knowledge has become the core production factor for success of the enterprise, while how to manage the knowledge efficiently while the enterprise faces such mass information has become a new task in enterprise knowledge management. This paper has discussed development and application condition of enterprise knowledge management by cloud computing and knowledge management overview and pointed out a good method to apply the advanced cloud computing technology in enterprise knowledge management.

41.1 Introduction

21st century is an age when information economy develops rapidly as well as knowledge will substitute equipment, materials and capitals to become the most important production factor in economic production, with increasing knowledge explosive growth, the enterprise not only faces shortage of knowledge but also knowledge possessed (skill, experience, information and summary etc.) by the enterprise that becomes more and more scattered and difficult to manage, so the enterprise must make efficient management and application of knowledge, the most valuable property of the enterprise. Enterprise knowledge management is to accumulate employees' and enterprise knowledge and then realize knowledge value to make it intangible assets by exchanging and sharing knowledge. So we can consider knowledge management and application as decisive power ahead in

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cut-throat competition among enterprises. Meanwhile, with rapid development of information technology, improved network technology and computer technology, especially generated "cloud computing" model, offer upgrading of enterprise knowledge management technology a powerful support [1].

41.2 Related Definitions

41.2.1 Cloud Computing

As to cloud computing, its concept and definition cannot be determined for a long time, and it is well known that cloud computing is a super computer mode based on internet, namely it makes co-work of huge software and hardware as well as application services distributed in each server, personnel computer even mobile phone and other devices.

41.2.2 Enterprise Knowledge Management

With development of information technology and the coming knowledge economy, knowledge management is an important part of enterprise management system and its nature is to make scientific management of employees' experience, knowledge and abilities in the enterprise and accordingly to share knowledge and effectively realize transition of knowledge value, to promote continuous development of knowledge-based enterprise as well as more efficient operation of the enterprise and gain an advantage in market competition [2]. However, due to low cognition and attention to enterprise knowledge management, we cannot make full use of its potential.

41.3 Problems of Enterprise Knowledge Management

41.3.1 The Enterprise Lacks Enough Cognition of Its Own Knowledge Value

Most enterprises pay most attention to maintain and expand current scope of the enterprises and stress tangible assets, but lack enough cognition of intangible assets like knowledge, which is mainly represented by: lack of clear understanding of knowledge assets; lack of specific understanding of close relation between such intangible assets knowledge and enterprises, instead, they do not realize the direct contact of knowledge and enterprises [3]. In fact, among current market economic activities, the employees, as the carrier of creating, applying as well as mastering knowledge and technology, have played more and more important roles in the

process to strengthen enterprise competitive strength, and competition among enterprises is mainly reflected in talent and knowledge competition. Knowledge, as one production factor, has contained in product and production technology process and become the base of enterprise comprehensive strength as well as the key of development. Therefore, the enterprise, which wants to keep a proper space in knowledge economy, must change its traditional understanding of tangible assets and operate and manage knowledge assets as important assets of the enterprise.

41.3.2 The Enterprise Has Low Informatization Degree

Informatization is the base of knowledge management, and advanced information technology is the premise to realize knowledge management, for which, we need a faster and more efficient space to transfer knowledge in terms of knowledge management. Presently, informatization construction of most enterprises is still weak with informatization structure under construction, which is not good for realization of knowledge management target of the enterprise.

41.3.3 Enterprise Trust Mechanism Needs to Build Up

One universal problem among the enterprises is lack of trust resulted in influence of sharing knowledge. Trust is the premise to realize knowledge exchange, share and application, only trust mechanism among enterprise employees can build up beneficial cycle of knowledge as well as reduce generation of egoism in sharing knowledge.

41.4 Advantages of Cloud Computing Applied in Enterprise Knowledge Management

Facing the huge information, how to obtain rapidly the useful knowledge and the necessary knowledge of the enterprise and employees so as to improve work efficiency of the employees is the hot and difficult problem in enterprise knowledge management all the time [4]. While cloud computing can solve storage, retrial and management of existing huge information and make more intelligent data by distributed data transaction technology, whose main advantages are mainly reflected as follows:

41.4.1 Security

Cloud computing service supplier possesses safe data storage center and specialized team to manage client information. Because cloud computing has strict access

control strategy, the users can share data safely with specified person by storing data in cloud and are not afraid of information security like losing data and virus attack.

41.4.2 Convenience

Cloud storage is supported by a variety of service and application software, so we can use it more conveniently and rapidly. Cloud application software does not need download and can upgrade automatically, the users can connect Internet device by mobile phone and PDA and then get cloud service at any place and at any time.

41.4.3 Economy

The enterprise does not need to invest lots of capitals to purchase, upgrade and maintain the high priced hardware facilities as well as to employ management and maintenance personnel; instead, it can construct its own informatization platform by renting cloud, and then spend fewer assets to obtain network computing resources from cloud computing service supplier by applying cloud computing service. Meanwhile, daily maintenance of server is also supplied by cloud service supplier. So the enterprise can reduce its investment but also improve efficiency greatly and accordingly realize maximum enterprise economic benefits.

41.4.4 Sharing

Related enterprises can built up enterprise information sharing space together by relying on cloud computing mode, thus various enterprises can share the infrastructures connected by a great many systems. As to cooperative enterprises, they can obtain the real-time data of other enterprises by cloud computing technology in enterprise cloud so as to meet user demands for information and realize information resources sharing at a greater degree.

41.4.5 High Efficiency

"Cloud computing" possesses millions of servers, so even one server does not work, other server of "cloud computing" also can rapidly copy the data of the very server to the other server and start a new server to offer service in a very short time

by applying cloning technology, then it makes the enterprise realize unremitting safe service and improve operation capacity of servers.

41.4.6 Maximization of Computing Resources

Rapid upgraded knowledge asks for higher demands for software and hardware of enterprise knowledge management, however, capacity of enterprise and personnel devices is limited. Cloud computing applies high transmission capacity of internet to transfer data analysis process from personnel device to computer agglomeration with supercomputing capacity on internet, which has solved the problem of computing capacity shortage. Meanwhile, cloud computing offers the users dynamic expandable computing resources, so the users can apply elastic resources of cloud computing, which can solve the problem of computing resources shortage resulted from rapid increased demands but also avoid waste of idle surplus. Therefore, the enterprises can spend less money in applying cloud computing technology to obtain "cloud" service offered by ten thousands of servers, and accordingly to supply almost unlimited space and computing capacity to users, whose request can be responded in a minute, thus the enterprises can obtain higher benefits at lower cost [5].

41.4.7 It Helps the Enterprise to Solve Talent Problem

The core of knowledge management is talent-based. Knowledge management considers talent with information and innovation ability as object of management, and pays attention to the persons with great innovation ability, which is totally different from management that only pays attention to materials and technology, and which reflects the very nature and characteristic of knowledge management. Talent shortage is a big problem of current enterprises. Employees, as the carrier of creating, applying as well as mastering knowledge and technology, are playing more and more roles in the process of improving enterprise competitive power in current market economic activities, and competition among enterprises is mostly reflected by talent competition. There is not a lack of talents in the enterprises; instead, there is a lack of a pair of eyes to find the talents. "Cloud computing" is such a pair of eyes! Cloud computing platform covers the whole process of selecting, applying, cultivating and keeping talents, and makes the enterprises select, cultivate and apply the talents through simple allocation in the view of cloud computing.

41.5 How to Effectively Apply Cloud Computing Technology in Enterprise Knowledge Management

41.5.1 Stress and Support from Enterprise Managers

It is a long term process to apply cloud computing technology in enterprise knowledge management, and it needs great investment at earlier stage while its benefit can be only obtained after a long time, and the enterprise managers are easy to lack of confidence, thus the first problem to solve for applying cloud computing technology in enterprise knowledge management is stress and long-term support to knowledge management of enterprise managers.

41.5.2 Realize Enterprise Informatization

A basic view of knowledge management is to get development from mutual communication; and knowledge is valueless when knowledge is not used by people. Therefore, enterprise informatization is the base of enterprise knowledge management, and the enterprise shall build up its own informatization platform by cloud for issuing information, searching knowledge and study and training of its employees as well as medium of exchanging information, sharing knowledge, and cooperative innovation between employees and between employees and leaders, and thus make full use of internet knowledge resources.

41.5.3 Build Up Enterprise Employee Study "Cloud" Organization

Enterprise employee study "cloud" organization is a virtual organization based on cloud computing network in a new type of knowledge management guarantee of enterprise and employees by expanding traditional employee study type organization. Enterprise employee study "cloud" organization is an organization based on common wish to improve personal specialized technical ability and specialized technical development. Not only the employees of the organization can create, share and obtain knowledge from cloud computing network, but also knowledge "cloud" of the enterprise can be continuously accumulated and renewed. Communication can be done between enterprises and employees also between employees. Meanwhile, they can ask for experts so as to get more new specialized technical knowledge, which is good for promoting innovation of enterprise and employee knowledge and creating a new knowledge innovative culture atmosphere by such mutual promotion and influences.

41.5.4 Build Up Incentive System of Knowledge Innovation

Through building up incentive system of creating, transmitting, sharing and applying knowledge, enterprise employees can be given incentive to study, create and share knowledge through cloud computing network initiatively and actively. Incentive system shall include two parts involving material and spiritual incentive. It is not right that most enterprises only stress material incentive, but neglect spiritual incentive. Enterprises shall combine both and encourage the employees to study, create and share their knowledge.

41.6 Conclusion

This paper has taken knowledge management theory as base, according to the features of enterprise knowledge management, combined theory of cloud computing knowledge, analyzed influences of cloud computing on knowledge management, and pointed out how to realize enterprise knowledge management in cloud computing environment. The author hope this paper not only can make enterprise stress knowledge management, but also offer a new knowledge management method to the enterprise in knowledge economy and bring real effects for enterprise operation and management activities.

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Chapter 42
Knowledge Management Strategy Using Activity Theory for a Law Firm

Sanath Sukumaran, Kanchana Chandran and Kalpana Chandran

Abstract The practice of law is one that has been associated with the practice of knowledge and skills which invariably requires objective use of information. Law firms are now being challenged by the need to better manage their collective knowledge as an asset to their business. Traditional methods of managing human capital, innovation, and learning within law firms, have proven ineffective as they more often than not fail to contribute to a firm's success. In an ideal setting, having a good knowledge management initiative in place may offer the opportunity for a practising lawyer to experience a better work or life balance. Some legal firms are on the threshold of embarking on comprehensive knowledge management strategies aiming to improve the way they manage their knowledge. However, such strategies are far more complex as one would imagine. Knowledge Management (KM) initiatives should not merely be seen as an attempt to alleviate some of the problems of poor control and poor use of knowledge and information resources in the face of increasing complexity but also as a means for organisations to have better leverage on what it does best. A holistic implementation of a KM initiative is deemed necessary so that such an initiative does not disrupt existing work processes, but adds value to a legal setup leading to improved productivity and better clientele services. Such an initiative should not only make a lawyer's job easier but perhaps also result in greater work satisfaction for a lawyer over time. This case study based research dwells into embedding law firms with a holistic

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implementation of KM. It proposes a KM initiative for legal establishments albeit to one firm. The aforementioned legal establishment would need to remain anonymous due to the nature of the research and will hereafter be referred to as AP.

Keywords Knowledge management (KM) · Tacit knowledge · KM initiatives · Knowledge transfer

42.1 Background and Literature Review

Although one could argue that KM has been practised in one form or another for a long time, it made its appearance in western legal literature only less than two decades ago [1]. As such, within the legal community at least, KM is still a relatively young industry with many firms trying different approaches, resulting in KM meaning different things to different firms [1].

Having said that, it is not primarily an organisation's stock of knowledge that creates value, but how an organisation can transform that knowledge into a product, a conversation, a process, an advice, a good reputation—anything that contributes to the financial and competitive success of the firm. To improve KM in a law firm or any other organization, someone within that organization needs to identify specifically what obstacles are impeding the gathering and sharing of knowledge and develop specific methods for removing those obstacles [2].

The benefits delivered through the implementation of KM are knowledge, awareness, efficiency/effectiveness, risk management and enabling work that would not otherwise have been possible to be undertaken. The aforementioned 5 measures are described below by Whalley [3];

> Knowledge refers to increasing one's knowledge and understanding of the legal and regulatory issues related to the specific line of work. Awareness denotes increasing one's awareness of the relevant legal and regulatory developments. Efficiency relates to reducing the time taken to do one's job or enabling one to do the job better. Enabling means undertaking work or task that would not have been possible if the service was not provided. Risk management helps one to identify and manage legal risks on behalf of one's clients.

At the core of KM, lies the concept of tacit and explicit knowledge which is best described below by Mitra [4];

> Dissemination of knowledge takes place in explicit and tacit forms. While it is easier to disseminate explicit knowledge, the same cannot be said of tacit knowledge. Explicit knowledge usually exists in some visible form making it relatively easy to replicate and convey to the masses. However, explicating tacit knowledge is a difficult exercise in itself since such knowledge is highly contextual and hard to divulge. Such knowledge is usually born out of conscious experience and behaviour rooted in the processes of knowing and action. Amazingly, a substantial part of an individual's knowledge will [almost] always remain tacit.

In a legal setting, explicit knowledge tends to be precedent agreements, checklists, research memos, opinion letters, and "know-how" guides [5]. Equally, if not more important, is tacit knowledge, which entails what lawyers know, their experience, expertise and professional judgment. Capturing and organizing explicit legal knowledge can be relatively straightforward and involves a combination of technologies (internal document management systems, searching and tagging technology and intranets). Capturing and organizing tacit legal knowledge can be more challenging. In most firms, tacit knowledge is transferred through mentoring, training and allowing a knowledge-sharing culture to flourish as espoused by Tjaden [5].

The demand for KM in law firms is derived from four inter-related areas namely, efficiency, new competition, poor communication and retirement [6]. It is important that law firms address these issues in order to ensure the growth and sustainability of their practices.

In short, KM is comprised of a set of tools, techniques, tactics, strategies and technologies aimed at maximizing an organisation's intangible assets through the extraction of relevant data, pertinent information and germane knowledge in order to facilitate appropriate decision making so that the organisation attains and maintains a sustainable competitive advantage over its competitors [7].

42.2 Objective of the Research

This case study was done on a top ranked firm in The Legal 500, hereafter referred to as AP, located in Kuala Lumpur, Malaysia. This case study had the following objectives:—to identify key knowledge management practices already embedded within AP.

- to identify gaps and highlight opportunities in relation to knowledge sharing practices in AP in order to make the work of lawyers and other members of the firm more effective and efficient.
- to propose a KM strategy for AP.

42.3 Case Study

AP is a mid-sized commercial law firm in Kuala Lumpur consisting of more than 11 partners and 22 associates. The firm offers a full range of legal services in the banking and finance, corporate, commercial and banking litigation, arbitration and dispute resolution, corporate and retail real estate sectors. AP's clientele includes several state owned entities and numerous local and foreign companies, multinationals and government-linked corporations (GLCs), financial institutions, private equity investors, and other professional firms. The criterion for selecting AP in this research was due to the importance that AP placed on its KM initiatives

(being a mid- sized legal establishment) and its keen interest in wanting to relook at its KM initiatives.

A structured interview was conducted using standardised interview questions. The questionnaire was adopted from an online knowledge assessment tool which serves as a baseline assessment of AP's existing KM initiatives. Specific questions were asked in a set order and in a set manner to ensure there were no variations in the structured interviews. The answers were recorded on the questionnaire form during the interview process, and the completed questionnaires were analysed quantitatively. Although the structured interview denied the interviewer the opportunity to either add or remove questions, it allowed for probing questions and intermittent clarifications and discussions as and when required. The structured standardized interviews enabled the interview process to be systematically directed with each interview taking approximately 90 min. The interviewees were partners of AP.

42.4 Main Findings

The interviews revealed that AP recognised the importance of KM initiatives and measures to ensure its sustainable growth by leveraging its intellectual assets from the onset. This is evident first from its mission statement. To focus in its direction towards KM, AP has assigned a senior partner to oversee and implement KM-related initiatives for the firm.

The interviewer was made to understand that AP already has a document management system called iManage. The iManage system is integrated with the outlook email system thus automatically archiving documents when emails are sent out as attachments [8]. Invariably this brings up the challenge of effective email management. The majority of the documents in the document management system are emails according to Tjaden [1]. Although not all emails are important, some are important. Having said that, most emails form an integral part of proper client/matter management (in order to ensure that all the correspondences on a particular matter are properly stored), stressed Tjaden [1].

The implementation of KM in AP is very much dependent on lawyers "making time" for KM practices. Some lawyers and senior partners do it on their own accord. For others, given the legal practice culture of billable hours, focus is on billable hours rather than on non-billable hours. Lawyers do not get excited about KM as it is not tied to their billable hours. KM practices cannot be billed according to Martin [9]. Successful lawyers are also rightly reluctant to abandon their personal working habits and tools that contribute to their success, according to Ronald [10]. AP should be commended for investing in the highly recommended iManage Document Management System. However, it remains to be seen if all the features of iManage have been fully exploited and that it becomes a "living repository" just as "law is a living concept".

The knowledge transfer within AP takes place by means of lecture series, litigation diary meetings, informal meetings and interactions. While these are rich and

very often effective forms of knowledge-based exchanges, the challenge would be to ensure that such tacit exchanges are made explicit. Informal communities of practice groups (people who share a common concern or passion for something they do and learn) are somewhat present in AP although this is yet to be formalised across the organisation. Email correspondence is the predominant communication channel in AP. Continuing professional development is encouraged in AP and lawyers are often sent for trainings, seminars and conferences, and this in turn reflects AP's on-going commitment towards nurturing and empowering its staff.

The concerted effort by AP to implement KM is truly commendable. There is a great range of opportunities available for KM initiatives to be further infused into AP. A successful KM initiative includes creating intellectual connections, networking groups, a supportive and sharing culture and incentives for promoting sharing—without these, a company will not be able to make full use of its potential and existing knowledge resources [11].

42.5 Analysis of Findings Using Activity Theory

Analysing the findings of AP's case study research can be effectively done using Activity Theory. Activity Theory, best described below by Sukumaran [12] focuses on the interaction between human activity and its environment;

> An activity is the transformation process driven by people's needs. This process transforms objects into the outcome that satisfies those needs. The active component that carries out the activity is the subject. Tools are elements used in transformation. Communities on the other hand are the set of subjects related directly or indirectly to the same objects. The relationships between subjects and communities are determined by rules, for instance laws or social conventions whereas the relationship between communities and objects are determined by the division of labour.

The tenets of Activity Theory (AT) is best infused using a 10 step approach, as espoused by Uden [13].

Step 1 is the most important because the main motives and expectations about the outcome from stakeholders are mapped. Key activities mapped better understanding of 'motives and influences from stakeholders' was first espoused by Engeström [14].

Step 2 involves defining the mechanism of an activity system in detail. Based on this case study, the researchers analysed the activity based on specified *subjects, objects, communities, rules, division of labour* and *tools* [14]. These terms are described as follows:

Activity	The activity of interest in the current case study research is the knowledge sharing practice in AP
Object	The purpose of this activity is to uncover knowledge management processes involved in dissemination of legal advice
Subjects	Client advice by which instructions and legal advice are prepared
Tools	Knowledge of the legal domain, example, litigation, conveyancing, etc.

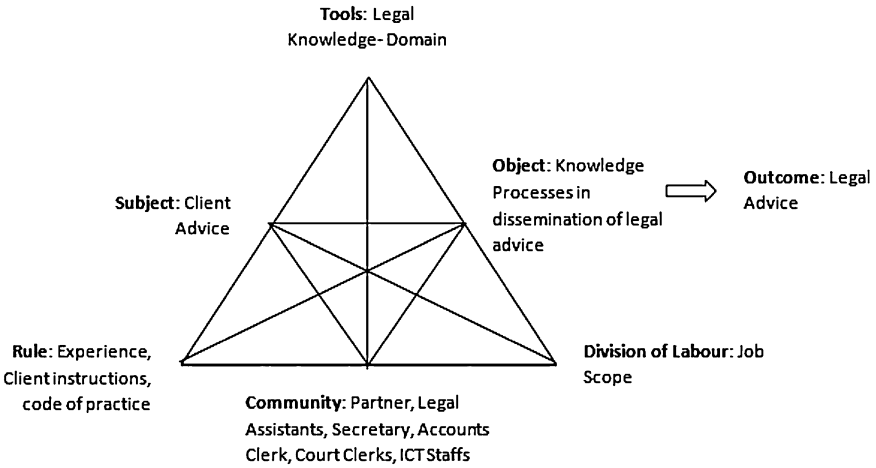

Fig. 42.1 Activity system derived from the case study and analysis of AP

Community	Partners, legal assistants, secretaries, accounts clerks, court clerks, Information Communications Technology (ICT) staff
Rules	Experience, client instructions, code of practice

Division of labour: Job scope

Step 3 involves analyzing the information generated from of the activity that was collected in the preceding stage in order to produce the activity as shown in Fig. 42.1.

Step 4 involves analysing the activity system. Activities (i.e. knowledge management process) within the activity system can be broken down into various operations that analyse the context within which it was set up for. Consequently, the interaction process between, *communities, subjects* and *objects* can be understood more clearly. The researchers were able to draw greater insights from the activities carried out as part of the legal advice process based on the activity system mentioned above. For instance, from the analysis of the activity, validated through interview questionnaire, it was observed that successful lawyers are reluctant to abandon their personal working habits and tools that produce their success.

