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Value Creation in E-Business Management

15th Americas Conference on Information Systems,
AMCIS 2009, SIGeBIZ track
San Francisco, CA, USA, August 2009, Selected Papers

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Preface

Recent economic, political, and technological forces are changing the landscape of electronic business and electronic commerce. Although great strides have been made over the past in understanding, researching and advancing e-business, rarely have we witnessed its use so profound and yet its limitations so pronounced, than what has been on global public display for the past 18 months. As a result, new e-commerce strategies and techniques are emerging, collaborative value creation is essential and e-business models are being refined and developed, with special attention towards IS in financial markets, health care and related institutions. It is for these reasons (and many more) that we are so particularly excited and grateful for the collection of papers included in this *Value Creation in e-Business Management* LNBIP volume number 36.

The papers selected in this volume address these emerging e-business issues and are organized into four research lines: Business Models for the Digital Economy, Electronic and Mobile Commerce Behavioral and Global Issues, IS in Financial Markets and Institutions, Web 2.0 and E-Commerce and Collaborative Value Creation. The first group, *Business Models for the Digital Economy*, provides a closer examination of business models from a rich mixture of segments in the IT industry. They include Hoyer and Stanoevska-Slabeva's business model types for enterprise mashup intermediaries, Riehle's 'commercial' open source business model, Chen's interesting comparison between i-Phone versus Kindles in electronic book sales, and Lyons and coauthors business models in emerging online services. Also in this first section, Costa and Cunha, using the actor-network theory (ANT), provide an especially intriguing look into an actor's value proposition in virtual networks in complex business model design. Ruch and Sackmann's examination of customer's risk management in e-commerce and Stott and Taneja's realistic viewpoints from multiple stakeholders and their offering of DRM business model adjustments moving forward, round up an exceptional group of e-business model papers in this first section.

The second group, *Electronic and Mobile Commerce Behavioral and Global Issues*, provides multiple views of consumer behavior and perceptions in e-commerce. Yan and Dai's close examination of influential factors in consumer retail shopping decision making begins the second section, followed by Wan and coauthors novel inquiry into generational (age) gaps and their impact on the consumer's quality of goods perceptions. The next two contributions cover important user (consumer)-interface design considerations through Aljukhadar and Senecal's development of a website usability taxonomy and its impact on the performance of different types of websites and Islam's study of website interactivity effects on online retail shopping behavior. The remaining papers in this section shift towards a business / commercial perspective in e-commerce, with Tams' look into website trust and vendor reputation, Liu and coauthors' pricing strategies of homogeneous goods and addressing the question of high-reputation sellers charging more and, finally, Kokemüller and coauthors' comprehensive study of use cases in security issues of independent mobile sales agents and their offering security extensions as remedies.

The third group, *IS in Financial Markets and Institutions*, provides an exceptionally timely, candid and novel look into some of the most pressing issues confronting this space. The first two papers include Wang and coauthors' examination of the transformational aspects of people-to-people lending and Webb's innovative approach towards forecasting of U.S. home foreclosures. Both papers squarely address two emerging issues that have been dominating much of the recent business press in the U.S. The next three contributions include Schaper's revealing study of vertical integration and other economies of scales in organizing equity exchanges, Chlistalla and Lutat's look into new execution venues on the European market's liquidity and Wagner and Riordan's keen analysis of lead-lag effects in system latency in spot and future markets.

The fourth group, *Web 2.0 and E-Commerce and Collaborative Value Creation*, provides exceptional insights of the ever-increasing phenomenon of virtual social networks and their value proposition. The first paper by Gneiser and coauthors examines the levels of interconnectedness in social networks and their value, and the second paper by Kundisch and Zorzi examines social capital considerations through the quality of financial advice. The next three papers extend the collaborative value creation discussion by addressing older information technology (IT) issues but in a new context. Specifically, Blinn and coauthors examine design science but in a newer Web 2.0 social network setting, Bitzer and Schumann revisit the business / IT gap in service-oriented architectures (SOA) but in a newer mashup setting with its complementarity to SOA, and Zheng and Jin reexamine online reputation systems and draw sharp contrasts with new opportunities in the Web 2.0 era. Finally, Karhade and coauthors' evolutionary look into the use of business rules in IT portfolio management rounds up this sections exceptional collection of papers.

The collection of papers in this LNBIP volume were selected exclusively from the E-Commerce and E-Business (eBIZ SIG) tracks at the 15th Americas Conference on Information Systems (AMCIS) which was held in San Francisco, California, during August 6–9, 2009. Overall, 76 papers were submitted to eBIZ SIG related tracks at AMCIS 2009, 46 were accepted for conference and 25 were selected for this *Value Creation in e-Business Management LNBIP volume number 36*.

We would like to thank all of the contributing authors, the eBIZ SIG Track Chairs and reviewers who contributed to this effort. We would also like to thank Ralf Gerstner and Christine Reiss from Springer for their incredible support in the production of this LNBIP volume.

June 2009

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Generic Business Model Types for Enterprise Mashup Intermediaries

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Abstract. The huge demand for situational and ad-hoc applications desired by the mass of business end users led to a new kind of Web applications, well-known as Enterprise Mashups. Users with no or limited programming skills are empowered to leverage in a collaborative manner existing Mashup components by combining and reusing company internal and external resources within minutes to new value added applications. Thereby, Enterprise Mashup environments interact as intermediaries to match the supply of providers and demand of consumers. By following the design science approach, we propose an interaction phase model artefact based on market transaction phases to structure required intermediary features. By means of five case studies, we demonstrate the application of the designed model and identify three generic business model types for Enterprise Mashups intermediaries (directory, broker, and marketplace). So far, intermediaries following a real marketplace business model don't exist in context of Enterprise Mashups and require further research for this emerging paradigm.

Keywords: Enterprise Mashups, Business Models, Intermediaries, Interaction Phase Model, Design Science.

1 Introduction

1.1 Motivation and Problem Scope

Since the beginning of the 1990s, companies have optimized their corporate IT by introducing transaction systems such as enterprise resource planning (ERP), customer relationship management (CRM), or supply chain management (SCM). By following a process-oriented approach (Hammer and Champy 1993) and evolving towards modular Service-Oriented Architectures (Alonso et al. 2004), IT departments were enabled to adapt their automated IT systems according to their business needs. The next wave in corporate technology adoption, the Web 2.0 and peer production philosophy, addresses ad-hoc and situational application (Chui et al. 2009). In this context, a new trend for software development paradigm, known as Enterprise Mashups, has gained momentum. Enterprise Mashups bridge the gap between the automation

transaction and the peer production world as indicated in Figure 1. The market research institute Gartner identifies the paradigm in the top 10 strategic technologies for 2009. Forrester also predicts that Enterprise Mashups will be coming to a \$700 million market by 2013 (Young 2008).

At the core of the Mashup paradigm are two aspects: First, empowerment of the end user to cover ad-hoc and long tail needs by reuse and combination of existing software artefacts. Second, broad involvement of users based on the peer production concept. According to Yochai Benkler, who coined the term peer production, “*it refers to production systems that depend on individual action that is self-selected and decentralized rather than hierarchically assigned*” (Benkler 2006). Thereby, the creative energy of large number of people is used to react flexible on continuous dynamic changes of the business environment. Instead of long-winded software development processes, existing and new applications are enhanced with interfaces (so-called Application Programming Interfaces, APIs) and are provided as user friendly building blocks.

Companies considered this trend and opened their IT systems for their ecosystem (customer, supplier, government, etc.) by encapsulating them via well defined APIs. In addition, the Internet evolves towards a programmable platform. Web providers offer value added services to the Internet community. Besides simple services such as news feed, weather information, maps, or stock information, business relevant services such as storage, message queuing, or payment came up in the last years.

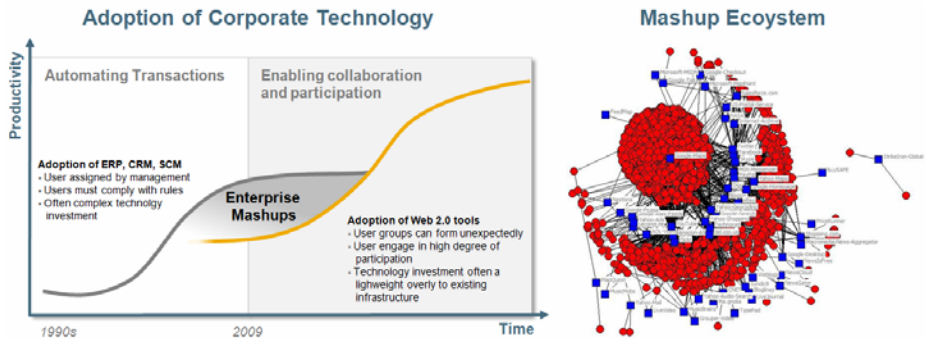


Fig. 1. Adoption of Corporate Technology (adapted from Chui et al. 2009) and Mashup Ecosystem (Yu, 2008)

The explosive growth of these mashable components¹ and the emergence of the Enterprise Mashup paradigm (Hoyer and Fischer 2008) will have an enormous effect on intermediation. As indicated in Figure 1, existing services (rectangles) are composed to new value added applications (cycles) in an ad-hoc fashion. Existing research efforts focus mostly on technical aspects as well as relevant platform and tools for the composition of these components – i.e., IBM Mashup Center, Intel Mash Maker (Ennal et al. 2007), Microsoft Popfly, and SAP Research RoofTop Marketplace (Hoyer et al., 2009). The underlying technical concepts and principles are

¹ 1171 Mashup APIs (<http://programmableweb.com>), 27.813 online Web Services (<http://seekda.com>).

presented by Maximilien et al. (2008), Yu et al. (2008), or Hoyer et al. (2008). However, the discussion of the intermediary role from a business perspective of these Enterprise Mashup environments is still missing in the scientific community. Important questions in this context are: Which features have to be provided by Enterprise Mashup intermediaries to match the supply and demand? What generic business model types exist?

The goal of this research paper is to fill this gap by designing an interaction phase model for Enterprise Mashup intermediaries. The general research questions guiding this research are to model the required features regarding from a consumer and provider perspective as well as to identify generic business model types for Enterprise Mashup intermediaries.

1.2 Research Design: Design Science Applied

All activities within a research project as well as its scope are defined by the research design. For answering the research questions motivated in the previous section and characterized by a practical nature, engaged research is needed in order to provide rigorous solutions. Design science research aims at solving practical and theoretical problems by creating and evaluating IT artefacts intended to solve identified organizational problems. Hence, it is considered as a problem-oriented approach (Hevner et al. 2004). Artefacts represent the final result of a design process. They can be characterized as constructs, model, methods, or instantiations (March and Smith, 1995).

To come to rigorous and relevant research results, we draw upon on Peffers et al. (2008) to specify the following phase of the design science research process applied:

1. **Problem Identification and Motivation.** In section one, we specify the specific research problem, show the practical relevance and justify the value of a solution. Based on the problem scope, we derive the research questions guiding this paper.
2. **Define the Objectives for a Solution.** In the second section, we infer the objectives of a solution from the problem definition and knowledge of the state of problems. A literature review in section two presents the state-of-the-art of Enterprise Mashups, describes the interacting agents and their roles (consumer, provider, and intermediary) and presents a business model hierarchy to structure relevant terms and concepts of business models.
3. **Design and Development.** In section three, we propose an interaction phase model artefact based on a literature review in order to structure the features of Enterprise Mashup intermediaries. Thereby, we built on the research results of Legner (2008), Hoyer and Stanoesvka-Slabeva, (2008), and Carrier et al. (2008) who observed many similarities of Enterprise Mashup environments and marketplaces. Enterprise Mashup intermediaries should enable the matching of supply and demand in a way similar to conventional market phases (knowledge, intension, contract/ design, and settlement).
4. **Demonstration.** By means of five case studies of relevant Mashup intermediaries (StrikeIron, Seekda, ProgrammableWeb.com, iGoogle, and IBM Mashup Center), we demonstrate the application of the designed artefact in section four. In addition, we identify three generic business model types for Enterprise Mashup intermediaries: Directories, brokers and marketplaces.

The results of each of the above activities are presented in the remaining part of the paper. Finally, the last section closes the paper with a brief summary, limitations of the conducted research and an outlook to further research.

2 Objectives of the Solution: Background and Related Work

2.1 Enterprise Mashups – Definition of Terms and Characteristics

In literature, the exact definition of Enterprise Mashups is open to debate. In this work, we refer to the definition of Hoyer et al. (2008). “An Enterprise Mashup is a Web-based resource that combines existing resources, be it content, data or application functionality, from more than one resource in enterprise environments by empowering the end users to create and adapt individual information centric and situational applications”. Thereby, Enterprise Mashups focus on the User Interface integration (Daniel et al. 2008) by extending concepts of Service-Oriented Architecture (SOA) with the Web 2.0/ Peer Production philosophy (Janner et al. 2007).

With the assistance of a layer concept, the relevant components and terms can be structured in an Enterprise Mashup Stack consisting of the elements resources, widgets, and Mashups (Hoyer et al. 2008). **Resources** represent actual contents, data or application functionality. They are encapsulated via well-defined public interfaces (Application Programming Interfaces; i.e., WSDL, RSS, Atom, CSV, etc.) allowing the loosely coupling of existing Web-based resources – a major quality of SOA (Alonso et al. 2004). These resources are provided by existing enterprise systems or Web providers (i.e., Amazon, Google, etc.) and are created by traditional developers who are familiar with technical development concepts.

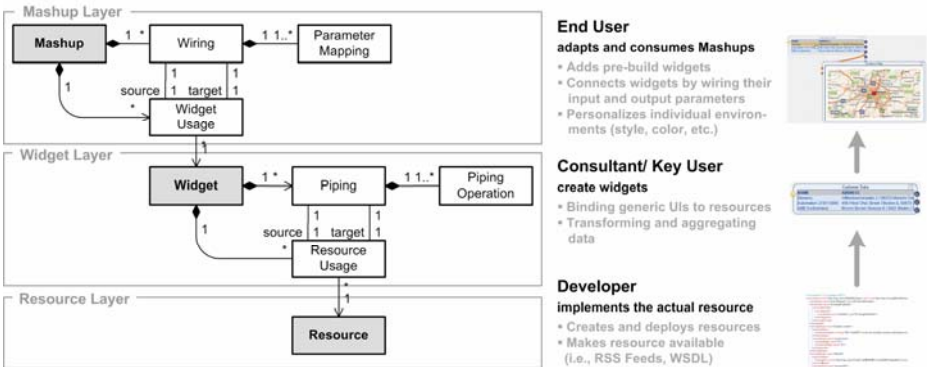


Fig. 2. Enterprise Mashup Stack – Meta Model and User Roles (Hoyer and Stanoevska-Slabeva, 2009)

The layer above contains **widgets** which provide graphical and simple user interaction mechanism abstracting from the underlying technical resources. In reference to the UNIX shell pipeline concept, a so-called *piping* composition allows the integration of heterogeneous resources defining composed processing data chains/ graphs

concatenating successive resources. Aggregation, transformation, filter, or sort operations adapt, mix, and manipulate the content of the underlying resources. The creation of the widgets and the piping composition can be done by consultants or key users from the business units who understand the business requirements and know basic development concepts.

Finally, the end users from the business units are empowered to combine and configure such visual widgets according to their individual needs, which results in a **Mashup**. Thereby, the visual composition of input and output parameters of the widgets on the Mashup layer is called *wiring*. For example, the sales person Tim uses daily a “Customer Data” widget, which requests resources from the backend Enterprise Resource Planning system. By wiring this widget with a “Google Maps”, Tim can display the customers on an interactive map as depicted in the figure below. He doesn’t need to contact his IT department.

In addition to the lightweight composition styles (wiring and piping) by reusing existing building blocks in new ways, the mass collaboration principle from the Web 2.0/ Peer Production wave is also an important characteristic. The willingness of users to offer feedback to the Mashup creator, who may be unaware of problems or alternative uses, directly contributes to the adoption of the Mashup and can foster its ongoing improvement. Rating, recommending, tagging or sharing features for the different Enterprise Mashup layers support the collaborative reuse of existing knowledge to solve ad-hoc business problems.

2.2 Interaction Agent Model

From a conceptual perspective, Enterprise Mashups put a face on Service Oriented Architectures by abstracting from the underlying technical protocols by means of small modular components which can be composed according to individual needs. To describe the relationship between the mashable components (Mashup, widget, and resource) and the interacting agents as well as their tasks and roles, we refer to the following interaction model well known in Service-Oriented Architectures (Papazoglou 2003) but also in electronic markets (Sarkar, Butler, and Steinfield 1995, Legner 2007, Hoyer and Stanoevska-Slabeva, 2009): A *provider* develops and publishes a mashable component via an *intermediary*, where a *consumer* can find it and subsequently may compose and consume it.

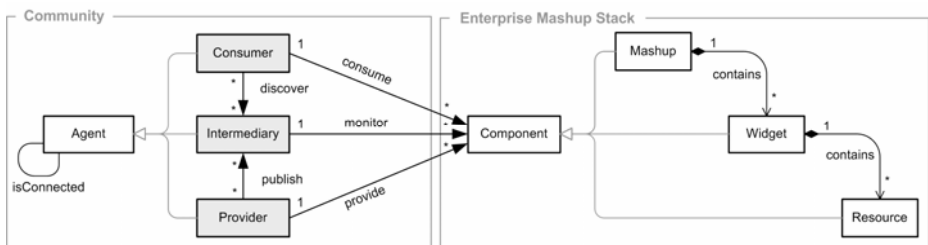


Fig. 3. Interaction Agent Model for Enterprise Mashups

As depicted in the figure above, the interaction between consumers and providers is always managed by an intermediary. The tasks of the three agent roles are described in the following:

1. **Provider.** A provider implements and hosts a Mashup component which encapsulates the actual content or knowledge. To promote their provided functionalities, the provider annotates the component with relevant information and publishes it to an intermediary through which the component description is published and made discoverable.
2. **Intermediary.** An intermediary mediates and coordinates between providers and consumers in order to match the supply and demand in a way similar to electronic markets (Legner 2007). Available components are classified and offered by providers and potential customers search for the most suitable ones and if required pay for the usage. In contrast to traditional SOA-based specifications like UDDI or ebXML (Dustdar and Treiber 2005) that provides only directory services to find a component, novel forms of intermediaries are currently about to emerge which improve navigation, transparency, and governance. They monitor continuously the parameters (such as availability or response latency) and provide performance metrics and other evaluation results which may be used by potential consumers to select a right Mashup component (Schroth and Christ 2007). Thus intermediaries play an important role in structuring and classifying the available Mashup components, in providing a platform that can host a Mashup community, in facilitating the process of Mashup integration and in facilitating the process of Mashup payment and delivery.
3. **Consumer.** Based on the information provided by the intermediary, a consumer is able to retrieve a Mashup component according to his/ her individual preferences. Consumers take also over the role of annotating Mashup components by tagging, recommending, or rating them. Therewith, consumers create indirectly a folksonomy, essential a bottom-up, organic taxonomy that can be used to organize the growing number of Mashup components.

According to the peer production characteristic of Enterprise Mashups, users often act as consumer and provider. For example, Tim working in the sales department creates a Mashup by combining a “Customer Data” widget with the “Google Maps” widget. During lunch time, he mentions the Mashup during a discussion with his manager who is also interested in it. So Tim publishes the Mashup (provider role) and recommends it to his manager who is now able to use the Mashup as well. In this sense, he contributes to the community base by providing a created and adapted Mashup back in the community pool.

2.3 Business Models

The term business model has been predominantly coined in practice culminating in a buzzword status during the dot.com period. Only gradually it has been adopted and researched by the scientific world (Morris et al. 2005). The concept of the business model is not new, but for a long time the focus in scientific analysis of firms has been on industry (Porter 1980) and resources (Wernerfeld 1984). The business model shall

be deemed to be the replacement or complement of the traditional unit of analysis as a result of the changed surrounding conditions. The business model concept itself has been subject of a series of publications (Afuah and Tucci 2001, Osterwalder et al. 2005, Timmers 1998). However, a universal definition has not formed until today, what hinders the realization and comparability of empirical investigation (Morris et al. 2005).

In order to structure relevant terms and concepts, we refer to a business model concept hierarchy proposed by Osterwalder et al. (2005). It classifies business models in three different layers that are hierarchically linked to each other.

1. A **business model concept** is an abstract overarching concept that can describe all real world businesses. This level consists of definitions of what a business model is and what belongs to them. In this work, we refer to the definition of Timmers, who defines a business model as “[...] *an architecture for product, service and information flows, including a description of the various business actors and their roles; and a description of the potential benefits of the various business actors; and a description of the sources of revenues.*” (Timmers 1998). Stanoevska-Slabeva and Hoegg (2005) leverage this definition and its business model components as a foundation and enrich it with additional relevant aspects. The resulting business model concept framework consists on seven major components: First the *Features of the Specific Product* comprises the actual design of a product or service, the way it is perceived and consumed by the customer and the value proposition for the customer. The component *Features of the Specific Medium* defines possibilities for transaction and interaction via certain media between the stakeholders of a business model from a technical point of view. The *Customers* component refers to the target groups of an offered product or service and explains their respective business needs. Fourth, the *Value Chain* component is devoted to reflecting all players that are involved in the production and delivery of a product and their respective interrelationships. The component *Financial Flow* identifies in which way the products and services are monetized and explain the roles different stakeholders play. *Flow of Goods and Services* describes the stakeholders’ activities that are essential for the creation of the product or services. Last, the *Societal Environment* reflects relevant outside influences on a business model (e.g., legal aspects and competitive situation).
2. **Types of business models** describe and cluster a set of businesses with common characteristics. This distinction reflects different degrees of conceptualization. Furthermore, the type can be a subclass of an overarching business model concept. The classification of business models in types is discussed intensively in literature. Timmers (1998) identified eleven Internet business models: e-shop, e-procurement, e-auction, e-mall, third-party marketplace, virtual communities, value chain service provider, value chain integrator, collaboration platforms, and information brokers. Rapa (2007) proposes a classification of nine Web business model types: brokerage, advertising, infomediary, merchant, manufacturer, affiliate, community, subscription, and utility.

3. A **real world business model** presents aspects of or a conceptualization of a particular company. This level consists of representations, and descriptions of real world business models.

3 Design: Interaction Phase Model for Mashup Intermediaries

The design activity of our research is structured according to the business model concept hierarchy. We design an interaction phase model representing a conceptual model to analyze required services (business model component *Features of the Specific Product*) for Enterprise Mashup intermediaries. The model is based on existing concepts and theories from the scientific knowledge base as proposed by Hevner et al. (2004) for design science research.

Legner (2008), Hoyer and Stanoevska-Slabeva (2008), and Carrier et al. (2008) observed many similarities between the Enterprise Mashup paradigm and electronic markets; Enterprise Mashup intermediaries match the supply and demand between providers and consumers. In order to structure and design an interaction phase model for Enterprise Mashup intermediaries, we leverage the St. Gallen Media Reference Model (Schmid and Lindemann 1998) due to its roots on electronic markets and due to its successful application for structuring Enterprise Mashup environments (Hoyer and Stanoevska-Slabeva, 2009).

The interaction phase model between the three agent roles (consumer, provider, and intermediary) is structured according to the four market transaction phases. Starting with the *knowledge phase*, the agents of the Enterprise Mashup environment are able to find information about the offered mashable components (resources, widgets, or Mashups) and about the agents. During the *intention phase*, the agents signal their intention and needs in terms of offers and demands regarding the mashable components. In the *contract (design) phase*, consumers combine different mashable components, configure it according to their preferences to new value added applications in order to solve ad-hoc business requirements. Finally, in the *settlement phase* the Enterprise Mashup is executed according to the contract/ design using the Enterprise Mashup environment's settlement services offered for this purpose.

In addition to these market phases, we use the findings of Sarkar et al. (1995) and Legner (2008), who identified relevant features of intermediaries in electronic markets for mediating between consumers and providers. Figure 4 depicts the resulting interaction phase model by using the Business Process Modeling Notation (BPMN). The interaction process is characterized by permanent loops between the four phases (converging design and runtime). The need to adapt the operational environment in an ad-hoc manner leads to adding, removing, or replacing existing mashable components.

Knowledge Phase. After registering to the Enterprise Mashup environment, both agent roles consumer and provider are able to discover the Mashup community, the members, and the provided features of the Enterprise Mashup environment. By means of interactive demonstrations in form of short videos and tutorials, the benefits of the Enterprise Mashup environment are demonstrated to the potential customers. Only if a huge amount of agents are convinced of using the environment, it will exploit its actual potential. In addition, the usage conditions and fees are communicated. By aggregating the continuously monitored consumption data, in particular, providers of

a mashable component are able to identify new trends and to evaluate the success of new developed mashable components. The aggregated information – for example the reputation of a provider or the quality of a mashable component (i.e., availability, reliability, popularity, etc.) – reduces the risk for consumers to select and to use a mashable component that does not fulfill required performance aspects. By certifying mashable components or providers indicating compatibility, trust or reputation aspects, the Mashup intermediary takes care of an improved transparency. On the other side consumers can review, recommend, rate, or share mashable components. All this information is provided to the consumers in order to find and select relevant mashable components. Due to the growing number of components, expert assistant (i.e., wizard) supports the consumer determine their needs according to their context (i.e., industry, department, country) and preferences. Also, providers require services for publishing a Mashup component in order to informate the consumers about the existence and characteristics (underlying business model such as fee, usage license, permission, etc.) of their offer. Ultimately providers are not interested only in providing information for consumers; they are interested in selling their offers by influencing the consumers with service placements.

Intention Phase. While in the knowledge phase available components are classified, rated and explained in different ways in the intention phase, the concrete offers are provided in a more structured manner. For example a Mashup component might be purchased based on a subscription or based on pay-per-use. The offer includes the component, the payment mode and price as well as delivery conditions. In context of Enterprise Mashups this might be a description of the quality of service to which the provider is obliged.

Contract (Design Phase). In case the consumer retrieves a mashable component and accepts the underlying business model that is defined by the provider, he/she can compose it with others by connecting the input and output parameters (wiring/ piping). To reduce traditional interoperability challenges, the Mashup intermediary has to provide assistance and to hide the complexity from the consumer who is characterized by limited programming skills. Especially, the composition of information from different and heterogeneous IT systems provided internal and external agents has to be handled in the design phase. In contrast to the classical software development, the design of ad-hoc applications uses real resources and no demo systems.

Settlement Phase. In this sense the consumption in the settlement phase differs only from the hidden configuration capability in contrast to the design phase. In case a new business situation comes up, the consumer shifts quickly to the design or intention phase to adapt the individual operational environment. As already mentioned before, the Mashup intermediary monitors and protocols all consumption activities. Based on this collected data, the actual billing and accounting process is handled as well as the data aggregation features in the knowledge phase.

Besides these functionalities in the four market phases, we note that often provider and consumer interests are in conflict. So an important intermediary function is to balance and integrate the needs of provider and consumer. For example, a provider of a mashable component may to inform potential consumers about the existence of a mashable component while consumers would rather search and evaluate Mashup components.

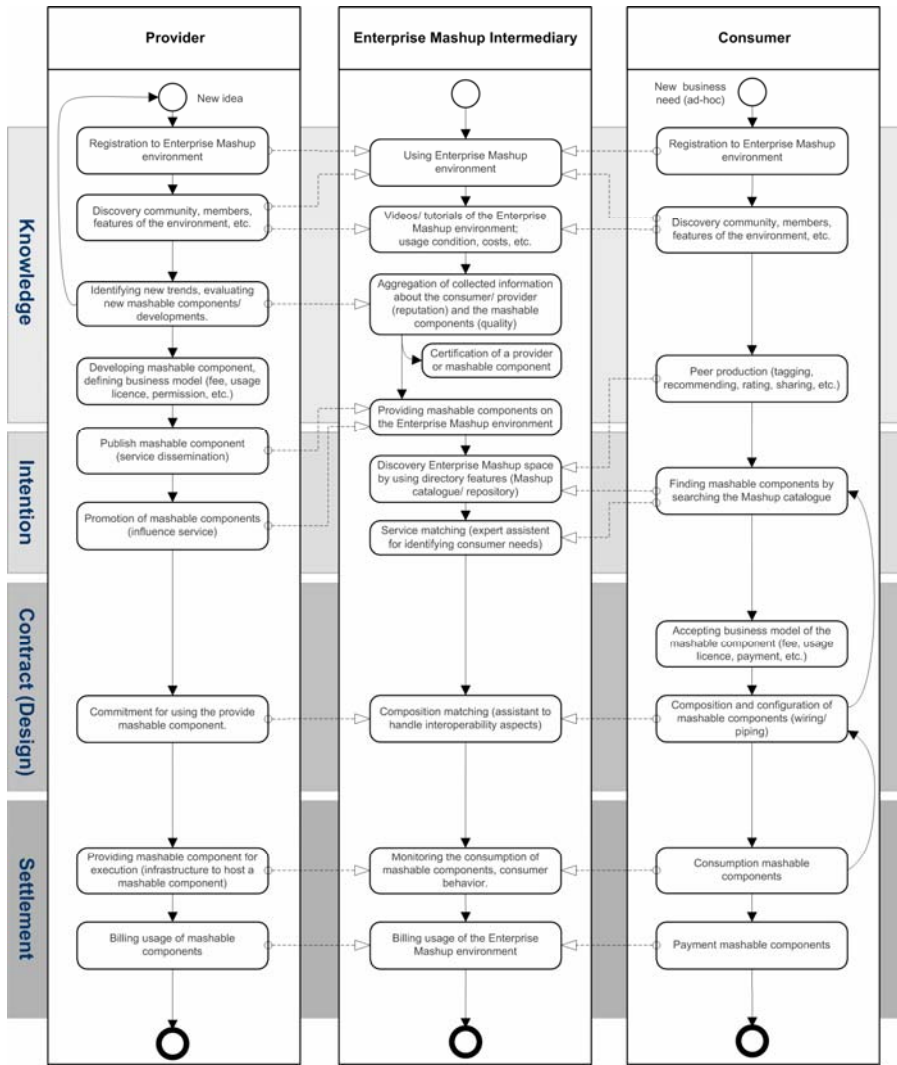


Fig. 4. Interaction Phase Model and Features of Enterprise Mashup Intermediaries

4 Demonstration: Case Studies

By means of five case studies we demonstrate the application of the designed interaction phase model. According to the business model concept components proposed by Stanoevska-Slabeva and Hoegg (2005) and the designed interaction phase model, we analyze five relevant Mashup intermediaries. They represent business model instances according to the business model concept hierarchy. Summering up, we derive and cluster three generic business model types (directory, broker, and marketplace) for Enterprise Mashup intermediaries and describe their characteristics and provided features.

4.1 Instances of Mashup Intermediaries

To mediate between providers and consumers, various Mashup intermediaries arose during the last years. We selected five relevant Mashup intermediaries which focus on different layers according to the Enterprise Mashup Stack. StrikeIron represents a traditional intermediary focusing on heavyweight Web Services resources. An analysis of other traditional intermediaries can be found by Legner (2007). Similar to StrikeIron, the Seekda project, built on results of the EU funded research project DIP², focuses on Web Services resources. In addition, Seekda is continuously crawling the Web for services and monitors the performance (in particular the availability)

Table 1. Case Studies: Business Model Instances of Mashup Intermediaries

Intermediary	StrikeIron	Seekda	ProgrammableWeb.com	iGoogle Gadgets	IBM Mashup Center
Potential Customers					
Focus	Inter-Organization	Inter-Organization	Inter-Organization	Inter- and Intra Organization	Intra-Organization
Target Market	Enterprise	Enterprise	Consumer and Enterprise	Consumer and Enterprise (in combination with Google Apps)	Enterprise
Value Chain					
Role	StrikeIron takes over both roles, intermediary and provider. It provides resources from different sources.	Intermediary, research project	Intermediary	Intermediary and provider. The potential benefit of iGoogle is the seamless integration of other Google services (Gmail, Docs, etc.)	Intermediary
Financial Flow					
Revenue Model	Consumer have to pay for using the StrikeIron resources.	Research project, integration of Google Ads	Private Web site, advertisement	-	IBM Mashup Center is a software product. So far, the revenue model is based on software licenses.
Flow of Goods and Services					
	All transactions are handled by StrikeIron	Seekda crawls the Web for existing services and monitors their availability.	ProgrammableWeb provides only discovery services	Google provides the presentation layer of the distribute running gadgets	
Features of the Specific Medium (Technology)					
APIs	StrikeIron Marketplace API	-	Full access to the catalogue capabilities based on OpenSearch, Atom Publishing Protocol (Google GData); http://api.programmableweb.com	Google Gadget API	Open Ajax
Web GUI (Portal)	All features are accessible via the Website	All features are accessible via the Website	All features are accessible via the Website	All features are accessible via the Website	All features are accessible via the Website/ Portal

² <http://dip.semanticweb.org/>

of the services to improve transparency issues as discussed before. Programmable-Web.com represents one of the upcoming intermediaries addressing explicit the requirements of the Mashup paradigm. The consumer-oriented iGoogle Gadget Repository provides a simple and initiative navigation concept how to retrieve Mashup components (in this case widgets) by users without any IT skills. Finally, we analyze the IBM Mashup Center hosted by the Greenhouse project of IBM. Due to its business orientation, it gives first impressions about governance aspects that have to be addressed. The results of the case study analysis are depicted in the tables below. In the first table the business models of the five intermediaries are described in general terms based on the structure provided by the generic business model concept of Stanoevska and Hoegg (2005). In the second table the core features of the four market phases applied by the five intermediaries are analyzed and compared.

All intermediaries address enterprises as potential customers, while two of them also consider individuals as additional potential customers. Two of the intermediaries are at the same time providers and intermediary. Three are only intermediaries. The five intermediaries differ in the way how they generate revenues. Intermediaries as ProgrammableWeb.com that are basically collecting Mashup components are financed by advertising. The two intermediaries providing also own components apply a certain payment model: StrikeIron a pay-per-use model and the IBM Mashup Center a software licence model. Only StrikeIron seems to cover main parts of all market phases. However, StrikeIron doesn't support the actual design features to compose Enterprise Mashups.

Table 2 summarizes the functionalities offered by the observed cases according to the four market phases.

Table 2. Case Studies: The four market phases of Mashup Intermediaries

Intermediary	StrikeIron	Seekda	ProgrammableWeb.com	iGoogle Gadgets	IBM Mashup Center
General Information					
Owner	StrikeIron	University of Innsbruck, STI	John Musser	Google	IBM, Greenhouse Project
Supported mashable components	Resources	Resources (Web Services)	Resources (Web Services, REST, etc.)	Widgets	Resources, Widgets, Mashups
#Components (Mashups, Widgets, Resources)	40 Resources	27813 Resources	1171 Resources, 3731 Mashups	> 50.000 Widgets	475 Resources, 47 Widgets, 107 Mashups
Active	2002 - today	2006 - today	2005 – today	2006 - today	2008 – today
Supported Features of Enterprise Mashup Intermediaries					
Knowledge Phase					
- Registration	Online registration (free)	Online registration (free)	Online registration (free)	Online registration (free)	Online registration (free)
- Support (videos, tutorials, samples, etc.)	-	Introduction how to use Web Services	-	-	Videos on YouTube, sample pages (Mashups)
- Provider description	StrikeIron acts as provider of all resources.	Name, country, home page	Name	Name, company, email address, website	Name, company

Table 2. (continued)

Intermediary	StrikeIron	Seekda	ProgrammableWeb.com	iGoogle Gadgets	IBM Mashup Center
- Component description	Name, description, features, benefits, service endpoint, price conditions	Name, provider, country, description, user, rating, tags, availability, service endpoint	Name, provider, description, tags, user rating, date added, technical protocol, security, support and signup/ licensing	Name, provider, description, preview of widgets, popularity, average rating	Name, provider, description, popularity, version, average rating
- Aggregation of collected information about the consumer/ provider (reputation)	-	List of all provided Mashup components	List of all provided Mashup components	List of all provided Mashup components	List of all provided Mashup components
- Aggregation of collected information about the quality of mashable components	Monitoring of performance and uptime	Extensive analysis of the availability (response time,	-	-	Popularity
- Browsing/ discovery of the catalogue	Free text search, sort by categories	Free text search most used, recently found services, providers by country, tag cloud	Free text search, sort by categories, newest, most popular, API scorecard, Mashup matrix tag cloud	Free text search sort by categories, hottest, most users, newest	Free text search sort by categories top ratings, most popular, tag cloud
- Certification of mashable components or providers	-	-	-	-	-
Intention Phase					
- Annotation components (tagging, recommending, rating, sharing, etc.)	-	Tagging, rating, reviewing	Tagging, rating, reviewing	Tagging, rating, reviewing, sharing (integration with Google contacts)	Tagging, rating, reviewing
- Publication of Mashup components	-	Online form to add resources (URL) for the crawling engine	Online form and API to add a resource or Mashup	Adding of new widgets/ feeds (URL)	The provider is also able to specify the permission of the components (view or edit mode)
- Promotion of Mashup components	-	-	-	-	-
- Service matching by wizards (expert assistant)	-	-	-	-	-
Contract (Design) Phase					
- Design and creation of an individual working environment/ application	Sample application allows testing a component.	A Web Services Invoker allows to test a Web Service; a real design environment does not exist	-	Individual environment with several themes and so-called Google gadgets (widgets) which can be added to the environment	It allows to create and individual page by adding widget from the catalogue.
- Composition of mashable components	-	-	-	-	Widgets can be wired and resources can be piped.
- Composition matching (assistant to handling interoperability aspects)	-	-	-	-	-
Settlement Phase					
Monitoring the consumption of mashable components and consumer behavior	-	Long term database monitors the availability of the Web Services	The popularity of APIs is documented indirectly by analyzing	Popularity based on the consumer consumption is documented	Popularity based on the consumer consumption is documented
Billing usage of mashable component	Commercial agreements and sales conditions	-	-	-	-
Management of the payment	Online subscription with credit card payment	-	-	-	-

4.2 Generic Business Model Types: Directory, Broker and Marketplaces

Based on the findings of the five case studies presented in the previous section, we observe and identify three generic business model types for Enterprise Mashup intermediaries: Directories, brokers, and marketplaces.

- **Directory.** Similar to traditional repositories well-known in SOA environments such as UDDI or ebXML, directories focus only on the organization, i.e. collection and classification of mashable components. Providers are able to publish a mashable component to the intermediary, where the consumer is able to find it. ProgrammableWeb.com and iGoogle follows a directory business model. Thereby iGoogle covers also the contract (design) phase to create an individual environment. The Mashup directories take a low risk and concentrate on offering added value by just closing the information asymmetry regarding availability of components among providers and consumers. Given this, they can only leverage the available information as a basis for advertising based business models or subscription based business models where providers listed in the directory pay a fee for being listed.
- **Broker.** In contrast to directories, brokers go one step further in diminishing the information asymmetry among providers and consumers. To select and use a component, consumers need additional information concerning the availability, reliability, reputation, or quality. This type of information is provided by brokers (see for example Seekda).
- **Marketplaces.** The third generic business model type is a marketplace. Besides the provided features of brokers, it covers all market phases including the settlement phase with the billing and the accounting features. Only one of the observed cases – StrikeIron - can be considered to be a marketplace.

The analysis of the cases reveals that most of the emerging intermediaries are directories or brokers. Thus, the prevailing intermediaries cover only part of the functionality proposed in the interaction phase model (see figure 4). Marketplaces that completely cover all four market phases are not present yet. This might on the one hand be due to the fact, that trading of mashups and of components for mashups is a very new business area and not mature yet. At the same time, the risk of the intermediary increases the more he covers all four market phases. At the same time the demand for Mashup components might not be mature yet as well. Current low volumes of Mashup trading cannot cover the costs of operating a complete market place. However, intermediaries that offer already broker functionality can evolve to marketplaces when transaction volumes increase.

5 Conclusion and Future Work

The aim of this paper is the design of an interaction phase model for Enterprise Mashup intermediaries. In order to achieve this, we follow the design science methodology. After defining the main terms related to Enterprise Mashups and business models, we presented a designed interaction phase model for Enterprise Mashup environments by leveraging the transaction market phases proposed by Schmid and Lindemann (1998) and intermediary features according to Sarkar et al. (1995). By means

of five case studies, we demonstrate the application of the model artefact. We observed three generic business model types for Enterprise Mashup intermediaries (directory, broker, and marketplace) and described their characteristics. Figure 5 depicts the results of this research according to the business model concept hierarchy (Osterwalder et al. 2005).

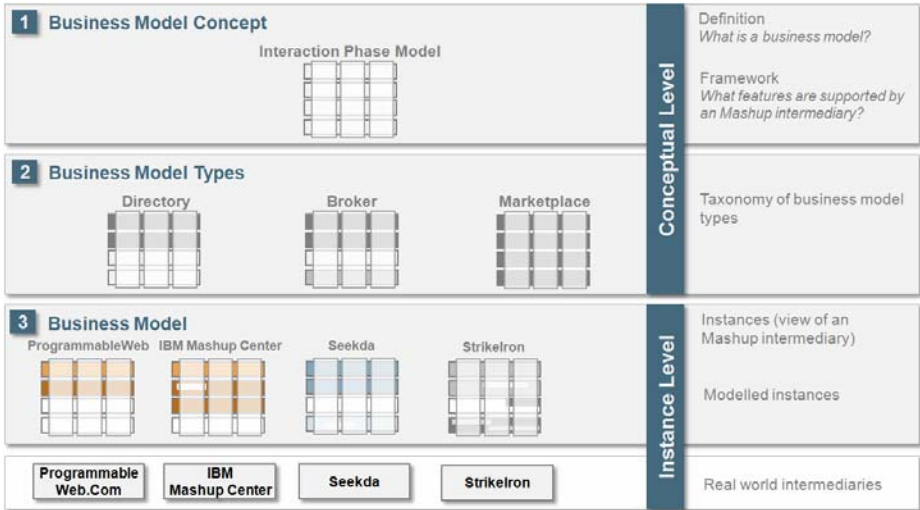


Fig. 5. Generic Business Models Types for Enterprise Mashup Intermediaries

What is still missing is a broader application of interaction phase model and the generic business model types. Further research will deal with the design and development of an Enterprise Mashup marketplace which covers all features as identified in this paper. The technical infrastructure will be based on the SAP Research Roof-Top Marketplace prototype (Hoyer et al. 2009) and of the EU funded projects FAST/EzWeb³ that are currently under development.

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³ <http://fast.morfeo-project.eu>

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The Commercial Open Source Business Model

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Abstract. Commercial open source software projects are open source software projects that are owned by a single firm that derives a direct and significant revenue stream from the software. Commercial open source at first glance represents an economic paradox: How can a firm earn money if it is making its product available for free as open source? This paper presents the core properties of commercial open source business models and discusses how they work. Using a commercial open source approach, firms can get to market faster with a superior product at lower cost than possible for traditional competitors. The paper shows how these benefits accrue from an engaged and self-supporting user community. Lacking any prior comprehensive reference, this paper is based on an analysis of public statements by practitioners of commercial open source. It forges the various anecdotes into a coherent description of revenue generation strategies and relevant business functions.

Keywords: Open source, open source software, commercial open source, community open source, commercial open source business model, dual-licensing strategy, open core business model, business model, go-to-market strategy, open source sales, open source marketing, open source product management, open source licensing, software engineering, collaborative development.

1 Introduction

Open source software¹ is software that is available in source code form, can be modified by users, and can be redistributed even in modified form without paying the original owners.

Open source is changing how software is built and how money is made. In 2006, open source software had a market share of 0.7% of the total packaged software market in terms of revenue [31] [21]. The prediction for 2008 was a market share of 1.1%. This data is underestimating the usage of open source software as it accounts only for paid-for open source software. According to a 2008 IDC report, less than 1% of all installations had third-party attendant services [20], demonstrating that open source is being used significantly more widely than it is being paid for.

The total amount of work invested into open source software projects is growing at an exponential rate and can be expected to continue growing at this rate for a while

¹ See <http://www.opensource.org>

before slowing down [12]. In general, the size of individual open source projects tends to grow at a linear or quadratic pace [23] [19]. The driver behind the overall exponential growth of open source is the exponential growth in the number of viable projects. Viable open source software is now available for any domain including business software, not just infrastructure software.

In many ways, the economic success of open source appears to be a paradox. How can companies make money of software they are making available for free? There are many answers to this question, as discussed in the next section. This paper focuses on one particular category of firms, called commercial open source firms [29] [9]. Commercial open source firms are firms that are the sole owner of a product they generate revenue from. Examples are MySQL², SugarCRM³, Jaspersoft⁴, and Alfresco⁵. According to a recent Gartner⁶ report, by 2012 more than 50% of all revenue generated from open source software projects will come from projects under a single vendor's patronage, that is, from commercial open source [18].

The benefits of commercial open source stem from the creation of an active and engaged user community around the product while at the same time preventing the emergence of competitors from that community. In a nutshell, this community helps the company get to market faster, create a superior product, and sell more easily, all at a lower cost than possible for traditional competitors. In exchange, the company offers a professionally developed product of compelling value to the community that this community is free to use under an open source license.

The contribution of this paper is to comprehensively present the core properties of the business models underlying commercial open source companies. Prior work typically addressed open source in general without special consideration for commercial open source. This paper reviews every relevant business function and how it works in a commercial open source business model. Methodologically, the paper is based on the reception of interviews and presentations by practitioners of commercial open source as well as the author's review of the behavior of commercial open source firms in the marketplace.

2 Prior and Related Work

Like the author of this paper, Capra and Wasserman make a fundamental distinction between commercial and community open source [9]. *Community open source* is open source software that is owned by a community or a legal entity representing the community. The community members typically don't derive direct revenues from the software but subsidize it from ancillary products and services. *Commercial open source*, in contrast, is open source software that is owned by a single legal entity with the purpose of deriving revenues from the software. The next section discusses this distinction in more detail.

Various authors have provided summaries of how companies generate revenue from open source software. Watson et al. distinguish five models of software

² See <http://www.mysql.com>

³ See <http://www.sugarcrm.com>

⁴ See <http://www.jaspersoft.com>

⁵ See <http://www.alfresco.com>

⁶ See <http://www.gartner.com>

production and distribution [38]. Three of these they call open source business models. The “corporate distribution” model encompasses the providers of software distributions, for example, Red Hat⁷ or SpikeSource⁸. “Sponsored open source” is open source that does not generate revenue for the contributing companies, for example, Apache Software Foundation⁹ or Eclipse Foundation¹⁰ projects. Finally, “second-generation open source” is open source where supporting companies generate revenue from complementary services. This last category puts all revenue generating strategies into one basket without drawing distinctions between such different models as consulting and implementation services, e.g. JBoss¹¹, or license sales, e.g. MySQL.

Brian Fitzgerald introduces what he calls “OSS 2.0” [15]. He argues that prior to OSS 2.0 there were only two revenue models: “Value-added service-enabling,” which created revenue from services around successful open source projects, and “loss-leader market-creating,” which created revenue by upgrading users of a free open source project to a commercial more feature-rich version of the same software. OSS 2.0 now provides a more differentiated approach to the loss-leader strategy and adds two new strategies, “leveraging community software development” and “leveraging the open source brand.”

Many more classifications of open source business models have been made. For example, the European Union’s FLOSSmetrics¹² project analyzed 120 firms which derive their main revenue stream from open source, and clustered these firms into six main categories [17] [11].

Open source has been discussed from an economic perspective before, for example, by Perens [28], Valimaki [34], and others [13]. However, there is quite a gap between a general discussion of the economic properties of open source software and the specifics of commercial open source.

Perhaps the clearest account of commercial open source has been provided by Michael Olson in his discussion of the “dual-licensing strategy” of commercial open source firms [27]. Olson focusses on intellectual property ownership and the business strategies resulting from such ownership, most notably the right to provide the product under both a (free) open source license and a (paid-for) commercial license.

With the exception of Olson's work, none of the prior works focus on commercial open source, and Olson mostly addresses its intellectual property aspects. In contrast, this paper comprehensively discusses the key properties of commercial open source firms across all business functions.

3 Commercial vs. Community Open Source

Open source projects can be categorized into either commercial or community open source projects [29] [9]. Community open source projects represent by far the majority of projects. These two types of projects are distinguished by their different control and ownership structures.

⁷ See <http://www.redhat.com>

⁸ See <http://www.spikesource.com>

⁹ See <http://www.apache.org>

¹⁰ See <http://www.eclipse.org>

¹¹ See <http://www.jboss.com>

¹² See <http://www.flossmetrics.org>

- *Community open source* is open source that is controlled by a community of stakeholders;
- *Commercial open source* is controlled by exactly one stakeholder with the purpose of commercially exploiting it.

3.1 Community Open Source

Examples of community open source projects with a diverse set of stakeholders are the Linux operating system¹³, the Apache web server¹⁴, and the PostgreSQL database¹⁵. The source code of these projects is available under one and only one license, and anyone can enter the market and generate revenue from the project without being disadvantaged.

The contributors to community open source projects used to be the group of volunteer software programmers who developed the open source project. In this case, control is determined by ownership of copyright to the code in the project and related intellectual property as well as social structures such as having the commit (write) rights to the code repository.

Today, the volunteer communities of economically relevant projects are increasingly being represented or replaced by non-profit foundations such as the Apache Software Foundation or the Eclipse Foundation [25]. Legally, many of the foundations have become the sole owner of the project; however, since the foundations are being controlled by their members, they still represent a community of stakeholders that run the foundations' projects.

As the previous section showed, there are many ways of generating revenue from open source software, including community open source. The three dominant ones are

- consulting and support services around the software,
- derivative products built on the community project, and
- increased revenue in ancillary layers of the software stack.

More details are described in a related paper [29].

3.2 Commercial Open Source

Commercial open source firms build their business around an open source software project that they fully control, typically by having developed the software and never having shared control with third parties. This is done by owning the full copyright to the code and related intellectual property such as patents and trademarks.

According to Olson, the maintenance of full control over the project is crucial to the functioning of commercial open source [27]. One consequence is that commercial open source firms do not accept outside contributions to the code base. Or, if they accept them, they require a transfer of copyright from the creator to the firm to not dilute the firm's rights to the project. Augustin, however, argues that full ownership transfer is not needed and that receiving relicensing rights is sufficient [6].

¹³ See <http://www.kernel.org>

¹⁴ See <http://httpd.apache.org>

¹⁵ See <http://www.postgresql.org>

Commercial open source firms differ from traditional software vendors by not only providing the product for free as an easily installable binary but also by providing it in source code form. By providing the source code under an open source license, such firms qualify as open source firms. However, because these firms own the copyright to the product, they are not constrained to only one license but rather they can relicense the software to customers as they see fit.

Typically, the free open source form is provided under a reciprocal license like the GPL to drive adoption but stall possible competitors. Paid-for versions of the software are then provided under a commercial license like traditional software vendors do. This is also known as the dual-license strategy of commercial open source [24] [27].

4 The Commercial Open Source Business Model

In this paper, the term business model is defined as the combination of revenue generation strategies and supporting business practices and functions. This definition is a simplification over recent work defining electronic business models, for example, Timmers or Clarke [33] [10]. The focus on traditional business functions, however, lets this paper stay close to the structure and behavior of real firms and leaves the creation of a more general abstraction to future work.

Practices and functions include sales and marketing processes, software production processes, and customer support processes. Thus, this paper first discusses what customers pay for and then how it is being produced and sold. It is understood that there is not just one but many commercial open source business models. Hence, this section focusses on those key properties that are shared across all or most commercial open source firms.

4.1 Revenue Sources

Generally speaking, the products and services that customers pay for are not new. Bearden identified several categories of products and services that customers pay for [7]. Paraphrased by the author of this paper these are the four categories:

- *Core product.* Some customers pay for the software, simply because they cannot accept the open source license. Mostly, this is for legal reasons. For example, companies may pay for a commercial license to receive certification or indemnification or to embed the software into their products without having their own code touch open source code.
- *Whole product.* Commercial users pay for the utility derived from using the software. Increasingly, the free open source product does not provide the full utility, only a more comprehensive non-free commercial version does, as summarized by Asay [2]. To meet all requirements, commercial users have to upgrade from the free to the non-free version.
- *Operational comfort.* Customers also want to ensure that the software reliably fulfills its duty. Thus, they may be buying hot-line and technical support, subscription services to bug fixes, or real-time systems monitoring. There are many such non-functional requirements that companies may want to buy, many of which are specific to the software at hand.

- *Consulting services.* Finally, customers may want to pay for training, documentation, and implementation services.

Different names have been given to different aspects of commercial open source. The term “dual-license strategy” refers to selling a commercial license to the project separate from the open source license [27]. The term “freemium model,” a word play on “free” and “premium,” refers to withholding features from a free version and making them available only in a commercial version [14]. Lampitt coined the term “open core model” which combines the dual-license strategy with a freemium approach [24]. Asay puts it together in what he calls a “phased approach” to creating commercial open source businesses [1].

Selling a comprehensive product and providing operational support for it is not really novel. What is novel is how the software is being built and sold.

4.2 Business Functions

Releasing a product’s source code as open source can create an engaged user community which can impact the various functions of the commercial open source firm in multiple positive ways. This impact can create a significant competitive advantage over traditional (non-open-source) competitors. Thus, we first need to discuss

- *Community management:* How to create and sustain an engaged community.

From the community then, the following benefits accrue, listed by business function:

- *Sales:* More and easier sales due to customer-side champions.
- *Marketing:* More believable and cheaper marketing through engaged community.
- *Product management:* Superior product thanks to broad and deep user innovation.
- *Engineering:* Superior product that is developed faster thanks to fast and immediate community feedback.
- *Support:* Lower support costs thanks to self-supporting user community.

Open sourcing also has its downside, for example, increased risk of getting sued for patent violations or of leaking important intellectual property. Also, catering to a non-paying user community and providing the public infrastructure for the community increases costs. The biggest danger, however, is that the firm’s commercial product ends up competing with its own free open source project. This challenges product management as discussed below.

4.3 Community Management

An engaged community is at the core of any working open source software project [37]. In *community open source* projects, this community comprises both users and developers, as the development work is carried out by the community itself. In *commercial open source*, almost all of the core product development work is carried out by the commercial firm, with occasional contributions from the community [26].

Commercial open source firms are interested in creating an active and self-supporting user community. Such a user community is key to achieving the desired

business benefits. Commercial open source firms are also interested in creating an ecosystem of developers and service companies that extend the core product to increase its overall value proposition.

The main problem with seeding and growing a user community is the support cost. With closed source software, only the firm developing the software can provide the support. With a rapidly growing user base, the support cost can quickly outgrow any existing revenue or cash reserves.

Commercial open source firms address this problem by leading the community to become self-supporting. For this, they provide not only an easily available product, they also provide the source code to the product under an open source license. From a user perspective, this has the following benefits:

- *Free use.* Providing the product under an open source license grants free irrevocable usage rights; thus, users do not have to worry about having to pay down the road if they don't want to.
- *No lock-in.* Because the source code is available under an open source license, users can become independent of the commercial firm and hence (sometimes naively) think are not locked into the firm's future decisions.
- *Self-support.* Because the source code is open source, users can solve their problems themselves without having to resort to asking the firm, which might not want to provide that support to non-paying users in the first place.

From the firm's perspective, providing the product as open source accelerates adoption without increasing support costs. Specifically, it reduces hurdles to adoption as potential users perceive no or little lock-in, and it makes it possible that the community becomes self-supporting once it reaches critical mass.

Walker as well as Capobianco provide some insights into how commercial open source firms seed and grow such communities [37] [8]. On the most basic level, communities need a place to gather, and they need tools of communication. For this reason, most commercial open source firms host a software forge with integrated or ancillary tools like wikis, forums, and mailing lists. Much of the general advice on community building on the web applies, like aiding the construction of explicit social structures and rewarding members for good behavior [22].

More specific to commercial open source is the application of traditional marketing techniques: Firms need to understand the different sub-communities and their significance and target and support them accordingly. Specific programs aimed at different segments may become necessary. In general, community managers try to create win/win situations, which are easy to achieve as each constructive contribution by a community member not only benefits the product and the firm but increases that member's buy-in and his or her reputation within the community.

Each of the following business functions (sales, marketing, product management, engineering, support) has its own requirements and best practices of engaging with the community, and they are discussed in turn.

4.4 Sales

Augustin provides an account of the commercial open source sales funnel, as depicted in Figure 1 [5]. An eventual customer goes through a process of downloading,



Fig. 1. Commercial open source sales funnel according to Augustin [5]

installing, and using the software, before they are recognized as a lead, become a prospect, and finally are converted from user to customer.

Compared with the traditional sales funnel,

- commercial open source has a different *lead generation model*, and
- it replaces the traditional pre-sales-to-sale activities with a *user-to-customer conversion process*.

Because the open source product is available for free, potential customers can download, install, and use the product without ever getting in touch with the commercial firm behind the product. At the same time, the firm can track via (typically voluntary) download registration and community forum activities who is actually using the product. Some products also provide usage information back to the firm.

A lead analysis can then determine which of these users might be potential customers. More often than not, however, the firm will wait until a non-paying user steps forward and asks for a sales contact to purchase any of the services outlined in the revenue generation section. Thus, leads emerge from the existing user community, either voluntarily or by analysis. Of course, the commercial firm can still engage in a traditional sales cycle with non-using prospects as well.

In a traditional setting, a software firm's product is unknown to the potential customer except through marketing material. In the commercial open source setting, the potential customer is sometimes already using the product and hence is familiar with it. Thus, from the buyer's perspective, the open source project has significantly less risk associated with it. In this situation, there is likely to be an inside champion in the buyer's organization who downloaded and installed the product and is using it. These factors make a sale significantly easier than possible if the software firm had no prior relationship with the buyer.

As free open source software, commercial open source can make it into potential customer companies under the radar screen of the CIO. IT organizations may have strict rules in place not to install arbitrary software, however, in practice these rules are frequently circumvented [26]. Such early footholds in potential customer companies drive customer acquisition cost down significantly [39]. Whether a significant percentage of potential customers is already using the product typically depends on the type of product. For some it is the case, for others it is not.

One role of the community is to support the potential buyer during the lead generation phase. For economic reasons, the commercial firm cannot provide this support on a broad scale, since only a small and hard-to-identify percentage of users might

actually turn into customers. According to Taylor, conversion rates of 0.5-2% are common for commercial open source firms [32]. Since the user is not paying at this stage, voluntary community support is typically acceptable. As soon as the user is converted into a paying customer, professional support becomes available.

4.5 Marketing

Most commercial open source software firms engage in traditional marketing: They advertise, they exhibit at trade shows, and they give talks [8]. What is new is that an engaged user community aids these marketing efforts. More specifically, the community makes marketing more effective and cheaper than possible without this support.

Marketing is more effective because non-paying users are credible sources of good testimonials. Thankful for a good product and the positive engagement in the community, users evangelize and market the product themselves without much support necessary from the commercial firm [39].

Free marketing can significantly reduce the marketing cost of a software firm, and hence create a competitive advantage over a competing traditional firm. According to Augustin, the ratio of sales and marketing (S&M) expenses to research and development (R&D) expenses in traditional software firms is 2.3 (and sometimes much higher), while it can be much lower for commercial open source firms [4]. In the CRM space, for example, the S&M / R&D ratio of non-open-source firm Salesforce is 6, while Augustin estimates the S&M / R&D ratio of a hypothetical open source CRM vendor to be 0.6, suggesting significant savings in sales and marketing expenses [3]. From a startup perspective, such a reduced cash burn rate increases the likelihood of survival for the commercial open source firm over the traditional firm.

4.6 Product Management

Von Hippel has shown how user innovation can be a significant source of product innovation for any commercial firm [35] and Shah has shown how this applies to open source software [30]. Mickos discusses how user innovation has aided the MySQL database [36] [26]: By providing the source code, firms encourage volunteers to innovate and contribute to the product for free. As mentioned, no such contributions will be accepted unless the rights are transferred to the commercial firm. Nevertheless, such user innovation can significantly improve the product, and if only through ideas rather than code.

An engaged community actively discusses strengths and weaknesses as well as future prospects of the open source product. Almost every commercial open source software firm provides the means to such discussions in the form of mailing lists, forums, and wikis on a company-run software platform. Thus, product managers can easily observe and engage with the community and discuss current and future features. This in turn brings product managers close to users and customers, aiding the product management process, for example, by helping feature definition and creation of a product roadmap.

In commercial open source, this community does not only include current customers but also current non-paying users and possibly even researchers and students. Thus, compared with a traditional community of customers, the breadth of perspectives in such discussions is much higher. This breadth of perspective in turns helps

product managers understand new features and issues that have kept non-users from becoming users as well as existing users from converting to customers.

Many commercial open source firms distinguish between a free community version of the product and a paid-for enterprise edition. Product management faces the challenge of motivating enterprises to purchase a commercial license without annoying the non-paying community by withholding important features. Smart product managers address this problem by determining which enterprise features are irrelevant to the open source community and by taking a time-phased approach to making features available that are needed by both communities.

Product management benefits greatly from the immediate connection with the community, which provides ideas and feedback and keeps the product focused on its needs. Thus, the community helps the firm create a superior product.

4.7 Engineering

Obviously, volunteer contributions can speed up development. Also, an engaged technical community represents a potent pool of possible future employees that proved themselves before being hired, taking risk out of the hiring process.

More importantly, however, and similar to product management, are the benefits of direct and immediate feedback from the community. A commercial open source company is likely to provide the latest release, sometimes a daily release, to the community, including potential bugs. An engaged (and fearless) community picks up the latest release and provides feedback to the company about bugs and issues they found, sometimes together with a bug fix. While such community behavior may appear as counterintuitive, it is nevertheless what practitioners experience [26] [36].

The distinction between an experimental community edition and slower-paced but more stable enterprise edition in turn lets the commercial open source firm sell operational comfort, that is, the stable enterprise edition, more easily. Still, engineering management may not want these two versions to become too different from each other to avoid (re-)integration problems with outside contributions as well as unnecessarily redundant development on both versions.