Step 5 entails analyzing the activity structure to obtain information regarding tools and mediators. One such structure is the activity system for *tools-subject-community* as shown in Fig. 42.2 below. Similarly, various other activity structures can be devised through the activity system for *tools-rules-object* in order to obtain important insights and unearth latent and implicit knowledge.

Step 6 involves decomposition of the activity systems in Step 5 into smaller manageable units. This exercise enabled the researchers to examine areas that were not considered during the interview questionnaire process. For instance, a separate activity system could be devised for each legal knowledge domain—litigation, conveyancing, corporate and those involving criminal and civil cases to discover additional insights.

Fig. 42.2 Activity system for tool-subject-community

Step 7 involves generating specific questions as a result of the mediation activity carried out in Step 5 and the decomposition of the same in Step 6. These questions form a rich input on tacit knowledge. They are validated by a senior partner (during the second round of interview) before making its way into the knowledge repository, i.e. tacit knowledge domain.

Step 8 involves detail investigation of the questions generated in Step 7. The main goal here is to discuss and bring to light conflicting issues within the activity system. Upon examining various combinations of the activity system (similar to Fig. 42.2), the researchers were able to derive conflicting but unique practices that have been carried out by lawyers across AP. Such observations and findings are validated by a senior partner.

Step 9 involves soliciting various context based on the outcome of the exercise carried out in Step 8.This step infuses context-based knowledge which is a crucial step to ensure that deposited knowledge can be reused in a similar context.

Step 10 involves all the data that has been gathered, analysed and interpreted with regards to AT.

42.6 Recommendations of KM Initiatives for AP

Based on the investigations and findings, the researchers were able to bring to light opportunities that existed within AP in relation to the implementation of KM initiatives. KM initiatives with AP's operational imperatives (KM objectives being closely tied to AP's business objectives) as spelt out below;

- To keep the contents limited and contextualized for effective search. Hence, expanding the scope of the research team or librarian's role. While much of the storage and management of records and documents are currently in the hands of the ICT staff (and the automated features of the iManage), the reins of such a role should indeed be in the hands of the librarian who is the ultimate knowledge manager. The librarian will be in a far better position to understand the taxonomies of knowledge than the ICT staff. For instance, the librarian can make better use of internally developed knowledge assets such as precedents, letters, research memos, pitch documents, newsflash and internal articles.
- To design and execute an internal and coordinated communication plan developed by the senior lawyers and staff that compliments with the KM initiatives. For instance, decisions and measures taken should be saved electronically and made available for future reference with the appropriate access rights, hyperlinks and filters. Mistakes, warnings, cautions and issues (including experience and lessons learnt should be made available in separate repositories so that it is possible to access it at a later date.
- To include one KM-specific objective in the annual, formal KPI (Key Performance Index) for each person.
- To incorporate KM into the annual performance appraisal review when setting performance targets/goals.
- To tie KM with/into the training and development function. iManage should be used as a means for Training & Development. The training and development syllabus should emphasize the importance and use of iManage. Junior lawyers must be made aware that iManage. It is more than a just repository but a platform for them to minimize the learning curve and gain quick know-how which would otherwise take them a long and arduous journey to master.
- To conduct trainings on iManage periodically. Employees must be encouraged to make full use of the information contained in iManage in their day-to-day work. Employee contributions must be tracked by the iManage and individuals who contribute towards effective sharing of tacit knowledge within the organisation should be acknowledged and rewarded.
- To include meta-data in the iManage Document Management System. The document tagging feature currently present in the iManage should be leveraged to the fullest, consistent with what was espoused by Martin [15]. Remote and mobile access with 'access rights' to the iManage ought to be made available so that the staff can access and contribute content (tacit and explicit) anytime anywhere.
- To maintain control over technology, and "Keep It Simple". A task force should be formed to examine the ease of use and seamless operation of iManage. Although further investments may not be deemed necessary at this stage, it is imperative that the system currently being used does more than just store and manage records and documents. The task force may want to examine smarter products like 'Recommind', 'ContactNetworks', 'BranchIT', and 'SharePoint Knowledge Network', among others, in support of AP's KM initiatives.
- To develop Communities of Practice (CoP) within each department. For instance, the litigation department should have a KM professional support

lawyer to play an important role in cascading such roles to include sub-domain KM specialists for areas within the litigation department like banking litigation, commercial, arbitration and dispute resolution.

The KM strategy proposed in this paper for AP when implemented would result in increased awareness, accessibility, availability and timeliness amongst members and staff. However, the researchers reckon that in the final analysis, passionate support and active involvement by senior lawyers and partners are essential to ensure success of the KM initiatives in AP.

42.7 Conclusions

KM's greatest value for money is when the intellectual capabilities of an organisation are used more effectively to deliver a product or service. Nowhere is this more critical than when providing advice or making key decisions.

The KM initiatives proposed in this research for AP in particular and law firms in general are aimed at creating an environment that fosters information-sharing and that values lifelong education. The KM proposed initiatives enable the capturing, organizing, updating and making available of the explicit legal knowledge content. Finally, our findings show that the KM initiatives when implemented in AP will facilitate the training and mentoring of lawyers and staff and hence promote the transfer of tacit legal knowledge using both, human-training and technology medium (iManage).

The researchers are aware that for the proposed KM strategy to gain fruition and eventually benefit the organisation, large amounts of data at the right time and place and in the correct context must be availed of. This can easily be made possible at AP with the advent of electronic records, and a little tweaking of AP's ICT infrastructure (iManage and possibly other recommended ICT tools) to foster a continuous learning environment. Such a learning environment will eventually form a learning culture that will enable lessons learned to be conscientiously updated to create what can be termed as organisational memory. Maintaining an effective learning culture is arguably the most significant determining factor in the success of a KM initiative. This is coherent to the views espoused by Kabene [6].

The limitation of the research lies in the fact that the case study was based on one legal firm; in this case, AP. Consequently, generalisation of the findings cannot be made. Having said this, an observant reader will immediately notice that the case study presented tenets of a typical medium scale legal set-up and therefore renders much of the challenges and issues espoused by AP similar to that of most other legal establishments. Hence, the findings presented in this research could quite easily form building blocks to implement KM initiatives in other legal establishments.

In this paper, the researchers have established and analysed the importance of sound KM initiatives in AP. The business environments in which organisations compete (law firms included) are continuously changing. Given the advancement

of the legal practice today and the competitive nature of the industry, it is imperative for legal establishments to adopt KM initiatives as an essential part of the legal set-up.

42.8 Further Research

The legal domain not only provides challenging opportunities for managing knowledge but it is also one of the areas where it is often most poorly understood and deployed. This predicament is slowly being addressed (particularly in South East Asia with the exception of Singapore) as more and more KM-focused projects are initiated and professionals with better understanding of KM are getting involved. This research has strong orientation towards mapping out a KM strategy for a leading legal establishment, presenting gaps and espousing prevailing opportunities. Work on knowledge management strategies never ends and challenges are always present. The next phase of this research shall encompass knowledge creation and management initiatives which is to be undertaken by AP once the proposed KM initiative espoused for AP has been rolled out, i.e. endorsed by the management.

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Chapter 43
Towards New Framework of the Change Management of Stakeholder Dilemma in IT System Implementation

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Abstract In this paper, we report a method of the dilemma solution among the stakeholders in the Information Technology (IT) system implementation. We found a difficulty to mitigate the dilemma among the stakeholders at the time of the IT system implementation so far, whereas the necessity of the IT system should be introduced for strategic objective. From this background, we propose a framework named of Change analysis matrix dilemma transformation and evaluate the effectiveness the proposed method with the person of the rank and file type expert. From the result of the evaluation, we confirmed the effectiveness of the proposed method.

Keywords Dilemma · Project · Management · Methodology · Transformation

43.1 Introduction

IT system implementation, it is necessary to change the entire organization with the aim of maximizing corporate profits beyond the wall of the sector. In this paper, we have targeted the IT of strategic Objective such as customer relationship

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management systems and supply chain management system. Regarding to the type of organization in this paper, we deal with the organization of the site to perform the operation work. However, if companies prioritize the interests of the whole, stakeholders might be faced with a dilemma for psychological pain in terms of personal gain. That pain makes them lose the intrinsic motivation of work. The intrinsic motivation refers to the motivation to have feelings in themselves rather than incentives from outside. Therefore, you must sense the dilemma of individual stakeholder, and must take to deal with the resistance, and must give the intrinsic motivation to stakeholders. Our research question is finding out how to mitigate the dilemma and to give intrinsic motivation. Therefore we tried case study of the change due to the IT system implementation. Thus, this paper is to provide a method to discover the dilemma, measures to resolve it intended. Therefore, we tried to develop a methodology to consider measures to give the intrinsic motivation for people to accept the change that you want to alleviate the dilemma, aimed at overall optimization. Also, we make sure the results from another trial of the third party participant who has experience of implementing IT, the validity of the tool.

43.2 Previous Research

In this chapter, we review research on the dilemma of stakeholders in IT implementation project first. Next, we review the research on how to deal with and resolve the dilemma. Malone said about transformation of companies by IT as follows [1]. IT makes it possible to reduce constantly the cost of transmitting information, and to decentralize the organization without sacrificing the economies of scale for companies. So for knowledge workers, importance of the motivation, creativity and flexibility have increased have increased, and They are faced with the need to change themselves. And, he explained case study result of many leading companies to transform organization effective to obtain the business value of the IT system implementation project. Their issues were as follow.

- Loose hierarchy
- Using of democracy
- Market outside of the organization
- Market inside of the organization
- Decentralization.

Avraham Y. Goldratt Institute has proposed “Cloud” as a tool to solve the dilemma [2]. They insisted on using the tool “Cloud” to find out a common purpose. If you find a common purpose, you have just only need to solve problems to achieve the purpose. However, they are not focused on the fact that we propose a method to consider the challenges to achieve a common purpose. Further, Axelrod has presented the following results by computer simulation [3]. The dilemma is going to be solved by strategic behaviors. Strategic behaviors are cooperation to a cooperative partner, and opponent behavior to a non-cooperative partner. In contrast, Research

of Yamagishi insists as follow by experiment. Strategic behavior (incentive negative) and Selective incentive (incentives positive) weaken "intrinsic motivation" for the cooperation. Therefore these incentives cannot eliminate dilemma. These lead a vicious cycle to conduct non-cooperation [4]. In other words, positive and negative incentives are not the way of practical countermeasures to eliminate dilemma. However, the research has not focused on the proposal of measures to resolve the dilemma. The purpose of this paper is to propose measures to resolve the dilemma.

43.3 Examination of Dilemma Analysis Framework

43.3.1 Case Study of Equipment Manufacturer

This section will examine the framework by case. We adopted the general methodology of the case study of Eisenhardt [5]. In this case, as a consultant, Nomakuchi, one of the authors were involved. In the case of equipment manufacturer company, they have invested to construction of a large warehouse to deal with an increase in shipping volume and inventory of maintenance parts. Installation automation equipment such as a rack and automated material handling equipment in the warehouse reduced the load and non-efficiency of workers in the warehouse in past time. Therefore, they take the shipment business method "seeding". The method "seeding" in general are a method collecting to one work area to ship all of the components of the day at first, and sorting by each shipping at second. On the other hand, the method "plucking" is a method in which each separate ship-picking from storage shelves, sorted immediately, workers in the warehouse is always moving around. The company has conducted a survey, and found out Competitors delivery of the order has been the next day. Moreover, in this company, It was a situation that they cannot plan time of deliver at time of the sales order receive. Because of restrictions on the amount of daily shipment by method "seeding", they sometimes cannot ship the planned maintenance parts in the day time. The cause is slow shipping and speed of the automatic warehouse to handle the maintenance parts. They also could not ship high priority order in AM of the day. The implementation of a new IT system means the elimination of automatic rack.

That was obtained transformation of the method from "seeding" to "plucking" for maintenance. Resistance, such as the following is generated due to the dilemma.

- Resistance caused by the abolition of automatic operations warehouse
- Resistance caused by loss of behavior ("seeding" method) that was setup work by themselves seeding method
- Resistance caused by picking method "plucking" of running around like machine "waltzing mice"

- Resistance, due to the ambiguity of the causal to market share from next day delivery of maintenance parts.

Encounter resistance as described above, requirements definition of IT system implementation was difficult.

43.3.2 Analytical Framework of Stakeholder's Dilemma

Respect to analysis for the stakeholder's dilemma at IT implementation, what this company have done is the following Table 10.1. If they force the change, resistance would be predicted because of the following reasons from Table 10.1.

In the case of the "plucking" method, they cannot assimilate the work from intrinsic motivation. So code of Conduct for low productivity is born.

- Due to repeat the work that has been simplified and fixation-division of labor, they cannot feel acting voluntarily.
- Workers will be separated from each other, with becoming "waltzing mice" alone. therefore they would press against each other and the responsibility for the failure.

They would be possible to predict the above situation by answering the questions in Table 10.2 and the following was possible. That situation was expected reasonably, from the answer to the question that is in the following Table 10.2. We can obtain action from the three questions of Table 10.2.

43.3.3 How to Deal with the Stakeholder's Dilemma

This company was able to mitigate the dilemma by responding to the following three questions, to achieve service levels of maintenance parts logistics.

Table 10.1 Dilemma analysis matrix

	Disadvantage	Merit
Transform	•An increase in workload due to the loss automatic rack •Non-human waltzing mice •Loss of job satisfaction and intrinsic motivation	•They can curb the decline in market share •Growth and maintenance of a business can be •Continuation of employment
Not Transform	•Lose market share •The production will be reduced or abolished •The business could not continue. Unemployed	•Business and familiar can be performed •We can continue job-satisfaction because we can be work of intrinsic motivation

Table 10.2 Framework to consider how to deal with dilemma

Question	Seeding (The current situation)	Plucking (After transformation)
1. Can they feel really that they correspond to the expectations of the job properly?	•They are able to respond effectively to their work and the role given by the company	•They repeat the work that has been simplified division of labor is completely immobilized. So they cannot understand the value for the work
2. Can they feel that they can decide on their own work and behavior?	•There is distinction between novice and an experienced person. Direction and decision can be made by themselves •They can advise and help each other. An experience can teach to novice. Therefore, they can feel the purpose of their own work	•They cannot imagine to assimilate the purpose with self-work. They would work with low productivity only for a simple goal •They feel that their decisions and actions cannot be obtained voluntarily
3. Can they feel that they have been really friendly to fellow, and they have been taken into account from fellow?	•They can complete the work in a cooperative way with others •Therefore, without pushing each other of work responsibility and burden there is no isolation of each other	•Because of Isolation of each other, each other pushing of responsibility and burden will happen •With becoming "waltzing mice", sick leave, absenteeism would be occurred

Action 1. "Can they feel really that they correspond to the expectations of the job properly?"

- Reduce the load on the work by introducing the bar code information reader equipment as supporting.
- They redesigned the sales department work, separating emergency shipping from usual shipping by the data segmented. They showed the explicit need of immediate shipment.
- Action 2. "Can they feel that they can decide on their own work and behavior?"
- On the data to identify the priority of the order, to be aware the customer needs .
- With providing team structure, they eliminated the simplification of work by method "Plucking".

Action 3. "Do you think you can feel they have a real friendly fellow himself, and his companion have been taken into account from?"

- Because of the classification data on shipping priority, they divided into teams, they clarify the purpose and responsibilities.

43.4 Trial and Evaluation of the Proposed Framework

43.4.1 Attempting with a Project Manager (Project Management Expert)

In order to confirm the effectiveness of the above-mentioned framework, a Project manager (here after abbreviated as PM) tried to fit the project experience. That is a cell production and IT system implementation. PM is an Expert of Project management as certified Project Management Professional (PMP). In cell production system, a few people work to assemble product. In cell production system, one person worker in charge operates the whole process machining, and multi-step. They work in line called cells arranged in a U-shape such as parts and tools. The result of an attempt to "project analysis matrix transformation dilemma" by PM, is in Table 10.3.

In addition, Table 10.4 and the following is a result of PM tried to attempt to consider how to deal with the framework from the experience of the implementation of the cell production and IT system.

And this PM designed business operations with IT system, as follows;

Action 1 "Can they feel really that they correspond to the expectations of the job properly?"

Table 10.3 Implementation of cell production system dilemma analysis matrix

	Disadvantage	Merit
Transform	•Increasing in workload due to the loss conveyor •Workers are isolated and inhuman. •The clear difference in an individual's skill •Because of the separation of people who use and create a cell, they cannot make decisions on one's own work of Business Conduct	•Small-lot, high-mix low-volume production can be performed •They can respond flexibly to fluctuations in demand •They can reduce the inventory of parts and products •Maintain domestic production •Continuation of domestic employment can be •They don't need unnecessary capital investment to change the products line
Not Transform	•Out of business, and lose market share if it does not correspond to a high-mix, low-volume •Domestic production and reduced or discontinued due to cost disadvantage compared to overseas factory production •The reduction or abolition of domestic factories, unemployed	•They can operate business performed by a conveyor accustomed •Because of the setup by self-determined, they feel ongoing job satisfaction •Since the difference between the skills of the individual does not appear, lack of capacity of the individual is not discovered •Technology of veteran will not become obsolete

Table 10.4 Implementation of cell production framework to consider how to deal with dilemma

Question	Conveyor production (The current situation)	Cell production (After transformation)
1. Can they feel really that they correspond to the expectations of the job properly?	•They can feel that they conduct an efficient mass production by the conveyor	•They must work in the cell completely orphaned, among the line constantly changing, with exploring a new way. They cannot feel efficient
2. Can they feel that they can decide on their own work and behavior?	•They can make their own decisions and supervise such arrangements and roles of production by themselves. Experienced labor can advise to novice •They feel that work is not mandatory. Mutual advice and help each other is possible. Therefore, they can feel their own purposes and objectives of the team	•People would be divided to designer of cell production and worker of cell inside. For worker only using cell are given only simple goal, they cannot imagine to assimilate their own purposes and work. Therefore Norms for low productivity was born •For the production of single work, they feel work as endless and boring
3. Can they feel that they have been really friendly to fellow, and they have been taken into account from fellow?	•They can complete the work in a cooperative way with others. Therefore, They have no isolation of each other and no rubbing each other of responsibility and burden	•For isolation each other, they would push each other of responsibility and burden •Sick leave, absences occur

- Using forecast and actual sales from IT, worker can be conscious of the market and customers.
- For the elimination conveyors, they feel burden of picking parts and catering.

They can reduce the load by assigning workers for catering parts (whirligig beetle).

- By the assignment of the whirligig beetle, workers in the cell to concentrate on work.

Action 2 "Can they feel that they can decide on their own work and behavior?"

- In order to derive the requirement of workers in the field, they conduct surveys by meetings.
- For increasing or decreasing of production volume and variety, voluntary decision by workers in cell was allowed such as a change in staffing or work assignment.

Action 3 “Can they feel that they have been really friendly to fellow, and they have been taken into account from fellow?”

- For avoiding isolation of worker in cell production line, workers are self-contained within the cell, but they are belong to same team system.
- Because of team system, veteran was able to teach the novice.
- Always, the administrator go to the site, and to resolve the problem on the day.

43.4.2 Assessment from PM

- Regarding to the two frameworks, PM evaluation comments are the following.
- Because of Utilization of frameworks is very smoother than trial and error to find out the dilemma and to deal with the resistance due to dilemma.
- PMBOK defined the criteria for the validity of the Project management methodology as “the four points” [6].

There is a consensus of value as the framework

The framework can be adapted to actual projects

The framework have usefulness

The framework would increase accuracy of project success

The framework of these two will be evaluated based on these four points. So the framework of these two there is a practicality and usefulness.

43.5 Conclusion

In the IT systems implementation with the aim of overall optimization, there is benefit to the entire organization. But there is also dilemma that occurs when individuals feel disadvantage that makes them lose the intrinsic motivation psychologically. We were dealing with this type dilemma. In this paper, we describe the important experience to PM who carried out the transformation from conveyer type production into a cell type production by IT system. Regarding to Change due to the IT system implementation, we proposed on how to remove the dilemma of stakeholder. In this paper, we formalized experience as a methodology from the case. In addition, we have confirmed from the result of an attempt by the PM as a third party. He verified usefulness of the framework. Its evaluation is that framework to be methodology hypothetically. Moreover, by using practically the framework, there is also a need to continue to improve the practicality and versatility of a methodology. We should thank PM by wrote his name here, but we could not do so because of the anonymity.

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Part VI
Knowledge Transfer, Sharing and Creation

Chapter 44
Knowledge Sharing in International Innovation Course

Anne-Maria Aho and Lorna Uden

Abstract Collaboration is a key driver of successful innovation. Knowledge sharing is not only vital for firms, but important for students in their learning too. For students to learn effectively, they must construct knowledge and collaborate with their peers. Knowledge sharing is essential to learning especially when it comes to the learning of innovation among students. However, this is not a trivial task. Business management students are reluctant to share knowledge among their peers. This paper describes the experience of a Finnish-Vietnamese international innovation course for business managers. The authors found that there are barriers to knowledge sharing among the students. This paper attempts to give theoretical underpinnings to the barriers and propose guidelines to help overcome the barriers.