4.8 Support

An engaged community supports itself by and large. Users who are not customers typically don't expect professional support from the commercial firm and are willing to utilize (and contribute to) community support. The commercial firm needs to aid in the support, but does not have to perform the bulk of the work. It would be prohibitively expensive for the commercial firm to provide support to all users, including those that don't pay. Thus, a self-supporting community is necessary to grow a large (non-paying) user base that might be converted into paying customers later. Paying customers can then receive full support from the commercial firm as part of their maintenance contracts.

The self-support activities of the community benefit the support activities of the commercial firm as well, reducing its cost. Specifically, engaged communities frequently develop and manage their own documentation, or at least contribute to and expand company documentation. User-maintained wikis and knowledge bases have become common. Thanks to the power of Internet search, many users, including

paying customers, find it easier and faster to browse for problem solutions before turning to paid support in the form of phone calls or emails. Thus, the community takes some of the support burden of the commercial firm's shoulders, reducing the overall support expenses.

5 Conclusion

Open source is changing how software is built and how money is made. Industry analysts predict that by 2012 more than half of all open source revenue will accrue to single-vendor dominated open source projects, called commercial open source. This paper comprehensively presents the core properties of commercial open source firms as well as their main business functions. Through a review of interviews and presentations by practitioners of commercial open source as well as other sources, this paper shows how at the core of the successful commercial open source firm is an engaged and self-supporting user community. From this user community, many benefits accrue, touching almost every business function of the firm: Sales are eased and increased through inside champions and reduced customer risk, marketing becomes more effective through better testimonials and active community support, product management more easily meets customer needs and benefits from user innovation, engineering creates a superior product faster and cheaper, and support costs are reduced. Thus, first order of business for a commercial open source firm is to create and sustain this community, a business function frequently non-existent or neglected in traditional software firms.

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iPhone or Kindle: Competition of Electronic Books Sales

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Abstract. With the technical development of the reading equipment, e-books have witnessed a gradual and steady increase in sales in recent years. Last year, smart phones announced to be able to perform additional functions as e-book reading devices, making it possible for retailers selling e-books for smart phones (SPR) such as iPhone to differentiate with those selling e-books for specific reading equipment (SER) such as Amazon Kindle. We develop a game theory model to examine the competition between SER and SPR retailers. We derive the equilibrium price and analyze the factors that affect equilibrium outcomes under both scenarios of complete and incomplete information. Our results suggest that reduced cost due to inconvenience of reading e-books over iPhone lowers equilibrium prices, and reduced cost of specific reading equipment leads to more intense price competition. Under information asymmetry, we show that SER retailers will increase the price at equilibrium.

Keywords: E-book, information goods, game theory, price competition.

1 Introduction

Recently, the publishing industry has experienced a successive decrease of revenue together with a grim forecast for the near future. According to Association of American Publishers (AAP), book sales drop 2.4% in year 2008. However, e-books have witnessed an outgrowth in sales. According to the Association of American Publishers (AAP), in November 2008, “e-book sales jumped up by 108.3 percent for the month (\$5.1 million), reflecting an increase of 63.8 percent for the year”. In fact, e-books have seen a steady growth in these years. According to the International Digital Publishing Forum, e-book wholesale revenue has reached almost 14 million in the third quarter of 2008, almost an increase of 75% compared with the same period of 2007 (see Figure 1).

A couple of reasons may explain the gradual but steady development of e-book sales. First, technology advancements, especially that of new reading equipment for e-books such as Amazon Kindle and Sony e-book reader, make it possible for a higher level of reading comfort. For example, high-definition technologies have made reading a more enjoyable experience, and broadband technologies have turned downloading e-books into an easy job. In addition, newly developed equipments such as Amazon Kindle are capable of storing a large number of e-books, which relaxes the constraint of e-book storage. Second, selling e-books provides an additional revenue

source for book retailers. Retailers typically need to face high fixed costs in obtaining published books, such as the copyright expenses charged by publishers and/or authors. However, once the books are transformed into digital format, the marginal distribution costs are extremely low. Thus, any additional way that can help increase revenue such as distributing published books in e-book format will be a big plus. Third, publishing e-books provides a lower barrier for independent writers to build reputation and distribute their work as self-publishers.

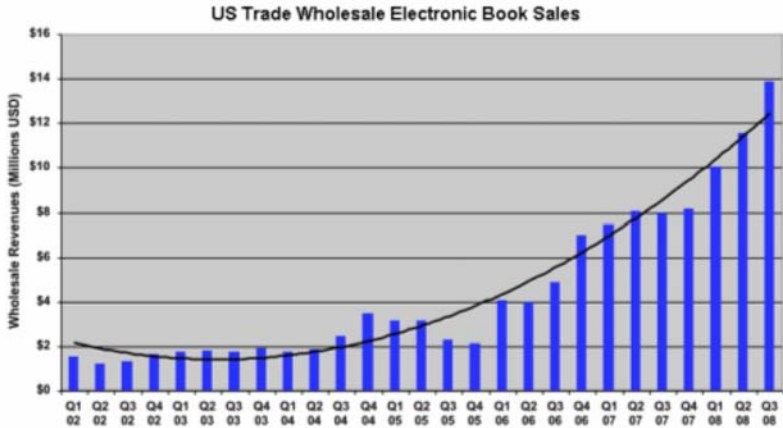





Fig. 1. US Trade Wholesale E-book Sales

Last year, smart phones such as iPhone, announce that they can involve new software to perform additional functions as e-book reading devices, providing an alternative for e-book readers. For example, beginning July 14, 2008, Lexcycle Stanza, a software program for reading e-books, digital newspapers, and other digital publications, was available for users of Apple iPhone and iPod Touch. Lexcycle Stanza enables electronic books and articles to be displayed in an easy-to-read (and adjustable) format and allows pages being turned with the flick of a thumb. Up till now, the software has supported a variety of e-book formats including Mobipocket, PalmDoc, HTML and PDF. In addition, Stanza allows users to manage a library of books through a customizable reading interface on iPhone and iPod Touch. Right now, the list of Stanza’s partners includes many online e-books such as BooksOnBoard, Fictionwise, and Smashwords and continues to increase. On those websites, consumers can purchase e-books and download them wirelessly on their iPhones.

The appearance of smart phones as e-book reading devices may lead to an enormous change of the industry. Compared with previous e-book readers such as Amazon Kindle and Sony e-book readers, the distribution channel of smart phone has the following advantages: First of all, phones are routine equipment for millions of people. One typical example of smart phones is iPhone, the total sale of which reached 13 million in the fourth quarter of 2008. Therefore, consumers purchasing e-books for smart phone do not need to purchase specific equipments for e-book reading, especially for those people who are unwilling to carry a lot of items. Second, although the price is similar for newly released books for both smart phones such as iPhone and

specific reading equipment such as Amazon Kindle, it is relatively cheaper for royalty-free classical books on iPhone which usually cost just 99 cents or even less for each. Finally, for those independent publishers, the large population of iPhone users is surely much more attractive compared with that of readers using specific e-book reading equipments (see Table 1 for a brief comparison of smart phone, Amazon Kindle and Sony e-book readers). However, we assume that the trade-off of reading e-books on smart phone will incur a lower level of reading comfort, or say a higher inconvenience even if the content of books have little difference compared with the e-books for specific reading equipment.

Table 1. Comparison of E-book Reading Equipment

Smart Phone	Amazon Kindle	Sony e-book Reader
		
<p>More than 13 million iPhone alone till the forth quarter 2008**</p>	<p>Around 380,000*</p>	<p>Around 300,000*</p>

* The sales figures are estimates in Kharif.

** The sales figure is from Wikipedia <http://en.wikipedia.org/wiki/IPhone>

In our opinion, the entry of smart phones such as iPhone will lead to new competition in the e-book industry. With smart phones, there are two types of retailers for e-book industry: retailers selling e-books for specific reading equipment (SRP) and retailers selling e-books for smart phone. Essentially, this is a competition between retailers who sell homogenous information goods (e-books) but for different ultimate consumption devices. Although it is important for companies to derive their strategies under competition, few research have investigate competition of e-books due to different reading devices. In this research, we aim to make an exploratory study on the pricing strategies of retailers under this competition scenario. In specific, we want to answer the following questions:

- (1) What is the optimal price of both types of retailers in selling e-books?
- (2) Are there any differences in the scenario of complete and incomplete information competition?

2 Literature Review

In this paper, we use e-books as our research subject. Different from many recent research studying e-books from the aspect of copyright and education (Shiratuddin 2005; Srisaard 2005), our paper is based on e-books' properties as information goods. In a broad sense, e-books can be seen as one type of information goods whose

content consumed in digital format such as digital music, videos, and software products (Asvanund, Clay, Krishnan, and Smith 2004; Fan, Kumar, and Whinston 2009). Because of information goods' unique property of digitalized content, related issues are frequently studied such as the sharing of information goods (Asvanund et al. 2004), the bundling of information goods (Geng, Stinchcombe, and Whinston 2005) and the sampling of information goods (Wang and Zhang 2007). In our paper, we examine the issue of competition of retailers of e-books based on different consumption devices (SER and SPR). Before the emergence of the Internet, conventional distribution and consumption of reading is based on physical books. The Internet makes it possible for book retailers selling and distributing physical books and e-books. Previous research has illustrated the advantages of online distribution compared with traditional channels (Dewan, Freimer, and Seidmann 2000). However, the competition we are interested in is on the consumption stage rather than the distribution stage. Here, we examine the competition where there are two different e-books due to the reading device of them, which is new to the industry of e-books.

Our research is related to the literature on competition games of firms selling homogenous and similar products. In our research context, there are two competing firms who sell e-books with the same content but through different consuming equipment. Previous research in economics often applies Hotelling's approach to model competition, which assumes that consumers' valuation lies on a continuous base. In the research of competition information goods sales, Bakos and Brynjolfsson (2000) discuss several different types of competition, including upstream and downstream, and bundler and single information good (Bhargava and Choudhary 2008). Another research stream related to our work is optimal pricing of information goods. Chen and Seshadri (2007) find optimal pricing strategies for a seller who faces heterogeneous customers in both marginal willingness to pay and chances of getting information goods other than the seller. Sundararajan (2004) investigate strategies of optimal pricing for information goods under the scenario of incomplete information.

What distinguishes our work are the follows: (1) We focus on pricing strategies of firms selling e-books whose competitions are based on two different consumption devices of information goods. The distinct property of competition in our research context is that the quality of the products, e-books are in some senses determined by the reading equipment of consumers, which is different from previous research contexts such as physical goods. (2) We extend our model to the incomplete information scenario and analyze how factors such as inconvenience cost, cost of specific reading equipment and customer keeping ratio affect companies pricing strategies. Our research is relevant to the e-book industry which is experiencing a rapid and fundamental transformation, and provides important managerial implications for firms to effectively manage the competition to maximize their revenue. The research discussed above ranges over different aspects of our study, however, to the best of our knowledge, the issue of competition based on two different consumption devices of homogeneous information goods, especially e-books, has not been studied before.

3 Model

We develop a game theory model of e-books sales under competition between two companies: Company one who sells e-books that need specific e-book reading

Table 2. Decision Variables and Parameters

Decision variables		Parameters	
p_1	Price of e-book from SER retailer	c_1	Cost due to inconvenience of SER retailer
p_2	Price of e-book from SPR retailer	c_2	Cost due to inconvenience of SPR retailer
z	Customer-keeping level	c_e	Cost of specific reading equipment
		α	Discount factor of equipment cost
		β_1	Coefficient of variable cost of SPR retailer
		r	Customer kept ratio

equipment (SER) to read and company two who sells e-books that need smart phone (SPR) to read. The parameters and decision variables in our model are presented in Table 2 which will be further explained in this section.

In our research setting, customers make their decision of which company they want to buy e-books from based on their utilities. We assume that the e-books offered by both companies have little difference in terms of content, but have certain level of quality difference in terms of reading comfort, or say inconvenience. We denote the cost due to inconvenience when reading through specific reading equipment such as Amazon Kindle as c_1 and the cost due to inconvenience of reading smart phones such as iPhone as c_2 . We suppose $c_1 < c_2$, which implies that the customers will lose more convenience reading e-books on smart phones such as iPhone compared with reading e-books on specific reading equipments such as Amazon Kindle. The rationale of making such assumption comes from the features of two different equipments. Compared with iPhone, Kindle has a larger reading screen, delivers higher-contrast letters on an off-white background, and resembles more like real book page.

We assume that consumers have heterogeneous sensitivity ϖ to such cost due to inconvenience. This technique of modeling competition is consistent with the literature (Fan et al. 2009). We also assume that the customers share a homogeneous valuation of v for e-books. In addition, as mentioned earlier in the Introduction Section, consumers who want to get an e-book from SER retailer needs to purchase a specific e-book reader with the cost c_e . The reason we assume that consumers will not purchase an iPhone special for e-book reading is that smart phone is most often used for making calls and sending short messages. The utility of reading e-books on iPhone only consists a small portion of the total utility of using smart phones. We also have not involved in bundling reading equipment with e-books sales because it is not common in real business practice that one consumer will get a reading equipment for free or together with purchase of an e-book.

In our model, customers choose to purchase e-books from one of the two retailers based on their personal preference of price and sensibility of the cost due to inconvenience. Suppose that a customer's utility is $u_1 = v - p_1 - \alpha c_e - \varpi c_1$ for purchasing e-books from SER retailer and $u_2 = v - p_2 - \varpi c_2$ for purchasing e-books from SPR retailer. The constant α , $0 < \alpha < 1$ refers to the expected discounted factor for the cost of reading equipment on each e-book. A higher value in α implies that the

equipment is not often used and for each e-book the discounted cost of using the equipment is high while a lower value in α implies that the equipment is frequently used and for each e-book the discounted cost is low (companies can estimate α based on historical consumption records).

We assume that a customer is indifferent between the two e-book providers if $u_1 = u_2$, or say, $v - p_1 - \alpha c_e - \bar{\omega} c_1 = v - p_2 - \bar{\omega} c_2$. Solving this equation leads to $\bar{\omega}^* = \frac{p_1 + \alpha c_e - p_2}{c_2 - c_1}$, which is the indifferent point for customers.

When $\bar{\omega} > \bar{\omega}^*$, the customers will choose to buy books from SER retailer because $u_1 > u_2$. When $\bar{\omega} < \bar{\omega}^*$, the customers will choose to buy books from SPR retailer because $u_1 < u_2$ (see Figure 2).

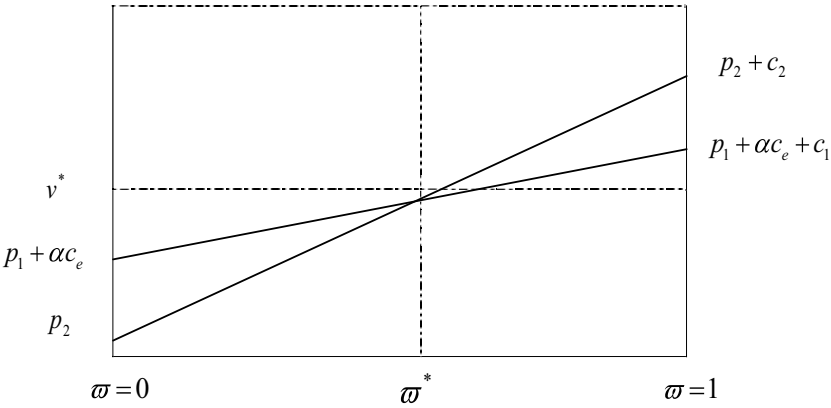


Fig. 2. Demand for E-books

Here, we assume that there are demands for both iPhone-based e-books and Kindle-based e-books. As shown in Figure 2, when $v = v^*$, $\bar{\omega} = \bar{\omega}^*$, $u_1 = v^* - p_1 - \alpha c_e - \bar{\omega}^* c_1 = 0$ and $u_2 = v^* - p_2 - \bar{\omega}^* c_2 = 0$. Therefore, it is straight forward to find the value of $v^* = \frac{p_1 c_2 + \alpha c_e c_2 - p_2 c_1}{c_2 - c_1}$. As shown in

Figure 2, consumers with low sensitivity to cost due to inconvenience $\bar{\omega} \in [0 \ \bar{\omega}^*]$ will choose SPR retailers while consumers with high sensitivity to cost due to inconvenience $\bar{\omega} \in [\bar{\omega}^* \ 1]$ will choose SER retailers. Thus, we find demand for the two types of e-books retailers using sensitivity as an index:

(1) The demand for company one is:

$$D_1 = 1 - \varpi^* = 1 - \frac{p_1 + \alpha c_e - p_2}{c_2 - c_1}$$

(2) The demand for company two is:

$$D_2 = \varpi^* = \frac{p_1 + \alpha c_e - p_2}{c_2 - c_1}$$

Consistent with the assumption of zero marginal cost of information good, the profit function for company one is:

$$\pi_1 = D_1 p_1 = \left(1 - \frac{p_1 + \alpha c_e - p_2}{c_2 - c_1} \right) p_1$$

For company two (SPR retailers), we need to consider the additional cost of keeping customers. Since SPR retailers do not directly distribute e-books to consumers, they need to use the network of communication companies such as AT&T who are also responsible for various type of services such as phone calls (both incoming and outgoing), short messages, other digital content such as images. Therefore, the higher level SPR retailers want to keep their customers to avoid complaints such as low download speed and high rate of transfer failure, the higher the maintenance cost. For simplicity, we denote this cost $f(z)$ in the linear form of level of keeping customers, $f(z) = \beta_0 + \beta_1 z$, where z is the level of keeping customers. The higher the level of keeping customers is, the higher the maintenance cost.

Thus, the profit function of company two is

$$\pi_2 = D_2 p_2 - \beta_0 - \beta_1 z$$

subject to $\frac{z}{D_2} \geq r$, which means that the customer-keeping ratio needs to be no less

than r , $0 < r < 1$.

In our paper, we establish a game theory model for competition between SER and SPR retailers. Consistent with previous literature (Fan et al. 2009), we model the game in two stages. In stage one, both companies simultaneously set their prices. In stage two, the company that distributes e-books over smart phones chooses the customer keeping level. The rationale here is that prices of e-books are visible to consumers immediately and frequent change of prices may bring negative effect to retailers such as discouraging current and potential consumers. On the other hand, the customer keeping level is in some senses an internal decision and can be adjusted based on market response of competition.

3.1 Competition under the Scenario of Complete Information

In the competition under the scenario of complete information, we assume that both companies set the price simultaneously in the first stage and the company selling

e-books through iPhone sets up the service level in the second stage. Using backward induction, we solve the second stage first. Since we assume that price and demand are given in the second stage, the problem can be simplified to

$$\text{Min}_z \beta_0 + \beta_1 z$$

subject to $\frac{z}{D_2} \geq r$.

For any given demand, it is straight that the solution is $z = rD_2$. Substituting the equation back into SER and SPR retailer’s profit functions, we can solve the equilibrium for the price competition game. The results are summarized in Proposition 1.

Proposition 1. The SER retailer’s optimal price and SPR retailer’s optimal price and the service level establish a Nash equilibrium, with p_1^* , p_2^* and z^* given as follows:

$$p_1^* = \frac{2c_2 - 2c_1 - \alpha c_e + \beta_1 r}{3}$$

$$p_2^* = \frac{c_2 - c_1 + \alpha c_e + 2\beta_1 r}{3}$$

$$z^* = \frac{r}{3(c_2 - c_1)}(c_2 - c_1 + \alpha c_e - \beta_1 r)$$

For brevity, the proof is relegated to the Appendix. The comparative static for the equilibrium results is presented in Table 3.

Table 3. Comparative Statics Results

Variables	c_1	c_2	α	c_e	β_1	r
p_1^*	-	+	-	-	+	+
p_2^*	-	+	+	+	+	+
z^*	?	?	-	-	-	-

* + increase; - decrease; n/a, no effect, ? no closed-form solution.

We first examine the equilibrium prices. We find that the equilibrium prices of e-books for both SER and SPR retailers will decrease when the cost due to inconvenience of reading e-books from SER retailers (c_1) and/or from SPR retailers (c_2) increases. This result suggests that when consumers who use smart phone incur lower cost due to inconvenience, then the equilibrium price of both the e-books sold by SER and SPR e-book retailers will go down accordingly. In another word, the market price

will decrease as the technology related to smart phone e-book reader improves and reading e-books on smart phones such as iPhone is less significantly different from reading e-books on specific reading equipments. We also find out that when the price of equipment (c_e) decreases, the price of SER e-books will increase and the price of SPR e-books will decrease. This result implies that as the equipment goes cheaper, the SER retailer will take this advantage and charges higher price on e-books, but the SPR retailer needs to lower the price to remain competitive. Previous literature suggests that distinct differentiation may lead to reduced price competition. In some sense, our finding is consistent with this result since a lower cost of e-book reading equipment refers to a less distinct differentiation. In addition, our results show that equilibrium prices also increase in customer-keeping ratio (r) and variable cost of service (β_1) of the SPR retailer. This is intuitive because both customer-keeping ratio and variable cost of service contributes to the marginal cost of SRP retailers. Naturally, a higher marginal cost leads to a higher equilibrium price for SPR retailers.

As for the optimal customer-keeping level, comparative statics results suggest that a higher customer-keeping ratio (r) or a higher variable cost of service (β_1) will lead to a lower level of SPR retailer's customer keeping level. An inspection of the SPR retailer's profit and cost function suggests that as the cost for IT capacity goes up and service level goes up, SPR retailer need to lower the customer-keeping level expectation to guarantee the smooth operation of the business. An interesting finding is that as the SER equipment price and usage ratio goes up, it is optimal for SPR to decrease the customer-keeping level expectation. This result may imply that when the differential effect in price is not significant, there is risk for SPR retailers to invest to keep a high level of customer-keeping expectation.

3.2 Competition under the Scenario of Incomplete Information

We extend the analysis in the previous subsection and analyze the game under the scenario of incomplete information, or say information asymmetry. We assume that the SER retailer has incomplete information of SPR retailer's cost function that the SPR retailer's variable cost for customer-keeping is β_{1H} with probability γ , and is β_{1L} with probability $1-\gamma$, where $\beta_{1L} < \beta_{1H}$. This setup leads to a Bayesian game which is frequently used in models of incomplete information. Assume that SPR retailer will choose either a high price or a low price. When it chooses high price strategy, its profit function is $\pi_2^H = D_2^H p_2^H - \beta_0 - \beta_1^H z$, and when it chooses low price strategy, its profit function is $\pi_2^L = D_2^L p_2^L - \beta_0 - \beta_1^L z$.

We follow the same game structure in the previous subsection and we assume that SER retailer wants to maximize its profit by choosing the optimal price. In another word, the SER retailer's objective function is as follows:

$$\text{Max}_{p_1} \quad \pi_1 = D_1^H p_1 \gamma + D_1^L p_1 (1 - \gamma)$$

where D_1^H and D_1^L refers to the demand of the SER retailer as a function of price of both retailers.

Solving the above game of incomplete information, we have the following result:

Proposition 2. The solution to the Bayes Nash Equilibrium of the SER and the SPR e-book retailers is as follows:

$$\begin{aligned}
 p_1^* &= \frac{2}{3} \left[\left(c_2 - c_1 - \frac{1}{2} \alpha c_e \right) + \frac{\gamma}{2} \beta_1^H r - \frac{\gamma}{2} \beta_1^L r + \frac{1}{2} \beta_1^L r \right] \\
 p_2^{H*} &= \frac{1}{3} \left[(c_2 - c_1 + \alpha c_e) + \frac{\gamma}{2} \beta_1^H r + \frac{3}{2} \beta_1^H r - \frac{\gamma}{2} \beta_1^L r + \frac{1}{2} \beta_1^L r \right] \\
 p_2^{L*} &= \frac{1}{3} \left[(c_2 - c_1 + \alpha c_e) + \frac{\gamma}{2} \beta_1^H r - \frac{\gamma}{2} \beta_1^L r + 2 \beta_1^L r \right] \\
 z_H^* &= \left(\frac{r}{c_2 - c_1} \right) \frac{1}{3} \left[(c_2 - c_1 + \alpha c_e) + \frac{\gamma}{2} \beta_1^H r - \frac{3}{2} \beta_1^H r - \frac{\gamma}{2} \beta_1^L r + \frac{1}{2} \beta_1^L r \right] \\
 z_L^* &= \left(\frac{r}{c_2 - c_1} \right) \frac{1}{3} \left[(c_2 - c_1 + \alpha c_e) + \frac{\gamma}{2} \beta_1^H r - \frac{\gamma}{2} \beta_1^L r - \beta_1^L r \right]
 \end{aligned}$$

We can see that at the equilibrium of the scenario of incomplete information, the SER retailer's optimal price under competition will be higher than the scenario of complete information because $p_1^{incomplete} - p_1^{complete} = \frac{\gamma}{3} (\beta_1^H r - \beta_1^L r) > 0$. This result reveals that under the scenario of information asymmetry, SER retailers will tend to increase the price of their e-books. One explanation is that since there is uncertainty in the strategies SPR retailers will take, charging a higher price helps SER retailers to differentiate themselves with SER retailers and capture potential customers.

4 Conclusion

The introduction of smart phone in this industry may bring a significant transformation to the whole industry. This research uses a game theory approach to examine competition brought by this issue. We distinguish our research by modeling the competition as a two-stage game between two retailers who differentiate with each other by selling e-books for different reading devices: Smart phones such as iPhone or special equipment such as Amazon Kindle. We derive the equilibrium price and analyze the factors that affect equilibrium prices under both scenarios of complete and incomplete information. Our results suggest that equilibrium prices decrease in cost due to inconvenience of reading e-books. We also find that reduced cost of specific reading equipment and information asymmetry leads to more intense price competition.

Our research provides important managerial implications to retailers of information goods. First, under competition of homogenous goods but on different consumption devices, a company who wants to lower the intensity of competition needs to narrow the difference of reading experience of consumers through different reading equipment. Second, retailers under incomplete information are likely to differentiate with his or her competitors by prices. Although our research is particularly relevant to the e-book industry, it can be extended to other types of information goods on different equipments such as playing digital music or videos through either Apple iTouch or PDA.

This research has several limitations. First, we assume that both companies fix price in the same stage. In reality, companies can take the strategy of waiting to see their competitor's behavior before they set their prices. Second, we only consider the scenario in which the companies sell either e-books for smart phones such as iPhone or e-books for specific reading equipment such as Kindle. For future research, it will be interesting to investigate scenarios of competition where companies sell both e-books for smart phone and e-books for specific reading equipment. We also observe that there are new models of selling e-books online, such as providing a free first chapter to customers. Investigation on those new business models can also be an interesting extension of this paper. For example, Kindle recently has announced a reader application for iPhones, which makes Amazon a seller of both Kindle-based e-books and smart phone-based e-books. In that scenario, we will have competition between sellers of both type of e-books and cannibalization is going to be an issue.

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Appendix

Proof of Proposition 1

We first get the profit function for both the SER and the SPR e-book retailers as follows:

$$\pi_1 = \frac{c_2 - c_1 + p_2 - p_1 - \alpha c_e}{c_2 - c_1}$$

$$\pi_2 = (p_2 - \beta_1 r) \left(\frac{p_1 + \alpha c_e - p_2}{c_2 - c_1} \right) - \beta_0$$

Then we take the first-order condition of both profit functions

$$\begin{cases} \frac{\partial \pi_1}{\partial p_1} = \frac{c_2 - c_1 + p_2 - 2p_1 - \alpha c_e}{c_2 - c_1} = 0 \\ \frac{\partial \pi_2}{\partial p_2} = \frac{p_1 + \alpha c_e - 2p_2}{c_2 - c_1} + \frac{\beta_1 r}{c_2 - c_1} = 0 \end{cases}$$

The last step is to solve the previous equations simultaneously to get the optimal solutions of prices and find the optimal result of z accordingly.

Proof of Proposition 2

Similar to the proof of Proposition 1, we first get the profit function for the SER retailer, the SPR retailer with high price strategy and low price strategy:

$$\begin{aligned} \pi_1 &= D_1^H p_1 \gamma + D_1^L p_1 (1 - \gamma) \\ &= \frac{p_1 \gamma (c_2 - c_1 + p_2^H - p_1 - \alpha c_e)}{c_2 - c_1} + \frac{p_1 (1 - \gamma) (c_2 - c_1 + p_2^L - p_1 - \alpha c_e)}{c_2 - c_1} \end{aligned}$$

$$\pi_2^H = (p_2^H - \beta_1^H r) \left(\frac{p_1 + \alpha c_e - p_2^H}{c_2 - c_1} \right)$$

$$\pi_2^L = (p_2^L - \beta_1^L r) \left(\frac{p_1 + \alpha c_e - p_2^L}{c_2 - c_1} \right)$$

Then, we obtain the first order conditions of the previous profit functions and solve them simultaneously to get the solutions.

Business Models in Emerging Online Services

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Abstract. Due to advances in technology and the rapid growth of online services, a significant number of new and inventive web-based service models and delivery methods have been introduced. Although online resources and services are having an impact on more traditional service delivery mechanisms, it is not yet clear how these emerging mechanisms for online service delivery will result in profitable business models. In this paper, we consider emerging business models for online services and their implications for how services are delivered, used, and paid for. We demonstrate the changing roles of user / consumer and provider / seller. We also discuss the applicability of different business models for various domains.

Keywords: Business Model, Online Profit Model, Software-as-a-Service, Social Computing, Virtual Worlds.

1 Introduction

Web-based services are having an impact on more traditional service delivery mechanisms, raising questions concerning how these emerging mechanisms for online service delivery will result in profitable and viable businesses and how the availability of web-based services may co-exist with traditional service delivery models. In this paper, we address the following question: *What new business models are emerging and how are they influencing the way services are delivered, used, and paid for?* We explore this question by first presenting three case studies of emerging online services (software-as-a-service, social computing tools, and virtual worlds) which were identified during a workshop (CASCON, 2008) where participants considered

several questions about the services defined by each case study: essential elements of the service type; current business models; current and potential target markets; vulnerability to other service delivery mechanisms; procedures for measuring the effectiveness of the associated business models; and, potential user concerns. Outcomes from the workshop were further researched and compared with a recent discussion of emerging online services business models (Rappa, 2008). The results of that analysis are presented in this paper as well as a description of how the typical roles of provider / consumer or seller / buyer are changing in the context of emerging online services. As we move from a goods-dominant to service-dominant world (Vargo & Lusch, 2004), these roles are becoming blurred and additional third-party participants are playing increasingly significant roles in successful online service business models.

Before we begin, it is important to clarify our meaning of *business model* in the context of this paper. Al-Debi, et al. (2008) define business models for the world of digital business by arguing that the dynamic environment, high level of competition, and uncertainty in the world of digital business have created a gap between business strategy and processes which requires new ways of thinking about business models. In this paper, we adopt a more narrow definition of business model:

In the most basic sense, a business model is the method of doing business by which a company can sustain itself -- that is, generate revenue. The business model spells-out how a company makes money by specifying where it is positioned in the value chain (Rappa, 2008).

With this definition in mind, we examine three case studies by focusing on the essential elements of each service type, the current business models around it, and its current and potential target markets. We also discuss vulnerabilities to other service delivery mechanisms and outline possible procedures for measuring the effectiveness of the associated business model and potential user concerns.

2 Software-as-a-Service

Software-as-a-Service (SaaS) is defined as a model of software deployment where an application is hosted as a service provided to customers across a network. We differentiate between providing SaaS to consumers (in which case it is typically a web-based service with an associated end-user license agreement) and providing SaaS to enterprise customers (in which case, the service provided is described in a contract or service agreement).

In the SaaS model of software deployment, customers do not have to install and run the software application on their own system. This means they do not have to maintain, upgrade, operate and otherwise support the software application themselves or through service and maintenance agreements. These tasks become part of the service provided. However, this also means that they give up control over upgrades and specific change requirements. The cost of the software is on-going as compared with the typical one-time cost when software is purchased. This new model for software deployment has some authors comparing SaaS to other radical shifts that have affected the software industry such as PCs, client-server, and the Internet (Dubey and Wagle, 2007).

There are several organizations working to define levels of SaaS “maturity” (Ried, 2008 and Carraro, 2006). In the Forrester SaaS maturity model (Ried, 2008), the highest (most mature) level includes provision of user-specific applications based on packaged and custom business applications where these applications are orchestrated and provisioned dynamically in a multi-tenant environment. The lowest level according to Forrester’s maturity model amounts to outsourcing of information technology services. These levels of SaaS maturity differentiate current versus future SaaS vendors and the type of applications offered (such as customer resource management (CRM), payroll, human-resources, financial services, supply chain services, etc.) (Dubey and Wagle, 2007). Example services in this domain include Concur Technologies, Digital Insight, Digital River, Gmail for enterprise, Rightnow Technologies, Rypple, Salesforce.com, Taleo, Ultimate Software, WebEx, WebSideStory, and Workstream.

2.1 Suggested Pricing/Delivery Structures

The basic method of charging for SaaS is on a per time-period basis using a periodic fee structure (i.e., leasing of software in lieu of owning licensed copies). Another model uses on-demand pricing based on per-use, per-transaction, or per-feature. SaaS vendors can also include targeted advertising in the software service delivery paid for by a third party, which is frequently the case for the consumer-oriented SaaS.

2.2 Target Market Segments

In this paper, we have defined the target segment for SaaS as businesses or large enterprises. However, SaaS shares similarities with consumer-oriented web-based applications; therefore, future analyses may benefit from considering consumer-based applications together with SaaS applications. Service providers may target the consumer market by providing a service for free in order to create demand within organizations for enterprise-wide use of the service – examples of this include Google’s enterprise Gmail service (Press Release, 2007) and Rypple, a recent innovative offering that provides feedback and rating services to individuals and organizations (Economist, 2008).

2.3 Procedures for Assessing Business Model Effectiveness

In the SaaS model, from the client perspective, the cost arising from a subscription or pay model should be less than the cost of owning and maintaining the software. Effectiveness may also be measured by the ability to achieve better service delivery through SaaS. From the perspective of the SaaS provider, the effectiveness of the business model is measured by the cost of providing the levels of service required relative to the income generated from customers. SaaS vendors are less profitable than some traditional software vendors today but this should change as SaaS vendors scale (Dubey and Wagle, 2007).

2.4 Vulnerability to or Threat to Other Business Models

Traditional delivery mechanisms of software development and sales and out-sourcing models provide alternatives to the SaaS business model. The SaaS model, however, is starting to threaten the out-sourcing environment and traditional licensed software. Gartner predicts that 25% of new business software will be delivered as SaaS by 2011, and IDC forecasts a compound annual growth rate of 32.2% for SaaS over the next four years (<http://www.hroassociation.org/file/4035/software-as-a-service-.html>).

2.5 User Concerns

Businesses moving from in-house IT installations to acquiring IT services through SaaS may have concerns such as potential or perceived lack of customization, ongoing cost, lack of ownership, issues of data security and reliability, and complicated service contracts. Loss of control over software applications has been cited as a top concern among potential SaaS users (Ma and Seidmann, 2008). An additional concern is the difficulty faced by users when attempting to make non-customized software applications fit smoothly within existing IT systems (Ma and Seidmann, 2008).

3 Social Computing Tools and Services

Social computing tools and services can be differentiated from other kinds of services on the web by their use of user profiles, articulated social networks, discovery of common interests, and collaborative processes to facilitate social activities through computing technologies. Social computing tools and services tend to focus primarily on communication systems that allow users to interact and share data, and collaborative systems that enable information sharing and collaboration among users (Wikipedia, 2009). Within this space, we see social-networking sites (i.e., LinkedIn, MySpace, Meetup and Facebook), information and media sharing sites (digg, reddit, Flickr, YouTube and Blogger), and extensions to commercial sites (i.e., the rating systems of Amazon and eBay). Some of these systems are very lightweight, such as the voting and tagging systems of digg, reddit and Delicious; others support collaboration and complex content creation, such as Wikipedia and Google Docs (Chi, 2008). Example services in this domain include Blogger, Delicious, Digg, Facebook, Flickr, LinkedIn, Live Journal, Meetup, MySpace, Nexopia, reddit, Twitter, wikis, Youtube, etc.

3.1 Suggested Pricing/Delivery Structures

Some social computing services have adopted traditional business models such as advertising. Indirect ads are high volume and low price and are not targeted to users or specific content on the site. They appear as banners or pop-up on the site and are provided alongside content or as click-throughs before accessing content. Targeted ads (such as Google Adwords) make explicit use of the context or exchange on the site or the demographics of a site's members. These work well for social networking sites that bring people together on a specific topic or theme. Facebook does this through their automated marketing (Facebook Ads, 2009). The social networking site is typically paid by advertisers when users click on the ad using a cost-per-click or

cost-per-impression model. Some brands engage with users of a particular site through email, messaging, contests, and polls to raise the brand's profile. This kind of advertising is low volume but high price. Social networking sites also use the subscription-based fee model, where users pay a fixed amount each time period. In some cases the basic features of the site are provided for free and a premium version is available through subscription. In some cases, the site is free but extras are provided on a pay-per-feature or pay-per-use basis. In other cases, merchandise is sold that is affiliated with the site but this method is more effective for advertising and building loyalty than making money.

More novel business models include the brokerage and the affiliate-marketing models. In the former, web applications bring buyers and sellers together and take a percentage of each transaction that goes through, as is done by Paypal or eBay . An analog for social-networking sites is the infomediary model, where the site monetizes the value of the data collected from either users or producers including demographic and browsing information or product information. In the affiliate-marketing model, one (affiliate) website is used to drive traffic to another such that the target website company compensates the affiliate website company. This kind of model is also manifested as referrals in Amazon or iTunes, for example. Many community sites are free but benefit from the value created by that community (for example, Wikipedia). Some sites allow users to create applications that serve as ads or channels (e.g., Facebook) by having a viral effect among connections when popular participants use or talk about products. Note that targeted advertising based on analysis of content submitted by the user as is used in Gmail can be met with resistance in social networking sites.

3.2 Target Market Segments

The target market for social computing tools is primarily consumers although many enterprises make use of internal social computing tools to connect employees and enable collaboration. In this paper, we limit our discussion to social networking sites for the consumer market.

Consumers are motivated to participate in (sometimes more than one) social network for different reasons and multiple social networks often overlap in their populations. For example, there are people on both LinkedIn and Facebook but there are people on LinkedIn who do not participate in Facebook. Facebook is primarily about connecting and sharing with friends and others in one's life (Facebook, 2009). LinkedIn is primarily about connecting one's professional network to help in career advancement (LinkedIn, 2009).

There are also specific target markets for social networking sites. Some target people within a geographic location, others bring people in a specific demographic together, others are promoted as environments for a particular activity or theme, and some social networking sites target specific media such as video (YouTube) and photographs (Flickr). A large demographic of users of many social networking tools are young people. As these people enter the workforce, the target segments for social computing tools will change and their use in corporate settings may grow.

3.3 Procedures for Assessing Business Model Effectiveness

From a user perspective, the models are effective if they provide enhanced interactions and data sharing and ways for people to connect with others without excessive cost (through subscription or up-front monetary costs) or overhead (too many or obtrusive advertisements or a feeling of loss of control of user information). From the perspective of the social networking site, business model effectiveness depends on the ability to attract a sufficient number of users, such that revenue (from any of the various methods employed by the site) exceeds the cost of providing the services. Effectiveness may also be measured by users' loyalty, as indicated by the length of their membership history, the frequency with which they log on the site, and time they spend on it.

3.4 Vulnerability to or Threat to Other Business Models

Most models rely on a large number of participants; therefore, social computing sites can compete with one another for their user base. With the low cost of entry, many sites are emerging that provide free services. Sites that provide a base service for free and charge for features or a premium service risk charging for what others are providing for free. They also risk alienation by subscribers when service levels change. Since the user base is drawn from the world's population, there can also be problems administering online payments of some users and with some forms of advertising.

3.5 User Concerns

A primary concern of users of social computing sites is privacy and having their information exploited by the service provider (Schmidt, 2006 and Baute, 2009). Nearly 700,000 Facebook users complained when Facebook launched a feature called News-Feeds that sent a notice to people's friends registered with the service when their profile was updated (Solove, 2008). Facebook was met with another privacy objection when it attempted to launch a two-part advertising system. Whenever users wrote something positive about a product or a movie, Facebook would use "Social Ads" to send friends their names, images and positive endorsement in advertisements. "Beacon" was used to allow data-sharing among Facebook and other commercial Web sites such that if a user made a purchase on one of the networked Web sites (for example, bought a movie ticket on Fandango), that information would pop up in that person's public profile (Solove, 2008). Both of these applications were changed after the ensuing user outcry and an online petition (Solove, 2008). Providers of social computing services must be careful not to violate the trust of their members.

4 Virtual Worlds

Virtual worlds provide an online three-dimensional environment where thousands of people interact simultaneously through their avatars (representations of themselves). The history of virtual worlds can be traced back to their precursors in electronic gaming and online social networking (Messinger, et. al., 2009). Now, virtual worlds blend synchronous 3D video engagement with social computing functionalities, enabling

people to interact with each other in settings where users are free to pursue their own personal objectives for participation. Many companies have a presence in virtual worlds and use these spaces for brand awareness, advertising, selling (virtual and real goods and services), and communication with customers and among employees (DMD, 2007). These varied uses are resulting in many unanticipated implications for how we work, learn, interact, use the Internet, shop, and play (Messinger, et. al., 2009). Several different kinds of virtual worlds exist for different target markets and with varying kinds of business models. A typology of virtual worlds is presented in (Messinger, et. al., 2008); two of the five dimensions that define this typology consist of the profit model and the target population. Here, we provide a brief overview of this work. Example services in this domain include ActiveWorlds, Club Penguin, Entropia, Neopets, Habbo Hotel, Second Life, WebKinz.

4.1 Suggested Pricing/Delivery Structures

Several of the pricing and delivery structures presented in the previous two sections are also used in virtual worlds including providing a free basic service and charging for a premium service (ClubPenguin), advertising (ActiveWorlds), and charging for features (such as Land in Second Life). Virtual worlds mimic real world spaces and many physical advertising features also exist in virtual worlds such as billboards and kiosks. One distinctive model, used by Webkinz, targets children and creates a strong link between the virtual and the real world. To obtain an avatar in Webkinz, a stuffed animal plush toy is purchased which comes with a login code onto the Webkinz World. The child's avatar is a matching virtual pet, which "lives" in a pet-oriented virtual world. This world, which monetizes its value through the sale of ancillary objects, constitutes an additional kind of business model.

4.2 Target Market Segments

Several different kinds of virtual worlds target users by age, gender, activity, and geography demographics. There are education-focused virtual worlds, which provide opportunities to achieve training in specific areas such as architecture and design, procedural skill development, and language learning. There are also theme-based virtual worlds designed to support a particular type of media content (e.g., vSide promotes music through audio and video). Geographic-focused virtual worlds target members within a particular country or geographical region and use the national language for in-world interactions and communications (e.g., the HiPiHi interface is in Mandarin, targeting users from China). Some virtual worlds provide environments for children or teenagers (Whyville) and focus on a particular in-world population such as animals (Webkinz, ClubPenguin). Finally, some virtual worlds do not target any particular market but provide a self-determined or open-objective environment that can be used in creative ways by its participants to augment their real social or business lives (e.g., Second Life, Kaneva).

4.3 Procedures for Assessing Business Model Effectiveness

Several factors may influence the effectiveness of virtual worlds' business models. For example, it should not be too difficult to become proficient in experiencing the

world. Furthermore, several popular business models provide opportunities for users to create value by creating their own virtual objects or by doing work, giving rise to a business ecosystem. Finally, providing social networking elements together with the ability to accomplish tasks (as in online games) and the opportunity to transcend physical barriers makes virtual worlds attractive for many people; thus, supporting pricing strategies which rely on large numbers of participants.

4.4 Vulnerability to or Threat to Other Business Models

Simpler 2D social-networking sites provide similar value and benefits to users with less overhead. Online games can provide a social interaction along with quests or specified goals that attract some users. However, virtual worlds provide a distinctive environment with many potential benefits and issues that have not yet even been explored.

4.5 User Concerns

A primary concern is the high level of technical ability and set-up required for some virtual worlds. Users can also encounter in-world behaviors and environments that may make them feel uncomfortable.

5 Implications of Emerging Business Models

In the previous sections we described business models used for three types of new online services. In this section, we synthesize salient features of these business models in a larger context. In Table 1, the rows describe four generically different classes of service. For each, we describe the nature of the value exchange and common fee structures. The four classes of business models consist of the following: (1) computational processing and database services, offered as old-style utilities; (2) content providers from the old media (gathered by news teams and shared through wire services) and new media (gathered from the Internet or created by online communities); (3) transactional services for physical products and packaged software information, or media products; and (4) brokerage or affiliate models that help bring partners together to make their own transactions or barter. The value exchange column largely follows Rappa's (2008) categorization of business models. The fee structures provide ways to monetize the value created by the business model.

In the value exchange, we consider three main parties (user, provider, and third-party). The third-party category can take on several different roles: broker, advertiser, infomediary, sponsor, and affiliate. The category denoted as users can also be referred to as buyers, consumers, customers, end-users, subscribers, community-of-users, or audience. Providers are also referred to as sellers, firms, wholesalers, retailers, e-tailers, merchants, applications, or website owners. In addition to identifying the roles of the three parties, in our analysis, we consider business models that include both financial and service exchanges. Our summary synthesis in Table 1 shows that for different business models each of the three parties can be providers or receivers (exchangers) of value and the value exchanged might be money, services, or both.

Table 1. Service Classes, Business models, and Fee Structures

Service Class	Value exchange: Business Model	Fee Structures (with Examples)
Computational processing and database services – offered as old-style utilities	Utility Model: User pays \$ to provider; provider provides service to user.	<i>Fee-for-Access:</i> Various forms of SaaS. <i>Fee-for-Service:</i> Salesforce.com, Concur Technologies, Digital Insight, Digital River, Rightnow Technologies, Ryppe, Taleo, Ultimate Software, WebEx, WebSideStory, Workstream
Content providers in the old media (gathered by news teams and shared through wire services) and new media (gathered from the Internet or created by online communities)	Advertising Model: Third-Party (advertiser) pays \$ to content provider; provider places advertising in media; end-user receives services for free and is exposed to advertising.	<i>Fee-for-Service:</i> Google, Yahoo, Standard newspapers such as the New York Times. Applies for advertising, wherein
	Subscription Model: User pays \$ to provider; provider provides service to user.	<i>Fee-for-Access:</i> Standard newspapers and cable TV. SaaS applications. <i>Fixed Fees:</i> World of Warcraft
	Infomediary Model: Third-party service provider pays \$ to info provider; info provider consolidates list of service providers; user selects service provider; third-party provides service to user. (User may also co-create the service and provide ratings of service providers.)	<i>Fee-for-Service:</i> Doubleclick, Cnet. (the only difference from traditional media is the nature of the content).
Transactional services for physical products and packaged software information, or media products, and	Community Model: Provider makes available service to user; users create content which attracts other users; third-party pays \$ to provider (advertising); user may pay \$ to provider (subscription).	<i>Free:</i> Wikipedia, Facebook, Youtube, Amazon customer review <i>Fee-for-Access:</i> Second Life, LinkedIn, Cyworld, ClubPenguin, ActiveWorlds, World of Warcraft <i>Fee-for-Service:</i> Facebook Ad, Youtube Ad, Second Life Land, ActiveWorlds Land, Webkinz Toys (Ancillary objects), World of Warcraft merchant (in-world)
	Merchant: User provides \$ to provider; provider makes available products or services to user; provider may create service or procure products or services from third-parties for \$.	<i>Fee-for-Service:</i> Most standard eCommerce: 1800flowers.com, Apple's iTunes Store, Borders.com, sears.com, runningroom.com.
Brokerage or affiliate models that help bring partners together to make their own transactions or barter.	Manufacturer (Direct): User pays \$ to provider; provider sells product or service to user	<i>Fee-for-Service:</i> Ikea, SaaS.
	Brokerage: User pays \$ to broker; broker facilitates match-up of users and service providers (which may involve a service exchange).	<i>Free:</i> FriendFeed. <i>Fee-for-Service:</i> eBay (auctions), expedia.com (travel), Comfree (real-estate). Often commission based.
	Affiliate: Users click through to third-party for service; third party pays \$ to provider; user pays \$ to provider.	<i>Fee-for-Access:</i> Google Affiliate Network <i>Fee-for-Service</i> (per click): Amazon Affiliate Program

Table 1 also highlights three types of fee structures – fixed fees, fee-for-access, and fee-for-service – chargeable with online services, provided that proper metering technology is available. This contrasts with traditional broadcast media for service delivery, such as radio and TV over the airwaves, which is not metered when used. If fee-for-service is not metered, then a fixed or periodic fee may be the only alternatives available. Periodic payments may be suitable when users are loyal to particular content or service stream, and for which there are periodic updates.

It is worth acknowledging that a key advantage of offering computational processing and database services online consists of centralized economies of scale for the provider on the supply side, with remote dissemination on the demand side. The first online service class described in this paper, software-as-a-service, falls under the first class of business models (online computational processing). By contrast, a key advantage of new media consists of decentralized content creation by users themselves on the supply side (and again remote dissemination on the demand side). The second and

third online services described above, social computing and virtual worlds, fall under the second class of business models (specifically new media content co-created by users). In distinct contraposition relative to these first two classes, the last two classes of business models (transactional services and brokerage models) were among the first tried on the Internet and are also common to old-style commerce.

Firms with monopoly power are often in a best position to charge fixed fees for bundled services. In the presence of competition, one may expect de-bundling and sales of products and services on the basis of fee-for-service. Also, the availability of substitutable online services may influence the fee structure a competitor can charge, especially when similar services are available for free. Finally, fee structures are also influenced by the target market, which may be consumer or business-to-business markets.

According to old-style “Product Dominant Logic”, products are transacted between buyers and sellers (either manufacturers or distributors). According to “Service-Dominant Logic,” users participate in co-creating value with service providers. In the former, buyers pay sellers. In the latter, the party that “should” pay for service is far less clear-cut. When users are creating content, themselves – and the content is what attracts traffic – it may be best for the service provider to allow users to create content for free (or in extreme cases pay users for creating content). Generally, we think that the party who receives the service tends to be the party that obtains greater value from the relationship or exchange. In many situations, several parties contribute services and create value.

Note that advertising and subscription models tend to work in tandem, whereby fees are charged to advertisers for access to the subscribers, and fees are charged to subscribers for access to the content. These models are traditionally for older media, such as newspapers, cable TV, radio, and movies. Many services provide a basic version for free and a premium for-fee service. This can encourage loyalty from users and help build a community. Other factors that contribute to different fee structures include competition in the market, allocation of value between the receivers, levels and update frequency of service, and content generation mechanism.

Clearly, a particular service may combine several different business models, and it is the target market that influences the choice. Services used by enterprise or business customers use different business models than services for consumer markets. The willingness to pay by business customers may be influenced by the availability of in-house IT services and out sourcing arrangements. In addition to these factors, the amount of customization available to users can influence choice of business model. Finally, we note the low cost of entry for many online services often prevails such that different services with varying business models can be tested and evaluated with low initial investment.

6 Conclusions and Future Work

In this paper, we analyzed three types of online services and their corresponding business models. The variety of services offered, the range of their domains, and the complexity of the business models they adopt highlight the movement from goods-dominant to service-dominant logic as described in (Vargo & Lusch, 2004). There is opportunity

for new online services to emerge that make use of the large numbers of people, openness, globalization, and low cost of entry to be successful by employing new and creative business models on the web. However, it will be interesting to see what effect the global economic downturn will have on the business models and services described. As funding sources dry up it will become less attractive for entrepreneurs to create a new online service with the hope that a large company will buy it. In the future, we plan to extend our analysis to additional domains such as gaming, dating services, telecom services, and 3D design and manufacturing and to examine additional success factors such as those reported for user-community-driven Internet ventures (Loebbecke and Huyskens, 2008).

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Business Model Design from an ANT Perspective: Contributions and Insights of an Open and Living Theory

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Abstract. The way the Internet has connected millions of users at negligible costs has changed playing field for companies. Several stakeholders can now come together in virtual networks to create innovative business models that would be unfeasible in the physical world. However, the more radical the departure from the established models of value creation, the bigger the complexity in ensuring the sustained interest of the involved parties and the stability of the bonds. To address this problem, we sought inspiration in the Actor-Network Theory (ANT), which is capable of providing insights into socio-technical settings where human and non-human agents interact. We describe how several of its principles, ideas, and concepts were adapted and embedded in our approach for complex business model design or analysis. A simple illustration is provided. Our iterative approach helps systematically scrutinize and tune the contributions and returns of the various actors, ensuring that all end up with an attractive value proposal, thus promoting the robustness of the network. Guidelines for the services that an underlying information system must provide are also derived from the results.

Keywords: Actor-network theory, business model design, business model stability, value networks.

1 Introduction

Information and communication technologies have been steadily transforming the way companies conduct business. The Internet, for instance, has enabled unprecedented ubiquitous connectivity at negligible costs. This, in turn, has sparked innovative business models and significant power shifts. Amazon displaced established booksellers; Priceline.com gives its users the possibility to name their own price when shopping for flights, hotels, and car rentals, by aggregating demand and then negotiating with suppliers of those services. A number of exciting new ventures continue to emerge, using the web as a platform.

In the business models described above we can find phenomena of cooperation and competition, known as co-opetition (Tapscott, Ticoll and Lowy, 2000). It is urgent to introduce new tools to address this business model complexity, which cannot be developed based on intuition and hints alone. We present a novel approach to aid in the design, analysis and tuning of these business models, ensuring that all required actors have an enticing reason to participate. An iterative and incremental process of negotiation seeks the alignment of their interests, so that each can find an attractive and sustainable value proposal. The outcome is a balanced business network that documents all the interactions between actors, their contributions, their returns, and provides clues to design the supporting information system.

Researchers advocate that system development failures can be attributed more to social and organizational factors than technical ones (Doherty and King, 1998). In the interconnected worlds we described, these factors assume a reinforced significance. They can provide valuable insights about organizational, social and political viewpoints (Rose and Scheepers, 2001), improving the knowledge about the business scenario. We used concepts and contributions from Actor-Network Theory (ANT), to complement business model theories. As a result, contextual influences were integrated in the model specification, clarifying contextual perspective.

We illustrate ANT's contributions to the approach through its application to the case of a portal-supported mediation business to manage restaurant order requests. Based on simple examples, we describe the ANT' concepts that inspired us, how they were adopted, the problems they solved, and the artifacts we created to apply them in the field. This assimilation of ANT's principles makes it possible to create innovative forms to interact with the stakeholders and understand the emerging value network. The analysis of the value proposals also affords clues about the services that must be provided by the supporting information system.

The remainder of the paper is structured as follows: section 2 explains the innovation introduced by value network concept in the business model analysis. Section 3 briefly presents ANT, while section 4 clarifies why we sought inspiration in a social theory. Section 5 illustrates how ANT's concepts were integrated into our proposal to align actors' interests and achieve a stable network, and how the approach works and what are its main results. Finally, in section 6, conclusions are provided.

2 From Value Chains to Value Networks

In 1985, Michael Porter (1985) introduced the concept of value chain – a set of interrelated generic activities common to a range of firms. Products pass through all the activities of the chain in order (Figure 1). Upstream, suppliers provide input. Then, the firm adds value to this input, before passing them downstream to the next actor in the chain, the customer.

Stabell and Fjeldstad (1998) supervised the application of the value chain model to more than two dozen firms, from a variety of industries. They found the value chain well suited to describe and understand traditional manufacturing companies, but less appropriate to the analysis of activities in a number of service industries. With the technological advances and the use of the Internet as a business platform, this limitation is emphasized. Firms are more properly viewed as connected to each other

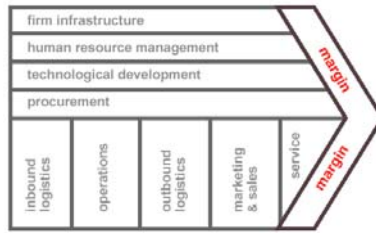


Fig. 1. Porter’s Value Chain (adapted from (Porter, 1985))

in multiple networks (Gulati, Nohria and Zaheer, 2000). Amit and Zott in (2001) also stated that innovative value proposals, supported by new forms of collaboration, go beyond the value that can be realized through the sequential configuration of the value chain.

Cisco’s business model is an excellent example of these value chain configurations. The company delegates physical production and other non-core functions to partners around the world. It concentrates itself in increasing the value proposal of its services. The new value proposition is service-enhanced customization (Tapscott, Ticoll and Lowy, 2000). Figure 2 illustrates the Cisco value map configuration. Those relationships would not show up in the classic “value chain” analysis.

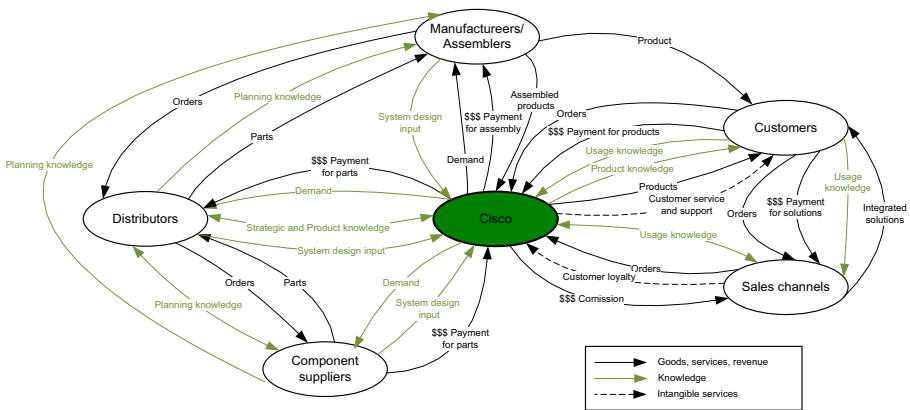


Fig. 2. Cisco Value map (adapted from (Tapscott, Ticoll and Lowy, 2000))

The highly dynamic changes in the configuration and inter-relationships of the business players provide new opportunities (Gulati et al., 2000). Factors that have always seemed peripheral turn out to be key drivers of change in a company. Invaders from previously unrelated sectors could change the rules of the game overnight (Normann and Ramírez, 1993). In such a volatile and competitive environment, the analysts need to consider not only the behavior of a given company, but its universe of interactions. This dynamic capacity of adaption provides the ability to look at the

system from the point of view of the final customers, fitting the solutions obtained with the customers' demands. Gordjin (2002) and Osterwalder (2004) works are examples of the research performed in this field.

With the Internet capacity to connect stakeholders at negligible costs, the dynamic and complexity of the networks configurations increased, as well as the importance to consider the social aspects of those configurations. To integrate this perspective in the approach, our perception and vision of the network is inspired by ANT. We present this theory in the next section and subsequently explain how it helps us in the approach conceptualization.

3 A Brief Overview of Actor-Network Theory

In 1981, Michel Callon and Bruno Latour developed ANT (Callon and Latour, 1981). Subsequently, ANT has been enriched by its original actors and others like John Law (1992) and Madeleine Akrich (Akrich and Latour, 1992).

According to ANT the networks are a shifting system of relationships, alliances and exchanges among their elements (Underwood, 1998). These networks are heterogeneous – link together human and non-human actors (e.g., people, machines, software, and ideas) – but ANT describes them using the same language, and analyses them in the same way. ANT considers that social and technical perspectives are entangled and, for that motive, they must be analyzed together and with the same degree of importance (Akrich and Latour, 1992). The symmetric treatment has been criticized in the literature (Collins and Yearley, 1992). However, we do not interpret that assumption literally. In our approach, to regard them as equal means considering the roles, activities and importance assigned to both types as they are engaged in the network.

Each actor has its own view of the network and its individual goals. These goals gain relevance when, through negotiation processes, they are shared by different actors, creating a common set of interests. Actors' heterogeneous interests become aligned and embedded into technologies that stabilize the network, at least temporarily (Callon, 1991).

The process of negotiation between the actors involves two concepts: translation and inscription. The former is responsible for the interpretation and conciliation of positions/commitments, which can lead to representations of common interests (Callon and Latour, 1981). The latter describes how patterns of behavior are “wired” into the network, using artifacts, to create action programs (for instance, the rules for processing a customer complaint) which the actors must fulfill (Latour, 1991). These concepts influence themselves mutually, enabling a relative stability or the exposition of new issues that will contribute to new network configurations. Translation includes four distinct phases (Callon, 1986):

- **Problematization:** a focal actor (the ones driving the creation of the new network or changes to the existing one) frames the problem and defines the identities and interests of other actors that are consistent with his/her own. The focal actor renders her/himself indispensable by defining a process under her/hir control that must occur for all actors to achieve their interests. This process according to (Callon, 1986) is defined as an obligatory passage point. The actions performed by the focal

actor can be viewed as part of a strategy to align the other interests with her/his own (Tilson and Lyytinen, 2005).

- **Interessement:** encompasses the strategies by which the focal actor attempts to enroll others (includes searching for new allies, isolating actors and encouraging others to overcome obstacles in the way of passing through the obligatory passage point). This is the process of recruitment of actors – creating an interest and negotiating the terms of their involvement. Groups of actors with the same goals can be represented by a single actor (spokesperson).
- **Enrolment:** requires more than one set of actors imposing their will on others for enrolment to be successful (Uden and Francis, 2009). Actors achieve that when they take on the network's problematization as their own and accept the roles defined for them in the newly defined network during interessement. This leads to the establishment of a stable network of alliances.
- **Mobilization:** occurs when translation is complete, actor interests are stabilized and controversy is removed. Mobilized actors are committed to a common course of action (Holmström and Robey, 2005). These actors are given the tools to create for themselves an interest in the network or to develop sub-networks. Due to the wide acceptance of the solution adopted, the number of absent entities represented by spokespersons increases (Uden and Francis, 2009). In order that the spokesperson will not betray the interests of their group a set of methods are developed.