Keywords Collaboration · Cultural differences · Innovation · Knowledge sharing · Study motivation

44.1 Introduction

For companies to remain competitive, organisations must innovate. Innovation and entrepreneurship have become the current buzzwords in the world. The teaching of entrepreneurship or innovation is critical to our nation's wealth and prosperity.

In traditional teaching, we teach innovation using causal reasoning that comes to life through careful planning and subsequent execution—the sequential

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progression from idea to market research, to financial projections, to team, to business plan, to financing, to prototype, to market, to exit, with the caveat, of course, that surprises will happen along the way. What is needed is effectual reasoning that lives and breathes execution. In effectual reason, plans are made and unmade and revised and recast through action and interaction with others on a daily basis [35]. The entrepreneurs know that surprises are not deviations from the path. Instead they are the norm from which one learns to forge a path through the jungle. The unexpected is the stuff of entrepreneurial experience and transforming the unpredictable into the utterly mundane is the special domain of the expert entrepreneur.

The best approach to teach students these skills is by working in teams to generate, evaluate, develop, and market their innovation. Traditional approach to innovation involves the process of taking an idea from initial conception to market is called product development. It includes idea generation, market research, product evaluation and selection, design and development, product protection and commercialization [17].

Open innovation is often recommended as the best approach for innovation. The notion of open innovation suggests that firms can boost their innovative performance by both acquiring knowledge from outside the company and deploying external paths to market for commercialization of non-core technologies. Lichtenthaler [22] identifies open innovation as "systematically performing knowledge exploration, retention, and exploitation inside and outside an organization's boundaries throughout the innovation process." A key component of open innovation is knowledge sharing. KS activities create opportunities for organizations to maximize the ability to gain competitive advantage [3]. Knowledge is a potential source of competitive advantage because it is difficult to imitate. Likewise, knowledge sharing is important for companies to be able to develop skills and competences, to increase value, and to sustain competitive advantages [21]. Innovation occurs when employees share and combine knowledge in organization.

Knowledge sharing is a vital process of managing knowledge because it is an initial for innovation [45]. It is our belief that KS capabilities have a positive impact on innovation capabilities, because KS is the precondition for innovation.

Knowledge sharing is not only vital for firms, but important for students in their learning too. For students to learn effectively, they must construct knowledge and collaborate with their peers. The learning environment from the classes would help students to acquire the knowledge sharing culture that is vital for promoting innovation. However, promoting knowledge sharing among students is not trivial. This is especially so when it comes to students who are from a different culture. This paper describes the experience of teaching an innovation course among managers in a Vietnamese University. There are many barriers facing students when it comes to promoting knowledge sharing. This paper begins with a brief review of innovation and the teaching of it. It is followed by discussion on the importance of knowledge sharing. Subsequent sections of the paper describe the case study. This is then followed by discussions of why knowledge sharing did not work. The paper then proposes future improvements and further research.

44.2 Innovation

Innovation is much talked about, in industry, government and academia alike. For companies to remain competitive, they must innovate. There are many definitions given to innovation. Drucker [12] defines innovation as the process of equipping in new, improved capabilities or increased utility. Others define innovation as the process of introducing new ideas to the firm which result in increased performance. According to Rogers [33], innovation is concerned with the process of commercialising or extracting value from ideas.

The teaching of innovation is critical to our nation's business enterprise, it is therefore important to place great emphasis on teaching it. Teaching innovation must be innovative in its own right. Analyzing case studies or using current knowledge is not sufficient. We must provide students with creative tools and using hands-on exercises, teaching new perspectives and breaking through ideas of common thought. It is necessary to use those concepts to instruct students via innovative practices by giving them tools to truly challenge current thought processes.

Students today need skills to lead and thrive in a global economy. It is important to teach, entrepreneurship, leadership and innovation. Students can the use the skills to identify new business opportunities and develop the tools to capitalize on these observations. Although there are debates if innovation can be taught, we concur with Drucker [13] that innovation can be taught and learned.

Drucker [13] suggested that entrepreneurship is the 'practice of innovation'. He further argued that innovation is the specific tool of entrepreneurship, the means by which they exploit change as an opportunity for a different business or a different service. It is capable of being presented as a discipline, capable of being learned, capable of being practiced (p. 8). Therefore, this has led him to conclude that "Innovation is the specific instrument of entrepreneurship" (p. 30).

Chesbrough et al. [6] defined open innovation as 'the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation, respectively.

Procter and Gamble announced that they were able to increase their product success rate by 50 % and the efficiency of their R&D by 60 % by introducing the open innovation concept to the organization [14].

Collaboration is a key driver of successful innovation. A group of diverse people tend to challenge and stimulate each other to come up with more creative solutions. Very few successful innovations can be achieved without collaboration. Collaboration is a necessity because few companies have all the necessary competencies in-house to successfully innovate today. Successful innovation does not occur in isolation, but at interactions where different disciplines, companies and ideas meet, merge and adapt as a collaborative effect [30]. Innovation is rapidly becoming a network phenomenon—a result of collaborative effects among different actors in complex value networks.

44.3 Knowledge Sharing

Innovation depends intensively on the availability of knowledge. The only sustainable way of keeping a competitive advantage is to share knowledge. The new paradigm—sharing rather than protecting trade secretes—is the way forward [15]. According to Foroohar [15], as the world is getting smaller—and its problems (from global warming to virus hunting) are getting more complex—it's increasingly apparent that we'll need coordinated teams to get things done.

For firms to develop competitive advantage, sharing and accumulating knowledge becomes crucial [19, 27]. It has been suggested that knowledge sharing is essential for developing new technologies and products [28]. Knowledge sharing is the important issue for companies to develop skills and competences that bring about innovation, which occurs when employee knowledge is shared in an organization.

Knowledge is a principle source of value creation [39]. Bartol and Srivastava [2] defined KS as the activities in which employees diffuse information to other members across the organization. KS is an important issue to organizations, useful for firms to develop skills and competences, helps to increase value, and sustains competitive advantages [21].

Sharing of knowledge occurs when an employee in firm is willing to learn from others in development of new capabilities. Knowledge sharing is a vital process of managing knowledge because it is essential for innovation [45]. KS is positively related to a firm's innovation capabilities [7]. Armbrecht et al. [1] argued that knowledge sharing leads to the diffusion of innovative ideas, critical creativity and ultimately innovation in the organization.

Studies have demonstrated that knowledge sharing is essential because it enables organizations to enhance innovation performance and reduce redundant learning efforts [36]. There are different influences on employee knowledge sharing activities, such as individual, organizational, and technology factors [41]. Knowledge sharing depends on individual characteristics such as experience, values, motivation, and beliefs. Wasko and Faraj [46] argued that individual motivators may enable employee willingness to share knowledge. Employees are motivated when they think that knowledge sharing behaviors will be worth the effort and able to help others. Expectation of individual benefits can promote employees to share knowledge with colleagues. When referring to the organizational dimension, the different aspects of organizational climate are critical drivers of knowledge sharing, such as reward systems linked to knowledge sharing [2], open leadership climate [41], and top management support [26]. For the technology dimension, ICT can be effectively used to facilitate the codification, integration, and dissemination of organizational knowledge [38].

There are three dimensions of KS capability: (willingness to share knowledge, capability to learn, and capability to transfer knowledge). The willingness to learn new things is essential for the development of knowledge management [48]. Thus, an employee's attitudes and competencies may impede knowledge sharing.

Nonaka and Takeuchi [28] argued that main problems to knowledge sharing are as follows: lack of trust, which can be improved through face to face conversation, lack of learning ability which can be solved by more skill interest and open-minded workers. Knowledge sharing implies synergistic collaboration of individuals who work toward a common goal [5].

Knowledge sharing comprises a set of shared understandings related to providing employees access to relevant information and building and using knowledge networks within organizations [18]. Top management encouragement of knowledge sharing intentions is necessary for creating and maintaining a positive knowledge sharing culture in an organization. [25].

Knowledge sharing enhances innovation capability [23, 24]. A firm that promotes employees to contribute knowledge within groups and organizations is likely to generate new ideas and develop new business opportunities, thus facilitating innovative activities [8]. Openness to experience and awareness are the main factors for KS [44].

The failure to share knowledge in organizations is nothing to do with the technical issues. Several reasons are given for the unsuccessful nature of knowledge sharing. Among these are people's reluctance to share knowledge for fear of losing ownership [31], the uncertain relationship between source and receipt of knowledge [40], as well as dysfunctional cultures or inadequate rewards.

Skyrme [37] lists the following barriers to knowledge sharing:

- Knowledge is power.
- ′Not invented here′ syndrome.
- Not realizing how useful particular knowledge is to others.
- Lack of trust.
- Poor means of knowledge capture.
- Inadequate technology.
- Internal competition and top-down decision-making.

44.4 Case Study

I-SME Vietnam is a training course aimed at small and medium sized enterprises that were target and growth oriented. Enterprises faced fierce competition—management skills in innovation are the key for the development and growth of an enterprise. The I-SME Vietnam professional training course has been designed to support small and medium sized enterprises in managing and planning business operations to nurture innovation. The course was led and taught by Innovation Management and SME professionals from Finland in cooperation with professionals from Vietnam. The training consists of four modules. The goal throughout the four training modules was to learn to formulate a viable business plan for innovation. The four modules are:

1. Innovation strategy and management.
2. Process Perspective in Innovation: Services and products.
3. Financial Perspective: Economic Aspects of Innovation.
4. Customer Perspective in Innovation: Sales and Marketing.

There are altogether thirteen participants in the first training round, representing eight enterprises and three non-profit organizations. Of the participants, eight come from enterprises that operate in various industries, two from universities' business faculties, and three from the development organization′s accounting department. This means that the group of participants was a mixture of organizations involved in business development, enterprise, training and financing bodies.

The participants include CEO's, one assistant to the CEO, directors of different departments in the enterprise and enterprise staff. The majority of the participants from management position in the company either as a CEO or as a director of a department in the company. Representatives of universities were a management position at the faculty of business at their universities. Administrative staff includes accountants.

The eight enterprises that participate in the training are operating in the following industries:

- Construction and design.
- Oil distribution industry.
- Food industry.
- Information Technology and Communication.
- Web design, electronics distribution.
- Power industry.
- Consulting services (e.g. law).

The role of knowledge sharing in the course was important because the whole course was based on active knowledge sharing. The participants were encouraged to work in teams and share their knowledge. They were two kinds of teams: small groups and the whole course group. After they have worked in small teams, they presented their results for the whole group and results were discussed with the whole group and teachers. In discussions translation was simultaneous. Because English was not the native language of the students, the assignments were conducted differently from the traditional classes. The procedure was as follows: Teacher wrote assignment in English, translation to Vietnamese, students answered in Vietnamese, and translation to English.

The qualitative research approach was used for participants during the training process to gain insights into knowledge sharing. In our study, observation, questionnaires and interviews were used. The logic behind the use of multiple methods was to secure an in-depth understanding of the phenomenon in question.

44.5 Discussion of Problems Encountered

Although knowledge sharing was fundamental for the students in the innovation classes, we found that there were many barriers. First teaching innovation to students in a foreign language is not trivial. The main problem we found was the language and translation issues. This was especially so during discussion time with the Finnish tutor. Because the students could not express themselves in English, it must first be translated from Vietnamese to English and vice versa. Meaning was lost during the translation process. This resulted in much misunderstanding between the student and tutor.

Second there was the culture issue. Although innovation education is becoming popular around the world, its education in each country is different, based on its cultural context. Dana [9] argues that "A key prerequisite to training people is to understand them, their cultural values, historical experiences and mindset" (p. 410). One must not assume that entrepreneurs can be trained in the same way in Vietnam as in Finland. (p. 411). Thus, Dana recommends that alternate methodologies are required for teaching entrepreneurship in transitional economies.

Our study has shown that the national culture in Vietnam was very different from the Western culture of Finland. The barrier to knowledge sharing among the students was due to the first dimension of what Trompenaars [42] calls 'Individualism versus Collectivism.' Owing to their traditional culture, the students decided to put their own interests and those of their families ahead of the interests of others; the individual before the group. It was important to them that knowledge they have should not be shared. The students are bound by loyalty to their families and companies and fear harming them if knowledge was shared to others.

Third the heterogeneous groups in the class were a big challenge because participants came from different background and abilities. There was a lack of collaborative capabilities in the students. Blomqvist and Levy [4] suggested that collaboration capability can be seen as a generic meta-capability enabling leverage of both internal and external knowledge bases for changing needs in uncertain and complex environment. According to Tyler [43], collaborative capabilities consist of information processing, communication, knowledge transfer and control, management of intra- and inter-unit co-ordination, trustworthiness/ability to engender trust and negotiation skills.

Fourth, there was a lack of commitment from one of the parties. Every training module required two teachers; one from Finland and another one from Vietnam. Their co-operation was important, but it didn′t happen. Welty et al. [47] defined commitment as a sort of binding between a customer and a performer, based on a set of conditions of satisfaction within a predefined cycle time. The commitment level in this case was different between the two parties. It is our belief that there was a lack of solidarity among the team, making commitment impossible. Solidarity is the measure of the members of the community or organisation to pursue shared objectives, regardless of personal ties [16]. A joint sense of purpose or objective is vital. Even if members did not know each other, a sense of solidarity

of objective brings them together to act as one. Learners must take ownership of their own learning by recognizing that they share the same objective that is to solve the problem. This gives them a sense of response to competitive encroachments and a low tolerance of poor performance.

Prentice et al. [32] suggest that there are two distinct routes to commitment to a group: People can identify with the group as an entity (common identity) or they can feel close to individual members of the group (common bonds). Better communication among team members promotes group common bonding. The main reason this did not happen was due to the language barrier among the team.

Fifthly there was a lack of motivation among the students to collaborate. Knowledge-sharing motivation is a function of reciprocity issues, relationship with the recipient, and rewards [20]. Motivation theories distinguish between different types of motivation—notably, intrinsic and external motivation [29]. External motivation means that an individual engages in an activity to attain a positive or to avoid a negative external outcome. Typical external motivators include external rewards, such as money and praise, as well as avoidance of punishment. Intrinsic motivation involves doing an activity because it is in accord with the individual's intrinsic interest and personal values [11]. Intrinsic motivation therefore implies that the individual is free from pressure and tension when engaging in a particular behavior [10]. The lack of motivation was attributed to the students' inability to generate interest in group discussion because of communication problem of having to have translations instead of direct interaction between the Finnish staff and Vietnamese staff and students.

Lastly, but not least important is the trust issue. There was a lack of trust in knowledge sharing among the groups. Trust is the most important precondition for knowledge exchange [34]. Although the transfer of knowledge is a voluntary behaviour, we often need to share values and/or establish a common shared objective with someone before we are willing to transfer any knowledge. Conversely, trust is also voluntary; especially to trust initially is a voluntary act of faith. [44]. From our observation, we found that there were a lack of 'benevolence-based trust' and competence-based trust' among the students. 'Competence-based trust' is trust that describes a relationship in which an individual believes that another person is knowledgeable about a given subject area. Benevolence-based trust' is trust in which an individual will not intentionally harm another when given the opportunity to do so. There must be training given to students to build trust before the start of the next course.

44.6 Conclusion

Knowledge sharing is important for the teaching of innovation among students. However, effective knowledge sharing is not easy to achieve as we have found in our case study. There were many barriers for knowledge sharing especially in a

different culture. We would like to present some guidelines knowledge sharing can be promoted when teaching innovation to students of a different culture.

First teaching innovation to business managers in a foreign language is challenging, because in innovation training the interaction between the tutor and students is essential. This can be overcome by giving local tutors bigger responsibility such as leading team discussions in their own language. Second, cultural context should be emphasized in the training process. We should create custom made training process and methods for the Vietnamese business managers by taking account of their cultures.

Third because of the role of heterogeneous groups, there should be collaborative capabilities training for the groups before the start of the course.

Fourth, in order to avoid the lack of commitment from local tutors, we should let the local tutors have a bigger role to lead the training. There should be more organised knowledge sharing between the tutors.

Fifth, because motivation among the students to collaborate plays key role in innovation training, it is essential to promote motivation among students. Lastly, we can conclude that most important issue in knowledge sharing is the trust. There must be time to create collaboration based on trust between participants.

We are intended to implement the above guidelines to our next innovation course for students. The work is current going on and we are expecting improvements to the course in our next evaluation by the students and staffs.

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Chapter 45
Effectiveness of Information Systems Infrastructure and Team Learning in Integrating Knowledge Management and e-Learning Technologies

Ali Mahdi Owayid, Khalid Alrawi and Khaled Shaalan

Abstract E-learning is an emerging field in the intersection of education learning, and business, and refers to information and education services delivered or improved via Internet services and related technologies. This paper attempts to show how knowledge management (KM) and E-learning (EL) specifically can be of prominent support in the workplace. The model presented in this paper explains the factors or elements of support that facilitate the integration of KM and EL which is characterised by a dynamic alignment of an information systems infrastructure with team learning and flows of knowledge leading to the successful acquisition of knowledge in organisations. This framework offers integrated support and effects on the various medias involved in education systems. The model is a suggestion to improve the teaching and learning process and explains how KM can assist educational consumers in selecting and evaluating EL media. The model is based on an analysis of KM and EL literature and the information search process.

KeyWords Knowledge Management · E-learning · Knowledge Management Enablers · Information Systems Infrastructure · Team Learning

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45.1 Introduction

Knowledge does not have a universal definition which makes defining knowledge a complex task. Its main function can be seen as the processing of information associated with perceiving and understanding events which occur in the contiguous environment [9]. Knowledge Management (KM) is a way of determining, discovering, creating, sharing, applying, developing, measuring and maintaining the knowledge of the organisation. Technology has helped recent studies to identify that not all organisations are successful in managing such knowledge initiatives [37].

E-learning (or distance learning) offers solutions to teach and train learners remotely by using internet services or through interactive software. EL is the use of all information and communications forms of electronic technologies to improve the performance of teaching and learning systems [20]. Recently, EL has emerged as a more advanced strategy for learning in many places all over the world, particularly in the fields of education and business through electronic technologies and the Internet [2]. Accordingly, new action plans and programs have been developed to be more compatible with this update system [42].

Today, large organisations are using information technology (IT) as a tool of empowerment to improve services or products, establish new networks with suppliers, with the aim gaining competitive advantages over their rivals, and radically leveraging their internal operations [41]. Technology undoubtedly plays an important part in home education solutions, and must be available and usable for all. Technology which is simple and easy to use keeps learners active and engages them with their education. Considering the positive effects of digital technology in education, we can assume that it can play a role in meeting the demographic challenges of different ages across the world [4].

However, most centres of learning are built around the concept of team learning even in large groups, as a means to pursue individual learning. The learning concept may be necessary for the organisation to possess the necessary skills to function effectively. From the point of view of KM, all learning levels are significant and most organisations are currently focused on team learning [8]. Therefore, organisational learning points out to the ability of the organisations to discover the required skills to sustain and compete in their environment.

Broadly speaking, EL not only represents a technical development, but also other issues such as a state of mind, a way of thinking, learner attitude and a commitment to networking and global thinking. In this way, information and communication technology (ICT) could be used to help improve E-learning locally, regionally and worldwide [23].

This paper revolves around the model of KM and EL specifically. The catalyst for success in implementing KM is a change within the whole process: technology deployment, other elements of the infrastructure, the mindset of the people and the systems and processes of the organisation. The paper, therefore, attempts to show how knowledge management KM and E-learning EL can be of a paramount

support in the workplace. Furthermore, this paper analyses and examines the enablers or crucial success factors that, in addition to determining the effectiveness of KM within an organisation's EL process, also influence the whole performance of the firm. Following the existing literature, two vital factors are outlined. These factors—information systems infrastructure and team learning—are both considered to be important for effective KM implementation in the EL process. The researchers have attempted to provide a model by specifying the primary variables which should be examined in the context of the literature in order to show the relationship between KM and EL [39]. In doing so, the benefit of using KM tools and techniques for improving EL delivery will be clearly shown.

45.2 Literature Review

45.2.1 Quality Learning and Quality Knowledge Objects

KM is a social phenomenon of which learning is considered to be the cornerstone [35]. KM and learning terms are used next to each other and these terms have a lot in common. At the strategic level KM is often coupled with organisational learning based on the similarities between their goals, methods used or organisational conditions that recognise, support and value employees' collective intelligence. Historically rooted in various fields, KM and organisational learning often have different places in the organisational structure which inhibit any possible fusion between those fields [13].

Both KM and EL serve and support the same purpose: facilitating learning and developing the organisations capabilities. KM is linked to the perception of the organisation that encourages people to make their knowledge explicit through the creation of knowledge elements that can be stored on a database for reuse or to participate in communities of practice. EL on the other hand emphasises on individual acquisition of new knowledge and provides the technical tools to support the knowledge building process [30]. Therefore, communication skills among employees must be strong in order to understand and implement the organisation's mission [22]. Accordingly, the integration of KM and EL is more than centralised process of sharing information controlled by management of learning [24].

E- Learning centres must find a way to make KM and learning more visible to other experts and to the organisation by distributing skills amongst the entire community. For providers of EL to support KM, they would actually access to real-time knowledge stores which people use in their daily work [11] and this access is accomplished by using technology which can enhance E-learning and facilitate a shift from poorly performing communities to effective performing communities [1].