Inscription is the act in which actors perform on other actors, shaping their attitudes and properties (Akrich and Latour, 1992). This process consists in the definition of a program of actions that specify the requirements of the network, embedding the social agendas of the actors into technical artifacts, such as information systems. Human actors are able to inscribe onto non-human actors, and vice-versa (Lindahl, 2005). As inscriptions become stable and routine, they reduce the possibility of being challenged or questioned at a later date (Callon, 1991; Holmström and Robey, 2005).

4 Why Seeking Inspiration in Actor-Network Theory

New solutions are required to systematically integrate the nature and behavior of the business models into design. Our approach proposes a radical departure from the dominant conceptions in the literature and adopts a social-technical approach inspired by ANT. One of its main contributions is the revolutionary and freshness towards the concept of network. ANT views a network as a series of transformations (translations), in which each actor is influenced by its relationships.

ANT's rich vocabulary describes how the actors come together to create a network, their relationships, the diversity of flow between them, and the agreements they establish. It offers complementary perspectives of the network. ANT's capacity to disclose the value that each actor provides to the network, as well as its ability to analyze actors' relationships reveal tactical insights. This information is used by the negotiation artifacts created in our approach to develop a business model that ensures sustainable value proposals for all the actors (as suggested by ANT). To provide

feasible scenarios in the negotiation process, we take into account information such as: the actors' gains, efforts, and relationships.

Our approach also provides clues for the development of the information system that will support the network. We, much like others (Mumford, 1983; Holmström and Robey, 2005), believe that information systems development is a socio-technical process. Under this perspective no project is purely technical or purely social. The social aspects' importance and impact is also emphasized by (Schmidt, Lyytinen, Keil and Cule, 2001), who defend that many of the success/failure factors are organizational rather than technical. Integrating ANT principles in our approach allow us to increase the chances of developing an information system that is able to respond to the business model demands.

The integration of the concepts provided by ANT in the design of business models demands a new analytic perspective. "Artists, writers, and scientists do not hesitate in their creative efforts and researches to borrow ideas outside their special fields", begins Philip Wiener, in his preface to the Dictionary of the History of Ideas (1974). How to adopt ANT to design business models and their supporting information system remains open to research's imagination and is not prescribed by ANT's proponents. According to Law, "Only dead theories and dead practices celebrate their self-identity. Only dead theories and dead practices hang on their names, insist upon their perfect reproduction" (Law, 1999). Also Latour describes ANT as very crude method (Latour, 1999).

ANT's ideology is embraced in our approach through the development of an iterative and active negotiation processes that intend to achieve the alignment between the stakeholders' interests. In this process, stakeholders are identified and characterized, their relationships are understood, and the overall scenario is described. However, our approach does not intend to produce just a detailed description of a story. We developed a set of artifacts to assist the negotiation process and enhance visibility over the interplay of aims of each actor. The insights obtained enable the tuning of the alignment of interests, in order to balance them and ensure sustainable value proposals for all the actors. Our aim is to ensure that each stakeholder gets what is expected and, thus, becomes committed to the enduring success of the emerging value network.

5 A Business Model Design and Analysis Approach Based on Actor-Network Theory

In this section we will clarify how ANT's ideas and concepts influenced our approach. For each contribution borrowed from ANT, we will explain the problem it helps to solve, as well as the artifacts developed to apply its principles in the field. ANT's contribution is illustrated through simple examples, obtained by applying the approach to an illustrative business idea. This idea was chosen because of its simplicity, which allows the reader to concentrate on the adaptation of ANT and not on the case specifics. It must be stressed, however, that the proposal itself emerged and was validated by combining case studies Yin (2003) and action-research (Baskerville and Wood-Harper, 1996), both applied to complex real world systems. This multi-methodology tactic was used to minimize the limitations of individual research approaches (Bouwman, Hooff, Wijngaert and Dijk, 2005).

5.1 FoodAtYourDisposal Business Idea

FoodAtYourDisposal is a company that intends to create a business to manage take-away orders for several restaurants. The mediation between the customers and the restaurants should be supported by a portal. When an order is received, the request is sent to the selected restaurant that confirms the availability to satisfy the request. When this happens, a cooking time is presented and the portal sends the information back to the customers, to reconfirm. If they agree with the presented conditions, a staff from FoodAtYourDisposal will pick up the order at the restaurant and deliver it to the customer, from which payment will be collected.

FoodAtYourDisposal revenues are obtained through a small activation rate to access the portal and a fee of 5% over each request. Paying extra fees, the restaurants can strengthen their presence in the portal (e.g., put their menus at the top of the search results list or have special sections to advertise promotions).

5.2 Assessing the Business Model

Our proposed approach is organized in three phases. First, we identify the network actors and study the structural aspects that influence their behavior. Then, we analyze the network and suggest eventual adjustments to better align their interests. Finally, in the third phase, we evaluate the business model stability.

Phase I – Identification of actors and of structural aspects

We need to identify and characterize the actors, as well as to analyze the scenario in which the network will operate. As a source of inspiration we use ANT's Problematization concept, which guides us on our study of understanding actor interests, behaviors and relationships. The items that we use to describe those aspects are introduced in Figure 3 through the application of our approach to the FoodAtYourDisposal's business idea. In this scenario, we identified four actors: FoodAtYourDisposal's board, the portal, the restaurants, and the customers. The first two are characterized and used as an example of a human and non-human actor (top row), respectively.

The characterization of the actors enhances the visibility over the interplay of interests. For instance: "Relevance" exposes the actors' importance in the network, which provides clues on how to respond to their demands; "Relationships" (respecting ANT's recommendation of following the actors) depicts each actor's interactions, which allows to spot future alliances or possible conflicts. When focal actors characterize the network scenario (Figure 3, row below) they can use the privileged information about the other actors to define the "Present goals" and "Organizational Interactions". The former gather all the information obtained for each actor, balance it, and propose a first draft of the network goal. It corresponds to ANT's obligatory passage point. The latter, based on the actors' individual relationships, allows the focal actors to perceive the existing relationships and to disclose the entire network configuration. The remaining items of the network scenario are introduced to provide clues about structural restrictions that may influence the actors' relationships, complementing ANT's perspective.

FoodAtYourDisposal's board	FoodAtYourDisposal Platform
<ul style="list-style-type: none"> • Relevance: high (fundamental to deploy and maintain the business) • Relationships: restaurants, customers • Roles: defines Company's strategy; manages financial viability; supervises operational aspects; manages the interaction between restaurants and customers; develops and maintains the portal • Goals: obtain revenues; deliver the food on time; offer a good set of order and reservation choices; allure a high number of portal users 	<ul style="list-style-type: none"> • Relevance: high (critical to support the business) • Relationships: customers, restaurants • Roles: provides features that stimulate the use of the platform; manages portal database; analyses profiles; supplies data to enhance advertising mechanisms; mediates orders request
Network Scenario	
<ul style="list-style-type: none"> • Present goals: encourage restaurant participation in the project; offer qualified services; advertise the business; assure customers satisfaction • Organizational interaction: the portal acts as a mediator between the restaurants and the customers that intend to request a service; FoodAtYourDisposal establishes agreements with the restaurants • Existing power relationships: FoodAtYourDisposal enables the restaurants to advertise their products on-line; FoodAtYourDisposal depends economically on fees it charges to the restaurants; FoodAtYourDisposal established agreements with the restaurants to offer differentiated proposals; FoodAtYourDisposal depends on the number of active customers • Institutionalized sanctions: restaurants that do not provide quality services, or do not pay the established fees can be removed from the database; customers that don't pay their bills are not allowed to request more services • Existing rules: restaurants should answer the requests as quickly as possible; restaurants must pay the fees on time; users must pay the order to the delivery staff • Available resources: computers, network infrastructures, technical knowledge, motorcycles • Direct rivals: Not known 	

Fig. 3. Topics that describe actors and the network scenario

Phase II – Negotiation towards alignment

This phase aligns the interests of the various participating actors (in terms of their contributions and returns), so that the resulting network is balanced and resilient in pursuing the goal set by the focal actors. To help us in this endeavor, we conceived four artifacts illustrated in Figure 4:

- **Common Goal Diagram (Cell 1).** Inspired by the concept of *interessement*, it aims to understand how actors can be engaged. With this purpose, it describes how each activity contributes to the overarching purpose of the business model and how individual goals interlock in a solid network of interactions that supports the ultimate objective. For instance, the activity “Order request” receives contributions from other activities, and contributes itself to the network goal.
- **Negotiation Diagram (Cell 2).** Influenced by the concept of *enrolment*, it describes the adjustments carried out by the actors to establish a stable network of alliances. This diagram is enhanced progressively as the negotiations to align the various actors’ interests demand adjustments. This process is completed, similarly to *enrolment*, when the actors perceive the proposed business model as their own.

For the case in analysis, it allows us to recognize the influences that the actor “Customer”, who performs the activity “Order request”, suffers or exerts on other actors and activities. These influences can be rated on the scale [-3..3]. A negative value means that the actor must spend effort to contribute to the activity, whereas a positive value indicates how much the actor gains. The activities analyzed are the ones directly connected with the Common Goal Diagram (Cell 1). A Negotiation Diagram should be created for each of these activities, as well as for activities that can compromise the achievement of the overarching goal of the business model.

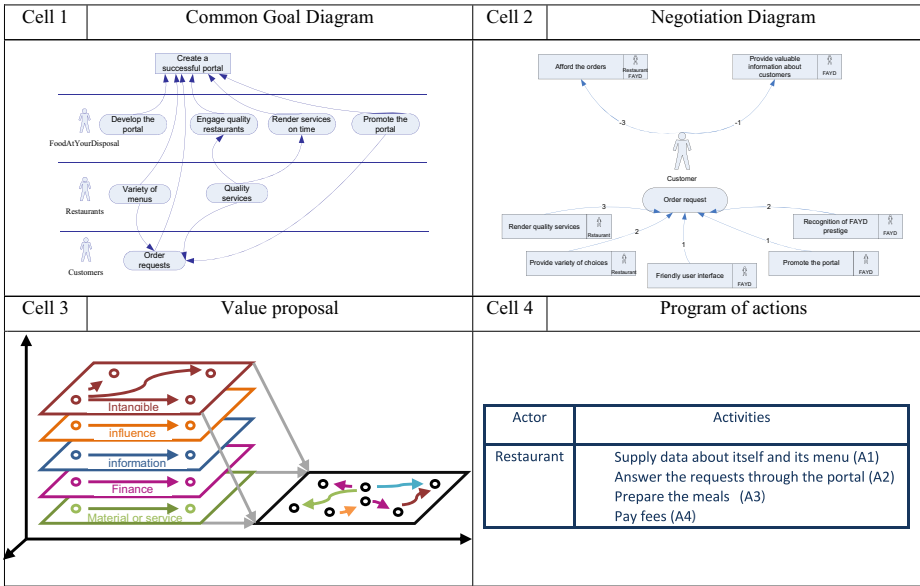


Fig. 4. Artifacts used in the negotiation process

- Value Proposal (Cell 3). It integrates in our approach ANT's principle of following actors' relationships. With this purpose, the diagram describes the value proposals ascertained among all actors in the previous negotiation process. We characterize these value proposals according to several types of flows: materials or services, finance, information, influence and intangible connections (e.g., customer loyalty, and relationships between actors). To enhance readability, the different flows can be represented in layers that can be analyzed in isolation or overlaid. The full value proposal among the actors of FoodAtYourDisposal business model is represented in Figure 5.
- Program of actions (Cell 4). After achieving an alignment of actors' interests and a description of their value proposals, it is possible to specify the activities that they should perform. These activities support the actors' individual goals, and the choreographed unfolding of their roles describes the network behavior. The program of actions materializes the ANT concept of inscription. It represents the first attempt to achieve a stable network configuration and to inscribe actors' requirements into technical artifacts, such as information systems.

Phase III – Assessment of business model stability

After understanding the network of interactions that compose the business model, it becomes necessary to assess its stability. We look for acceptable trade-offs between the effort demanded of each actor and the benefits it gets to ensure their sustained interest in participating, as suggested by ANT's mobilization phase.

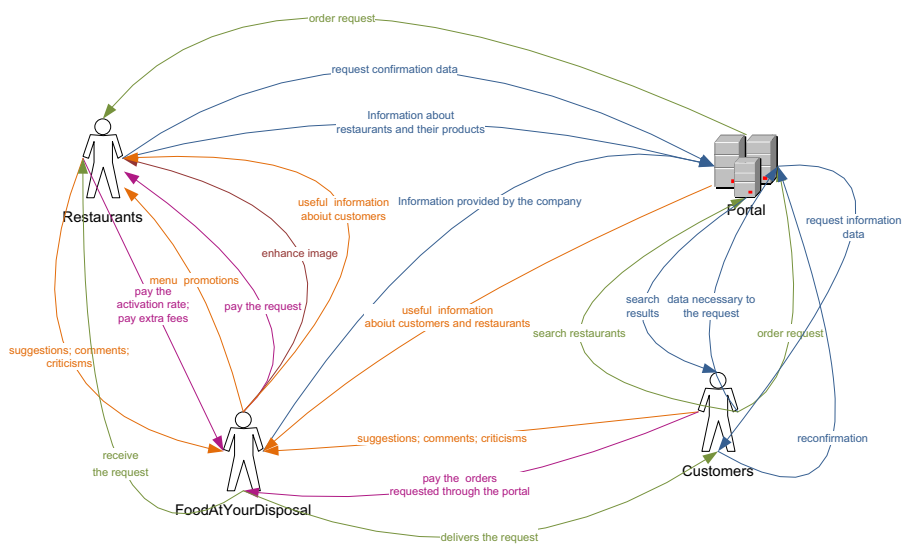


Fig. 5. FoodAtYourDisposal's value proposal

We study network stability and its value proposal configuration from three different perspectives:

- The activities carried out by the actors that contribute to a specific value proposal. It reveals the actors associated with a specific value proposal, clarifying their contribution to the network goals;
- The correlation between value proposals and actors' efforts or gains. Helps detect possible imbalances for each actor, leading to adjustments in the business value proposal if it does not correspond to the actors' expectations;
- The influence among the different value proposals. It anticipates any "domino effects". For instance, an actor can be involved in a particular value proposal that influences positively the value proposals of others. If that actor decides to quit the business, the gains of others could be affected, potentially leading them to reconsider their participation as well.

Besides the described guidelines, special attention should be given to important actors with major influence in the network, such as those who invest considerable time or money, those that hold key resources or capabilities, those with a high degree of influence, those that connect sub-domains (e.g., an actor who works in automobile industry and is a university lecturer), those that cannot be replaced, or those that are central (those located in the position with most connections and relationships). The centrality concept, borrowed from social network analysis, can contribute to enhance the business stability evaluation in our proposal, and we plan to include it in the future (Wasserman and Faust, 2008).

The information gathered in the approach (e.g., actors, activities, and value proposals) allows the definition of the business services and of the activities that the

information system supporting the network should provide. This perspective, based on the concept of business services, offers a high level of abstraction that will establish a connection with the internal business processes implemented by the actors. For the reasons aforementioned, we are considering a mapping to a service-oriented architecture.

6 Conclusions

We presented an approach to help design and assess the soundness of inter-organizational business models. In an iterative negotiation process inspired by ANT, we analyze the interplay of interests of all involved actors from organizational, social, and political viewpoints. As shown, ANT provides clues to develop flexible mechanisms that assist the management of uncertainty and ambiguity in business models. It helps us ensure that each actor gets an attractive value proposal and, thus, becomes committed to the enduring success of the emerging value network. Tracing the activities that the actors must perform to obtain their value proposals also provides indications about the services that must be provided by the information system supporting the network.

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Customer-Specific Transaction Risk Management in E-Commerce

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Abstract. Increasing potential for turnover in e-commerce is inextricably linked with an increase in risk. Online retailers (e-tailers), aiming for a company-wide value orientation should manage this risk. However, current approaches to risk management either use average retail prices elevated by an overall risk premium or restrict the payment methods offered to customers. Thus, they neglect customer-specific value and risk attributes and leave turnover potentials unconsidered. To close this gap, an innovative valuation model is proposed in this contribution that integrates customer-specific risk and potential turnover. The approach presented evaluates different payment methods using their risk-turnover characteristic, provides a risk-adjusted decision basis for selecting payment methods and allows e-tailers to derive automated risk management decisions per customer and transaction without reducing turnover potential.

Keywords: Risk management, customer value, customer risk, payment, online retailer, e-commerce.

1 Increasing Turnover Potentials and Risks in E-Commerce

The economic impact of e-commerce has been growing since it was established as a new distribution channel, shown by consistently increasing turnovers in latter years (Eng, 2008). For example, in 2006 the transaction volume in German business-to-consumer e-commerce reached 46 billion euros and 145 billion euros are forecasted for 2010 (BITKOM, 2009). Unfortunately, these increasing turnovers come with – from an e-tailers point of view – a simultaneous increase in risk (BDV, 2008). Companies following an integrated value-oriented management approach have to manage such risk explicitly. Since customers in e-commerce are the most important driver of sustainable increases in company values and risk, special focus should be directed to the identification, quantification and management of the risks resulting from customer behavior and customer transactions.

A recent survey of 292 companies (Sackmann, Kundisch and Ruch, 2007) summarized payment fraud and customer migration as being significant and hugely damaging economic risks (Stahl, Breitschaft, Krabichlerm and Wittmann, 2007). Current

customer relationship management (CRM) systems partially support a quantification of these risks and the derivation of management measures. However, in e-commerce, it becomes necessary to make automated ad hoc decisions, e.g. which price or payment conditions should be offered to a customer in the online shop. To meet to this real-time requirement, current approaches take customer risks into consideration either by increasing retail prices by an overall factor to compensate for risk losses (risk precaution) (Romeike and Finke, 2004) or by focusing only on the risk of payment fraud. To reduce or avoid payment fraud, a restriction of accepted payment methods according to an (external) customer score value is generally used (Siegl and Sackmann, 2008). However, such restrictions can lead to cancelled transactions (Stahl, Breitschaft, Krabichlerm and Wittmann, 2008) and also inherently reduce potential turnover. Thus, exclusively focusing on payment fraud risks will not lead to optimal results if other target variables exist, such as turnover, profit or market share. Since the resulting interdependencies lead to a trade-off between risk reduction and reachable turnover (Stahl et al., 2008), the effects of risk management measures should be considered on both the risk side and the turnover side. There are no previous approaches which systematically detect customer-specific risk and turnover potential, simultaneously evaluate these and enable real-time risk management decisions for e-tailers.

In this contribution we present an innovative valuation model for bridging this gap. The model brings together customer values, customer risks, and risks of specific payment methods. Based on this information, e-tailers can calculate risk-turnover combinations per customer and transaction, which in turn provides an objective and comparable foundation for integrated risk-turnover management decisions. The model consists of two modules: The first module evaluates risk-adjusted customer potentials and the second module integrates payment-specific potentials according to turnover and risk. Before introducing the model, we define a business scenario in the next chapter. Subsequently, current approaches for customer valuation and risk assessment are analyzed and brought together, providing a risk-turnover combination that is payment method specific. Finally, the results are summarized and an outlook on further developments and evaluation of the model is given.

2 Business Scenario: An E-Tailer with Risk Management

A non-market dominating e-tailer is our exemplary e-commerce scenario. The e-tailer aligns his pricing decision with existing market prices. It is further assumed that the e-tailer manages customer risk by increased average retail prices, compensating for risk losses through an overall risk premium. Customers visit the online shop via the e-tailer's website and then request product information (see Figure 1). The shop engine fetches product-specific data from the product database, and also queries the customer database for previously collected customer data. If the customer is unknown, a new customer account is created. Payment fraud risk is managed by retrieving scores from external scoring providers. These scores are interpreted as payment fraud probabilities for each specific transaction (Siegl et al., 2008). Subsequently, the customer is provided with the actual price, and, based on the score, the e-tailer offers specific payment methods. Such a "traditional" approach to manage the risk of payment fraud (see upper half of Figure 1) is widely used. However, negative effects on customers and on the reachable turnover are completely neglected, although these are relevant factors (Stahl et al., 2008).

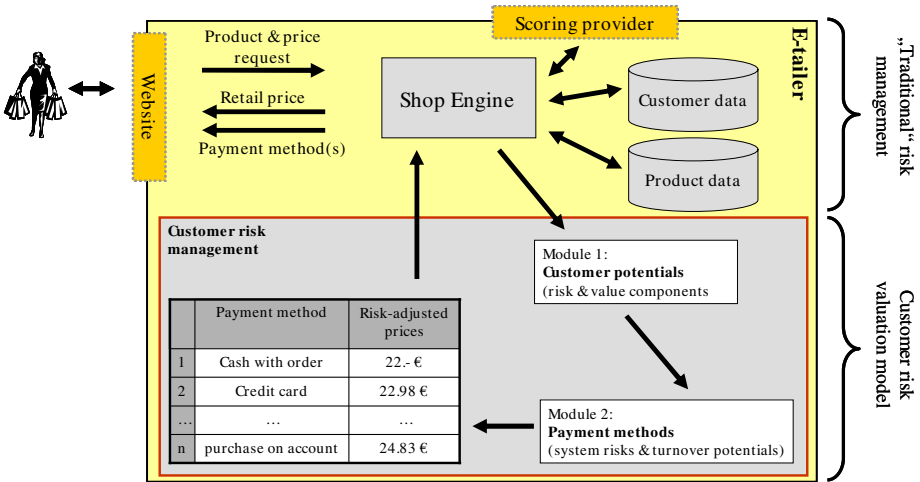


Fig. 1. E-tailer with „traditional“ risk management plus an innovative customer risk valuation model

In order to achieve an integrated management of risk and turnover, we propose an extension of this “traditional” approach through an additional “customer risk management” tool (see the box at the bottom of Figure 1). The new tool asks the shop engine for the customer data and the internal base price of the requested product, and then calculates risk adjusted prices for each payment method. The tool is divided into two modules: the first module calculates customer-specific potentials by incorporating customer values, e.g. the Customer Lifetime Value (CLV). Furthermore, it calculates the identified mitigation and payment fraud risk of the customer. The second module essentially assesses the general system risks and risk of transaction cancellations. The result of the second module is a combination of expected risk and turnover for each customer and offered payment method. Based on these results, comparable risk-turnover combinations and risk adjusted prices for every single transaction can be derived, enabling risk management decisions without jeopardizing turnover potentials.

3 Customer Valuation and Risk Aspects

3.1 Module 1: Evaluating Customer Potentials

Existing methods for a comprehensive evaluation of customer potentials claim to account for customer-specific value as well as risk aspects. However, these methods are limited in their ability to quantify the effect of risk management measures, such as restricting payment methods, on value and risk simultaneously (Kundisch, Sackmann and Ruch, 2008). Therefore, established methods for customer value and risk estimation are analyzed in this section, with the aim of identifying feasible and compatible approaches which can be used to simultaneously calculate values and risks in our model.

3.2 Measuring Customer Values

The concept of *customer value* is used in both theory and practice to evaluate customer-specific shares that support a company's economic objectives such as turnover or profit (Rudolf-Sipötz, 2001). An overview and a categorization of the manifold estimation methods can be found in, e.g., (Krafft, 2007) and (Schroeder, 2006). For an integrated and comprehensive estimation of customer value, the evaluation approach should fulfill the following criteria:

1. *Prospectivity*: Since management decisions should be optimal in the long run, the decision-making process should take a customer's future potentials into consideration. Therefore, evaluation approaches directed exclusively towards the past, e.g. ABC analyses, are deemed unsuitable for an integrated estimation of customer value.
2. *Analytical approach*: The approach should be built on an analytical method, i.e. it should provide systematical and comprehensible results. This is required for achieving a consistent scaling, weighting, and, in consequence, an objective comparability of customer values and risks.
3. *Monetary value*: The approach should have monetary values as result. In order to summarize all resultant value components of a customer relationship in one figure, all value components such as market potential (e.g. turnover and cross-selling potential) or resource potential (e.g. reference and information potential) have to be measured in the same unit of measurement. This allows different value components to be compared with costs, and the resultant values can also be used by other company units such as the controlling or marketing department and for strategic decisions at the management level.
4. *Customer-specific evaluation*: With the aim of efficient investment and management decisions, the approach should provide values for each single customer and not only offer an overall estimation of a customer segment or portfolio value and risk. The valuation of each customer is a requirement to (automatically) derive customer-specific management decisions if needed.

Analyzing established customer valuation methods shows that the customer lifetime value (CLV) method and its extensions best fit these criteria, even if the method imposes heavy requirements on the underlying IT and the necessary customer data. Nevertheless, since CLV is increasingly used in companies (Sackmann et al., 2007), and e-tailers in particular have extensive possibilities for collecting and processing the required customer data under cost-efficient conditions, CLV is proposed in our model as method for customer evaluation. The CLV as analytical, one-dimensional, and monetary method, forecasts for a customer i future cash flows R which are discounted by an interest rate d to a net present value less the acquisition costs I :

$$CLV_i = -I_i + \sum_{t=0}^n R_{it} \cdot (1+d)^{-t} .$$

3.3 Measuring Customer Risks

Similar to the customer value estimation, various methods for quantifying customer risks exist, and some of them also address risk integration in CLV (e.g., (Hogan, Lehmann, Merino, Srivastava, Thomas and Verhoef, 2002; Schroeder, 2006; Borle, Singh and Jain, 2008)). One category of these methods quantifies customer risks in the form of an overall risk variable – widely used in practice – for reducing the expected cash flows in order to build up risk reserves (e.g., (Jain and Singh, 2002; Gupta and Lehmann, 2003)). However, this does not allow risk to be quantified and managed at the customer-specific level. The same shortcoming can be observed in the suggestion of increasing the discount rate used in CLV to compensate the uncertainty of predicting distant future cash flows (Eberling, 2002). Other approaches use the Weighted Average Cost of Capital (WACC) as the theoretical, capital market consolidated discounting rate (Dhar and Glazer, 2003; Gupta, Lehmann and Stuart, 2004; Hogan et al., 2002). This approach is based on the Capital Asset Pricing Model and divides the total risk into a systematic risk and a completely diversifiable, unsystematic risk. The discount rate is thereby determined by the expected return from the interest rate of a secure investment, plus a segment-specific risk premium (Hopkinson and Lum, 2002). However, the usage of WACC also brings some shortcomings. Relations between enterprises and customers can vary strongly (e.g. individual costs of the relationship setup and maintenance, future cash flows varying from customer to customer). Hence, a planned segment-specific risk premium can – if at all – only be calculated under restrictive assumptions (Hogan et al., 2002). In addition, perfectly diversified customer portfolios cannot be assumed (Kundisch et al., 2008), and therefore it is disputable whether the unsystematic risk is actually entirely diversifiable.

In contrast to these overall risk approaches, another category of quantification methods follows a risk segmentation approach, where the total risk is divided into relevant, uncorrelated single customer risks. To realize such an approach, various methods for quantifying single customer risks are already established (Schmittlein, Morrison and Colombo, 1987; Berger and Nasr, 1998; Dwyer, 1997; Gupta et al., 2003). In the context of customer risk, *migration risk* and *payment fraud risks* have been identified as relevant for e-tailers, since competitors are only “one click” away, and financial losses caused by fraud have been permanently increasing for many years (Sackmann et al., 2007; Stahl et al., 2008). Evaluating risk on an individual customer level is seen as a promising way forward for e-tailers, since it allows for the characterization of risks in a customer- and transaction-specific way. Our model follows this approach and integrates both migration risk and payment fraud risks.

To integrate different *migration risk* quantification methods (Calciu and Salerno, 2002) into the CLV, so-called migration and retention models are available (Berger et al., 1998; Dwyer, 1997; Gupta et al., 2003). Both models assume specific market conditions whereas retention models presume a lost-for-good situation, in which consumers fulfill their needs only via one single supplier, while migration models presume an always-a-share situation in which several suppliers fulfill consumer needs (Schroeder, 2006). Because of these restrictive market and behavior assumptions, both models are seen as ill-suited for adequately evaluating customer risk in the dynamic e-commerce

environment. An alternative with less restrictive assumptions for quantifying migration risk is the NBD/Pareto model (Schmittlein et al., 1987), its extension (Schmittlein and Peterson, 1994), and further developments built hereupon (Jerath, Fader and Hardie, 2008). The basic model generates a probability $P(\text{alive})$ for non-contractual relationships which can be interpreted as a customer-specific repurchase probability (Krafft, 2007). Although the NBD/Pareto model has some minor weaknesses for market segments with long-lasting products, it is used in our model for estimating the migration risk of single customers since e-tailers are seen as capable of collecting and processing the required data regarding a customer's transaction history (Kundisch et al., 2008; Schmittlein et al., 1987).

Besides migration risks, the so-called *payment fraud risk* has been identified as relevant customer risk, i. e. the risk of a customer being unable or unwilling to pay for obtained services or products. Currently, several e-tailers are already evaluating this payment fraud risk for individual customers, e.g. by various scoring methods which have emerged as best practice approaches (Ryals, 2003). For calculating such scores, economically relevant monetary and non-monetary impact factors need to be identified. In most cases, the score value is generated by a simplistic weighted aggregation of these factors (Krafft, 2007). In our valuation model, such a scoring model is also proposed for estimating the payment fraud risk, since numerous external providers specialize in such scoring services. In principle, this enables e-tailers to estimate a customer-specific payment fraud probability for each individual transaction.

3.4 Module 2: Evaluating Risks of Payment Methods

The second module of our customer risk valuation model aims to assess the general *system risks* and *risk of transaction cancellations* for different payment methods. These risks are seen as independent of the customer-specific payment fraud risk but can likewise result in massive losses. Therefore these risks should also be taken into consideration for integrated risk-turnover management. Knowing the effects of specific payment methods on risk as well as on turnover is especially relevant for e-tailers, since the selection of accepted payment methods is an interesting "tool" for risk management. This selection can be adjusted to each individual customer and transaction, e.g., by offering more or less restrictive payment methods based on customer-specific characteristics. However, the concrete use of payment method selection for risk management varies according to cultural background: While payment via credit card is the prevalent method in many countries, in several countries other methods are equally important, for example in Germany where over 40 different payment methods are in daily use (Stahl et al., 2008). This means that for each e-tailer an individual adaptation of our valuation model is required according to the payment methods in use. In the following, we focus on five prevalent payment methods in e-commerce: cash with order, credit card, cash on delivery, direct debit and purchase on account. This selection does not limit the generality of our approach, since further payment methods, e.g. e-payment methods such as "paypal", can be easily integrated. From an e-tailer's point of view, with exception of the risk-free payment method cash with order, all methods hold specific system risks as Table 1 shows.

Table 1. Exemplary system risks of prevalent e-commerce payment methods

PAYMENT SYSTEM	SYSTEM RISKS
1. cash with order	– no risks for e-tailers
2. credit card	– inaccurate credit card data – exceeded card limit – chargeback (payment revocation)
3. cash on delivery	– incorrect delivery address – undeliverable mailing, customer not available – hoax orders
4. direct debit	– incorrect banking accounts – exceeded account limit – revocation of a debit entry
5. purchase on account	– missed term/maturity of payment – incorrect billing address

Since each payment method has specific risk characteristics, quantifying these risks is a nontrivial problem. Although there are established evaluation schemes for some of these system risks (Degennaro, 2006; Bezuidenhout and Gloeck, 2003; Bezuidenhout and Gloeck, 2004), for the sake of simplification we renounce with single risk evaluations and rely on first intersector empirical results to estimate overall system risks per single payment method (Stahl et al., 2008). Table 2 shows these results, assuming a risk neutral decision-maker:

Table 2. System risks values of prevalent e-commerce payment methods (in extension of (Stahl et al., 2008))

PAYMENT SYSTEM	SYSTEM RISKS
1. cash with order	0.0 %
2. credit card	0.9 %
3. cash on delivery	1.2 %
4. direct debit	1.7 %
5. purchase on account	3.7 %

Besides the payment method system risks, e-tailers should also consider negative effects of limiting payment methods, since these limitations increase the probability that customers cancel their transactions (See-To, 2007; Siegl et al., 2008). Empirical evidence shows that by offering less restrictive payment methods, the annual turnover of e-tailers can be increased. For example, an e-tailer raised its annual turnover by

about 12.5 % by also offering “credit card” and “purchase on account” in addition to the restrictive payment method “cash with order” (Stahl et al., 2008). Since there is no further empirical data available yet, we set the method “cash with order” as maximally restrictive and “purchase on account” as minimally restrictive payment methods for customers. Values for expected turnover potentials are interpolated as follows: credit card 4 %, cash on delivery 7 % and direct debit 9 % (see also Table 3). If better empirical data becomes available, the results of our model may improve.

Table 3. Turnover potentials of prevalent e-commerce payment methods (in extension of (Stahl et al., 2008), * interpolated values)

PAYMENT SYSTEM	TURNOVER POTENTIALS
1. cash with order	0.0 %
2. credit card	4.0 % *
3. cash on delivery	7.0 % *
4. direct debit	9.0 % *
5. purchase on account	12.5 %

3.5 Model for a Risk-Adjusted Customer Valuation

Efficient and integrated risk-turnover management requires the simultaneous assessment of risk and value potentials of customers and payment methods. All methods for evaluating customer value, customer risks, system risks, and turnover potentials of payment methods presented in the previous sections fulfill the criteria of monetary value, a single aggregated turnover and risk value can be calculated for every transaction. To calculate risk-adjusted prices in a competitive market environment, two additional factors are included in our model: the product base price, i.e. the lowest price an e-tailer demands for its product, and the average market price, i.e., the highest

Table 4. Input variables for detecting customer-specific risk-turnover combinations per transaction

VALUE VARIABLES		RISIK VARIABLES	
P	product base price	PPF_k	payment fraud risk of customer k , calculated by an external scoring provider
CLV_k	customer value of customer k	PFE_k	payment fraud risk of customer k , calculated by the e-tailer
TP_b	turnover potentials of payment method b	MR_k	migration risk of customer k
		SRP_b	system risk of payment method b

price an e-tailer would be able to realize. Thus, the product base price and the market price spread the manageable price range for the e-tailer. In total, our valuation model contains three variables for measuring values and four variables for measuring risk as shown in Table 4:

Consequently, the aggregated turnover variable u for a customer k and a payment method b is a function of the three value variables representing the effectively reachable turnover for a specific transaction, incorporating future customer potentials:

$$u_{kb} = f(P, CLV_k, TP_b).$$

Accordingly, the aggregated risk variable r for a specific transaction is a function of the four risk variables:

$$r_{kb} = f(PFP_k, PFE_k, MR_k, SRP_b).$$

Applying our model requires an identification of the formal interdependencies between the value and risk variables. Since there is no empirical experience currently available, we intend to aggregate P and the (weighted) variables CLV and TP by addition. Furthermore, as a starting point, we propose a multiplicative aggregation for the probability values of the risk variables. The application of our approach requires a concrete specification of the model. This is the current focus of our research, and we investigate the adaptation of methods from the financial and insurance sector. However, the results presented in the following are independent of the concrete specification of the model, and are discussed on a more abstract level by using exemplified business scenarios. Based on the above selected five exemplary payment methods, five risk-turnover combinations can be calculated for each transaction, one for each payment method. These risk-turnover combinations can be visualized by a risk-turnover diagram, so that all accessible risk-turnover combinations for a single customer can be directly compared as shown in Figure 2.

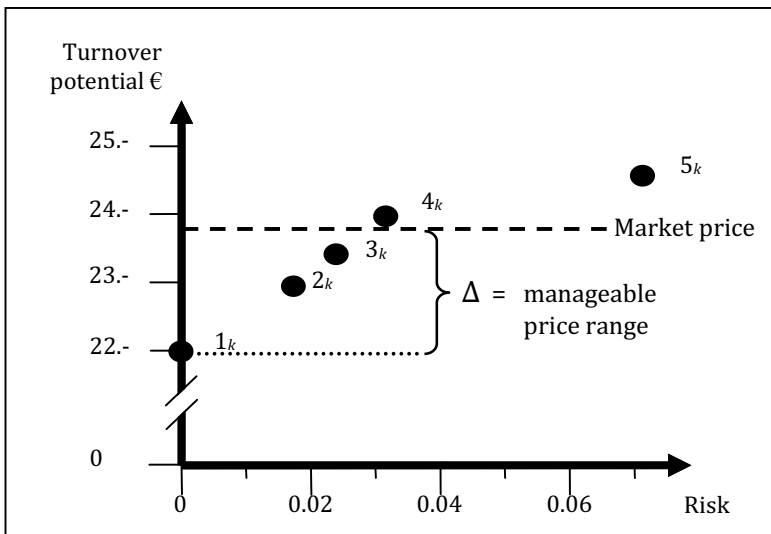


Fig. 2. Risk-turnover combinations for a customer k and five payment methods

The second module allows to determine the additional turnover reachable under a certain level of risk. Thus, an e-tailer is provided with risk-adjusted prices and an objective decision base for customer-specific risk management, taking turnover potentials into consideration. The company's risk preferences determine which of the payment methods (see points 1_k to 5_k in Figure 2) should be provided to the customer, and how the risk-adjusted price range (see Δ in Figure 2) should be used. Even if the calculated risk-adjusted price for a customer is higher than the market price (see points 4_k and 5_k in Figure 2), e-tailers can manage risks by automatically offering more restrictive and *ceteris paribus* less risky payment methods such as "cash with order", "credit card" or "cash on delivery".

The way in which the risk-adjusted prices are finally operated depends on further factors, such as a general pricing (Schwind, Hinz, Stockheim and Bernhardt, 2008), sales, or market share strategies. Nevertheless, if a risk-adjusted price lies under the market price, an e-tailer can manage this price range. For instance, the e-tailer can see this as additional margin, or can decide to pass this "premium" on to the customer in the form of a discount. Since the model defines the market price as the maximum price and only risk-adjusted discounts down to the minimal base price are addressed, there should be no negative reaction on the customer side to such marketing measures, and a general acceptance of risk based pricing should be achieved. However, marketing measures based on risk-adjusted pricing are not limited to discounts.

The model presented in this contribution is flexible and open to further, perhaps branch-specific value and risk variables that can potentially raise the forecast accuracy. Furthermore, the modular architecture of our valuation model also enables – to a certain extent – the evaluation of customers on which little or no data is available, as it is typically the case with new customers. Here, average branch or company experiences can be used to calculate risk and value data. Should this be impossible, single variables can be omitted from the model, allowing each customer to be evaluated with less accuracy but still allowing an automated management for e-tailers.

4 Conclusion and Outlook

A growing turnover potential in e-commerce inevitably goes hand in hand with an increase in risks (e.g. payment fraud and migration risk), which should be managed. Existing applicable approaches for e-tailers either increase average prices by an overall risk premium or manage risks by only offering low-risk payment methods. However, following a value-oriented strategy, these approaches prevent optimal risk-turnover management, since customer-specific value and risk factors as well as turnover potentials are neglected. Integrating these factors into a valuation model is proposed in this contribution. The new valuation model includes two modules for customer and payment method evaluation, which generate an objective decision base for a customer-specific risk management which integrates turnover potentials. To this end, the first module combines the customer lifetime value, migration risk (evaluated by the NBD/Pareto model), and payment fraud risk (evaluated by scoring methods) to estimate customer potential. The second module integrates payment system risks from offering different payment methods and the risk of transaction cancellations on the basis of first empirical data. As a result, customer specific risk-turnover combinations for every payment method and transaction are generated, enabling e-tailers to make

objective risk management decisions. Since the model requires a variety of inputs, and since optimal risk management decisions can only be made in conjunction with other customer management measures, our model should be seen as a possible extension of current CRM systems and not as a stand-alone approach.

Our next step is an extension of the valuation model by a third module which aims at automating the – currently manual – decision process of a risk-optimal selection of payment methods. To do so, currently company-specific risk preferences will be integrated into the model. Furthermore, we will analyze how the results can be used to support other company goals, e.g. for identifying valuable customers or for optimizing the whole customer portfolio under risk criteria as proposed in (Kundisch et al., 2008). Last but not least, a necessary applicability check (Rosemann and Vessey, 2008) is planned to test the results and performance within the shop engine of a German e-tailer. For this purpose, we will weight the used value variables at the e-tailer-specific level. A prototypical implementation as business process and pretests based on real customer data will then provide first results on practical quality and performance. The final evaluation of the model is part of a research project supported by the German Federal Ministry of Education and Research, and the findings will be used for an iterative improvement of the model concept presented in this contribution.

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An Evaluation of Multiple Perceptions of Digital Rights Management

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Abstract. Digital Rights Management (DRM) solutions have generated much interest because of their influence on the expectations and responsibilities of customers and related organizations. It was created to restrict piracy and enhance digital media sales, however, it is found to be unable to fulfill its objectives. We find the protections by DRM lack an understanding of the end user and the evolving nature of copyright and fair use. The potential motives for pirating appear to increase as DRM becomes more intrusive causing a conflict in the objectives of DRM. Thus, adjustments must be made to the current DRM model in order for it to become beneficial for both the producer and the consumer. Our research identifies the needs, desires, and responsibilities of the various DRM stakeholders so that a successful use of DRM technologies can be modeled: a challenge faced by the media industry.

Keywords: Copyright, digital rights management, DRM, electronic commerce, fair use, online music business, piracy.

1 Introduction

Rapid improvement in technology and processing capabilities of computing infrastructure is altering the nature of our society. The availability of the Internet has changed how we transfer data and communicate. We are not only using Internet applications like email to send messages, but are also utilizing the Internet to legally/illegally share the intellectual property (music, games, software, to name a few) with our friends, acquaintances, and strangers contacted both directly and indirectly over the Internet. Social networks and peer-to-peer (P2P) technologies further assist in the delivery of these digital files. Although some companies have made an attempt to restrict the transfer of their products by using encryption techniques, decryption is not difficult by today's tech-savvy generation. Content providers are trying to respond by utilizing techniques that restrict the way a user can use the media on a computer, MP3 player, iPod, etc. Digital rights management (DRM) technologies are aimed to manage the scope of the rights of the end user while providing protection to the owners of the digital assets.

If one were to search "DRM" in popular technology-related news website Slashdot.com, the result would be hundreds of articles containing grumblings and outcries

from the more technologically minded audience against DRM. Research on this widely debated topic, in general, tends to move toward the technical and away from the people that it affects the most: i.e. the average iPod user that has no idea how their iPod works, just that it plays music they like. These are the consumers DRM affects the most and the one crowd that gets little representation in DRM research. The cryptography sided research in DRM discusses how to implement a stronger form of protection using advanced algorithms and complicated frameworks (Heileman and Jamkhedkar, 2008). Such research is quick to forget that beyond the DRM implementation is a product that should appeal to a wide consumer base in order for it to meet full sales potential. Consequently, there is a need to understand the aspirations and constraints faced by various stakeholders in order to use DRM successfully.

The focus of this research is on the applicability and usefulness of DRM, especially in the digital music industry, and the viewpoint of each role played in the DRM system. The research aims to contribute by investigating the standpoint of each stakeholder affected by DRM along with its objectives to determine what attributes DRM must possess in order to work as a beneficial solution to the digital media industry.

The structure of this paper is as follows. The next section presents an overview and purpose of DRM. Subsequently, we discuss the viewpoints of the various stakeholders of DRM technology to gain a better understanding of their needs, desires, and responsibilities. Throughout this discussion we evaluate the advantages and disadvantage each stakeholder possesses in the current DRM model. This is followed by an assessment of DRM as a balanced system that supports the rights of all stakeholders. Finally we present our conclusions and areas for future research.

2 Digital Rights Management: An Overview

DRM is defined as a piece of technology that encapsulates, controls, and manages content (Kwok, 2002). DRM refers to a range of access control technologies used by content providers to limit and restrict use of provided content. The ways in which these management technologies are implemented vary according to the providers needs. The objectives of DRM can be simplified as the following (Garnett, 2001):

1. Provides consumers with a new way to enjoy digital media.
2. Protects and manages the rights of copyright owners.
3. Implements elements of copyright law and fair use in an appropriate manner.
4. Protects end user's personal rights and interests.

These objectives have an impact on various parties in different ways. For example, DRM can help the copyright owners to restrict the illegal sharing of digital media with other parties. However, it is frequently argued that the same systems can erode the capabilities provided to the users by fair usage doctrine. It is therefore important to first identify various stakeholders which are affected by the adoption of such systems.

3 The Stakeholders

The current DRM system model contains the following essential stakeholders: the creator, the rights holder, the distributor, and the end user (Bartolini et al, 1999;

Arnab and Hutchison, 2004). The legal requirements and conditions of DRM and the copyright/fair use discussions surrounding DRM lead to the recognition of lawmakers as an important addition to this list of stakeholders. Thus, one can establish the following essential stakeholders:

1. The author or the creator responsible for creating the work

In the case of music, this would be the musicians that composed or recorded the work.

2. The rights holder (or copyright owner) of the work

In the music industry, the company owns the work and controls all reproduction rights.

3. The media distributor

Music distributors gain licenses from the rights holders in order to sell their music.

4. The end user

The end user is the final step in the process involving the purchasing of the digital music through the distributor.

5. The lawmaker

Lawmakers pass copyright laws to protect the author and rights holder while allowing fair use exceptions for the end user.

4 The Creators' Viewpoint

For the creators of content, DRM serves to protect their creative output and labor. A moral problem exists where digital technology is used to pirate copyrighted content. This act cheapens the value of the authors' creativity and undermines the basic building blocks of modern society (Garnett, 2001). While the creative community desires to take advantage of the Internet and its possibilities, without the protection of DRM the ability to legally enforce the rights of the creators grows increasingly more difficult.

Analog content has high levels of integrity not only because of the difficulty of altering analog content but also because of its widespread distribution (Camp, 2002). Digital media lacks in this area. With the advent of digital media, distribution is now synonymous with copying, a nearly cost-free process that can now be completed almost instantaneously. With this in mind, creators could view DRM as not only trying to solve a piracy problem, but also creating a system of integrity for their digital content.

5 The Copyright Owners' Viewpoint

Copyright owners want to track the illegal use of DRM enabled media, collect the correct revenue for their works, create a secure distribution channel, and prevent the illegal use of their works (Arnab and Hutchison, 2004). DRM is the result of copyright owners demanding that distributors take law enforcement in their own hands. From the copyright owners' point of view, drastic action was needed because law enforcement was not able to make a large enough impact to discourage piracy (Schultz, 2006). DRM implementation offers greater control of the digital product and the potential to obtain the full possible revenue. While the protection that DRM offers

to the copyright owners appears beneficial, the current model fails to create any benefits to those on the receiving end (Callas, 2007).

Copyright owners have undergone heavy criticism for implementing DRM systems on CDs and computer software. Sony BMG was sued in late 2005 for installing spyware on music CDs (Bradbury, 2007). Girard Gibbs recently filed a class action lawsuit on October 27th, 2008, versus Electronic Arts for all games bundled with SecuROM (SecuROM Lawsuits, 2008). SecuROM, a DRM system created by Sony DADC, has become problematic because many legitimate users have experienced technical problems with their PC as a result of the software being installed. Users having made genuine purchases of these softwares became outraged because illegal DRM-free copies did not have the same problems. Backfires like these have caused a large focus of heavy criticism to fall on these companies.

Faced with a similar piracy problem, the television industry took a different approach. File sharers were uploading their video files of television shows and causing advertisers to complain to the networks because people were watching the shows without the advertising. The solution: FOX, NBC, ABC, and many other television networks made the shows available online for free for a couple month period after it aired. On these uploaded videos, brief commercials were inserted throughout the show. Not only did these videos appeal to advertisers as an additional and new way of advertising, but they also appealed to the users since the videos streamed quickly, were of a high quality, and were provided on a safe website.

6 The Distributors' Viewpoint

Acting as the man-in-the-middle, distributors must manage the demands of the music providing right holders while still remaining appealing to the consumer. It would be false to assume that online music business distributors have cornered the music market. Online music companies like iTunes have taken online sales to new levels, but there is still a large amount of competition from physical stores. The 2007 Digital Music Survey (Entertainment Media Research, 2007) estimates that digital downloading of music has not affected 45% of CD buying consumers with 7% of consumers buying more CDs as a result of digital music downloading causing the cost of CD's to drop.

In one of Steve Jobs' letters to the public he states that one of the difficult requirements Apple must meet to sell music from big name music companies is the protection of their content (Jobs, 2007). The problem is that there are many people who break DRM systems and publish their techniques allowing previously DRM-protected material to be accessed both legally and illegally (Jobs, 2007). If DRM is so easily broken by hackers, why not make a stronger system? While it is technically possible to create a DRM system that is almost unbreakable, it would be almost impossible to use (Bradbury, 2007).

As a result of the desires of copyright owners, alternative methods have been researched such as a DRM system that implements tracking of protected media. This creates a new problem that produces a logistical nightmare for ISPs requiring every ISP to implement such a tracking system (Arnab and Hutchison, 2004). Also, the use of firewalls and proxies will mean users will only get a consolidated bill and additional detectors will be required to detect the actual users of the work (Arnab and

Hutchison, 2004). Further more, analyzing data that is distributed on secure encrypted channels would not be worth the result.

Distributors are often criticized for creating DRM systems lacking fair use, with research and public opinion both demanding the implementation of fairer DRM rules (Fox and LaMacchia, 2003). This responsibility is unfairly placed on the distributor. The development of these systems has been the result of pressure from the copyright holders. The goal of DRM architects is to appease the wishes of the copyright holders in order that the distributors may gain the rights to sell the product. Furthermore, DRM vendors can not simply define fair use as it has no clear values and it is continually developing and changing with technology and common practice (Lohmann, 2002). Historically, the copyright system has allowed for consumers to use the court system to intervene and make fair use decisions if the right holder does not agree with the use. Steve Jobs position states “those unhappy with the current situation should redirect their energies towards persuading the music companies” (Jobs, 2007).

7 The End Users’ Viewpoint

End users are ready for a DRM system that handles most fair use scenarios, protects their confidentiality, allows for the transfer of rights, and is flexible according to its media type (Arnab and Hutchison, 2004). The reasons DRM has proven to be unpopular is simply expectation and cost: the consumer does not want DRM because nobody wants to pay for something that in the past was unrestricted. To many end users this basic conclusion appears to be ignored by the content providers and copyright owners, leading to a potential decline in online digital media sales if current DRM models remain in use.

The ability to connect millions of people together makes digital music, video, PC games, pictures, documents, and more available for the unbeatable price of “free” hard to beat. Technical support in case of problems as well as a fear of computer viruses is among the ten most important reasons for people to purchase rather than pirate software (Jaisingh, Kwan, and Tam, 2008). The same result does not appear true for music media (Jaisingh, Kwan, and Tam, 2008). Instead, end users fear that their security and privacy will be violated by quietly implemented DRM systems using rootkit techniques similar to those applied by Sony BMG (Bradbury, 2007).

The same consumers that use peer-to-peer systems to download pirated music are the same people that would never think of purchasing pirated CDs in the physical world (Garnett, 2001). Illegally downloading music does not have a social stigma attached to it. There is no perceived social cost as the result of pirating (Schultz, 2006; Balestino, 2008). With this lack of social cost there is no pressure acting on law enforcement from end users.

As mentioned earlier, the one sided design of DRM fails to offer any benefits to the one paying for the product (Callas, 2007). Since DRM-free music files are already available on CD and P2P networks, those already file sharing have little reason to stop. There are an estimated 885 million music files available for illegal downloading (Balestrino, 2008). With DRM detracting from the appeal of online media purchases, DRM is actually giving the consumer *more* reasons to share files; a dangerous threat to online media businesses. Consider this: If an individual pays for the music, the person is limited to how many times it can be played, how many times can be copied, and who

it belongs too. These constraints result in frustrating the user, who otherwise might have never illegally shared the work with another. Such a person might have simply used the file in different situations (MP3 audio player while in the car, or iPod while in a room). But, if one illegally downloads music, the person can convert the files freely and also can copy it unlimitedly, reflecting as if it really belongs to the person. DRM only manages to make a product less appealing to the end user. Content owners seek to use DRM to reduce piracy and change expectations while consumers are not concerned about infringement and demand full use of purchased content (Lohmann, 2002).

8 The Lawmakers' Viewpoint

Acting as the moderator of the other relationships, lawmakers are positioned to find a protecting balance between everyone. Copyright laws have been present in the United States as early as the Copyright Act of 1790. Copyright protected the creative property of maps, charts, and books. In an age where technology allows us to own most things digitally, copyright laws have extended themselves into the digital realm. The problem that we face today is that the laws behind copyright are becoming harder to interpret, as is ownership. Knowing "who owns what" is not as easy as searching a shelf of books anymore. On October 28, 1998, the Digital Millennium Copyright Act (DMCA) was signed into law by President Clinton (Pub. L. No. 105-304, 112 Stat. 2860). In brief, the act criminalizes the production and distribution of technology, devices, or services intended to circumvent measures that control access to copyrighted works. The DMCA also heightens the penalties for copyright infringement on the Internet.

DRM exhibits three basic flaws in the area of fair use (Felten, 2003):

1. Lack of knowledge about the circumstance: the DRM system cannot understand the situation that the protected content is being used in.
2. Inadequate artificial intelligence: currently, no computer's intelligence system is complex enough to make the same decisions that judges and lawmakers make. Computer programmers can not (at this time) program restrictions that take into account the maddeningly vague concept of fair use.
3. It is a system of approximation: in this system, both parties lose. DRM's weaknesses can be exploited for unfair use and legitimate users may be restricted from fair use.

To this, one can also add that DRM prohibits the evolutionary nature of copyright law. In the famous *Sony-Betamax* or *Universal City Studios v. Sony Corporation of America* case the U.S. Supreme Court ruled that Sony could not be held liable for illegal copying of copyright works made using their Sony-Betamax video recorder (Arnab and Hutchison, 2004). The evolution of fair use allowed for these home copies to become legal. Since DRM is not capable of acting as a legal enforcement of rights as it cannot compute the complexities of fair use, it must not be constructed in such a way that its management is stagnant and unwilling to change.

A further analysis of DRM technologies suggests that the DRM is not as much about copyright as it is about end-user agreements (Delgado, Garcia, and Gil, 2007). An end-user agreement is a legally binding contract between the users and the producers. The

user must consent to the agreement before they can gain access to the produced content. DRM enforces its ownership, not by copyright, but by an agreement between an individual and the distributor when clicking “Agree to the Terms and Conditions.” These terms and conditions do not treat the end user as if he has rights, but rather expectations. Since no technology, and in the same manner, no DRM system has proven to be unbreakable (Samuelson, 2003) it would seem that the main goal of DRM is not to stop piracy, but rather to change the expectations of the digital downloading consumers regardless of rights. But are our rights in the analog world comparable to our rights in the digital world? DRM emphasizes “restrictions” rather than “rights” (Samuelson, 2003); therefore making DRM an attempt to eliminate the lawmaker by creating a system of end user agreements rather than of copyright and fair use.

9 Conclusion

Copying right owners have strained the importance of protecting their content to media distributors (Jobs, 2007) because law enforcement is not making a large impact on piracy (Schultz, 2006). DRM has become that method of protection. DRM currently lacks the ability to model the vague concept of fair use (Felten, 2003) which effects DRM’s ability to mirror and form with social evolution. As shown in Table 1, there are needs and desires of various stakeholders which are yet to be filled under the current DRM mechanisms. In order to create the most stable and optimal balance between the information industries and the consumers, DRM needs to be modeled in a way that protects the rights of all parties (Chang, 2007) while balancing each of their needs and desires. Until the viewpoint of all the stakeholders is taken into consideration, tension will continue to present an unsuccessful online sales model. It is important to note that eliminating DRM completely fails to address the problems that digital content providers and copyright owners face. It is therefore important to assess the failures of DRM and find new models that satisfy the needs, desires, and responsibilities of each stakeholder.

Table 1. The Stakeholders Under Current DRM Model

Stakeholders	Needs/Desires	Responsibilities
Creators	Creativity protection Content integrity	Content creation
Copyright Owners	Correct collection of revenue for works Prevention of illegal use of works	Maintain and manage copyrighted content
Distributors	Profitable sale of digital content	Manage product demand and supply
End Users	Fair use of digital content Flexibility Confidentiality	Purchase content legally
Lawmakers	Cohesion between DRM stakeholders	Rights for content creators and owners Fair use for end users

DRM's current lack of balance endangers the ability online media sales have to compete with physical media sales. There will still be the desire for the convenience of digitally downloading music, but if legitimate purchasing methods mean restricted content, more reasons are created for piracy. DRM is currently not implemented on most physical music media allowing unprotected music to become available on P2P file sharing sites. P2P sites will offer the same digital product but DRM-free. This will create a poor marketing environment for legal distributors of music as consumers who are willing to pay for music may choose to pirate on the sole basis of getting a better product.

DRM must provide a neutral and trusted environment in which technology enforces these agreed-upon arrangements without giving one party an advantage over the other (Garnett, 2001). To achieve this goal, there is a need to maintain a free and effective commercial society that supports the rights of all participants equally. The current DRM is not capable of acting as a legal enforcement of rights since it cannot compute the complexities of fair use. Library and privately owned content no longer covers all aspects of ownership. DRM must also handle these complications (educational use, right to backup, etc) or the entire system fails (Camp, 2002). DRM has had a rough entrance into the media industry. To be successful, DRM needs to appeal to the consumer while still remaining a beneficial solution to content providers. DRM and the tools that break down DRM both have copyright and fair use elements, but neither have solved the problems that the copyright systems solved for physical media - that is, to create a balance, and hence, cohesion between the stakeholders.

10 Contribution and Future Research

We see the current DRM model as a step backwards for the entertainment industry. We are not only concerned about the rights that the end user should have, but we also wish for the success of the entertainment companies selling their products digitally. If DRM is going to be destructive to online media sales, then a new solution is needed and current DRM implementation needs to be completely reevaluated. This paper contributes by: 1) providing an understanding of the needs and expectations of various stakeholders affected by DRM, 2) evaluating and determining whether current mechanisms provide an effective and balanced solution beneficial to the digital media industry, and 3) identifying the areas for the needed improvements.

In future research, we plan on assessing the strengths and weaknesses of different implementations of DRM systems by various vendors. As mentioned before, certain television networks have created new ways to combat piracy that benefit all stakeholders. Evaluating the successes and failures of different approaches will help form improved systems and future online business models that are beneficial to everyone. We are also assessing the perception and expectations consumers have toward digital media in order to find a balance between the demands of the right holders and the end users.

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Consumer's Online Shopping Influence Factors and Decision-Making Model

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Abstract. Previous research on online consumer behavior has mostly been confined to the perceived risk which is used to explain those barriers for purchasing online. However, perceived benefit is another important factor which influences consumers' decision when shopping online. As a result, an integrated consumer online shopping decision-making model is developed which contains three elements—Consumer, Product, and Web Site. This model proposed relative factors which influence the consumers' intention during the online shopping progress, and divided them into two different dimensions—mentally level and material level. We tested those factors with surveys, from both online volunteers and offline paper surveys with more than 200 samples. With the help of SEM, the experimental results show that the proposed model and method can be used to analyze consumer's online shopping decision-making process effectively.

Keywords: Online consumer behavior, influence factors, decision-making.

1 Introduction

Consumer behavior on the Web has been the subject of considerable research in the last a few years, but it is difficult to understand it by the fact that the main entities involved, such as consumers, businesses and products, are very complex. Some researchers have discussed several benefits that online shopping provide to consumers, which are not quite available in traditional shopping channels. There is no doubt that internet has provide a different shopping experience in various ways to consumers, as there are much more benefits for consumers to purchase online. For example, they can buy product without the limit of space and time, they can access more information than ever before with the help of search engine and the other exploration tools on the internet, and thus consumers will feel more joyful and active during the online purchase process.

According to a China Internet Network Information Center (CNNIC) survey, online shopping is ranked the 12th purpose for people using the internet in China(CNNIC, 2006). Some researchers examined consumer's behavior during the online shopping stage and proposed that perceived risk is a critical determinant factor,

and which is a useful context to explain barriers to online shopping (Bhatnagar and Ghose, 2004). What's more, there have many recent publications discussing the issues of transaction intention and trust in electronic commerce (Gefen and Karahanna, 2003; Vijayasarathy, 2004; Kim, 2005).

When purchase online, consumers' psychology thought have many differences from traditional purchase activities. Traditional consumer behavior theories cannot explain their online purchase effectively. The objective of this paper is to gain a better understanding of Chinese consumer's online shopping influencing factors and decision making process, which will have three benefits at least: firstly, enterprises can achieve better marketing objectives with better designed marketing strategies and more effective created websites; secondly, it will be beneficial for the government to accelerate the development of e-commerce; thirdly, it will improve customers' acceptance about online shopping.

The structure of the remainder of paper is organized as follows. In the next section, we propose some definitions based on the discussion of relevant literature. Online shopping influence factors, such as perceived benefit and perceived risk are illustrated. In Section 3, we present an online consumer's decision-making model based on the former analysis. Section 4 describes the data and the method. Section 5 presents the results of analysis, and we also conclude managerial implications and directions for future research in this section.

2 Literature and Hypothesis

The definition of Consumer behaviors provided by American marketing association (AMA) is a dynamic interaction process between perception, emotion, cognitive, behaviors, and environmental factors, which is the base to fulfill the functions of the exchange. We can use consumer behaviors' theory to explain their decision-making process.

According to the classic economics theory, consumers will follow the principle of utility maximization in the decision-making process, thus we can treat all the external and internal factors that influence decision-making into two parts of gain and loss. According to Technology Acceptance Model (TAM) proposed by Davis (Davis, 1986), gain and loss perception of customer can be understood as perceived benefit and perceived risk. Zeithaml thought that consumers would make a selection with the maximum perceived benefit when making purchase decision (Zeithaml, 1988); However, Mitchell thinks that consumers tend to reduce the perceived risk rather than maximizing their perceived benefit when making purchase decisions (Mitchell, 1999), and he has provided a recommended model can be presented as:

Perceived risk = \sum_n Importance of negative consequences \times Probability of negative consequences

(Where n = facets of perceived risk, e.g. time, psychosocial, financial etc.)