According to Wang [38], the process cycle of knowledge creates three knowledge fields in an organisation: organizational memory, learning field, and performance field. The interaction between the learning and performance fields offers a field of interaction where knowledge workers share and advance their tacit knowledge through socialisation, and allows knowledge workers to add explicit knowledge to the organizational memory through externalising their tacit knowledge. In highly innovative institutions, the process of sharing information will eliminate secrecy in business and encourage team learning [21]. Therefore, knowledge acquisition has become a cornerstone of the success of these organisations. Academics use this knowledge to develop organisations depending on team learning rather than skilled individuals. To sum up, the primary task of such an organisation is the conversion and exchange of information and data into knowledge, irrespective of whether this information/data was inside or outside organisation [19].

45.2.2 How to Achieve Knowledge Management in the Institution

KM consists of knowledge chunks that must be collected, organised, and strategically utilised within a system [32]. To access these knowledge chunks, information management uses technology programs and infrastructure like hardware, software, programming languages, database storage, queries, graphic user interface, customisation capabilities, meta strategies, etc. [6]. Shared information among groups of employees within an organisation can be accomplished by building a database of best practices or establishing an electronic directory containing the available knowledge at the organisation. According to David Coleman, big companies can execute KM systems via pilot projects or through the existing technical infrastructure at the organisation. Many organisations have installed intranets as a kind of KM system where the existing software in organisations like Microsoft Exchange Server, Lotus Notes, and Google Apps are used to facilitate efforts to improve KM [10].

KM system is viewed as an ecosystem of integrated KM technologies. A good example in this respect is the knowledge-centred support framework which is applied in a large university in the USA to provide distinct benefits to the learning and teaching center as well as offering support to the academic staff [17]. Consequently, implementing and integrating various KM software tools is considered to be a creative process of KM system. It is important to mention here that some technologies have never been regarded as related to KM, for example Management Information Systems and Workflow management. Such technologies can become a worthy source for knowledge especially when integrated into technologies in a KM system [25].

Mostly, learning is addressed by KM as an element of the knowledge sharing processes. For this reason, KM puts more emphasis on ways to encourage informal learning and provides wider access to educational materials or experts such as Yellow Pages or knowledge bases which are considered to be a good example the resources used by experts [26]. KM also concentrates on particular figures of informal learning like learning in a community of practice (team) or accessing the main resources of information and experts. The involvement and active participation of learners in the learning process frequently enhances motivation and increases learning gain [40].

Most educational institutions have invested greatly in the education sector, innovation and development, anticipation and preserving the availability of experts and in a high-quality education [31]. Currently researchers working in one of these academic institutions, believe that practices like the KM network and best practices in education environments are at an advanced stage of development [15, 36].

The use of team–based learning supported by computer tools at educational institutions can add more features to the learning experiences through increasing the interactions beyond the classroom [14]. For instance, learning management systems such as Blackboard, Sakai and Moodle are software applications that provide features like file sharing, document management, chat tools and discussion forums [18]. Moreover, information technology can be leveraged when team members are acquiring and integrating their knowledge according to how the technology supports team tasks [5].

45.3 Research Methodology

The literature review is one of the simplest ways to economise on research efforts. It consists of a review and reconstruction of work already done by others and is intended to find, obtain and consult the literature and other materials that may be useful for the purposes of the research, and to extract and gather relevant information in relation to the research problem (available in different types of documents). The review material is selected from the large number of journal articles, books and other kinds of materials in different areas of knowledge. Besides that, these materials are relevant and contain the latest information. However, it must be inferred that all published materials are appropriate or reliable sources of information.

45.4 The Suggested Model

Based on existing frameworks and models, Theriou et al. [33] summarised most of the KM enablers through reviewing a significant number of research studies and models. In particular, Theriou et al. [33] outlined information technology and

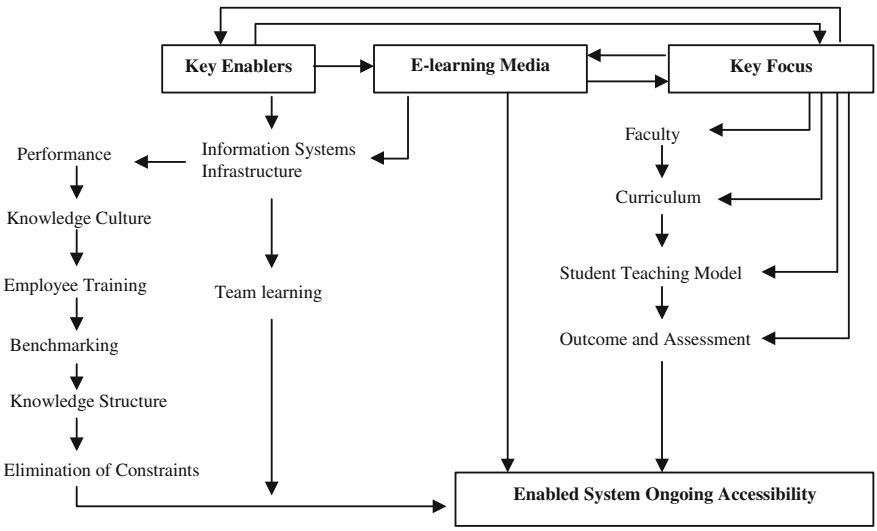

Fig. 45.1 Integration of KM and EL framework [3]

people (team) as the most significant and critical enablers or factors that determine the effectiveness of KM within organisations through discussing studies and models investigated by Earl (1997), Skyme and Amidon (1997), Davenport and Probst (1998), Liebowitz (1999), APQC (1999), Andrew et al. (2001), Hasanli (2002), Bixler (2002), and Mathi (2004).

On the other hand, Alrawi et al. [3] presented a model combines e-learning and KM into adaptable framework and discussed some factors or enablers that help learners in selecting and evaluating e-learning media. It is therefore, Theriou et al. [33] and Alrawi et al. [3] who have inspired us to present our model. In reviewing the literature, these researchers have noted that there is a strong and significant overlap between EL and KM. Figure 45.1 describes the process of team learning within active and interactive environment. Although there have been constraints on implementing KM as mentioned above, within the educational sector, universities and other educational institutions have been able to enjoy some of the outcomes of KM where it has been properly implemented. According to Choy et al. [12] and from the previous discussion, the outcomes of KM implementation in EL could be categorised as performance, knowledge culture, employee training, benchmarking, knowledge structure and elimination of constraints as shown in Fig. 45.1.

In fact, the learning process model carries huge competitive advantages and causes a block of new processes to move to a new stage of development [7]. Learning organisations normally make strides of progress when the learning process is modelled to tackle internal and external problems and when learners can overcome the challenges associated with skills and technical capabilities [28]. Example of such organization is Apple organization which was highly open and interactive with its environment [34].

The interaction between the internal and external environment through a learning process brings huge benefits as change knowledge will leverage the organisation's outcomes and double its benefits. In this learning environment, the expansion of the object of knowledge improves the EL environment and often becomes a reality [7]. The outcomes of this model represent the state of flow of knowledge between individuals or groups of learners within the organisation. Improving information and communication technology tools may also lead to the sharing of best practices of EL which could result in more highly developed employee skills, team learning and performance [16]. Therefore, the successful implementation of KM not only creates the means to better knowledge-sharing within the organisation, but also allows knowledge-sharing with other business partners. This is done mainly in the form of feedbacks where it helps the organisation to better create and offer value [27].

45.5 Findings and Discussion

In this paper, KM and EL are considered to be a subject of interest. Yet, the relationship between KM and EL has not been completely understood and utilised. KM and EL are known to work and interact closely and responsibilities for both of them—KM and EL—are supervised by different departments or units in academic institutions.

The researchers have concluded that the differences in results between organisations are due to their different capabilities to develop and deploy knowledge. Thus, KM can be considered as the most important dynamics of the company and the main driver for all skills and abilities. The literature review proposes the use of EL systems as a knowledge management tool, posing an integrative framework. Therefore, organisations should benefit from existing knowledge flows and conversion among users in order to create a new knowledge by capturing knowledge interaction existing within organisations. Capturing the perceptions and experiences of users can be facilitated by E-learning through asynchronous communication tools such as email and discussion forums, or through synchronous communication tools such as chatting or using a whiteboard.

The existing literature ([1, 4, 6, 26, 36] and others) on KM and EL mainly analyses it from a technological point of view (considering standards, which may include tools, technology platforms, etc..). Many reasons have been advanced to explain EL as a novel and useful technology for KM in organisations including its ease of use, communication, distribution and updating ([2, 20, 42], and others). The use of internal company networks or the Internet allows information content for different projects to be distributed at the same time at a low cost. By increasing the interaction among teams inside organisation, EL can create a virtual environment that enhances this interaction. In conclusion, it has been found that the differences between the KM environment and the EL environment are artificial, not important and undesirable [29]. In the main, supporters of integrating these

environments consider EL to be part of KM, and they regard KM as a tool to be used in E-learning.

45.6 Conclusion

The aim of this study is to demonstrate the huge power of KM, and the case examined (E-learning), also identifies the success factors required for this power to be recognised and realised. Although the transfer of ideas from technology to education does not seem to be identical, there is a certain basis where these settings are probably common. Although there are limits to the application of KM in the field of education in general, that is to say, the high cost of implementation, nevertheless the benefits outweigh the costs. Finally, we can confirm that integrating the process of KM with EL can be controlled and mastered only when researchers as well as developers of various disciplines cooperate or work together. Obviously, it is hard to discover a final and optimal solution during the coming years because the growth of both KM and EL systems is fast, therefore, various new studies, research articles and issues will come to the fore.

45.7 Limitation

There are many limitations to this research. The first limitation is a lack of historical data which makes conducting a quantitative research method inaccurate. Secondly, other studies could emphasise different enablers that may help in expanding and developing researches in order to study the same sector in many institutions. Failing to take account of the literature which identifies face to face recognition and not relying on information technology networks is another limitation of this paper.

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Chapter 46
Developing Innovative Training for Business Managers: I-SME Project Between Finland and Vietnam

Dao Ngoc Tien, Anne-Maria Aho and Lorna Uden

Abstract Organisations need to innovate to be competitive. People who want to start an enterprise or just want to be an outstanding employee, need to learn how to recognize opportunity, harness the resources to exploit that opportunity, exercise their creativity, and create sustainable solutions. It is important to teach, entrepreneurship, leadership and innovation. Although there are debates about whether innovation can be taught, the teaching of innovation and entrepreneurship has grown dramatically over the past decade. Through a case study describing a Finnish/Vietnamese project to teach innovation to business managers in Vietnam, this paper support the opinionthat innovation can be taught and learned. Based on the virtual enterprise methodology and blended learning environment, the training course has been delivered small and medium sized enterprises' managers in Vietnam by both Finnist and Vietnamese experts. This paper discusses the development of the joint course, the problems encountered and draw lessons in both practical and theoretical aspects.

Keywords Innovation · Entrepreneurship · Training

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46.1 Introduction

Entrepreneurship has become an everyday buzzword. Policymakers, economists, academics and even university students are talking about it. Today entrepreneurship is regarded as one of the best economic development strategies to develop a country's economic growth and sustain the country's competitiveness in facing the increasing trends of globalisation [1].

Students are told to be more entrepreneurial and innovative, as a new culture. We need to educate entrepreneurs and teach the processes of entrepreneurship and innovation. Debates about entrepreneurship education at the highest level of national policy are occurring in many countries. It is our belief that entrepreneurship education at university is both feasible and desirable.

'Entrepreneurship is considered to be a core competence for growth, employment and personal fulfillment' [2]. Entrepreneurship has been emphasized in many countries as a way of boosting economic growth and job creation. The teaching of entrepreneurship should be customized according to each country's unique cultural context.

Drucker has postulated that entrepreneurship is the 'practice of innovation'. In his book Innovation and Entrepreneurship, he has outlined an approach to entrepreneurship as the practice driven of innovation. Entrepreneurship is neither a science nor an art [3]. It is a practice. It is a knowledge base, but as in all practices, medicine, for instance, or engineering, knowledge in entrepreneurship is a means to an end. Indeed what constitutes knowledge in a practice is largely defined by the end, that is, by the practice innovation is the specific tool of entrepreneurship, the means by which they exploit change as an opportunity for a different business or a different service. It is capable of being presented as a discipline, capable of being learned, capable of being practiced [3]. This has led him to conclude that "Entrepreneurs innovate. Innovation is the specific instrument of entrepreneurship" [8]. In this paper the word innovation and entrepreneurship will be used synonymously.

Many universities and colleges around the world have responded to this demand by introducing entrepreneurial courses to students in an effort to promote entrepreneurship as well as a professional entrepreneurship career [4].

Universities play a functional role in promoting entrepreneurship education to develop regional and society economies [5]. It is the authors' belief that universities have a key role to play in promoting entrepreneurship since educational institutions are ideally considered the place in shaping entrepreneurial cultures and aspirations among students while they are studying to survive in today's robust business milieu [6]. This paper adress the question on whether and how innovation can be taught to enterprises. The paper begins with a discussion of the importance of the role of entrepreneurship education in today competitive economy. This is followed by the description of the case study involves the international project to teach entrepreneurship to business managers in Vietnam and its evaluation. Lessons learned and theoretical implications are discussed, and the paper concludes with further research suggestions.

46.2 Entrepreneurship Education

Research has shown there is a positive relationship between entrepreneurship and economic growth in terms of job creation, firm survival and technological change [7]. Binks defined entrepreneurship education as the pedagogical process involved in the encouragement of entrepreneurial activities behaviours and mindsets…' [8, p. 2]. The role of entrepreneurship education is mainly to build an entrepreneurial culture among young people that, in turn, will improve their career choices towards entrepreneurship [9].

Rae and Carswell stated that "Entrepreneurial learning is defined as 'a problem solving process centered on the acquisition, storage and use of entrepreneurial knowledge in long term memory'" [10, p. 221]. Many approaches have been used for Entrepreneurial learning. These include: learning theories such as competency [11], problem based learning [12], co-participation [13], action learning [14], and learning organizations as an orientation towards learning [15]. Other new entrepreneurial learning methods include the triadic model of entrepreneurial learning [16], the negotiated narrative [17] and virtual enterprise (VE). Borgese evaluate VE as a multi-faceted approach to entrepreneurship education, transformative, experiential methodology [18].

Innovation is the specific function of entrepreneurship [19]. Drucker argued that innovation is the means by which the entrepreneur either creates new wealth-producing resources or endows existing resources with enhanced potential for creating wealth. The teaching of innovation and entrepreneurship has grown dramatically over the past decade. Common tools for teaching entrepreneurship generally include case studies, business plans and computer simulations. However, there is still considerable uncertainty as to whether innovation and entrepreneurs are born or made, which has led to the questions about whether we can actually teach individuals to be innovative [20].

In entrepreneurship teaching, teaching is enhanced when students are engaged in the construction of knowledge by 'acquiring, generating, analysing, manipulating and structuring information' [21]. Entrepreneurship education should be based on activities, action learning and experiential learning.

New entrepreneurship programmes have been emerging at business schools in the entire world. In the USA, they have been launched at such prestigious institutions as Harvard, Stanford, Northwestern, and the University of Chicago. Traditional business schools tend to over-emphasise quantitative and corporate techniques at the expense of more creative skills [22]. Whereas entrepreneurial education should emphasise imagination, creativity, and risk taking in business.

While entrepreneurship programmes across different countries may have a common focus in terms of new business creation and the development of a business plan [23] or entrepreneurship as a discovery process [24], there may be differences in emphasis depending upon the particular needs of the participants, the country or the resources available [25]. Transitional economies have different

fundamental problems than do countries with a long history of capitalism and entrepreneurship [26].

Although Entrepreneurship education is becoming popular around the world, its education in each country is different based on its cultural context. Dana argues that, "A key prerequisite to training people is to understand them, their cultural values, historical experiences and mindset" [26], p. 410]. One must not assume that entrepreneurs can be trained in the same way in Vietnam as in Finland [26, p. 411]. Thus, Dana recommends that alternative methodologies are required for teaching entrepreneurship in transitional economies.

A country must customize entrepreneurship education according to its unique cultural context. A wide range of critical success factors for entrepreneurship, identified by previous empirical studies in different countries, support the importance of the customization of entrepreneurship education [27]. The next section of this paper describes the international project for entrepreneurship education for Vietnam.

46.3 Case Study: I-SME Vietnam

I-SME Vietnam professional training course has been designed to support small and medium sized enterprises in managing and planning business operations to nurture innovation. The course was led and taught by Innovation management and SME professionals from Finland in cooperation with professionals from Vietnam. The training curriculum of Seinäjoki University of Applied Sciences' Business School was adapted and used in Vietnam. The training consists of four modules. The goal throughout the four training modules was for trainees to learn to formulate a viable business plan for innovation.

Innovation strategy and management: The module concentrates on the following topics: Introduction to innovation management and strategy, market opportunities and customer needs, competences and resources. The module provides skills to develop a holistic perspective of a company, and skills to integrate the concepts and principles of strategy into the current state of a company. The module teaches how to think strategically and how to develop sustainable competitive advantage. The module also develops analytical thinking skills: participants learn to analyze the business environment and see opportunities and obstacles therein. The goal was to be able to provide a description for a development idea in innovation process.

Process Perspective in Innovation: Services and products: This module concentrates on the following topics: Customer value processes, Company processes and Service/product concept. Participants learn to understand why and how a service/product concept is constructed. The module provides understanding of the concept of customer value processes and how these processes are to be seen in the context of innovation for SME. The goal of this module was to write an extended description of an innovative customer-oriented service/product concept to support the further development of it.

Financial Perspective: Economic Aspects of Innovation: The module concentrates on the following elements of the economic aspects of innovation: cost analysis, pricing and investment decisions. The module provides skills to generate a financial plan and profitability plan of innovation. Participants learn to identify the main factors of profitable pricing. The goal was to develop a financial and profitability plan for innovation.

Customer Perspective in Innovation: Sales and Marketing: The final module focuses on preparing a marketing strategy and what are the key aspects in it. The participants learn to understand the role of marketing, market segmentation, targeting and positioning, distribution channels and promotion and sales. The goal was to develop a marketing plan for the developed services/products.

Methodology of the training. The innovative virtual enterprises methodology was applied in the training. The virtual enterprise is a combination of traditional university teaching with company consulting in management area to ensure both theoretical and practical views. The main characteristics of this methodology were as follows:

- Strong integration between practical environment and theory.
- Training, learning and practical development are simultaneous processes.
- The objective of training process was worklife oriented.
- Learning outcomes were proven by practical development input.
- Virtual enterprise can be student′s own enterprise or it can be based on case-example.

Organization of the training. The course was organized by blended learning using a combination contact and online training Within 4 months. The learning methods of this training course include:

- Two Written assignments that support learning in practice, for each module (in the first round).
- Contact training by topics lead by Innovation and SME experts from Seinäjoki UAS, Finland, and from Foreign Trade University, Hanoi. Includes group tasks that enforce mutual learning and teamwork. Contact training 12 h per module, total of 48 h.
- Self-studying and learning in an online virtual forum. The online forum functions as a virtual help desk where participants can interact with each other in order to find support for their work and also, ask questions from Finnish and Vietnamese innovation management experts. Estimated need for online learning 8 h weekly (includes all work outside contact training). See Fig. 46.1.

46.4 Results and Evaluation of the Course

There are teo rounds of pilots training organised with the participant numbers of 13 and 18 respectively. These small numbers of participants has advantage and disadvantage. The advantage was it allows for interactive activities during class

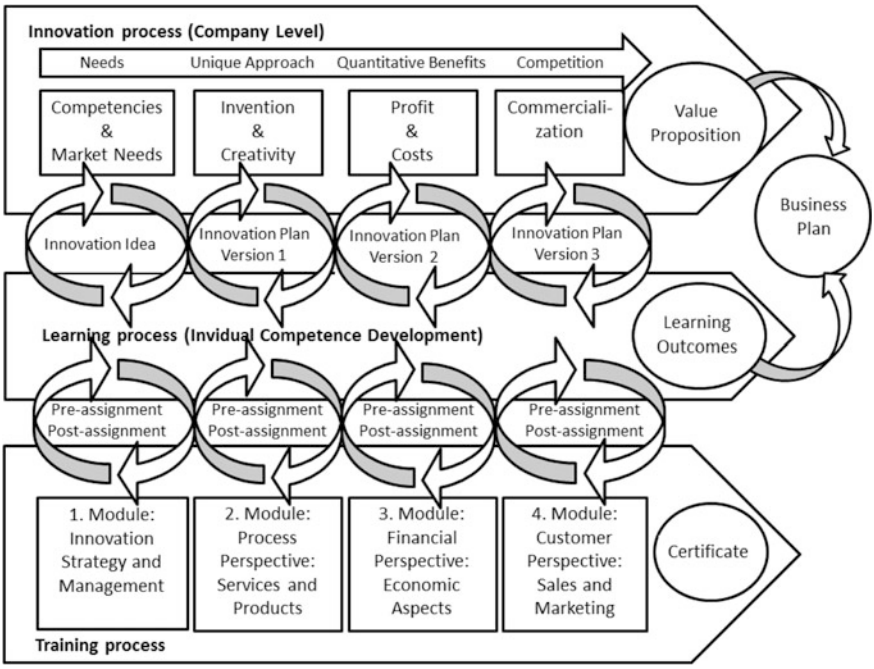

Fig. 46.1 The training process

contact training. The Disadvantage was that there were too few people in the class. Majority of participants come from enterprises, i.e. eight out of 13 and 16 out of 18 in the 1st and 2nd round respectively. In addition, there were people from universities' business faculties (two in each round). This means that the group of participants was a mixture of people from business enterprises and training bodies.