Similarly we can provide a recommend model of perceived benefit, which can be presented as:

Perceived benefit = \sum_n Importance of positive consequences \times Probability of positive consequences

(Where n = facets of perceived benefit, e.g. time, convenience, financial etc.)

In addition, we propose a supposed formula shown below in order to describe customer's online shopping decision-making process specifically, including both of perceived benefit and perceived risk, which is more consistent with the people's psychology thought about online shopping.

Online shopping possibility = Perceived benefits / Perceived risk.

2.1 Perceived Benefit

Perceived benefit has recently gained much attention from marketers and researchers because of its important role in predicting purchase behavior and achieving sustainable competitive advantage. Zeithaml conceptualized perceived benefit as "the consumer's overall assessment of the utility of a product based on perceptions of what is received and what is given." In his definition, the concept is measured at the product-level. It incorporates the quality of the (physical) product and its additional services delivered, in comparison with its relative price.

In general, we hypothesis that more values consumers perceived, more likely they will make a purchase decision. Existing literature and survey have shown that most consumers have similar opinions on perceived benefit when shopping online.

Afterward, we divide the online consumer's perceived benefit into the following four dimensions according to relevant literatures:

- (1) Convenience of purchasing (CP) (Lin, Wu and Hsu, 2007);
- (2) Low-cost (cost reduction) (LC) (Cairncross, 1997);
- (3) Individuation of product or services (IN);
- (4) Enrichment of information (EI) (Yadav, 2005).

2.2 Perceived Risk

The development of the theory of perceived risk in the context of consumer behavior began in 1960 (Bauer, 1960). According to Bauer, consumers' behavior involved risk because their purchasing actions "will produce consequences which he cannot anticipate with anything approximating certainty, and some of which at least are likely to be unpleasant".

According to the theory of consumers' perceived risk, consumers perceive risk because they face uncertainty and potentially undesirable consequences as a result of purchases. Therefore, the more risk they perceive, the less likely they will purchase. Perceived risk is powerful at explaining consumer's behavior because "consumers are more often motivated to avoid mistakes than to maximize utility in purchasing" (Zeithaml, 1988).

Many scholars have divided perceived risk into several part and to measure the risk based on different survey samples (Jarvenpaa and Tractinsky, 1999; Anthony and Fernandez, 2001), which demonstrate that the perceived risk exist in the online shopping process. Through survey on the internet and interview with the online consumers, we found that different from perceived benefit, consumer's perceived risk have obvious difference between consumers. Usually, it is easy to notice external, short-term, one time risk, for example the money loss, lower quality, time loss, and so on. However, for some other risk, such as intrinsic, long-term, and permanent effective risk are difficult to be noticed, for example the social position drops, health injury, etc.

Based on related literature (Nena, 2003) and interview to online consumers, we divided perceived risk into seven dimensions, which can be divided further by their characteristics respectively, which was shown in detail as following:

- (1) Economical risk (ECR) represents the possibility of monetary loss arising from online shopping. It can be further divided into three parts:
 - R11: Payment loss risk;
 - R12: Credit card embezzled risk;
 - R13: Online bank payment risk.
- (2) Product functional risk (PFR) refers to the possibility that the purchased products do not work properly and could not satisfy customer's anticipation. It can be divided into three parts:
 - R21: Possibility of Buying counterfeit goods, inferior product, damaged goods;
 - R22: The product performance not fit the need;
 - R23: Products damaged for third party reasons.
- (3) Time-loss risk (TLR) refers to the possibility of time wasting during the online shopping process. It can be easily divided into three parts:
 - R31: Too long information searching time;
 - R32: Too long transaction waiting time;
 - R33: Too long related service time, such as product maintenances and exchange.
- (4) Service risk (SER) refers the possibility of the on-line shopping maybe unable to have the right of exchanging goods or consultation service as traditional shopping way. It can be divided into two parts:
 - R41: Unable to obtain the service of exchange a purchase and some other similar service;
 - R42: Lacks of the neutralize organization to provide the arbitration service.
- (5) Information risk (INR) refers to the possibility of loss may brought by information unsymmetrical or falsehood information. It can be divided into three parts:
 - R51: Unable to obtain the specialist's consultation and explanation;
 - R52: Unable to judge the reliability of description about commodity and service provided by the online shop;
 - R53: Unable to confirm the validity of other information.
- (6) Social contact risk (SCR) refers to the possibility of online shopping may bring influence to the consumer's normal human social relations. It can be divided into:
 - R61: Individual information exposition risk;
 - R62: Individual prestige and the social position impair.
- (7) Health risk (HER) refers to the possibility of physically or psychologically health impair brought by on-line shopping. It can be divided into:
 - R71: The physically health risk;
 - R72: The psychologically health risk.

2.3 Online Shopping Relevant Elements

There are many factors may influence consumer's perception about benefit and risk. In order to identify items that have influence on online consumer's decision making, we interviewed about 30 people to get a raw conclusion before we started to construct models and design questionnaire. Persons in the pre-test we interviewed have certain knowledge of computer and internet, and also have experience of browsing commodity or have shopping experiences online. We asked their opinions about online purchase to observe their behaviors and psychology thought. After analysis of data collected by face to face survey, we found that there are three main elements, consumer, product and website, have influences on consumers' perception during online shopping process. Furthermore, each of these three elements can be divided into several influence factors as following.

First of the elements is consumer, which is the main participant in online shopping, and obviously played an essential role regarding the shopping decision-making. When shopping online, factors may influence consumers' perception about value and risk is shown as following:

- (1) Demographic data (C1);
- (2) Degree of involved in internet (C2);
- (3) Personal characteristic (C3);
- (4) Online shopping experience (C4) (Forsythe and Shi, 2003);
- (5) Degree of product cognition (C5);
- (6) Degree of involved in on-line shopping (C6).

The second one is product, which is the object of online shopping. The product characteristic determined whether it is suitable for online purchase. In other words, commodity itself will influence consumers' perception and will influence their online shopping decision (Peterson, Balasubramanian and Bronnenberg, 1997). There are several factors related with product have influence on consumer's perceptions:

- (1) Standardization (P1)(Dawar and Parker,1994; Peter and Ryan,1976; Cheng and He, 2003);
- (2) Price level (P2)(Covaleski,1997);
- (3) Seller's reputation and credit(P3);
- (4) Information reliability of Commodity (P4);
- (5) Region characteristic of Commodity (P5).

The last element is website, which is the business intermediary platform. The role of website is an intermediary agent in the process of online shopping. Some research results have shown that the website reputation, design style and other contents will have great influence on customer's purchase possibility(McKnight, Choudhury and Kacmar, 2003; Kaynama, Black and Keesling, 2003; Cox, Dale, 2002). Here, we consider website characteristics including following parts:

- (1) Rationality of website designs (W1);
- (2) Website's business security (W2) (Bhatnagar, Misra and Rao, 2000);
- (3) Convenience of transaction on the website (W3).

2.4 Online Shopping Conceptual Model

Based on above analysis, we can conclude all the factors together, and estimate their effect to the next variables. A conceptual model of online shopping decision making which describes all the hypotheses is presented in figure 1.

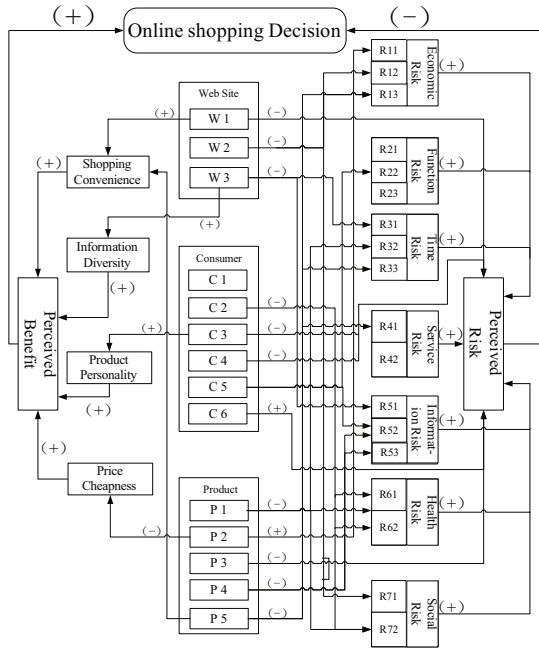


Fig. 1. Concept Model of Online Shopping Decision-making

In addition, we can suppose a more concrete formula of consumer’s online shopping decision possibility:

$$DP = \frac{WeightB * \sum_{i=1}^n (WB_i * B_i)}{WeightR * \sum_{j=1}^m (WR_j * R_j)}$$

With the condition $\sum WB_i=1$ and $\sum WR_j=1$.

Where *DP* is the possibility of consumer’s online purchase decision; *WeightB* is adjustment weight of perceived benefit, and *WeightR* is adjustment weight of perceived risk; *WB_i* is adjustment weight of *i*th perceived benefit, where *n*=4; *WR_j* is adjustment weight of *j*th perceived risk, where *m*=7.

3 Research Design and Methodology

3.1 Data Employed

The model was estimated on data collected from both online volunteer respondents and offline survey questionnaires with more than 200 samples from web and more than 100 from offline. After delete the answers with missing data, the number of final effective samples is more than 200 in total.

The survey questionnaire had four different sections. The first section is an overview of the respondent's online shopping experience, with the questions about their time and frequency of online shopping, their evaluation on the past experience of online shopping, their intention to purchase online again, their personal view on perceived benefit and risk of online shopping, and the possibility of purchase again based on the value and risk. Some studies have shown that both internet experience and a fast internet connection have a positive effect on online shopping (Farag, Krizek and Dijst, 2006).

In the second section, the respondents were asked about their worries during online shopping process, which including all the risks we have talked about above, and the measures comprise Likert-type statements, measured on five-point scales ranging from (1) "strongly disagree" to (5) "strongly agree".

In the third section, the factors including those characteristics of products and website which influence the consumers' decision during the process of purchasing online are asked, such as the degree of standardization, the price of the products, the brand or the reputation of the products, the credit of the seller, and so on. The measures also comprise Likert-type statements, measured on five-point scales ranging from (1) "strongly disagree" to (5) "strongly agree".

The last section contains several demographic questions about the inquired people, such as gender, age, education, career, income per month. Empirical studies indicated that men, the more highly educated, the higher income groups are more likely to buy online than the others which are women, the less well educated, and the lower income groups (Forsythe, et al, 2003).

The demographic profile of respondents indicates that males made up 56.9%, which was slightly higher than woman. The respondents were predominantly young, with 93.1% of them in the age group of 20–39 years and the majority is in their twenties. Most of the respondents are highly educated with 75.5% of them attaining at least a diploma or other higher qualifications.

4 Structural Equation Modeling

In this study, structural equation modeling (SEM) with AMOS is used to test and analyze proposed hypotheses. Based on the fact that the concept model which we proposed above is very complex for further analysis, we decompose it into several simple models, and new hypotheses are proposed.

4.1 Model 1 and Data Analysis

The first model contains three main factors: perceived benefit, perceived risk, and online shopping possibility. There are two hypotheses in this model shown in Figure 1.

Hypothesis 1: Perceived benefit will be positively correlated with the possibility of consumer’s online shopping decision.

Hypothesis 2: Perceived risk will be negatively correlated with the possibility of consumer’s online shopping decision.

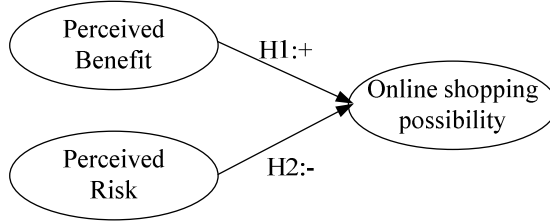


Fig. 2. Model 1

We test all the data including online survey and offline questionnaires with a total number of 275 samples, and the variables’ means, standard deviations and correlations are shown in Table 1.

Table 1. Means, Standard Deviations and Correlations*

Variables	Mean	s.d.	1	2
Perceived benefit	5.07	2.76		
Perceived risk	4.85	2.63	.31**	
Online shopping possibility	5.41	3.10	.65**	.27**

*. Listwise N=275; **. Correlation is significant at the 0.01 level (2-tailed).

The result reported in Table 2 demonstrates a statistically significant pattern between every two variables among perceived benefit, perceived risk and online shopping possibility. A regressive analysis is used to find out the effect on online shopping possibility bought by perceived benefit and perceived risk. At first, we use the original data collected from survey and then we get the reciprocal of perceived risk and multiply 10, and then we use the new perceived risk to do the same regressive analysis. Table 2 gives regression analysis result.

The result reported in Table 2 demonstrates that the model with new PR is better fit than the original one. Therefore, it proves that perceived risk is not simply direct related to consumer’s online shopping intention, but related it as a reciprocal form.

Table 2. Result of Regression Analysis of Model 1

Independent Variable		Online shopping possibility		
		β	Sig.	R ²
Step 1	PB	.075***	.000	.426
	PR	.626	.120	
Step 2	PB	.538***	.000	.321
	PRnew ^a	-.106*	.049	

*. Correlation is significant at the 0.5 level (2-tailed). ***. Correlation is significant at the 0.001 level (2-tailed).

a. PRnew=10/PR.

4.2 Model 2 and Data Analysis

Compare to perceived benefit, perceived risk is much more complicated and with too much dimensions. As a result, the conceptual model is not fit very well. Thus, we need to reduce the dimensions in the conceptual model, especially in the perceived risk.

According to the data collected in the survey, we construct Model 2 with ten perceived risk factors and consumer's online shopping intention as shown in figure 3.

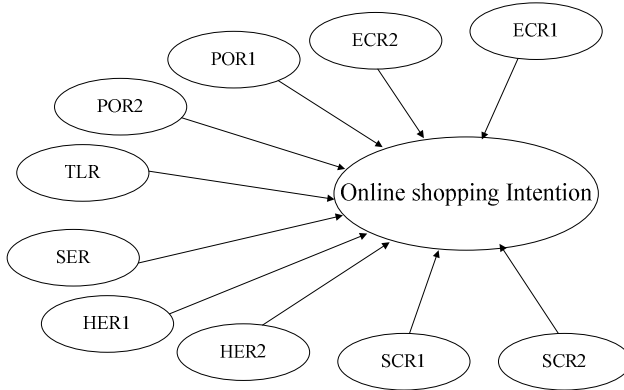


Fig. 3. Model 2

In order to reduce dimensions of perceived risk, a factor analysis is taken to find the similarity of different items. The correlations between every two perceived risk in those ten factors are tested before the factor analysis procedure, and relative results are presented in Table 3.

Table 3. Means, Standard Deviations, and Correlations^a

Variables	Mean	s.d.	ECR1	ECR2	PFR1	PFR2	TLR	SER	HER1	HER2	SCR1
ECR1	2.77	1.19									
ECR2	2.94	1.28	.49**								
PFR1	3.39	1.19	.49**	.57**							
PFR2	3.29	1.243	.38**	.55**	.63**						
TLR	3.05	1.10	.43**	.50**	.43**	.49**					
SER	3.49	1.21	.41**	.51**	.56**	.70**	.46**				
HER1	2.77	1.18	.28**	.42**	.40**	.26**	.44**	.30**			
HER2	2.61	1.08	.38**	.45**	.40**	.33**	.47**	.36**	.60**		
SCR1	3.15	1.21	.37**	.44**	.46**	.55**	.37**	.59**	.47**	.41**	
SCR2	2.46	1.19	0.12	.16*	.06	-0.03	.30**	-0.02	.50**	.47**	.29**

** . Correlation is significant at the 0.01 level (2-tailed). * . Correlation is significant at the 0.05 level (2-tailed).

a. Listwise N=190.

Then, with the help of factor analysis, a new segment of perceived risk can be made. The result is shown in Table 4.

Table 4. Rotated Component Matrix^a

	Component	
	1	2
PFR2	.864	.004
SER	.841	.044
PFR1	.788	.159
ECR2	.715	.292
SCR1	.624	.376
ECR1	.613	.217
TLR	.567	.445
SCR2	-.119	.872
HER1	.305	.776
HER2	.370	.729

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

The result reported in Table 3 suggests the first 7 items can combine together into a new factor, and the other 3 ones can be another new factor. Eventually, we find an acceptable method to distinguish items by classify them into material level and mentally level. Those items in material level are exterior and superficial, which can be recognized more easily during the Online shopping process. Moreover, the material level items are usually scaled by some units of measure, such as money, time, etc. The other new factor which we define as mentally level is more concern about the emotional and psychology part of a person, which is difficult to be recognized and measured.

4.3 Model 3 and Data Analysis

According to the result of factor analysis, we can decompose all the dimensions and reform them into two segments, material level and mentally level. Therefore, we separate the conceptual model into two detached simplified models, as shown in figure 4

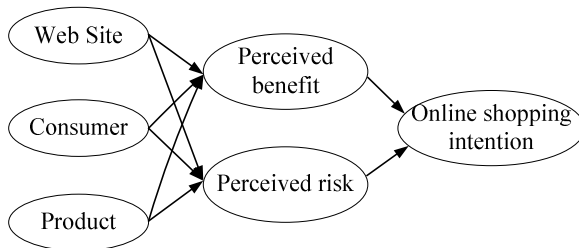


Fig. 4. Simplified Model 1

and figure 5. Then, we develop a new model of consumer's Online shopping decision making with these two detached models, which is shown in figure 6.

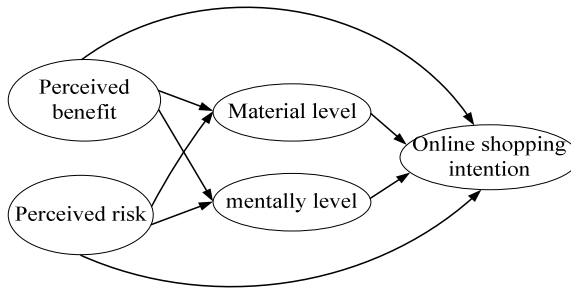


Fig. 5. Simplified Model 2

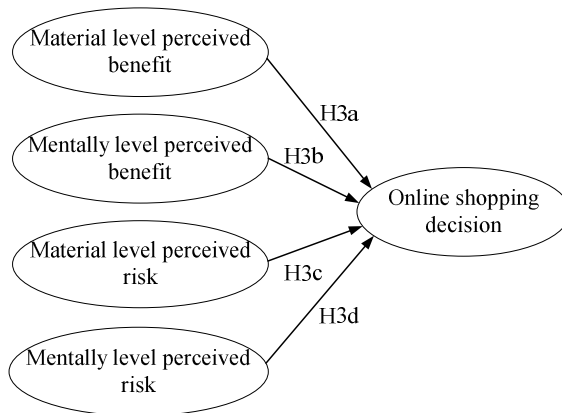


Fig. 6. Model of consumer's Online Shopping Decision Making

Based on the new model of consumer's Online shopping decision making, we generate new hypotheses related with it as following:

Hypothesis 3a: Perceived benefit in material level has a positive effect on Online shopping decision.

Hypothesis 3b: Perceived benefit in mentally level has a positive effect on Online shopping decision.

Hypothesis 3c: Perceived risk in material level has a negative effect on Online shopping decision.

Hypothesis 3d: Perceived risk in mentally level has a negative effect on Online shopping decision.

We choose perceived risk and Online shopping decision as an example to examine the validity of this method as shown in figure 7.

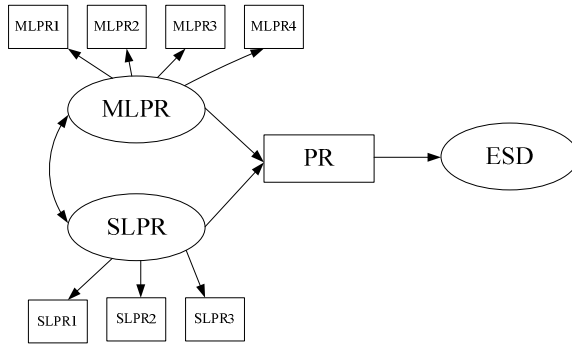


Fig. 7. Perceived Risk and Online Shopping Decision

Shown in Table 2, χ^2 index ($\chi^2=97.805$; $df=32$; $p<0.000$) indicates that our model fit the data. RMSEA, which is based on the concept of non-centrality, is reported at 0.083, and a little higher than the recommended cut-off level of 0.08. The other fit measures indicate that the proposed research model is reasonably acceptable to assess the research results as shown in Table 5.

Table 5. Fit Measure for the Model

CMIN	DF	CFI	NFI	IFI	RMSEA
97.805	32	.944	.921	.945	.083

5 Conclusion and Implication

This paper proposed a conceptual model of consumer’s Online shopping decision making process, and tested its validity with data collected by both web survey and offline interview. Some conclusions about online shopping stage were achieved.

Firstly, besides perceived risk, perceived benefit also have significant influence on consumer’s online shopping intentions. What’s more, the assumption proposed was proved by the model test, which is, perceived risk is not simply direct related to consumer’s online shopping intention, but related it as a reciprocal form.

Secondly, according to the result of factor analysis, we decompose all the dimensions into two segments, material level and mentally level in order to reduce the dimensions in the conceptual model, and reconstruct the model.

Thirdly, we split the perceived benefit and risk related to web site, product and consumer into material level and mentally level. New model was estimated with SEM by using AMOS. The result indicates that the proposed research model is acceptable to assess the research results, which proves the validity of our hypotheses in model 3.

However, the paper has many limitations. The amount of samples in the experiment is a little small compare to the other empirical researches with thousands results of questionnaires, and the variety of samples is not plentiful enough based on the number of samples, thus, more data and test should be undertaken in the future research.

Acknowledgements

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Generation Gap and the Impact of the Web on Goods Quality Perceptions

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Abstract. This study explores how age and general online shopping experience affect consumer perceptions on product quality uncertainty. Using the survey data collected from 549 consumers, we investigated how they perceive the uncertainty of product quality on six search, experience and credence goods. The ANOVA results show that age and the Web shopping experience of consumers are significant factors. A generation gap is indeed seen for all but one experience good. Web shopping experience is not a significant factor for search goods but is for experience and credence goods. There is an interaction effect between age and Web shopping experience for one credence good. Implications of these results are discussed.

Keywords: Online shopping, generation gap, product quality perceptions, search goods, experience goods, credence goods.

1 Introduction

Conventional wisdom is that teens and young adults shop online the most because they are very familiar with the Internet and mobile equipment. Older generation probably do not shop online as much because they are less familiar with computers and the Internet. Thus, the older generations shy away from online shopping more than the younger generations.

But, several recent surveys indicate that this may not be the case. For example, according to a survey by Pew Research (Jones 2009), though older generations use the Internet less for socializing and entertainment, they do use it more as a tool for information searches, emailing, and buying products. In addition, now both young and old equally pursue video downloads, online travel reservations, and work-related research. Another survey conducted by University of Southern California found that older Americans have equal or even more enthusiasm towards Web 2.0 than their younger, more tech-savvy counterparts (USC 2008). The same survey indicates that while instant messaging and video downloading still remain more popular with the younger generations, older Americans check the Internet more frequently for news. The older generations are logging onto online communities, researching purchases,

becoming socially active and playing games in increasing numbers(USC 2008). Also a survey by a UK-based media company in December 2008 found that there were no significant differences between younger and older generations in terms of their general shopping behavior and concerns about online fraud (NWA 2009).

The older generation might be slow in learning new technologies and might be disadvantaged in learning how to use the Web when compared to the younger counterparts. On a second thought, however, most people realize that the older generations do have more shopping experience, even though most of such experiences are rooted in the traditional environment. Yet such experiences may actually give them an edge in evaluating and purchasing products or services on the Web.

Thus the reality of online shopping by different age groups may be more complex than a simple dyad of young and old. It is possible that both groups have their advantages and disadvantages when shopping online. Their behavior and preference in online shopping might also be different because of their accumulated shopping experience in Main Street. The same survey by Pew Research found that, in terms of online shopping, instead of a downward linear trend with age, interest in online shopping is significantly lower among both the youngest and oldest groups – “38% of online teens buy products online, as do 56% of internet users ages 64-72 and 47% of internet users age 73 and older.” – and significantly higher among those in the medium range, with 80% for age 33-44 and 71% for age 18-32 (Jones 2009).

In addition to age, other factors like familiarity with Web and previous purchasing experience also influence an individual’s perception of goods. These other factors might interact with age to have a combined influence. This phenomenon calls for more elaborated explanation of age impact in one’s evaluation of products and services in online environment as well as its interaction with one’s online shopping experience. In this study, we explore this research question in the search, experience, and credence goods or SEC framework.

The remainder of this paper is arranged as follows. First, we give a brief literature review of previous studies on age groups and online shopping as well as SEC framework. Then we explain our survey-based empirical design as well as survey outcomes. Finally, we analyze the results and give our conclusion.

2 Previous Studies and Hypothesis

2.1 Search, Experience, and Credence Goods Perception

One major difference between Online and Main Street shopping is how consumers evaluate products and services in these two environments.

Since the birth of market, consumers are used to conducting shopping in an environment where they can inspect the goods directly and converse with the sellers or service providers face to face. And depending on at which point consumers can evaluate the quality of the goods, we can classify goods into three categories: search, experience, and credence (Darby et al. 1973; Nelson 1970, 1974). Search goods are those that consumers can evaluate the quality before the purchase. Experience goods are those consumers can evaluate the quality right after the purchase when such goods being consumed or serviced. Credence goods are those consumers can not evaluate the quality of them even a long time after the purchase. Thus, the SEC framework is

based on the classification of goods into these three categories. For each category, we see different advertising and promotion strategies for sellers and shopping behaviors for buyers. The SEC framework is a proven framework for over 30 years. It has been widely adopted in the advertising industry as well as used in consumer behavior research (Ekelund et al. 1995).

With the growing popularity of World Wide Web starting in 1994, a new online shopping environment became part of our daily life (Alba et al. 1997). In this new online environment, no goods can be inspected directly and only limited interactions with service providers are possible. Thus, we expect consumers have to leverage their prior shopping experiences and transform them into useful information for the online environment (Klein 1998). For the younger generations, they have limited shopping experience but using those shopping tools to leverage their existing shopping experience is their advantage. For older generation, while the leveraging adaptation process is longer, their rich shopping experiences give them advantages too. Thus, through the lens of SEC framework, we expect online shoppers may perceive the same product or service with different SEC ratings because of age gap.

2.2 Contributing Factors and Hypothesis

There are many factors that might influence one's perception of a good in the SEC framework. In the online environment, such factors may be *age*, *gender*, *Web shopping experiences*, *Web search experience*, and *prior purchase experience for the same goods*.

The generation gap seems to exist in the perception of goods for online shopping because of the different level of general shopping experiences accumulated through the years. Several studies on demographics, attitude and behaviors of online shoppers confirm this. One of the earlier studies (Bhatnagar et al. 2000), examining why some consumers become online shoppers while others do not, find out that age, years of using the Web, and gender affect purchase risk perceptions differently. A more recent study that examines the demographic factors like age, gender, income and location on online shopping found these factors influence online purchase frequency and expenditures (Chang et al. 2004). The study does not drill down to purchase frequency and expenditures by products.

Like age, gender is another important factor in explaining many differences in consumers' shopping behaviors and perception of goods. However, it seems this is not the case in online environment. A research study by Stafford et al. (Stafford et al. 2004) examine online shopping behaviors from international and cross-cultural perspectives. They find gender has no significant influence on shopping behavior. They also explore if older consumers are less likely to shop online regardless of country origin and find that the age group 25-34 is the most active online shopping group. The level of online shopping in this age group is statistically different from that of age group 18-24. The other age groups have similar levels of online shopping involvement. Similar findings from mobile commerce research find that younger consumers are more predisposed to use the mobile equipment as a shopping channel (Bigne et al. 2005). Gender and social class are not significant factors for mobile commerce adoption.

As mentioned previously, depending on when a consumer can confidently evaluate the quality of a product or service, that product or service can be categorized as a

search, experience, or credence good. However, such rating is mostly depending on an individual's previous purchase and usage experience, especially for experience and credence goods. Compared with the same product or service, an older consumer who has purchased and used a product or service before may regard it less as credence or experience good than a younger consumer who has no prior experience with it. We expect such differences also exist in the online shopping environment. Thus, we have our first hypothesis:

H1: Different age groups of online shoppers will evaluate the SEC rating for the same goods differently.

Based on existing research of the gender impact on goods perception in online shopping, we have following hypothesis:

H2: The gender of online shoppers does not affect the evaluation of the SEC rating for the same goods.

Web shopping experience, including using various Web-based decision support tools to conduct the searching, comparing, and analyzing products and services in the online environment, also plays an important role in the perception and evaluation of goods on the Web. Though some studies (Dennis et al. 2002; Udo et al. 2001) assume that younger people are "more Web-literate than older age groups" (Dennis et al. 2002), one research finds that young consumers with more Web shopping experience have a more positive attitude towards Web shopping than those without it (Dillon et al. 2004). The study implies that Web shopping experience begets a more positive stance towards Web shopping and that younger shoppers tend to embrace a non-traditional shopping channel, like the Web, more receptively than older shoppers.

Experience in using online information searching may also influence the perception of goods in online shopping. Sorce et al. (2005) report that older generations actually purchase more on the Web than the younger generations whereas older Web shoppers search significantly fewer products than did younger shoppers. This suggests that probably older Web shoppers have more experience for purchase decisions, needing less Web search for each purchase decision. Another research (Bigne et al. 2005) indicates that the Web shopping experience has a positive influence on adopting m-commerce.

Since online shopping is a relatively new shopping mode and is still less than 15% of the U.S. retailing market, we expect that the extent to which an online shopper benefits from online shopping is still highly influenced by that shopper's Web purchasing experience and online search skills. That is, the Web is still a new shopping environment where most online shoppers still need to learn how to use it effectively.

Thus, compared to a shopper with little or no Web shopping experience and few online information searching skills, a Web savvy shopper may rate credence goods more like experience goods and experience goods more like a search goods in the online environment. So we have our third and fourth hypotheses:

H3: Shoppers assess the SEC classification of the same goods differently based on their level of Web shopping experience.

H4: Shoppers assess the SEC classification of the same goods differently based on their level of online search engine experience.

Finally, when someone has prior experience purchasing a product or service, that shopper accumulates more experience about this "good" with each additional purchase.

Thus, one can change their future perception of this good. This experience accumulation can come from either online or Main Street purchases. Thus we have the last hypothesis:

H5: Shoppers give the same good a different SEC classification based on their level of prior purchasing experience with that good.

Now we have explained all our hypotheses. In the next section, we explain the design of our experiment to verify these hypotheses.

3 Research Design

We used online survey questionnaires to verify our hypotheses. Six goods were selected in this experiment as representative SEC goods, two in each category. We selected mostly common goods whose purchases are relatively neutral to age, gender, income and ethnic groups.