Enterprises that participated in the training came from different industries, from manufacturing (food, automobile industries) to service (consulting, publishing, IT and trading) sectors. However, majority of participated companies came from the services sectors in different application of IT technology, i.e. search engine, e-books, Internet television, e-commerce.

The diversities backgrounds of participant provided opportunity for class discussion because this enables innovation idea to be viewed from different perspectives. It also promotes more innovation ideas on products innovation by creating bundle/package of goods and services to satisfy customer's demand. However, the downside was the lack of process innovation as participants cannot go into details on the process of particular industry.

Of the enterprises that participated in the training, two was from a state-owned company, two were foreign invested enterprises and the rest were private enterprises (account for 85 % of participating enterprises). This shows that those enterprises that support innovation were mostly private enterprise as compared to

state own enterprise. All enterprises were newly established, the oldest one started in 2002 and the youngest one was only two years old.. This fits in with research in literatures that young enterprises are more dynamic and open to innovation.

The majority of the participants were from management position of their companies, either as a CEO or as a director of a department in the company. Representatives of universities were also from management. This was one of factors that contributed to the interactivity of the training days as participants were active, willing to share and comment on different innovation plans. It was due to top managers who were experienced and educated.

During training days we have observed that the CEOs were the ones who were actively participated in the discussion. In some cases where there was more than one person from the same company, only the CEO spoke or instructed others to speak. The subordinates were less active. This shows innovation in this case was a top-down innovation process.

Evaluation of the training. The method used for evaluation was Participant Feedback: evaluation forms and feedback discussion conducted during contact training days. SeAMK expert and FTU trainers' self-evaluation were also involved. The evaluation was measured on 5-points Likert scales of following criteria:

- Usefulness of the previous assignments
- Quality of teacher feedback on previous assignment
- Usefulness of information presented during the two-day training
- Ability to present topics in a way that is easily comprehensible to the participants
- Knowledge of the trainers
- Opportunities given to participants to present questions and participant
- Quality of interactive classroom activities (discussions, group exercises, presentations, etc.)
- Quality of the training material
- The amount of references/material provided on the website
- Quality of references/material provided on the website
- The use of practical examples, case studies
- Length of the lesson
- Use of audio and other teaching equipment
- Quality of lunch
- General satisfaction on the module

The objectives of the evaluation were:

- To evaluate suitability of the overall training programme and present necessary modifications for the second training programme.
- To evaluate the suitability of the assignments, contact training days, lecturing Materials and methods of teaching, and present modifications for the second training programme.

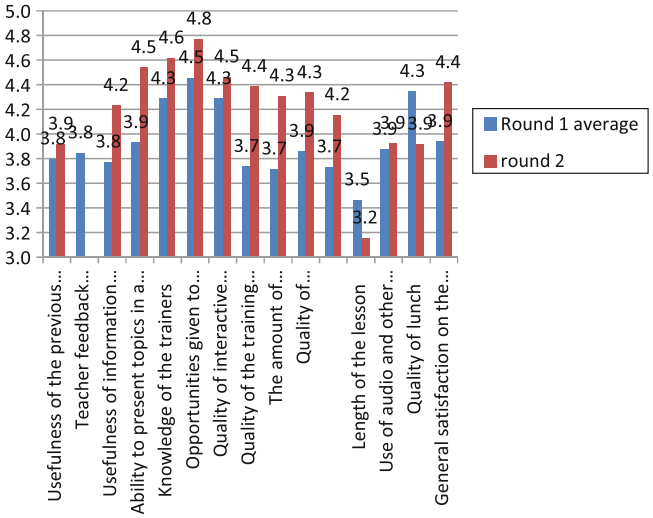

Fig. 46.2 Average feedback (Round 1) and the feedback of the Module 1 (Round 2)

– To Evaluate practical matters concerning organizing the contact days (Fig. 46.2).

Based on the participants' feedback, some revisions were carried out relating to the contents and organisation of the training. The training was focus more on practical issues, rather than academic content. More examples of innovations from both Finland and Vietnam were added on the project website. A training day was organized at an innovative company which belonged to one of the participants. Participants found the experience beneficial as they could see and discuss real life examples. The I-SME case has proved to be a success as the evaluation scores were all more than 3.7 out of 5. The overall assessment of the finished 1st round was 3.9. Also, the revision of round 2 as pointed out above has contributed to the higher evaluation of round 2.[1]

Among various criteria, those received consistent mark in both rounds were Knowledge of the trainers (4.3 and 4.6 in round 1 and 2 respectively); Opportunities given to participants to present questions and participant (4.5 and 4.8 in round 1 and 2 respectively); Quality of interactive classroom activities (4.3 and 4.5 in round 1 and 2 respectively). Those were determinants to the success of innovation training. In case of I-SME projects, another factor that contributed to the success of the training was the presence of Finnish experts bringing their experiences and fresh views from developed country.

[1] At the time of this paper, only 1st module has been completed.

46.5 Lessons Learned and Theoretical Implications

There were several practical lessons learnt from I-SMEs. Firstly, Innovation can be taught to adult people. To ensure its success, principle of adult learning were required, i.e. interactivity among participants and between participants and trainers. In reality, the interactivity was supported by diverse backgrounds, of participants. Secondly, Innovation is a process from idea to commercialisation, so teaching innovation we need to follow the process. This takes times to develop. Virtual enterprise methodology and blended learning environment help to overcome this challenge. Thirdly, Innovation training can be organised according to the different type of innovation. Product innovation, usually occur as a bundling of good and service are demand-driven and must be supported by a diverse backgrounds of participants, who should have direct contact with consumers. Otherwise, a supply-driven and process innovation would not be nurtured. Based on above lessons, conditions for successful innovation training are interactivity and practicality. Further innovation training should be implemented to promote either demand-driven with diverse-background participants or supply-driven with participant within one industry (even one enterprise).

Apart from the practical lessons learned, there are theatrical implications that we should consider when teaching innovation for manages. In our traditional teaching, we taught innovation using causal reasoning that comes to life through careful planning and subsequent execution.—the sequential progression from idea to market research, to financial projections, to team, to business plan, to financing, to prototype, to market, to exit, with the caveat, of course, that surprises will happen along the way. What is needed is effectual reasoning that lives and breathes execution. In effectual reasoning, plans are made and unmade and revised and recast through action and interaction with others on a daily basis [28]. The managers know that surprises are not deviations from the path. Instead they are the norm, from which one learns to forge a path through the jungle. The unexpected is the stuff of innovative experience and transforming the unpredictable into the utterly mundane is the special domain of the innovators.

It is our belief that although we can teach the practice of innovation, there are many factors that will influence its success. We concur with [29] that successful innovation depends on the need for achievement (N-Ach) of an individual. The person involved may either have (or lack) the necessary intrinsic motivation to undertake the hard task of acquiring the necessary knowledge base to practice innovation. N-Ach refers to the individual's desire for significant accomplishments. People with high N-Ach are characterized by a strong tendency to seek challenges and a high degree of independence. The recognition of their achievement is their reward. On the contrary, people with low N-Ach tend to prefer easy tasks that are not very challenging, in order to minimize the risk of failure. The relative security and predictability of a career is preferred to the challenge of starting a new business venture.

Another important observation that we have learned is that a teaching style that is action-oriented, encourages experiential learning, problem solving, project-based learning, creativity, and is supportive of peer evaluation. We need to foster a culture of enterprise and innovation. Innovation education emphasises imagination, creativity, and risk taking in business whereas traditional business schools tend to over-emphasise quantitative and corporate techniques at the expense of more creative skills [22].

46.6 Conclusion

Students today need skills to lead and thrive in a global economy. Universities should help develop graduates who will provide organizations with technical expertise and knowledge to help drive Innovation. The teaching of Innovation/ Entrepreneurial is critical to our nation's business enterprise. However, the teaching of innovation is not trivial. Teaching innovation should be innovative. Analyzing case studies or using current knowledge is not sufficient. We must provide students with creative tools and using hands-on exercises, teaching new perspectives and breaking through ideas of common thought. It is necessary to use those concepts to instruct students via innovative practices by giving them tools to truly challenge current thought processes.

Traditional approach to innovation involves the process of taking an idea from initial conception to market is called product development. It includes idea generation, market research, product evaluation and selection, design and development, product protection and commercialization. It is our belief that the best approach to teach students these skills is by working in teams to generate, evaluate, develop, and market their innovation.

Our case study shows that innovation can be taught, even in case of a cross-culture team of lecturers and participants. However, despite the positive feedback from the managers, it is impossible to evaluate the effectiveness of the training. The evaluation of entrepreneurship training is difficult because many variables such as: people, knowledge, behaviours and efficiency come into play. To evaluate the success of the training, it is imperative that evaluation be conducted. This will be our future research.

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Chapter 47
The Impact of Knowledge Sharing Platforms in Distributed Requirements Engineering Scenarios: A Systematic Review

Christian Sillaber and Ruth Breu

Abstract Knowledge sharing platforms promised to solve a number of challenges that complicate requirements engineering activities in globally distributed software engineering efforts. A systematic review of empirical studies of the impact of such knowledge sharing platforms up to and including 2011 was conducted. The selected search strategy identified 511 studies, of which 17 were identified as suitable empirical studies. The studies were evaluated according to the presented knowledge sharing platform, the requirements engineering setting as well as to the reported impact on the requirements engineering processes. This systematic review investigates what is currently known about the evidence for positive and negative impacts of knowledge sharing platforms in requirements engineering processes. The main finding of this systematic review is that currently little empirical data on knowledge sharing platforms and their use in requirements engineering processes is available and further empirical research is necessary.

47.1 Introduction

During the last two decades, the management, elicitation and analysis of software requirements have evolved from being concentrated at a single development team location to being geographically distributed across multiple countries and time-zones. A variety of business reasons including cost savings [1], the increased availability of skilled labour [2] as well as the possibility to develop software

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products 24/7 [3] has led to an increased difficulty of quickly sharing knowledge on software requirements.

Many remedies for improving the knowledge exchange between stakeholders have been suggested, from the re-use of established mediums as telephone and video conferencing to specifically developed collaborative knowledge sharing (KS) platforms. However, though there are many tools available for requirements engineers, little is known about their use in practice and what their effects are.

This systematic review seeks to evaluate, distill and present the empirical findings on the impact of KS platforms in requirements engineering (RE) to date, and provide an overview on the different research topics and their findings. We believe that this review will help the scientific community to identify areas and opportunities where research is lacking.

The article is organized as follows: In Sect. 47.2, we give an overview of RE with a focus on KS challenges specific to distributed environments. The methods used for this review are described in Sect. 47.3. Section 47.4 reports the findings of this review and presents an overview of the studies and the reported results. The benefits and limitations, strengths and weaknesses and implications for research are presented in Sect. 47.5. Section 47.6 concludes and provides recommendations for further research on the use of KS platforms for RE.

47.2 Background-Requirements Engineering and Knowledge Sharing

As part of the globalization efforts prevalent in the last decade(s), software development teams have increasingly become geographically distributed [3–5]. This trend of adding more (Global Software Development, GSD [6]) or less (Distributed Software Development, DSD [7]) distance between team members has created additional challenges for requirements engineers to share knowledge across team members [5, 8–10].

We first describe the field of RE and recent challenges that make the development and use of KS platforms inevitable. We then summarize previous works on the challenges of KS in RE processes and justify the need for this review. Lastly, we state the research questions that motivated the review presented in this paper.

Requirements engineering: Requirements engineering is a discipline strongly linked to the success and failure of software development processes regardless their size, available resources or the structure of the development team [11–14]. Beneath technical activities, RE involves a plethora of challenging non-technical activities including negotiation, analysis and management tasks [15]. These activities, requiring active communication and the exchange of knowledge can be found in all phases of RE processes and their importance has been shown in numerous works, e.g. [5, 16–21]. Team members need communication to

coordinate their activities and share knowledge as documentation often becomes obsolete and relevant knowledge often only resides with people [22]. The importance of KS in large, often geographically distributed, multicultural development teams comprised of diverse software and RE roles, that are prevalent today [10, 23], is well acknowledged in literature, e.g. [3, 5, 9, 24, 25].

Knowledge sharing challenges in requirement engineering: Distributed software development, in particular the associated RE processes are fraught with challenges [3]. In literature the five main challenges are *inadequate communication*, *cultural and language differences*, *process differences*, as well as *technical differences* [3, 5, 23]. The reasons for inadequate communication are manifold ranging from time-zone difficulties to inadequate means of expression [3, 9]. In the case of multinational requirement engineering teams, cultural and language difficulties arise from different stakeholder backgrounds [10, 26]. Besides differences in human culture, different corporate cultures pose additional challenges, as they may vary from one site to another, as language might [3]. Inadequate or incompatible processes often lead to challenging documentation and traceability problems [23]. While technical difficulties such as differences in bandwidth or available hardware resources might be solved in the foreseeable future, different platforms and document formats pose additional challenges. Often, these problems are interwoven and therefore challenging on the technical layers as well as the process and knowledge layer. For instance [3] reports that *"… remote practitioners are unable to hold effective discussions on requirements. Since existing requirements management tools do not provide rich support for collaboration, teams typically use these tools only as a shared requirements repository and hold all discussions outside of the tool in email, chats or phone-calls…"*. The variety of channels requires expensive cognitive switches and are also hard to track centrally leading to decreased trace-ability. Besides trace-ability issues, knowledge of stakeholders as well as their understanding of the requirements is hard to quantify and even harder to share in global scenarios as the individual interpretation of requirements might change according to the cultural or organizational background [3, 10, 25].

Objectives of this review: Knowledge sharing, and KS platforms have attracted huge interest from both software and RE research and practice. However, to the best of our knowledge, no systematic review of the impact of KS platforms in requirements engineering has previously been published. The existing works presented in the previous section only partially cover the evaluation of real-world solutions to address KS issues and challenges in RE practice. Furthermore, they do not include a systematic assessment of the actual impact of KS platforms in real world RE environments. The objective of this systematic review is to answer the following research questions: **(1)** What is currently known about the positive and negative impact of KS platforms in requirements engineering? **(2)** What is the strength of the evidence in support of these findings? **(3)** What are the implications of these studies for the requirements engineering industry and the research community?

47.3 Review Method

Following the methodology for integrating diverse software engineering study types, as presented in [27], as well as the established method of systematic review, we conducted the review in six successive stages: development of review protocol, the identification of inclusion and exclusion criteria, the identification of relevant studies, critical appraisal, data extraction and synthesis (cf. [27]).

(1) Protocol development: Following the protocol presented in [27], an Org-Mode protocol [28] for the systematic review was developed and aligned with [29]. In this protocol, we specified the research agenda and questions, search strategy, exclusion, inclusion criteria as well as data extraction and synthesis methods.

(2) Inclusion and exclusion criteria: We deemed articles presenting empirical data on the usage of KS platforms and their impact on requirements engineering processes in both academic and professional environments eligible for inclusion. Qualitative and quantitative research studies published in the English language until 2012 were included (not restricted to any specific model, methodology, or technology or the reported outcome). Furthermore, studies reporting only on the impact of KS platforms of specific (sub-) aspects were deemed eligible (e.g. only requirements analysis or only negotiation phase)-independently from the RE methodology. We excluded studies if their focus was not on the use of KS platforms in (software) requirements engineering. Also, studies that did not present empirical data or were mere "lessons-learned" papers were excluded. Papers describing the impact of KS platforms in non-software development processes (e.g. new product development) were excluded. As this review is concerned with the impact of KS platforms in RE as a whole, studies that focused on single techniques or aspects, such as requirements recommender systems in KS platforms were excluded.

(3) Data sources and search strategy: The search strategy included automated and manual searches in electronic databases. The following electronic databases were queried: ACM Digital Library, IEEE Xplore, ISI Web of Science, Science-Direct—Elsevier, SpringerLink, Wiley Inter Science Journal Finder, Jstom, and EBSco Host.

Figure 47.1 shows the structure plan for the systematic review process and the number of papers identified at each stage. In the first stage, the titles, abstracts, general meta-data and keywords of the articles identified were extracted from the corresponding electronic database. In the electronic database, we searched using the following query: knowledge NEAR sharing AND (software OR platform) AND requirement* NEAR engineering.

In case an electronic database did not support the NEAR syntax, an AND query was used instead and the results were manually inspected for word proximity. From the retrieved results, we automatically excluded editorials, article interviews, reviews, discussions, tutorials, and poster sessions. This search strategy resulted in a total of 511 hits from all electronic databases that included a set of automatically identified 475 unduplicated citations.

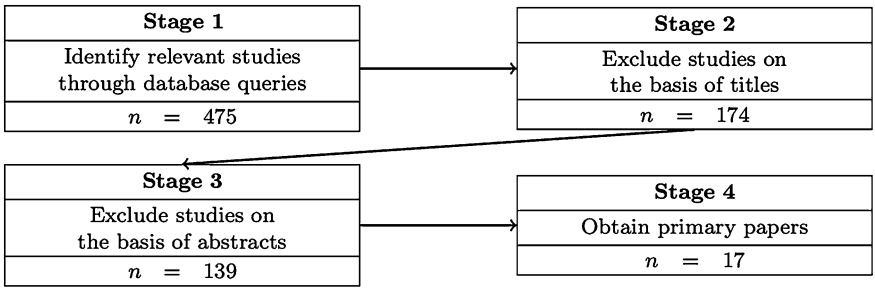

Fig. 47.1 Stages of the study selection process

(4) Citation management, study retrieval, and inclusion decisions: Relevant citations from stage 1 (n = 475) were automatically retrieved and stored with the aid of JabRef, a citation management software. There we recorded the retrieval source, decision, status and eligibility decision. For each subsequent stage, separate BiBTex databases were established.

In stage 2, we manually went through the titles of all database entries that resulted from the previous stage, to determine their relevance to the systematic review. At this stage, we excluded studies that were clearly not about the impact of KS platforms in requirements engineering, independently of their nature. As an example, because our search strategy was rather broad, including the terms "requirements" and "knowledge sharing", we got several matches about requirements for KS platforms as well as requirements for ontologies covering KS. Also studies covering requirements engineering not related to the development of software were dismissed. Articles with titles that indicated clearly that the articles were outside the scope of this systematic review were excluded. However, titles are not always clear indicators of what an article is about (similarly, e.g. [27, 30]). Also the use of the term "requirements engineering" was sometimes rather ambiguous. In these cases, the articles were included for review at the next stage. At this stage, 301 articles were excluded (n = 174). In the third stage, the abstracts of the remaining papers were evaluated according to the previously described scheme and 35 studies were excluded (n = 139).

Each of the 139 studies that remained after the previous stage was assessed, according to criteria presented in [27]. The therein developed criteria cover three main issues pertaining to quality that the authors believe to require consideration when appraising the studies identified in the review: *Rigor*: Has a thorough and appropriate approach been applied to key research methods in the study? *Credibility*: Are the findings well-presented and meaningful? *Relevance*: How useful are the findings to the requirements engineering community?

Based on these criteria and the suggested evaluation questions of [27], we developed the following assessment criteria as to whether: (1) The study reported empirical research on implementing KS platforms in RE projects in academia or industry, (2) the aims and objectives were clearly reported and whether the focus

was on knowledge aspects or requirements engineering aspects, (3) there was an adequate description of the context in which the research was carried out (e.g. industry setting, RE methodology), and (4) the reported findings were sound and clearly presented with a justified conclusion. The 139 studies from the previous stage went through the final evaluation according to the above scheme and excluded according to the answer to question (1). Out of the 139 studies, 122 were excluded and 17 remained for the detailed data extraction and synthesis.

(5) Data extraction and synthesis of findings: After going through stages 1 to 4, the data from the 17 studies selected for this systematic review was extracted according to a predefined extraction form. During the data extraction, annotations in the papers were used to highlight relevant passages and research results. These passages were imported into the Org-Mode document for future reference. To synthesize the findings, the terminology from the studies was at first taken verbatim from them and then "translated" according to a common glossary. Also, a rough categorization of the author's terminology was applied to ensure that similar or the same KS platforms hidden behind "different" names or commercial vendors' names were identified correctly.

47.4 Results

We identified 17 studies that report on the impact of KS platforms in RE. We categorized the studies into five main groups according to the main activities of RE: analysis, specification, modeling, validation, and management.

We found that out of the 17 studies, 9 (52 %) focused on a globally distributed software development scenario. Offshore software development scenarios were studied in 2 (11 %) articles. Studies describing general software development scenarios without any specific mention of the team members' location come next with 3 (17 %) of the studies. The results are shown in Table 47.1.

As shown in Table 47.2, most studies (82 %) dealt with professional software developers. The remaining (17 %) were conducted in an academic setting (e.g. Software Development course). Observed team sizes varied largely between studies. No particular focus on countries regarding the location of the team members could be observed. Regarding the year of publication, we found no suitable studies on the impact of KS platforms in RE prior to 2006 (Publications

Table 47.1 Studies after type of software development scenario

Software development scenario	Number	Percent (%)
Global Software Development (GSD)	9	52
Offshore Software Development (OSD)	2	11
General software development	3	17
Other	3	17
Total	17	100

Table 47.2 Overview on primary studies and their setting

ID	Reference	Research method	SD method	Professional/Student
S1	[38]	Multicase	OSD (RUP)	Students
S2	[10]	Survey	GSD	Professionals
S3	[9]	Survey	–	Professionals
S4	[39]	Survey	GSD (Scrum)	Professionals
S5	[26]	Singlecase	GSD	Students
S6	[40]	Singlecase	SD	Professionals
S7	[3]	Singlecase	GSD	Professionals
S8	[23]	–	GSD	Professionals
S9	[41]	Singlecase	GSD	Professionals
S10	[42]	Singlecase	GSD	Professionals
S11	[6]	Singlecase	GSD	Professionals
S12	[43]	Singlecase	–	Professionals
S13	[44]	Singlecase	–	Professionals
S14	[1]	–	OSD	Professionals
S15	[22]	Singlecase	GSD	Professionals
S16	[32]	Survey	SD	Professionals
S17	[45]	Survey	SD	Students

per year: 2006: 2 (11 %), 2007: 5 (29 %), 2008: 2 (11 %), 2009: 2 (11 %), 2010: 4 (23 %), and 2011: 4 (23 %)). In the following, citations starting with an uppercase "S" denote surveyed papers.

47.4.1 Challenges and Obstacles Addressed by Knowledge Sharing Platforms According to the Surveyed Literature

With the increasing number of integration projects and changing team setups the transfer of development knowledge becomes increasingly important [S4]. Studies described several obstacles that we tried to group according to the following scheme:

Inadequate communication: Several studies, e.g. [S4, S5, S14, S15, S16] report that the lack of face-to-face communication (e.g. "Communication gap" [S14]) is still a major inhibitor in RE. The inadequate measures available to early address communication problems often lead to costly problems and difficulties that spread over the different software development phase [3, 31, 32]. Inadequate communication is often due to a lack of common understanding of concepts. E.g. [S5] reports on the importance of commonly shared ontologies. Inadequate communication also often entails a lack of global project awareness as well as difficulties to transfer results between different business domains [S4, S14] (cf. "Interpretation" in [S8]). Trace-ability and the exchange of prioritization

knowledge still remains as a huge challenge in knowledge sharing practice [S8]. Few reported cases have addressed the challenge of discussing and tracking non-functional requirements [S5, S8].

Cultural diversity [S1, S2, S5, S7, S8, S11, S14, S15, S17] mention that, particularly due to recent outsourcing trends to Non-Western countries, cultural obstacles arise that must be addressed. According to [S7], a distinction can be made between differences in the individuals' culture as well as the corporate culture, the individual is part of. A problem highly related to the cultural diversity of stakeholder is that explicit knowledge on participating stakeholders is hard to share [S8]. In [S8] it is also reported that knowledge on different markets and customers varies largely between stakeholders.

Time difference: A rather frequently discussed problem, e.g. [S1, S2, S5, S7, S8] that is due to the fact that geographic separation of team members also often means that the time-zones of the team are also separated, and often even do not overlap. Different time zones also negatively influence the stakeholders' ability to quickly share information thus further worsening the communication problem. [S14] reports that adequate mechanisms for document maintenance and synchronization must be used.

47.4.2 Impact on Requirements Engineering

The overall goal of using KS platform to support KS activities in RE has been described by researchers: *"The aim of these knowledge intensive interactions, often embedded in requirements elicitation, analysis and verification activities, is to collaboratively transform the initial uncertain and ambiguous understanding of the domain problem into an application concept, consistent system requirements, and ultimately a software application that can be used by the target organization."* [S3]

[S4] observed that the majority of the participants view knowledge documentation as being important or very important. Regarding the scope of KS platforms used, [S4] observed that 47 % of surveyed agile developers use KS software supporting online discussions. Evidence is presented in [S5] that the selection of KS platforms, in that case groupware tools, which are closer to the stakeholders cognitive style measurably improved the stakeholders' perception of communication during the requirements elicitation phase. Stakeholder using a tool that did not match the cognitive characteristics led to a worsened perception of communication [S5].

From a technological standpoint, [S6] reported that a bias towards wikis existed for two reasons: (1) not many people knew about them and (2) personal bias existed toward new technologies. (1) can be easily understated by the fact that [S6] is among the oldest studies (2007) and awareness of Wikis and their use has increased in the meantime [33–37]. Several studies address how KS platforms are introduced and adopted in companies to improve the requirements elicitation

phase. The goal of [S5] was to develop and evaluate a framework to improve and understand communication during the requirements elicitation process. In [S14] a need for better trace-ability of requirements was established. In a similar vein, [S2] showed that it is important to identify stakeholder centric social networks in addition to purely managing communication responsibilities.

47.4.3 Reported Knowledge Sharing Platforms

The studies can be categorized according to whether they describe the results of (1) applying existing KS platforms in RE, (2) applying a KS platform developed by the authors in RE (3) analyzing KS platforms already used in industry settings. The established KS platforms described in type 1 studies are: e-mails, newsgroups, mailing lists, forums, electronic notice boards, shared whiteboards, document sharing, chat, instant messaging, wikis, and videoconferencing [S5, S7, S16]. The terminology for these technologies is used consistently across almost all studies. However no standardized definition of these KS platforms, in particular of "wikis", "document sharing" and "notice boards" could be found.

47.5 Discussion

This review identified 17 studies on the impact of KS platforms on RE. To the best of our knowledge, no systematic review exists in this domain. In this section, we address our research questions, starting by discussing the impact of KS platforms in requirements engineering, the strength of the evidence in support these findings as well as limitations and future implications for industry and research.

Impact of knowledge sharing platforms in requirements engineering: Studies addressing the introduction and adoption of KS platforms in RE processes fail to establish a unified picture of current practice. They provide sparse views into the experience of RE teams with KS platforms. For all the identified challenges (c.f. 4.1), KS platforms were reported to have a positive impact. However, little to none details on the actual impact and its quantification could be identified in the studies. Common agreement exists on the fact that KS platforms are required in any distributed RE setting. While KS platforms are often not explicitly named as such, there seems to be a common agreement on what KS platforms are. The reported impact was positive in all studies irregardless of the technical specifics of the KS platform, no negative reports could be identified. Apart from multitasking problems when using multiple KS platforms, no negative impacts were reported.

Strength of evidence and implications for research and practice: The findings of this review have a number of implications for research and practice. For research, the review shows a clear need for more empirical studies of KS platforms and their impact on RE. KS platforms seem to have become so

ubiquitous in recent years that hardly anybody seems to question their use-fullness or wants to evaluate their impact empirically. In our opinion, much more structured research is necessary to understand how KS platforms affect RE and how to properly respond to the broad adoption of such platforms. We have also seen during the review that Wikis seem to be, with rare exceptions, the only general purpose answer. Therefore, research on (1) other KS platforms and (2) the various types of Wikis is highly warranted, as there does not seem to be a common agreement on what functionalities such a Wiki must provide to successfully support RE. Another challenge is to increase the quality of the reported research results. In order to increase the usefulness of research on KS platforms and their impact on RE, we believe that researchers in the fields of KS and RE should collaborate to determine a common research agenda. The most relevant evidence for practice from the systematic review is that there exists a general agreement that KS platforms in general have a positive impact on all stages of the RE process. However, it is almost impossible to offer advice besides "use a KS platform to improve your RE processes", as there is often no evidence reported in the studies. Also it is almost impossible to compare an arbitrary industry setting against the studies as most of them lack the necessary details to make a well informed comparison. Therefore, this review only provides an initial overview to practitioners that need to carefully compare existing KS approaches to their own needs. This review clearly shows the need for knowledge and requirements engineering researchers to conduct more research in the future. We also urge companies to more openly participate in these research projects as the sometimes observed "unwillingness" to share data negatively impacts the quality of reported research.

Limitations of this review: The main limitations of the review are bias in the selection of publications and inaccurate data extraction. To minimize the selection bias, a research protocol, selection criteria and the specific research questions were developed beforehand. Building on that we created search terms for literature selection. As other systematic literature reviews before, this review also suffers from the fact that keywords are not standardized. While we used rather broad search terms, the risk of omitting relevant literature could not be completely mitigated. To further decrease the problem of selection bias, a carefully executed multi-stage process for selecting relevant literature was chosen. The data extraction phase suffered from the fact that almost all lacked sufficient details about the design and findings of the study. Very often, the study was a "by-product" of a developed methodology or tool. However, due to the fact that only 17 studies were identified for inclusion, a manual data extraction could be performed on all articles. During the manual data extraction, we frequently found that the researchers inadequately described the set-up, issues of bias and validity were almost never addressed and applied methods were hardly ever explained. Overall, a satisfyingly presented study could not be found. Therefore, there is a possibility that the data extraction may have resulted in inaccurate results.

47.6 Conclusion

We identified 475 studies from search of the literature in electronic databases, of which 17 were found to be relevant studies of acceptable rigor, credibility, and relevance. The literature fell into three thematic groups: evaluation of out-of-the-box tools, surveys, and evaluation of one KS platform developed by the authors. We identified a number of reported challenges and benefits of the introduction of KS platforms to RE processes. However, the strength of evidence is very low, which makes it difficult to make highly convinced suggestions to industry. Therefore, practitioners are highly advised to assess the findings in careful comparison with their own situation without prematurely making generalizations.

A clear finding of this systematic review is that the number and quality of studies on the impact of KS platforms must be increased. In particular, many of the already established KS paradigms such as wikis warrant further detailed attention.

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Chapter 48
Investigation of Key Resistance Factors in Knowledge Sharing Towards Information Security Culture in Healthcare Organization

Noor Hafizah Hassan and Zuraini Ismail

Abstract With the rapid technological change in health informatics environment, the security incidents are likely to occur. Thus make it important for the employee to acquire security knowledge to minimize the incidents. Previous literature addresses the issues on motivation towards the employee in knowledge sharing. Little has pay attention on the resistance factors that become the barrier in knowledge sharing in information security. This paper identifies the similarities of Knowledge Management (KM) and Information Security Management (ISM) according to previous literature. The purpose of this paper to investigate the key resistance factors in knowledge sharing towards information security culture healthcare organization. Based on secondary data collected, the key resistance factors identified are behavior, lack of trust, lack of communication, low security awareness, personality differences, cultural differences, lack of top management commitment and openness to experience. This in-progress study will be use to design a conceptual model to show the relationship between knowledge sharing and information security culture and further tested with selected healthcare organization.

Keywords Knowledge sharing · Security culture · Healthcare organization

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48.1 Introduction

The implementation of health information technology and electronic exchange of patients' information will form privacy violations and security breaches. The needs to take social aspects of information security are essential when technological tools are less practical [1]. This require full participation and commitments of all level employees to establish such a system and implementing it. Building information security culture is one approach to make sure that employees are responsible in minimizing any security incidents [2]. A good information security management should follow confidentiality, integrity and availability elements [3]. To fulfill these requirements, healthcare practitioners must be able to acquire knowledge regarding information security [4]. This helps the employee to create security culture in healthcare organization.

The research on knowledge management gives tremendous values and implementation towards healthcare organization particularly for health informatics environment. It is a must to create a KM infrastructure to measure the value of knowledge inside the hospital system within the organization [5]. Even there is a tool is developed for leveraging and sharing the intellectual capacity of the knowledge in the healthcare. Different focus of KM is being pointed according to the organization background. As in healthcare organization, five major components described in [6] which are (1) Communities of practice; (2) Content management; (3) Knowledge and capability transfer; (4) Performance results tracking; and (5) Technology and support infrastructure. Healthcare organization that seeks to deploy and implement KM must understand human element throughout the process. The transformation of health care delivery system especially in health informatics environment into more error-free with cost effectiveness will succeed through the proper KM approach implemented.

The creation of KM system enables the healthcare practitioners to have a portal that allows them to refer for any question and answer [7, 8]. However, this KM system is not yet being established in health informatics environment for information security context. Thus, it requires an understanding of the KM in health informatics environments and ISM. Knowledge sharing is important to ensure that the healthcare practitioners build information security culture. This paper makes an attempt to investigate the key resistance factors that become security barriers in knowledge sharing towards information security culture in healthcare organization. It reviews the current KM approaches on ISM and related literatures on possible knowledge sharing with the purposes of offering a more comprehensive security culture.

This paper is divided into 5 sections. The fist section is describing on the purpose and background of the problem on this study. In the second section, a literature review on KM is reviewed accordingly. Then in the next section the similarities of KM and ISM is explored. In the fourth section, the key resistance factors of knowledge sharing are discussed. On the last section, this paper concludes by giving discussion on the research, limitation and future direction of this research.

48.2 Knowledge Management in Health Informatics Environment

KM is refer to the process of acquire, store and disseminate knowledge between communicate in the organization. A successful KM system requires long-term strategy aligned with healthcare practitioners information needs, works process and environment for the purpose of usage in health informatics environment. In [9] stated that one of the most popular KM approaches in service-based are by providing communication support for one-to-one interaction via multiple media in building a culture of mutual support [10].

Health informatics that seeks to deploy KM in their approach, must understand human element throughout this process [11]. It is important to highlight the cultural factors to ensure that KM is aligned with healthcare settings [12]. The requirements of health information system that need to be designed for the purpose to store knowledge are urge need by healthcare practitioners in clinical practice, user-friendly KM tools, accessibility and minimum security barriers [8]. KM approach in healthcare organization must be more holistic, integral, organizational, which makes a use of knowledge as a multidimensional concept.

48.2.1 Knowledge Sharing

Knowledge has been identified as an essential foundation of the competitive advantage and value creation [13]. Knowledge sharing is refers as the process of exchanging amount of knowledge among individual and within and among teams, organizational units and organization [14]. This research focuses on knowledge sharing between individual in one who communicate it and the other who can assimilate it. However, there is a case where knowledge barriers become the issues in information sharing that originate from the individual and organizational barrier [15]. In information security, knowledge sharing is important to ensure that the knowledge can be transfer, disseminate and distribute to make it available to those who require it. Manager's knowledge of how an organization information security functions will affect the ISM in minimizing the security incidents [16].

Among the main reasons why communities of practice are effective tools for knowledge sharing is the fact that much of an individual's knowledge is intangible and tacit in character [17]. There are few studies on knowledge sharing health informatics environment. In [18], they has figured out the sustainable knowledge sharing within the health informatics environment are through blog by delivering it into: (1) self knowledge (2) validation (3) non-competitive environment (5) medium of health informatics environment (6) moderator. Physician's intention to share knowledge is influence by attitude, subjective, norms and personal behavior [19]. While in [20, 21], they have identified knowledge gap and flow as part of knowledge sharing among healthcare providers analysis.

48.2.2 Knowledge in Security Culture

In instilling the security culture in the organization, one of the biggest issues facing an organization's information is influence by the knowledge. In achieving employee who is knowledgeable can be achieve by using the concept of knowledge transfer and knowledge creation. [22] proposed to use Nonaka's Modes of Knowledge Creation between tacit and explicit knowledge to ensure that knowledge can be created and disseminated. The model introduced by Schein in 1995 to ensure that the knowledge can be embedded in the organization [23, 24]. Six principle in information security in order to transfer tacit to explicit knowledge from the perspective of senior management and identifying the roles to protect the information [24].

By sharing relevant knowledge can strengthen information security culture in value net companies [25]. As found in study in Australian SMEs, knowledge sharing, cooperation and collaboration were found important at individual and organizational level in order to develop information security culture [26]. Most of the knowledge in information security is from workplace where legislation and regulation is existed to provide clear motivations [27]. In building information security culture, basic security knowledge is needed to help the employee to adapt

Table 48.1 Comparison between information security management in healthcare informatics environment and knowledge management (Adapted from [32])

Knowledge management	Criteria	Information security management
Share their individual tacit and explicit knowledge with others to form and establish a comprehensive body of knowledge that can be used over the organization.	Dependence on People	Healthcare practitioners must be able to behave in a secure manner based on established procedure and mechanisms that making the right decision in case of unforeseen events.
Making use of this existing knowledge results in a higher working efficiency	Production of Public goods	Organization must be able to ensure that healthcare practitioners perform an appropriate information security practice to ensure that they protect patients' privacy and did not leak any confidential medical record for the purpose of public goods.
Enhancing visibility and accessibility of an organization's existing knowledge for every member Individual knowledge to generate profit for the organization as a whole.	Positive effect on usable knowledge	ISM aimed to decreasing the security incidents by applying the confidentiality, integrity and availability to the body of exclusively usable knowledge through achieving the goal of confidentiality of medical records
By restoring of existing and creation of new knowledge gain benefits to the organization regardless of exceeding the budget.	Challenge optimization	The amount spend on the information security might be not as expected even though the healthcare organization has invest a lot of money on security technology and tools.

security practice amongst organizational member. Six principles to ensure the knowledge creation in transferring from tacit to explicit knowledge since knowledge should be externalized in order to perform security task effectively in [28].

48.3 Knowledge Management and Information Security Management

KM has been widely implemented in ISM researches. ISM content is varying according to institution and organization. Organization can have a systematic approach on each objective identified by management in information security to ensure that the knowledge can be acquire through a needed resources [29]. A framework that makes use of KM in integrating with ISM for the purpose of risk management activity is proposed [30]. The concept of KM is also being use in case of banking to ensure that manager's awareness and knowledge of information security can be acquire to the employee [31]. There are few similarities described by [32] in

Table 48.2 Key resistance factors in knowledge sharing for healthcare organization

Key resistance factors	Description	Authors
Behavior	Healthcare practitioners reluctant to contribute information, use the provided toll and sharing the ideas on information security	[13, 35, 36]
Lack of trust	Healthcare practitioners had lack of trust in the accuracy and credibility of knowledge due to the source that they received	[37–39]
Lack of communication	The hectic business concept of healthcare organization reduce amount of communication among healthcare practitioners. Medium chosen to deliver the knowledge is not appropriate or accessible to the healthcare practitioners	[40, 41]
Low security awareness	Educating healthcare practitioners with the knowledge security awareness through security policy and procedures	[42–44]
Personality differences	Personality differences such as age; gender makes the healthcare practitioners reluctant to share the knowledge	[45–47]
Cultural differences	Differences in national culture or ethnic background; and values and beliefs associated with it such as language differences	[48–50]
Lack of top management commitment	Top management need to guide the healthcare practitioners towards adapting information security	[51–53]
Openness to experience	The unwillingness of healthcare practitioners to share their knowledge based on their intellectuality	[11, 54, 55]

comparing KM and ISM in the organization. Table 48.1 shows the similarities criteria of KM and ISM in the context of health informatics environment.

48.4 Key Resistance Factors in Knowledge Sharing

Knowledge barriers within the organization of information security has well discussed in [33, 34]. By extracting from the previous literature, key resistance factors in knowledge sharing are investigated accordingly. Hence, this key factor is identified to make it useful in healthcare organization.

Table 48.2 shows the key resistance factors that have been identified based on secondary data collected. The key factors identified are behavior, lack of trust, lack of communication, low security awareness, personality differences, cultural differences, lack of top management commitment and openness to experience becomes the resistance factors for the healthcare practitioners to adopt information security practice. The factors identified will be guidance for the top management towards building information security culture in healthcare organization. It might help the top management in building a good security policy standard strengthening to these factors in order to minimize the security incidents. It also guides the top management to create an efficient knowledge sharing in designing ISM strategy by looking on the factors identified.

48.5 Conclusion and Future Works

An investigation of KM and ISM has been conducted throughout this research and presented in this paper. This investigation encourages the organization to adapt KM approach in implementing ISM. This paper able to identify the key resistance factors in knowledge sharing that will be the barrier towards information security culture in healthcare organization. The key resistance factors identified are behavior, lack of trust, lack of communication, low security awareness, personality differences, cultural differences, lack of top management commitment and openness to experience. Healthcare organization that aimed to apply KM strategy and integrated with knowledge sharing need to focus more on the key resistance factors identified. The key factors identified offers more comprehensive ISM strategy for management to share the organization's current security knowledge base and requirements among healthcare practitioners to promote information security culture. The next stage of the study is by designing a conceptual model that shows relationship between the key factors identified and knowledge sharing. Then the model designed will be use to test with the selected healthcare organization in Malaysia.

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Chapter 49
Mainstreaming Indigenous Knowledge in Climate Change Response: Traditional 'Rainmaking' in Kenya

Tom Kwanya

Abstract A number of Kenyan communities practise traditional rainmaking rituals. Although rainmaking processes, materials and participants vary, most communities believe that the tradition enables them to predict, cause, redirect or dispel rainfall. Although some modern scientists have dismissed the practice as irrelevant, irrational and ineffective, others advocate its integration to conventional meteorological approaches. Given the gravity of the impact of climate change in Kenya, most stakeholders concur that mainstreaming rainmaking traditions in the national climate change action plan would result in a better response to the phenomenon.Data for this study was collected through key informant interviews, documentary analysis and participation in stakeholder forum discussions. The author proposes that traditional rainmaking can be mainstreamed in the national climate change response through validation of the tradition through scientific research; integration of traditional rainmaking in modern meteorological processes; integration of traditional rainmaking in meteorological training curricula; commercialisation of the practice; patenting of rainmaking materials and processes; documentation and preservation of traditional rainmaking; and popularisation of the tradition. The author concludes that mainstreaming rainmaking in the climate change action plan has the potential to facilitate a better interpretation of weather patterns leading to equally better coping mechanisms; conservation of natural ecosystems; regulation of exploitation of the natural resources; better understanding of scientific weather forecasts through local contextualisation; and increased community participation in the management of the consequences of climate change. These findings can be used by climate change researchers, ethnographic researchers, governments as well as institutions or individuals managing climate change in Kenya and beyond.

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49.1 Introduction

Many definitions of climate change exist but it is generally perceived as any change in climate over time—typically a decade or longer—whether as a result of a natural variability or human activity, which alters the composition of the global atmosphere [2, 3, 15, 24]. Climate change is commonly exemplified through rising atmospheric temperature, precipitation, cloud cover, rising sea level, recession of glaciers and melting of sea ice, longer severe droughts, extension of sub-tropical deserts, loss of biodiversity, and acidification of oceans, among others [12, 22, 23].

Climate change is one of the greatest and most complex challenges facing the world today. Studies have shown that 90 % of natural disasters result from severe weather and extreme climate change phenomena [8, 12, 23]. Climate change researchers predict that if the current trends of climate change are not reversed then over the next decade, billions of people will face greater life and health risks emanating from water and food shortages [8, 23]. Developing countries, like Kenya, are the most vulnerable to climate change impacts because they lack adequate social, financial and technological resources to adapt to or mitigate it accordingly.

Environment-unfriendly human activity such as unsuitable agricultural practices, poor soil and water management, deforestation, overgrazing and pollution constitute the most forceful drivers of environmental degradation in Kenya [8]. These activities have a great impact on the socioeconomic development and general wellbeing of Kenyans which is twined with environmental management. Anxiety is already building that if the current climate change trend is not managed well then it will endanger Kenya's vision of becoming a prosperous country with a high quality of life for all its citizens by the year 2030. Indeed the Government of Kenya estimates that the direct costs of climate change damage in the country will potentially amount to between one and two billion US Dollars annually by the year 2030 and considerably greater if indirect costs are included [8]. Actually, the cumulative impacts of climate change over the next two or three decades have the potential to reverse much of the progress made by Kenya towards the attainment of the Millennium Development Goals (MDGs) and its own Vision 2030.

For instance, agriculture which is considered as the backbone of Kenya's economy is one of the sectors on which climate change has a great impact. Kenya generally experiences major droughts every ten years and minor ones every three years. It is emerging that the incidence of major droughts is getting more frequent, now estimated at about five years [10, 13, 20]. Since agricultural activities in the country rely on rainfall, the impact of the frequently recurring droughts on food production and gross domestic product can be devastating [18, 20]. The other vulnerable sectors of the economy are water, energy, forestry, rangelands, health, social and physical infrastructure.

In order to enhance its preparedness to reduce vulnerability and build resilience of the society in line with the provisions of the United Nations Framework Convention on Climate Change (UNFCCC) and its implementing instrument–the

Kyoto Protocol–the Government of Kenya launched a National Climate Change Response Strategy (NCCRS) in 2010. The primary focus of the NCCRS is ensuring adaptation and mitigation measures are integrated in all government planning, budgeting and development objectives. In order to operationalise the NCCRS, the Government of Kenya has prepared a comprehensive Climate Change Action Plan (CCAP). It is noteworthy that the NCCRS has identified knowledge management as one of the key strategies of facilitating appropriate response to climate change in Kenya. The NCCRS also recognises indigenous knowledge on climate change as important to Kenya's response to the phenomenon.

49.2 Theoretical Approach

The author used the knowledge worldview model outlined by [6]. This model classifies perceptions of knowledge into two broad categories, that is, indigenous and scientific knowledge. Fleer [6] explains that these sets of knowledge define one's worldviews. She points out that while indigenous knowledge is founded on traditional worldview and produced for specific purposes to maintain particular societies, scientific knowledge is founded on the "civilised" worldview and produced for the sake of it. She argues that while scientific knowledge seeks power over nature and people, indigenous knowledge seeks to coexist with the same. She describes scientific knowledge as being materialistic, reductionist, rational, decontextualised, individual and competitive. On the other hand, she extols indigenous knowledge as being spiritual, holistic, intuitive, contextualised, communal and cooperative.

Although there appears to be a clear dichotomy between indigenous and scientific knowledge, this division is not realistic. These sets of knowledge interact with and influence each other. For instance, indigenous knowledge can be investigated, validated and documented as scientific knowledge. Thus, indigenous knowledge can produce scientific knowledge and vice versa. This illustrates the closeness of the two sets of knowledge.

49.3 Indigenous Knowledge

Also known as traditional knowledge or local knowledge, indigenous knowledge refers to knowledge systems embedded in the traditional cultures of regional or local communities accumulated, renewed and perpetuated through several generations. This body of knowledge includes technologies, know-how skills, safety and survival skills, practices, and beliefs which enable the community to exist favourably in its immediate and surrounding environment. Thus indigenous knowledge is unique to a specific culture and community [5, 11]. Ossai [21] describes indigenous knowledge as being local (location or culture specific), tacit,

oral, experiential, intuitive, learnt through repetition and necessitated by survival needs. Existing indigenous knowledge influences the local-level decision making in agriculture, health care, food preparation, education, natural-resource management, and a host of other activities in the concerned communities [9, 16, 25].

49.4 Traditional Rainmaking in Kenya

The concept of rainmaking in Kenya is basically founded on indigenous observations and interpretations of meteorological phenomena that have guided seasonal and inter-annual activities of local communities for millennia. This knowledge contributes to climate science by offering observations and interpretations at a much finer spatial scale with considerable temporal depth and by highlighting elements that may not be considered by climate scientists [17].

Rainmaking is a deeply rooted tradition in a number of Kenyan communities. Traditional rainmaking is a form of magic or prayer through which human beings influence weather conditions to cause rain or drought so as to bless or curse a community. Akong'a [1] explains that rainmaking could be a public event in which members of the community participated freely. He explains further that it could also be a private function led by known rainmakers able to diagnose the causes of either drought or too much rain and have the power to reverse the situation. Were [7] explains that rainmakers were so influential that they could climb up the social ranks to be chiefs or kings in their communities. Were [26] concurs with [7] and cites a case where a Luhyia ruler in Western Kenya was replaced by an alien—a Maasai—because he could not intercede and make rain during a devastating famine. Akong'a [1] further suggests that rainmaking tradition may have emerged from the communities living in the arid and semiarid regions as a means of coping with or mitigating unreliable and/or inadequate rainfall. Nonetheless, he acknowledges that rainmaking is also practised in some communities living in areas experiencing adequate rainfall. He says that in the latter case, rainmaking is a prestigious profession practised by elites keen on helping or exercising control over their communities. Regardless of its history, rationale or practice, the emerging challenges in climate change in Kenya is steadily turning people's attention to this traditional practice. The Akamba, Maasai, Meru, Kikuyu and Luhyia are some of the communities practising traditional rainmaking in Kenya.

The Akamba community held special rituals and dances known in their language as *kilumi* to pray for rain during droughts. The prayers were led by rainmakers or prophets who were believed to have the power to redirect or predict rainfall. Accounts of the actual procedures during rainmaking rituals are varied. However, it emerged that *kilumi* generally began with libations and prayers followed by beating of drums, blowing of whistles, shaking of rattles, singing and intense vigorous dancing. The community believed that unseen rainmaking ancestral spirits attended the dances. The participants therefore were obligated to

make an excellent performance to impress the spirits. Korster [14] and [1] explain that *kilumi* dances were also accompanied by sacrifices such as the blood of animals, milk, seeds, crops, beer or cooked food to appease the spirits. This is because droughts were considered as curses for wrongdoing. Successful *kilumi* dances ended with celebrations as the community members expected a favourable response of rain from the spirits. Most *kilumi* rituals were public requiring the participation of all members of the community [1, 14]. Indeed [1] explains that rainmaking occasions were chosen and announced in advance by old men or the rainmakers. The actual day was sacred and the members of the community were supposed to observe peace and purity; abstaining from quarrels and sex.

Another well known rainmaking tradition in Kenya is practised by the Nganyi clan of Bunyore sub-tribe of the Luhyia community living in Vihiga County, Western Kenya. It is believed that Nganyi, the patriarch of the clan was taught the art of rainmaking by an old lady from the neighbouring Nandi County. Other accounts, though agreeing that Nganyi was indeed taught the art by a foreign lady, suggest that the said lady was from Gwassi in Homa Bay County across Lake Victoria. As opposed to other rainmaking traditions, the Nganyi rainmaking power is only in the patriarch's family and is inherited by his kinsmen. These rainmakers practise their magic secretly—not even in the company of their heirs—only bequeathing the power when he is nearing his own death. For this reason, the details of the actual rainmaking process among the Nganyi family remain the guarded secrets of the rainmakers. The rainmakers are given livestock, money and other gifts to make rain to fall during drought or not fall during an important occasion such as a wedding or sports day. Akong'a [1] reports that the apparent belief in the power of traditional rainmakers was exemplified during Kenya's independence celebrations in 1963 when a Nganyi rainmaker was invited to Nairobi to ward off any rainfall during the historic occasion. To date the belief that the rainmakers have the power and medicines to cause or repel rain is still rampant in Western Kenya. Similar practices have been reported among the Maasai, Meru and Kikuyu with minor variations. Nonetheless, they are similar in several respects and closely mirror the biblical story of Prophet Elijah who caused rain to fall in Israel after a devastating three-year drought.

49.5 Problem Statement

Indigenous knowledge such as traditional rainmaking have the potential to offer valuable insights into environmental change due to climate change, and complement broader-scale scientific research with local precision and nuance [17]. Furthermore, given that most communities apply their indigenous knowledge to respond to the consequences of unstable environments, the same strategies may be applied in adapting to or mitigating the impact of climate change on them. In spite of its apparent potential, traditional rainmaking has not been effectively integrated into climate change mitigation or adaptation initiatives in Kenya. This situation

can be attributed partly to the lack of strategies to bridge the gap between scientific knowledge and indigenous knowledge. Mainstreaming of indigenous knowledge in scientific climate change strategies or plans is one way of bridging this gap. This study investigated the role of indigenous knowledge in facilitating effective climate change response in Kenya. It also explored the concept of traditional rainmaking in Kenya as well as the extent to which it is being incorporated in the climate change response by environmental management stakeholders in the country. The study also analysed the strategies currently being used to integrate rainmaking in the climate change response in Kenya and suggests more ways of mainstreaming the practice effectively.

49.6 Methodology

This study was conducted using the survey research method. Data was collected through key informant interviews and documentary analysis. Thirty-one respondents drawn from the Government of Kenya agencies and institutions; research and academic institutions; civil society organisations; members of the rainmaking communities; and the private sector participated in the study. The respondents were selected through information-oriented purposive sampling and snowballing. The author also participated in two climate change stakeholder forums organised by Kenya's Ministry of Environment and Mineral Resources (MEMR), as part of the national process to develop an action plan for the NCCRS.

49.7 Findings and Discussions

The findings of the study are presented and discussed hereunder:

49.7.1 Role of Indigenous Knowledge in Climate Change Response in Kenya

All the respondents agreed that indigenous knowledge can play a major role in helping local communities to deal with the effects of climate change in Kenya. They identified indigenous knowledge relating to farming methods; livestock breeding; traditional systems of governance such as Njuri Ncheke of the Meru community and Kaya of the Mijikenda; as well as rainmaking among the Luhyia, Akamba and Maasai communities as having a great potential to facilitate a favourable climate change response in Kenya.

The respondents pointed out that indigenous knowledge helps the communities to interpret or predict climate change indicators and develop coping mechanisms. In agricultural communities in the Rift Valley, for instance, this knowledge may be applied to determine what crops to plant and when. In pastoralist communities in Northern Kenya, on the other hand, such knowledge can be applied in breeding livestock which are resilient to harsh weather. Still in some communities the knowledge can be used to preserve seeds and livestock species threatened with extinction by unfavourable changing climatic conditions.

The respondents also explained that indigenous knowledge enshrined in traditional governance systems can be used to regulate the conservation and exploitation of natural resources such as forests which have impact on mitigating climate change. Among the Mijikenda in Coast Province, the Kaya elders regulate access to and exploitation of forest resources. Some of these are large forests of indigenous trees which are used as sacred shrines for prayers, rituals and sacrifices. The sanctity and integrity of these shrines have been preserved by the Kaya elders using myriad taboos and traditional rules. This practice has preserved several forests in spite of the rising population pressure and socioeconomic activities in the province. In fact, some of the sacred forests have now been gazetted and preserved. These forests have some of the richest collections of natural flora and fauna in the country.

The respondents also said that local communities utilise indigenous knowledge to validate scientific approaches to climate change management. Thus scientific approaches which are in tandem with the indigenous knowledge have the potential of being adopted widely than those which do not. To support this view, the respondents cited the case of traditional rainmaking in predicting weather patterns. They explained that communities practising rainmaking have little regard for scientific weather forecasts. When these sets of forecasts conflict, the communities trust and act on those given by the traditional rainmakers than the scientists. In such cases, therefore, the communities use indigenous knowledge as a filter for the other bodies of knowledge on climate change. Communities are repugnant to climate change response approaches that undermine or ignore their indigenous knowledge.

Integrating indigenous knowledge in climate change management initiatives also facilitates participatory, bottom-up and concerted response to the phenomenon. It is an acknowledgment of the capacity of the communities to deal with the climatic extremes over the years. It is also an expression of confidence that the communities are able to deal with the emerging climatic vulnerabilities by fusing their indigenous knowledge with modern ideas. Thus climate change response is projected as an internal community affair which is only supported by external actors for the benefit of the community.

Indigenous knowledge, due to its closer contextualisation, makes more sense to the communities when applied to climate change issues. Application of indigenous knowledge leads to locally relevant adaptation and mitigation strategies which have a higher potential of success. In fact, it is noteworthy that most traditional practices are environment-friendly because indigenous communities engage in

moral economies which are sustainable. This is largely because the communities depend on the local natural environment for sustenance. Thus they understand the consequences of environmental degradation and have over the years developed mitigation strategies. The use of indigenous knowledge therefore makes the climate change issue to be immediate and urgent and stimulates prompt appropriate action. In this way, indigenous knowledge acts as a catalyst to appropriate climate change response. Similarly, indigenous knowledge can be used to communicate climate change adaptation and mitigation interventions more effectively leading to greater adoption and compliance.

Importantly, the respondents pointed out that in inasmuch as indigenous knowledge is important for climate change response, it should not be elevated above conventional knowledge. They explained that indigenous knowledge and conventional knowledge should complement each other in exploring and executing an appropriate response to climate change in Kenya. They said that a close analysis of either approaches reveals very close similarity of principles, interests and ultimate goals. This view was also expressed in the reviewed literature which advocated the fusion of indigenous and conventional knowledge to develop best practices in responding to climate change [4, 19]. Nyong, Adesina and Elasha [19] emphasise that using either of the systems of knowledge on their own would generate least benefit than using an appropriate mix of both. They also explain that using both systems of knowledge provides mechanisms for dialogue between communities and scientists leading to meaningful and successful projects.

The respondents also cautioned against the belief by some people that all indigenous knowledge is beneficial to climate change. They cited the example of charcoal burning, weaving and other traditional economic practices which lead to environmental degradation. Similarly, they pointed out that even beneficial indigenous knowledge cannot be applied in every climate change situation. They recommended a careful analysis of each knowledge vis-à-vis the prevailing climate change scenario to determine applicability.

49.7.2 Perception of Rainmaking

The reality, relevance and effectiveness of rainmaking have been the topics of discussion among many meteorologists in Kenya and internationally. The majority (58 %) of the respondents believed that traditional rainmaking practices are real. It is noteworthy that most of the respondents who stated they do not believe in traditional rainmaking practices were meteorologists and other scientists. These respondents asserted that the perceived rainmakers have no power or magic to make or redirect any rain. They further described the practice as primitive, outdated, irrational and ineffective. Those who believe in the tradition, on the other hand, rebutted the arguments by stating that the success of rainmaking ritual sometimes is influenced by the faith and purity of the participants. This view is supported by social scientists like [1] who assert that rainmaking is true and real.

In fact he predicted that the practice will survive for generations. To support his view, he cited a case reported by the *Daily Nation*[1] on 28 April 1984 in which Meru elders reportedly participated in a rainmaking ritual which caused rain to fall and spared the community the devastation of the infamous drought and famine which ravaged the Horn Africa, especially Ethiopia, that year. He suggested that the government should not just permit but also encourage people to participate in rainmaking events during droughts.

49.7.3 Rainmakers Should be Integrated in the Climate Change Response

Again, the majority (54.8 %) recommended that traditional rainmakers should be involved actively in the climate change response in Kenya. As expected this view was held by the respondents who believed in the practice. It is noteworthy nonetheless, that 3.2 % of these respondents did not support the involvement of the rainmakers in climate change response even though they believed in the practice. They explained that the practice varies from community to community and may not be possible to harmonise at the national level. They further argued that rainmaking applies traditional science which cannot be combined with the conventional scientific approaches without conflict. Other respondents with this view also pointed out that it may be expensive to involve rainmakers in the national climate change response.

49.7.4 Strategies Currently Used to Mainstream Rainmaking in Climate Change Response in Kenya

One of the strategies used to mainstream traditional rainmaking in the climate change response in Kenya is integrating the practice in conventional meteorological research. So far various stakeholders have made efforts to bring together meteorologists and rainmakers especially to conduct weather forecasts. One such project involves a group of the traditional Nganyi rainmakers which is partnering with a team of scientists and researchers from two public universities and the Kenya Meteorological Department to study the adverse effects of climate change in Western Kenya. Researchers from Maseno University and the University of Nairobi, and a team from the IGAD Climate Prediction and Application Centre (ICPAC) are taking part in the project. The decision to bring the rainmakers on board in the project is based on the recognition of their unrivalled indigenous knowledge of weather patterns in the region. The rainmakers rely on the

[1] One of the leading daily newspapers in Kenya.

movement or mating of particular animals, birds and insects as well as leafing, budding or flowering of trees to interpret weather changes in specific regions. So far the collaboration has demonstrated that both "sciences" are valid and usable in the local context. Similarly, the forecasts thus produced have been disseminated through non-conventional means and have been received better by the communities.

The above project and others have also provided a framework for sharing information on the traditional rainmaking approaches. One of the ways this is being done is including these approaches in the curricula of the relevant university courses. These courses also provide a mechanism for validating the traditional approaches. Thus the knowledge is refined and improved over time. Key informants reported that Great Lakes University of Kisumu is one of the institutions of higher learning which have so far integrated traditional rainmaking in their curriculum. This approach is recommended by numerous scholars [1, 4, 14]. It is hoped that over time some institutions will even devote whole units to traditional rainmaking.

49.7.5 Strategies Which can Enhance Mainstreaming of Rainmaking in Climate Change Response

Another strategy which can be used to mainstream rainmaking is by popularising the tradition. As explained earlier the debate on whether the practice is relevant in modern times or not is ongoing. Climate change stakeholders should develop appropriate public awareness and communication plans to popularise the useful facets of traditional rainmaking in the emerging climate change scenario. This could be done through demonstrations of the traditional rainmaking processes, public lectures, publications, conferences and public meetings. Effective dissemination of adequate information about the tradition will demystify it and enhance its wider acceptance by the communities.

Traditional rainmaking can also be mainstreamed by commercialising the practice. This can be done by formally recognising the practice and the rainmakers as important contributors to climate change management. This recognition will ensure that the rainmakers are able to devote their time and resources to improve and perpetuate the skill as way of livelihood. Commercialisation may also be achieved by attaching traditional rainmakers in specific regions to the respective local weather stations. This way, the rainmakers can work as consultants complementing the work of conventional meteorologists and getting some form of compensation for their effort. Commercialisation may also be achieved through patenting the traditional rainmaking materials and processes. This will ensure that the bonafide rainmakers' commercial and intellectual rights are protected effectively. Kenya has already lost several sets of valuable but unprotected indigenous knowledge to foreign agencies and/or individuals. In the case of traditional rainmaking, this loss can be avoided through patenting.

Documentation and preservation of the traditional rainmaking knowledge is another way of mainstreaming it. Documentation not only facilitates effective sharing of the knowledge but also streamlines it. Preservation, on the other hand, enhances accurate perpetuation of the knowledge through the generations. Documents on traditional rainmaking will provide references for the practice and stimulate dialogue on the place of the practice in modern Kenya. Documentation of the tradition could be done on video, audio, photography or text saved on resilient and user-friendly media. These documents can be accessed from regional museums, community libraries, national archives and relevant research or educational institutions. Documentation of the practice should be done from cultural and scientific perspectives.

The stakeholders involved in climate change management in Kenya have developed a Knowledge Management for Climate Change (KM4C2) online portal to increase the creation, validation and dissemination of climate change knowledge and tools in Kenya. This facility provides potential climate change knowledge users in Kenya with a resource to explore, evaluate, synthesise, and learn about climate-related vulnerabilities and risks at multiple levels of details. The portal has provisions for diverse knowledge sources. However, there seems to be no provision or linkage with traditional rainmakers and other indigenous knowledge sources. The stakeholders should harness the obvious potential of this portal and other ICTs to facilitate the effective documentation, validation, organisation, transfer, retrieval and use of traditional rainmaking and other forms of indigenous knowledge on climate change in Kenya.

49.8 Conclusion

The gravity of climate change and its consequences to developing countries such as Kenya requires a multipronged response. Conventional adaptation and mitigation approaches are being advanced but equally beneficial practices such as traditional rainmaking have not been given the attention they require. This paper demonstrates that mainstreaming rainmaking can enhance Kenya's response to its climate change challenges. The relevant stakeholders should take the recommendations above seriously and integrate traditional rainmaking as much as possible to climate change interventions throughout the country. This will leverage the benefits already being recorded by the projects discussed above and boost the country's preparedness to adapt to and mitigate the impact of climate change.

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Chapter 50
ICT as a Means of Generating Knowledge for Project Management

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Abstract This research is aimed at businesses or organizations that find in the information and communication technology ICT, a means to generate knowledge in project management, recognizing competitive advantages by leveraging the basic specifications that techniques, tools and applications used by ICT give as an important contribution for profit in the execution of a project. These technologies are analyzed from the main factors assessed for both success and failure of a project, among which lack of collaborative work from the project team and others involved can be evidenced, as well as their interactions and the way each individual tackles and meets their functions. In a competitive environment, highlighting that collaborative work, performed through the use and appropriation of information and communication technology is fundamental, increasing not only the sense of belonging to the execution of a project, but the application of better practices, built out of mistakes and experiences from the team members. As a consequence to this approach, this paper shows the inclusion of the use and appropriation of ICT as a means of generating knowledge in project management.

Keywords Knowledge management · Project management · Social management of projects · Information and communication technology ICT · Collaborative planning

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50.1 Introduction

"Nowadays companies must get to the bottom of their organizations in order to reinvent their strategies" [1]. New trends force us to move and adapt to the use of new tools applied in recent technology, due to the fact that he who doesn't evolve, dies. ICT are increasingly impacting management aspects of everyday life activities, these have been playing an important role in fields such as education, health and economics, amongst others, with a variety of purposes like informational, process and project management through simpler methods, team collaboration and e-services. It can be observed how ICT are involved in global development in each of the fields of science governed by the information and knowledge society, being them strategic support in the management of new projects, showing the competitive advantages that their implementation brings, as they relate computing science, processes, virtual and online technology; with combinations of hardware and software capable of interchange, process and manage information and knowledge for projects. ICT, when involved in project management, creates great challenges for project managers, since it demands from them skills and abilities to generate added collaborative value when involving project team members in a teamwork environment, synchronized and aimed to the achievement of goals, significantly improving communication, risk evaluation, control and planning of all project processes.

This research was conducted in order to present some of the latest and most innovative trends warehousing services, cloud computing, information management and virtualization in the market and how these trends are supporting project management and appropriate to share experiences and knowledge of successful organizations that have achieved sustainable market maturity. Additionally to recognize the skills and knowledge needed to make decisions in case of opting for these tools that significantly reduce costs but also might present disadvantages depending on the field of action in which they can develop or not to become the ideal solution for organizational problems.

The research is based on concepts of project management as a system and social approach, we analyze the trends in ICT to support knowledge management in the corporate management of projects, to ask the question of whether knowledge can be generated from the use and appropriation of ICT and last are the answers and conclusions.

50.2 Fundamentation

50.2.1 Concept of Project as a Social System

According to [2], from PMI,[1] a Project is "a temporary endeavor undertaken in order to create a product, a service or a unique result", meaning temporary effort as the definition of the beginning and the end of a project. From this definition, this analysis could start by asking: Which factors determine a project as successful? A survey by PWC [2] [3], shows that the factors that determine the success of a project are: *stakeholders*[3] satisfaction (20 %), on time delivery (19 %), budget compliance (18 %), profit production (17 %) quality (15 %) ROI value (9 %) and other factors (2 %). Stakeholders satisfaction could be considered as an indicator that implicitly contains the other factors. For instance, for the client it means that products were delivered on time, within the budget and with the quality promised by the supplier. Furthermore it should be noted that it is the main indicator of the success of a project. On the other hand, it must be noted that stakeholders satisfaction undoubtedly depends on their commitment and on the way they interact, for it is important that there is an open and permanent communication among them.

Considering that a social system [4], is basically defined as "a set of relations among human beings who interact in many ways" in a project, the social system includes all the people that make part of it and the relations among them and the outer world. The social significance of projects is partly based on the steady growth of social media such as blogs, forums, content communities and social networks. Regarding the latter, a study by comScore,[4] presents world order data indicating that between June 2010 and June 2011, the total number of Internet visitors increased by 10 %; while the increase in the number of visitor of social networks went up in 22 % [5], trends that favor success in project management.

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[1] Project Management Institute is a non-profit association for professionals in project management. Its main objectives are: to define professional standards in project management and creating knowledge. through research and promote project management as a profession, through their certification programs.

[2] Price Waterhouse Coopers is a services firm with presence in over 120 countries, organized into three business areas: audit and technology risk, business and financial consulting, legal and tax advice.

[3] Group of individuals involved in the project that may affect or be affected by the results of the project.

[4] ComScore Inc., company whose purpose is to measure how people surf the digital world and turn the measurement results into relevant information for maximizing their clients digital investment.

50.2.2 Social Project Management

Social project management (SPM) means the collaboration among all project members, where each project is viewed as a social network. Two of the promoters of social project management are; the project approach based on the social interaction of people and technology [6]. The former is explained from the identification of project planning as a living process where it is important that those who perform the work are part of this process because they can contribute with relevant knowledge based on their previous experience; this scheme is known as Collaborative Planning [6]. It must be noted that in Collaborative Planning, the role of the project manager changes since planning, direction and control of the project is not 100 % their sole responsibility Participation of parties increases when they have a bigger understanding of the project because it is "transparent", which is to say that all the people involved have access to the information about decisions, who made them and why. From this point of view, technology fosters the social significance of projects because it facilitates human relations and the ability to organize and plan. According to [6], the most exciting use of new technology is when it is applied to build and maintain human relations, due to the fact that the result is a greater participation from the team to develop new and more effective ways to organize activities in a project.

It could be said that from the viewpoint of collaborative planning, the premise is teamwork, which increases the sense of belonging from the parties when it is articulated with the possibility of a greater participation in making decisions that are relevant to the project, this could be reflected in the level of satisfaction, which is one of the main factors to determine whether a project is successful or not.

For ProjectPlace[5] two of the benefits of social Project management are [7]: (i) Motivation within the project, today, a scarce resource. It is baffling to see many project managers using a large amount of hours in planning resources such as time and money without taking into account the social dynamics of their teams, that is to say that they do not take the time to find out if the team enjoys what is being done, if they communicate with each other or if they consider the significance of assigned tasks. (ii) Innovation as a social endeavor. Creativity and invention have been traditionally viewed as a solitary sport. A sole genius creates a new idea and changes the world without anybody's help. It has been recently proved that this picture is wrong. A new idea is a network. New ideas depend on social encounters; when shared, the idea adds new knowledge and gets more people involved in making it come true.

According to research [8], the planning scheme of traditional project management is obsolete, since it is strongly dependant on the plans of the project and its constant upgrades (management as planning) the execution takes place on completion of planned tasks and, according to authors, the progress of the project

[5] Project Place International. It is a European company that provides project collaboration solutions on the Web. Since 1998, it has been leading the development of online project tools.

is controlled through feedback methods as those used to control thermostats [9]. It is important to consider these reflections because the planning scheme in project management is widely recognized. It is then worthwhile to note that ICT supports the reflection in this field and could help in the validation of the statement in the sense that work is done in real time within a collaborative environment; therefore the planning scheme in management will produce results that provide real evidence.

They also state [8] that management as planning fails mainly because it is impossible that plans are upgraded in an effective way and it is assumed that in the execution, tasks input as well as resources will be available in the expected conditions. It must be noted that [2] five process groups are defined in project direction: starting, planning, execution, monitoring and controlling, and closing; where the planning process group is defined as composed by those processes performed to establish the full extent of the effort, to define and refine objectives and to develop the line of action required to achieve those goals.

According to this, it is advisable to revise at this point the results of the second worldwide survey prepared by PWC [3], about the current status of project management, from which it can be concluded that the main reasons for project failure are related to planning itself: wrong estimations, breach of scheduled times, scope changes and insufficient resources, these reasons constitute 50 % of the reasons for project failure in organizations that took part in the survey. It will then be a challenge for project managers to strengthen the use and appropriation of ICT in all project team members to learn from best practices, experiences and expert opinions, in order to counteract these issues, promoting collaborative environment and teamwork, in search of a solution to incidents that delay the implementation of the project and result in the use of more resources and budget.

50.2.3 Trends in ICT that Support Knowledge Management in the Social Management of Projects

In the predictions by IDC[6] [10], about ICT trends, it is argued that this industry is in the middle of a cycle (20–25 years) in the change of a technological platform for growth and innovation. [10] Has called this platform as the third platform, based on mobile devices, applications, internet services, mobile broadband networks, large data analysis and social technologies. The features of presented trends by [10] for 2013, are basically three; opportunity for growth, impact on industry and implication of significant structural changes on businesses, industries and on projects.

[6] International Data Corporation, is a global provider of market intelligence, advisory services, and events.

50.3 Question

¿Is it possible to create knowledge from the use and appropriation of ICT in social management of projects, where according to PWC [3], one of the main issues for being unsuccessful is precisely the lack of communication among the members of the team involved in the project?

50.4 Methodology

To build this paper in which ICT are adapted as a means for generating knowledge in social management of projects, we used the process of identifying information which was afterwards located, selected, gathered and synthesized. This process began with the formulation of the question that oriented the search in the documentary compilation of this study, then sources were identified and selected, afterwards the search and document retrieval strategy was defined, next the evaluation and analysis of information was performed and finally ICT as a means to support the creation of knowledge in social management of projects was published. Importantly, the literature review and cases of success and failure were essential to achieve document responses.

50.5 Results

Nowadays companies, through their technology departments, must face very important challenges such as the proper use of technology infrastructure, responsiveness according to business strategies and the flexibility to adapt to changes, among others, everything under the pressure of the restrictions that suppose achieving the execution and obtaining the scope, finishing on time, fitting the assigned budget, meeting quality standards, mitigating risks and maximizing the use of increasingly scarce resources. Because of all the above, in meeting these challenges, the use of ICT in project management is a new form of creating knowledge. Here are some:

50.5.1 Virtualization

In project management the term virtualization comes in response to the implementation of creative solutions which are necessary in goal achievement and in strategies for planning, execution, monitoring, control and closing. Virtualization, from a technologic perspective, is understood as a methodology that splits resources from a computer into multiple runtime environments through the application of one

or even more concepts or technologies which can be hardware and software partitioning, shared time, complete or partial machine simulation, emulation and service quality [11]. That is, the abstraction of physical resources where one machine can run multiple operating systems, each one of them with their own applications running concurrently. Given these new techniques used in companies to improve efficiency of their technological infrastructure, project direction, through managers, meet challenges when controlling their working team since in many cases they are not placed in the same physical space, but still succeed must be ensured in the implementation of projects. The key then is to have a good communication; this of course, implies that we need to talk about the Virtual Project Manager. Today having a virtual team is almost a norm and, for excellent management, a project manager must take into account not only ICT but management skills related to leadership, confidence, monitoring and communication, the latter being the most critical of all because the final result of the project depends on it, since stakeholders should clearly share the goals that must be achieved from the project itself.

Virtualization has enabled the appropriation of better communication practices, through them the project manager has been able to implement among members of their team the establishment of a clear communication plan, mastering technology, carrying out structured meetings and using e-mail efficiently, among others. Therefore, a virtual project manager should understand that is fundamental to maintain and permanently improve communication with team members.

50.5.2 Cloud Computing Services

The term "cloud" comes from the representation of Internet through the drawing of a cloud as the abstraction of its infrastructure in computer network charts. Cloud computing is a model of service provision such as access to applications, use of infrastructure and storage through Internet under a payment scheme on users demand.

For *NIST,*[7] cloud computing is defined as a model to allow proper and on-demand access to a set of configurable computing resources (e.g. networks, servers, storage, applications and services) that can be provided rapidly and made available for clients with minimal management effort and interaction with the service supplier. This is a model that comprises five essential characteristics, three service models and four implementation models [12].

The main characteristics that identify the cloud are: *Scalability:* allows meeting customer's changing needs over demand in the use of a service; *on demand self-service:* services may be requested by the user or client directly over the Internet.

[7] National Institute of Standards and Technology de EE.UU: Federal Agency of the Department of Commerce whose mission is to promote U.S. innovation and industrial competitiveness in the U.S. through advances in measurement science, standards and technology in ways that enhance economic security and improve quality of life.

User pays only for time of service*; ubiquitous access to the network:* services are accessible from any device with network access (personal computers or mobile devices), availability is 7/24; *pool resources:* attention to multiple users independently of the location of the resource and, *service measurement:* each resource that the user consumes and which is chargeable is measured not only for charging purposes but also for control. Some examples could be considered as basic cloud services, for they are very popular today, such as access to an email account, social networks (Facebook and LinkedIn), *webinars*[8] and document management. It is precisely the last in which project management succeeds in creating knowledge in the project team because updated and timely information is shared in real time.

The different types of cloud services can be grouped in three models:

- Infrastructure as a service: (IaaS). It is based on the virtualization that offers resources related to network technology, processing, disk space and database storage. An example of IaaS implementing is Amazon EC2 (Amazon's Elastic compute Cloud), where clients access is granted through a web interface of virtual devices.
- Platform as a service (PaaS). This model offers whatever is required to cover the life cycle of a project: analysis, design, unfolding development, tests, documentation and maintenance. Google App Engine is an example of PaaS, since it permits creation and hosting of web applications through technologies such as Java.
- Software as a service (Saas). It is a software distribution model where the supplier provides maintenance, support and operation of applications that will be used during a contracted period of time; users' access is allowed through an API from the Internet.

According to [13], Cloud computing benefits for project management are: complex project management that were not feasible in the past due to processing limitations and storage or network capacity within an organization; it also offers collaboration in real team among project teams scattered all over the world, furthermore it permits a rapid staging response, implementation and removal of a variety of computing environments based on the web as needed to test or validate an application and uses a wide range of tools based on the web. Cloud computing also generates, by reduction of operating load, available time for creativity and innovation because allows companies to work on business objectives, or research and development. It enables analysis of multiple transactions in a highly distributed environment and moves towards green ICT with less energy consumption and less C02 production.

Some projects related to the creation of systems for project management based on the cloud are:

[8] Webinars: Seminars transmitted via World Wide Web with specific date and time, its main feature is the interaction between the speaker and audience participants who are connected through their computers.

- Khan et al. [14] the creation of a Project Management System based on the cloud as SAAS is proposed as a project. The characteristics of this system are: it provides solutions to the lack of management skills and constant variation in project scope; it allows active participation in the development of the project. Each stakeholder will have access according to the priviledges defined for them; transparency between the customer and the company and implementation of agile methodologies in software development model must be noted.
- Small and medium companies are organizations that can benefit the most from cloud services, not only for the cost-benefit relation, but for access to new services, techniques and tools that directly impact every business model [15]. Competencies refer to: complex structures of processes that people put into action and creation for problem solving or performing of daily life activities in professional or work contexts, aimed at the construction and transformation of reality; integrating knowledge on different areas such as knowing how to know (see, analyze, understand and explain), how to do (performance based on procedures and strategies), how to be involved (participation and collaborative work) and knowledge about how to be (self-motivation, initiative, leadership and creativity) [15–17].

50.5.3 Storage of Information

It is important to note that in project management the proper governance of technological resources ensures efficiency, opportunity and availability of information; it also makes reference to the security issues that concern the proper storage of the most important resource of the company and its projects, being this "information". Today there are many storage solutions, choosing one above another is relative to each company, what is important is that information is properly stored and with the required safety standards for correct operation. In the market there are storage solutions both in the cloud as well as in physical space. A cloud storage solution drastically reduces costs in both hand work as well as equipment as physical information is not stored. However, one must be careful because cloud storage solutions are subject to policies of the company that provides them, and in many cases, the owner of the information is not even the company that pays for this service [16]. If decision is made to store information physically, the quality improvement of the availability of information must be considered, and for this there are many solutions in the market. One of the solutions with greater impact are SAN storage solutions that via fiber channel provide better availability and speed of access to information. Though costly because of the investment on hardware, this solution may become a trend over the next decade, as opposed to Cloud Computing competition, for they will compete against the advantages of one over the other. Although cost reduction is a critical issue in business, and therefore in their projects, the tendency is oriented towards solutions in which the company can have the sense of owning information. Over the next decade storage solutions in the cloud will not reach a reliability point,

neither the safety perception in critical process, as it won't reach a point in which companies will choose this solution. Managers must choose the most convenient solution in terms of storage, assessing convenience of the relation cost-benefit, without forgetting information safety. Although global companies increasingly place their information in the cloud, this latent trend as a current technological solution will make that project managers reach the desired impact in accordance with organizational factors such as: company size, process that are to be stored, storage option (cloud or physical) and criticality of information in case it falls into the hands of others. Therefore, the trend in storage solutions both physical as in the cloud will increase, but the response to storage solution will depend on each company according to what is stored and where it is stored.

50.5.4 Projects Management and ICT

Managers will face a challenge with the revolutionary changes in terms of technology and productivity; there is a state of transition where mind and cultural schemes must be broken. Managers must adapt to change, envisioning their business growth with plans for the organizations to lead changes, thus facing the risks that may appear, and the doubts or assumptions as preventive action.

Identifying opportunities should not always offer the same products or services, showing monotony in business is a factor of economical deterioration that causes the loss of strength in the market. Ways to attract new clients must be visualized, motivating them and creating the need of having the company in mind as their first choice over other organizations.

Technology corresponds to inventions, new things to be used in solving the problems that arise day after day through a body of knowledge that managers should use to their advantage in the life of the project. In any project, when implementing ICT, managers should know their working environment, conducting a compilation of information to know the needs of the target audience, the resources that the organization has at hand and the processes that take place on a daily basis. Currently, most of the organizations use at least the e-mail as a means of communication, as well as text messaging, but are people really acquainted with the proper use and real advantage of these tools? There are resources which sometimes are underused as intranet which purpose is internal communication. Other times websites are outdated or in many cases people are not aware of their existence. Because of this, before implementing ICT, the staff should be educated in digital culture through training or upgrading sessions, so that when involved with other technological resources such as implementation of collaborative systems to generate knowledge, the issue about company technology in the organization and its project is not new for them [18].

An example of use and appropriation of ICT as a way to generate knowledge as some of the most outstanding projects applying formal project management, according to the PMBOK Guide and have been successful are: Progress four

stadiums in nine months the U-20 Women's World Cup in Chile, Peru Hydro-electric Platanal in record time, program Panama canal expansion, Pan Ceibal: A laptop for every child in Uruguay and finally one of the most successful rescues in the history of 33 miners 700 meters underground in the San José mine in northern Chile [19].

50.6 Conclusions

- The success factors of a project are grouped in the stakeholders' satisfaction. Social management of projects aims for project success through the use of tools that will strengthen the relations between those involved in the project which brings along a greater sense of belonging that will be reflected on the project results [20].
- The factors of project failure are related to flaws in the planning stage. From the point of view of social management of projects, the aim is that everyone involved in the project can have access to relevant information through collaborative planning for decision making, so that any member of the team can influence the action plans based on their own experience in a particular matter to be solved [21].
- The social management of projects promotes collective innovation since its collaborative environment enables permanent interaction of those involved in the project and thus opens a space to share innovative ideas that together could become tools that optimize work in new products or services.
- Trends in ICT that support project management such as Cloud Computing benefit even SMEs since justifiable profits are obtained in relation to accessible prices according to the needs of these companies.
- The need to address the factors of failure of a project that come from planning and collaborative environment posed by technologies such as Cloud Computing inevitably leads to greater emphasis on the importance of the staff and their interrelation.
- Having the latest technology is not enough because organizations should ensure that projects implemented via ICT, obtain the proposed goals, it is for this reason that project management is a task closely linked to ICT, where global vision of a product or service is required; service or product which destination is a client and its aim is to solve a specific need of the organization. It implies planning that ensures budget compromise, task schedule and requirements that have been agreed with the final user.
- It is through projects that a company can improve competitiveness or generate economy in any of their areas.
- The development of technology, promotes the generation of new knowledge about the current and future professionals in order to apply to a competitive

workforce and managerial economics demand and existing markets, thereby providing added value to society, through project management.

- With the rise of these new tools of communication, companies are increasingly forced to maintain growth rate themselves through the implementation of new technological strategies that enable sustainability in the market. That is to say that their job is to be in steady evolution in all areas, being project management one of their priorities.
- Project management in virtualized spaces makes things easier since stakeholders and needs can be easily coordinated through the Web and virtualized offices. The use of ICT in business environments and in project management allows the concentration of productive capital achieving the formation of large virtual companies and reaching success of projects at a fast pace and with the required opportunity without geographical conditions or tools impeding their achievement.

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