- Search goods are *PCs* and *bestselling books* (Ekelund et al. 1995; Girard et al. 2003, 2002; Hoskins et al. 2004).
- Experience goods are *cell phones* and *cars* (Girard et al. 2002; Iacobucci 1992; Nelson 1970).
- Credence goods are *vitamins* and *auto insurance* (Chiu et al. 2005; Girard et al. 2002; von Ungern-Sternberg 2004).

We have three scenarios for examining the influence of shopping contexts. In the first scenario, shoppers can only shop online for the above six items (“Web Only”). In the second scenario, they cannot use the Web for shopping at all (“No Web”). In the third scenario, consumers can shop using any means – whether using the Web or not (“No Restriction”).

In each scenario, there are two survey sections. The first section solicits subject’s age, gender, Web shopping experience, and web search experience.

In the second section, respondents identified the SEC category for the six selected items. We used the same survey instrument as Iacobucci (1992) and asked respondents to rate items in their respective SEC category by using a 7-point Likert scale on a single item construct. That is, we asked the respondent to evaluate if the quality of an item “could be assessed prior to purchase” (search), “could be evaluated only after purchase” (experience), or “would be difficult evaluate even after trial” (credence). And similar ratings were conducted in all three scenarios.

For each of the six goods, we asked if the subject had purchased it from the Web or Main Street before, the frequency of purchases, and the ratio of purchases between online vs. Main Street.

After a pilot study with students from two Midwest and Southwest universities, we made improvements on wordings. We then recruited subjects from general population by using online forums and sites like Craigslist. A modest Amazon.com gift certificate was used as an incentive for participation.

Altogether this study got 549 valid completed questionnaires. We removed the questionnaire when its data set is incomplete or invalid (e.g., entering the first choice for all the questions). For the valid questionnaires, 52.4% are male, and 47.6% are female. All these indicate a largely balanced sample of the general population.

4 Data Analysis and Findings

We set the minimal age group sample size to $n \geq 30$, since we want to compare the means of the dependent variable for three scenarios within each age group. So “the age 60 or over” is removed from the analyses due to its small sample size ($n = 16$). We use factorial ANOVA models with the SEC rating as the dependent variable and the following items as control variables or factors: three-scenario treatments, age, gender, web shopping experience, Web search experience, and online shopping frequency of the product. Only age and Web shopping experience turned out to be significant control variables.

In other words, gender, web search experience, and online shopping and frequency of the product have no significant impact on the SEC ratings by online shoppers. Thus, Hypothesis 2 is supported. And Hypotheses 4 and 5 are not supported. For Hypotheses 1 and 3, the results of factorial ANOVA models (Table 1) affirmed them.

4.1 The Concave Relationship between Age and Web Shopping Experience

We find a concave relationship between age and Web shopping experience (Figure 1). Web shopping experience increases steadily from age group 18-19 to 40-49. This is probably due to patterns in income levels and family/life style. Web shopping experience peaks at 40-49, and then it declines.

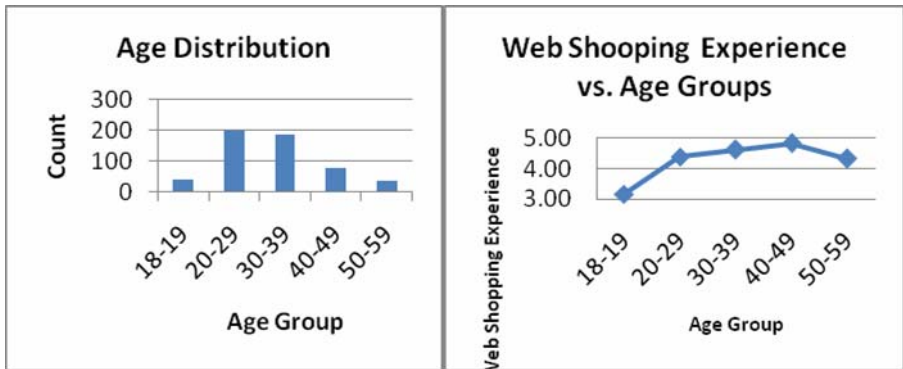


Fig. 1. Web Shopping Experience and Age Group

This pattern parallels that of consumer spending figure by age in the Consumer Expenditure Survey of the U.S. Bureau of Labor Statistics (see: <http://www.bls.gov/cex/2007/Standard/age.pdf>).

4.2 The SEC Ratings of the 6 Products by Age Groups

By closely examining the individual goods, we found that H1 is supported for all goods except cell phone. Specifically, PC’s SEC rating is higher for age 30-39 than for age 50-59. Bestselling book’s SEC rating is higher for age 20-29 than for age

40-49. Car’s SEC rating is higher for age groups 18-19, 20-29 and 30-39 than for age 40-49. Auto insurance’s SEC rating is higher for age 20-29 than for age 30-39 and 40-49.

While statistically not significant, the charts on SEC ratings vs. age groups show as follows (Figure 2). For cell phones, the SEC ratings of Web-only group of age 40-49 is more than a 0.5 point lower than those of the no-Web and no-restriction groups of the same age. For cars, the SEC rating of Web-only group of age 18-19 is 0.75 point lower than those of the no-Web and no-restriction groups of the same age. In the credence goods category, for vitamins, the SEC ratings of the Web-only group are much lower (by .8 to 1.3) than those of the no-Web group among age groups 18-19 and 40-49. For auto insurance, the SEC ratings of the Web-only group are lower by .5 to 1.0 point than those of the no-Web group among age groups 40 or above.

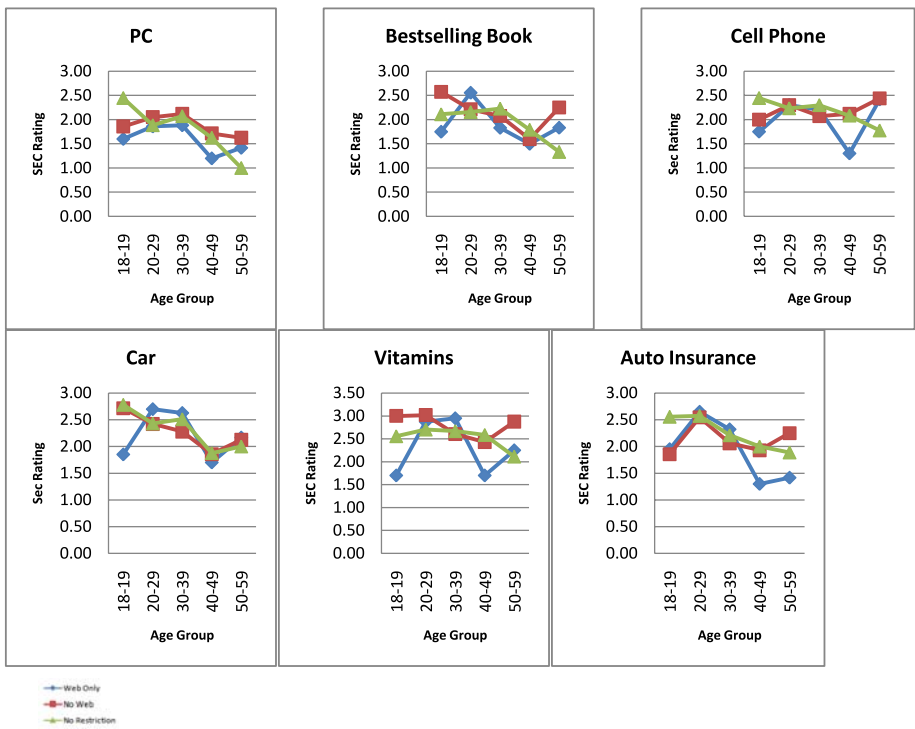


Fig. 2. Age Group and SEC ratings

4.3 Web Shopping Experience

Upon further examination of the age variable, we find that H3 is supported for experience and credence goods but not for search goods (PCs and bestselling books). In the experience goods category, we find that, for cell phones, shoppers with less Web shopping experience generally give higher SEC ratings. There is a statistically significant difference between the shoppers with the least Web shopping experience and those with the most Web shopping experience. For cars, similar results are seen.

The shoppers with the most Web shopping experience have statistically lower SEC ratings than the shoppers with the modest Web shopping experience. For credence goods like vitamins and auto insurance, the shoppers with the most Web shopping experience have lower SEC ratings compared with the shoppers that have less Web shopping experience.

4.4 The Interaction Effect of Age and Web Shopping Experience

Since both age and Web shopping experience have significant impacts on SEC ratings, their interaction effect may also influence. It is possible that the SEC ratings for the same goods are rated differently in their SEC category by consumers with a combination of age and Web shopping experience. Specifically, older generation with more Web shopping experience rate credence, experience, and search goods more towards experience and search goods compared with other combinations. Through our analysis, we found this is supported for search and credence goods, but mixed for experience goods.

Age impacts the SEC ratings only for search goods. For experience goods, car’s SEC ratings are affected by age and Web shopping experience. However, cell phone’s SEC ratings are affected only by Web shopping experience. Both age and Web shopping experience impact the SEC ratings of credence goods. The summary of ANOVA with post-hoc tests are as follows (Table 1).

Table 1. SEC ratings by age group, Web shopping experience and their interactions

Product	Significant factors for SEC rating
PC	age** (30-39 vs. 50-59*)
Bestselling book	age*** (20-29 vs. 40-49***)
Cell phone	web shop experience** (slightly above novice vs. expert web shoppers*)
Car	age*** (18-19 vs. 40-49**, 20-29 vs. 40-49***, 30-39 vs. 40-49***) web shop experience*** (moderate vs. expert web shoppers***)
Vitamins	age* (no between-age group significance) web shop experience** (occasional vs. moderate web shoppers***, moderate vs. expert web shoppers***)
Auto insurance	age*** (20-29 vs. 40-49***, 30-39 vs. 40-49*) web shop experience** (moderate vs. expert web shoppers**) interaction between age and web shop experience*

*: $\alpha = .10$, **: $\alpha = .05$, ***: $\alpha = .01$.

5 Implications

There are several important implications from this research.

First, we find that the more Web shopping experience an individual has, the less one feels uncertain about product quality regardless of age. This indicates that the traditional SEC classification for goods and its directive function on advertising maybe limited by an individual’s Web shopping experience. For younger generation, though they have less shopping experience that can be used to evaluate products and

services, their relatively rich Web shopping experience may compensate this limitation.

Second, even controlling for Web shopping experience, the age gap exists regarding how uncertain consumers feel about product quality. As indicated previously, age group 40-49 seems benefit most from their past Web shopping experience because they have an optimal combination of long enough Main Street and Web shopping experience. Their Main Street shopping experiences came from their accumulation through the ages. They are also the first generation that has both the income and opportunity to be familiar with the Internet and the Web as well as conducting online shopping. Thus, they have the comparatively best combined advantage. Their perception of goods, which is reflected in SEC ratings, is also significantly lower for most item categories in the experiment.

Third, the impact of online shoppers' age and Web shopping experience are different on search, experience, and credence goods. The evaluation of credence goods probably requires both cumulative (long-term) Web shopping experience and Main Street experience (age) to lower product quality uncertainty. This indicates age and Web-shopping experience are both very important to reduce the evaluation barrier for online shoppers. The SEC ratings of search goods, on the other hand, are more sensitive to age. It is a bit surprising to know that the SEC ratings are not affected by prior purchase experience for a specific product or service. This could be the easy access of product or service review information on the Web – since an individual could always depend on others' experience retried by electronic decision aids like comparison-shopping agents.

6 Conclusion

The generation gap exists in many shopping scenarios. This research explored the age gap in the perception of goods in search, experience, and credence goods, or the SEC framework, specifically for the online shopping environment. We find that age and Web shopping experience, and in some cases, their interaction, have significant influence on online shoppers' perception of search, experience and credence goods. Even controlling Web shopping experience, we found the effect of generation gap on how consumers feel about product quality. Web shopping experience and senior age can reduce the uncertainty towards credence goods while the perception of search goods are only sensitive to age. We believe these findings will have important implications for future research on the SEC framework in the online environment.

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How the Website Usability Elements Impact Performance

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Abstract. This research builds on the results of a large scale study in which participants performed an informational task on one of 59 websites spanning various industries to examine how the website usability elements (graphical attractiveness, information, interactivity, trust, and ease of use) drive users' attitudes and intentions toward the website and how these effects vary according to site experience and end product tangibility. Results show that while the effects of site interactivity and graphical attractiveness were more influential for services sites, the effects of site information and trust were stronger for tangibles sites. Alternatively, compared to returning site visitors, first-time visitors perceived the website as less easy to use, needed more time to accomplish the online task, and based positive attitudes and intentions more strongly on the site information and interactivity. The results of a second study performed in a proximate culture largely corroborate these findings.

Keywords: Website usability, website experience, product tangibility, usability elements, electronic commerce, cultural research.

1 Introduction

Websites with the fastest learning curves receive more visits and realize better business results by achieving higher levels of customer lock-in (Johnson, Bellman, and Lohse, 2003). Focusing on the process of customer lock-in, Zauberan (2003) highlights that learning and using the website increases switching costs and suggests that customers are not aware of the mechanism that lock them in. Alternatively, research in general affirms the focal role of ease-of-use on the decision to learn and use technology applications (Davis, 1989; Nielsen, 2000). Controlling for extrinsic factors such as perceived usefulness and company-related factors, a website that is easier to learn and to use (Nielsen, 2000) and delivers a "compelling" experience (Novak, Hoffman, and Yung, 2000) motivates visitors to use and return to the website. Nonetheless, need still exists for research that carefully evaluates the parameters that render the IT artifact useful, easy to use, and hence successful (Benbasat and Barki, 2005) and examines the relationships between usability elements and users' attitudes and behaviors toward the IT artifact (Benbasat and Barki, 2007). Indeed, little research investigates the role played by the website usability elements on performance while considering the role of user site experience and the end product the site offers

(Venkatesh and Agarwal, 2006). That is, how do different usability elements affect consumers' attitudes and behavioral intentions toward the website? And do these effects change according to customer site experience or the end product the site offers? This research addresses these questions by developing and testing a set of hypotheses in two proximate cultures (English vs. French-speaking Canadians).

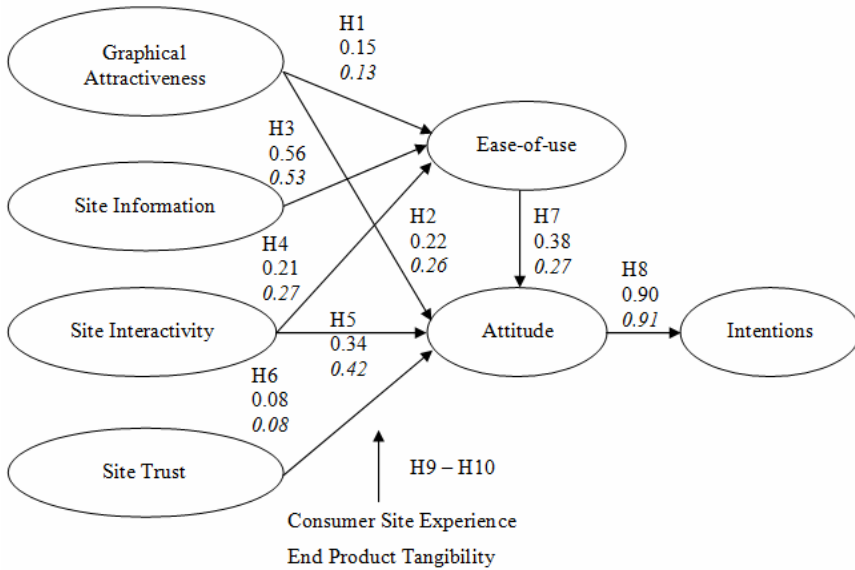
2 Literature and Hypotheses

Researchers developed measures for website usability and found that sites with better usability and quality perceptions deliver the highest performance (Lee and Kozar, 2006). Poddar, Donthu, and Wei (2006) cite a lack of research in the field and find purchase intentions to emanate from site quality. The role of the site usability captured by its different elements (site graphical design, information, interactivity, trust, and ease-of-use) in driving users' attitude and intentions is examined in this work. According to the Theory of Reasoned Actions TRA (Fishbein and Ajzen, 1975), usability elements as perceived by customers should have a formative role on consumer beliefs and attitude toward the website; attitude, in turn, is a major driver of behavioral intentions. This research additionally postulates that the latter effects will be influenced (moderated) by both the user level of site experience as well as the site's end product tangibility (services vs. tangibles). The following discusses these usability elements and their expected impact on attitude and intentions.

Site Graphical Attractiveness. To enjoy an experience, consumers seek sensations on multiple sensory channels (Holbrook and Hirschman, 1982). Graphical attractiveness is affected by the site templates, animated images, colors and associated themes. Enhanced by multimedia content and colors, site design and creativity form one site quality dimension (Yoo and Donthu, 2001). Graphical design affects ease-of-use in different ways; for example, design professionals consider images to be stepping stones that help the eye jump between textual elements (Garcia, 1993). Images encourage reading and enhance the comprehension of accompanied textual materials (Wolf and Grotta, 1985). Colors also play a role in site usability. While the artistry of a wallpaper design is acknowledged, a solid background color is generally recommended to enhance usability (Garcia, 1993). Certain colors were found to improve perceived download quickness as well as satisfaction by inducing relaxed feelings (Gorn et al. 2004). Visually attractive systems score higher on ease-of-use (van der Heijden, 2004). (see Figure 1 for a schematic representation of research hypotheses).

Hypothesis 1. Site graphical attractiveness associates positively with ease-of-use.

Bart et al. (2005) find site presentation and navigation experience to strongly predict intentions (to purchase and recommend the site to others). The website graphical attractiveness and appeal shape consumers' behavior by reducing purchase risk and conveying a trustworthy dealer (Schlosser, White, and Lloyd, 2006). A significant relation between design elements and an important site success measure (site traffic) is found (Bucy et al. 1999). Poor style, flaws, and incompleteness inversely relate to behavioral intentions (Everard and Galletta, 2005; Schlosser et al. 2006). According to TRA, usability elements influence intentions by impacting attitude.



* Standardized path coefficients of the first and second study are shown (in italics for the second study)
 ** All paths are significant (smallest t-values of 8.94 and 9.02 for the models of first and second study, respectively).

Fig. 1. Research Hypothetical Model and SEM Results

Hypothesis 2. Site graphical attractiveness associates positively with attitude toward the site.

Site Information. Underlying the back-end integration of data onto the website, site information is a vital success determinant (Liu and Arnett, 2000). Research regards the construct as the quality of content offered by the website and defines it as the extent to which the information is detailed, precise, and pertinent (Nelson, Todd, and Wixom, 2005). Novak et al. (2000) indicate that information quality, site security, and easy-to-perform actions contribute to delivering a compelling experience. Site functionality, adequate product description, and security are found to enhance intentions (Francis and White, 2002). The literature hence implies a strong role for pertinent, detailed, and tailored information (Yoo and Donthu, 2001) on ease-of-use rather than attitude formation (Chang et al. 2005; Lee and Lee, 2004).

Hypothesis 3. Site information associates positively with ease-of-use.

Site Interactivity. Underpinned by the strong relationship between interactivity and personalization perceptions, interactivity is defined as “the extent to which users can participate in modifying the form and content of a mediated environment in real time” (Steuer 1992, p.84). Interactivity is also seen as the degree to which a dialogue can be generated between the consumer, the website, and the company (Sullivan, 1999). Loiacono, Watson, and Goodhue (2002) find that interactivity predicts intentions. Personalization results in richer media that help create a better virtual experience and stronger

attitude; in addition, interactivity and vividness are strong predictors of telepresence, a precursor of flow, productivity, and satisfaction (Coyle and Thorson, 2001; Mathwick and Rigdon, 2004). Interactivity and personalization also impact ease-of-use by enhancing learning capabilities (Liu and Arnett, 2000; Suh and Lee, 2005).

Hypothesis 4. Site interactivity associates positively with ease-of-use.

Interactivity elements on the website homepage are significantly related to the traffic generated by the website (Bucy et al. 1999). Hyperlinks, multimedia, discussion forums, community groups, polls, e-mail contacts, processing speed, and timely, personalized communication are elements of the website that enhances its perceived interactivity (Song and Zinkhan, 2008; Yoo and Donthu, 2001). Captured by navigation and role playing, site interactivity, along with customer service interactivity are shown to predict attitude and intentions (Schlosser and Kanfer, 2001). Personalization level is associated with interactivity and is shown to have a linear relationship with intentions (Song and Zinkhan, 2008). Personalization is also found to predict consumers' online loyalty (Srinivasan, Anderson, and Ponnayolu, 2002).

Hypothesis 5. Site interactivity associates positively with attitude toward the site.

Site Trust. Site trust is the consumers' perceptions of the level of privacy and security a website offers. Some consensus exists about considering site trust an important site feature and quality determinant (Chang et al. 2005). Wolfenbarger and Gilly (2003) find security and privacy items to form a distinct factor representing the perceived security and confidentiality of personal data on the website. Similarly, Yoo and Donthu (2001) conclude that site trust forms a unique site quality dimension and named the construct security/confidentiality of personal and financial information. Kim et al. (2003) found trust to be a distinct site quality dimension with positive correlation with attitude toward the site. Site trust is a concept that is distinct from, although can correlate to, trust in each the retailer, service employees, and general online transactions. Consumers are particularly sensitive to privacy and security because of various fears ranging from spam to online identity theft; the process of building and enhancing site trust is thus distinct from that of building dealer or employee trust (Wolfenbarger and Gilly, 2003). Consumers trust a website because of certain cues the site exhibits, such as privacy assurance, third-party seals of approval, customer referrals and testimonials (Urban, Sultan, and Qualls, 2000), as well as perceived security of transactions and certain site properties (Yoon, 2002). The literature however does not imply a relationship between trust and EOU.

Hypothesis 6. Site trust associates positively with attitude toward the site.

Site Ease of Use. Ease-of-use represents the cognitive effort needed to learn and use an application and, as discussed, is cited to have an important impact on the consumers' decision to learn, use, and revisit the website. Consumers infer ease-of-use shortly after a brief, direct interaction with the application (Venkatesh and Davis, 1996). Ease-of-use is studied from different angles (site usability in Agarwal and Venkatesh 2002, retailer site quality dimensions in Yoo and Donthu 2001, website success factors in Liu and Arnett, 2000) and is considered a salient belief in driving the application acceptance and use (Davis 1989). Research suggests that ease-of-use is crucial in driving online intentions (Moon and Kim, 2001). Venkatesh and Agarwal

(2006) show ease-of-use as a major driver of the decision to use the website across four sectors (books, auto manufacturers, car rental, and airlines). Ease-of-use is an important belief the consumer formulates based on other usability elements and the navigation experience they deliver (Davis, 1989; Fishbein and Ajzen, 1975).

Hypothesis 7a. Ease-of-use associates positively with the attitude toward the site and (b) mediates the relations between graphical attractiveness, information, and interactivity with attitude.

Attitude and Behavioral Intentions. Attitude toward the site indicates the consumers' predisposition to respond favorably or unfavorably to a website during a particular exposure (Chen and Wells, 1999). Attitude, as a construct, has received extensive coverage and validation by researchers. The characteristics of the websites and products encountered in browsing significantly influence the level of arousal and pleasure the consumer experience (Menon and Kahn, 2002). According to TRA, attitude mediates the relation between consumer beliefs about the application and intentions. Alternatively, intentions predict actual behavior (Fishbein and Ajzen, 1975). Research generally supports a strong relationship between perceptual measures of intentions and actual behavior (e.g., correlation of 0.86 between purchase intention and actual site visits in Poddar et al. 2006).

Hypothesis 8a. Attitude toward the site associates positively with behavioral intentions and (b) mediates the relation between ease-of-use and intentions.

Site Experience. Although the literature considers the level of user skills an important factor that influence online behavior (Novak et al. 2000), studies investigating the role of experience in website use and online shopping are rare and inconclusive (Chang et al. 2005). Johnson et al. (2003) postulate and found that behavior change according to consumer site visit history. These authors found that consumers spend more time on e-commerce sites during initial visits and less time in later visits. This implies that the cognitive effort associated with learning and using the site diminishes as visitors become more proficient in using the website. In a goal-oriented environment (specific task accomplishment), the time the consumer spends navigating the website can be considered an objective proxy of the cognitive effort encountered in a session. Therefore, consumers with higher levels of site experience will need less time to perform their online tasks. In addition, these consumers should perceive and report higher levels of site ease-of-use than consumers with low levels of site experience (first-time visitors).

Hypothesis 9a. Perceived ease-of-use is lower for consumers with low versus high level of site experience.

Hypothesis 9b. Task accomplishment time is higher for consumers with low versus high level of site experience.

Investigating how the level of site experience affects the relations between usability elements and performance (Figure 1) sheds light on changing consumers' needs from the website. In developing a website service quality measure, Parasuraman, Zeithaml, and Malhotra (2005) find quality determinants to vary for customers with routine versus non-routine encounters with the website. It is plausible to expect that

the impact of usability elements will vary according to site experience. Visitors with low level of site experience need more elaborate and detailed, or quality information in order to learn the site and construct their attitude and usage intentions. Alternatively, visitors with high level of site experience are expected to be affected more by site trust because trust increases with site interaction frequency (Gefen, 2000; Yoon, 2002).

Hypothesis 9c. Site experience moderates the relation between information and ease-of-use so that site information will be more influential for consumers with low level of site experience.

Hypothesis 9d. Site experience moderates the relation between trust and attitude so that site trust will be more influential for consumers with high level of site experience.

Services versus Tangibles. Tangibility is a key product characteristic that shapes consumers' information search and purchasing behavior. Theory proposes differentiating websites based on the end product tangibility level (Laroche et al. 2005; Peterson et al. 1997). Indeed, researchers stress the need to distinguish the design, management, and delivery of services from those of tangibles, and underscore the particularity and complexity of managing services along with the prominence of service customizability (Fitzsimmons and Fitzsimmons, 2004; Rust and Chung, 2006). Services criteria (intangibility and complexity) are thus postulated to extend to its communication or ordering medium—the website. Therefore, attaining tasks on services sites will require more cognitive effort, and customers will thus perceive lower levels of the website ease-of-use and spend more time on these sites compared to tangibles sites.

Hypothesis 10a. Perceived ease-of-use is lower for services than for tangibles sites; likewise, (b) task accomplishment time is higher for services than for tangibles sites.

Interactivity and personalization are particularly vital in a service setting (Song and Zenkhan, 2008). As interactivity and personalization at services shopping increase efficiency, enhance perceptions of responsiveness, and augment delivered value and satisfaction (Ball, Coelho, and Vilares, 2006; Fitzsimmons and Fitzsimmons, 2004), these elements are expected to be more salient for services sites. Alternatively, when customers search and shop for tangibles, information quality is essential as it helps form attitude by reducing perceived risk and acting as a substitute for the inability to directly observe and physically touch the product (Peck and Childers, 2003; Weathers, Sharma, and Wood, 2007).

Hypothesis 10c. End product tangibility moderates the relations of interactivity with ease-of-use and attitude so that site interactivity effects will be more influential for services than for tangibles sites.

Hypothesis 10d. End product tangibility moderates the relation of information with ease-of-use so that site information will be more influential for tangibles than for services sites.

Role of Culture. Although culture is an important contingent factor, few studies have attempted to corroborate hypotheses or investigate online cultural differences (Schepers and Wetzels, 2007). Because the premise in any research is that the supported hypotheses predict the behavior of another sample within the same as well as proximate population, the above hypotheses are expected to hold true on French-speaking customers. In

addition, culture is expected to moderate the relations between usability elements with attitude and intentions (i.e., H1 through H8).

Hypothesis 11a. Research hypotheses hold true for consumers in a proximate culture (French-speaking Canadians); additionally, (b) culture will moderate the relations between usability elements with attitude and intentions (H1 through H8).

3 Method

3.1 Data Collection, Tasks, and Measure

A nationwide study was performed in collaboration with a leading market research company in Canada. The company had a consumer panel of over 350,000 participants at the time of data collection. Data were collected in the period between September 2004 and September 2006. To reflect the studied phenomenon globally and reduce the salient effects of industry and company-related variables such as brand loyalty, site accessibility and awareness (Yoon, 2002), various industries as well as multiple websites representing different organizations were included (Table 1). Sample random selections and data collection were performed separately, for approximately two months per industry. Differences in the task to be performed in each industry necessitated the latter step. Table 1 shows the samples size, the websites examined, and the informational tasks assigned for each industry. Data sets were then compiled for analysis. For the second study (which input was used to test H11), the same steps were followed but the samples were randomly selected from a panel of French-speaking consumers (residing mainly in Canada French province, i.e., Quebec) and the task and measure were offered in French. In addition, the French version of the website was assigned and several websites active in the French regions were added (Table 1).

For each industry (task), sample selection was randomly performed following an iterative process. If a randomly selected sample showed high bias to certain consumer groups (based on gender, age, spoken language, and location), part of the selected entries were deleted and replaced by a new set of randomly selected entries. When the sample was deemed representative, the email list was used to send selected panel members an invitation to participate in the study. Response rates were close to that of previous research projects of the company (20 percent). The market research company constructs its consumer panel mainly through its website and periodically updates the panel through a set of procedures. Panel members that enter personal and contact information have a chance to win monthly monetary prizes; and their chance to win increases when participating in a study. Upon reception of the invitation email, panel members could choose to participate by clicking on the link provided. The link opened a window that contains an interactive link to the company's server. This window provided an explanation of the task to be performed and a link to the randomly assigned website.

As consumers are generally goal-oriented during their navigation at e-commerce sites (Wolfenbarger and Gilly, 2003) and as this work studies usability in goal-oriented (rather than experiential) environment, task assignment was necessary. Tasks had comparable difficulty levels, were identical within each industry, and consisted in

Table 1. Sample Size, Websites, and Tasks in the English and French Studies

Task (Industry)	English Sample	French Sample	Website/Company
Looking for the availability of a condominium at a given size and price range in a given city (Real Estate)	410	575	Century 21, Remax, Royal LePage, Sutton
Finding the principal headline in the economy section published online at time of visit (Media**)	689	609	CBC.ca, Canada.com, Canoe Money, Radio Canada*, Canoe Argent*, CyberPresse*
Finding whether the site includes entries offering a certain product (i.e., winter tires) (Classifieds)	672	547	Classified Extra, eBay, Craigs List, Occasion Buysell, LesPac*
Finding the retail price of a given dictionary (Books)	490	620	Amazon.ca, Chapters-Indigo, Archambault, Renaud-Bray
Finding the possibility to obtain a home insurance quote using the assigned site (Insurance Services**)	668	474	President’s Choice Insurance, Wawanesa, RBC Insurance, AXA Canada, ING Insurance, Belair Direct
Finding the suggested retail price of the selected car model (Auto Manufacturers)	713	352	GM Canada, Daimler-Chrysler Canada, Ford Canada, Toyota Canada, Honda Canada
Finding the civic address of the closest store (Department Stores)	748	290	The Bay, Sears, Wal-Mart, Zellers
Finding the monthly cost of the lowest priced plan offering unlimited weekends calling (Communication Service**)	617	457	Rogers, Bell Canada, Fido, Telus
Finding the brand/model of the lowest priced digital camera at a given resolution (Electronics)	526	484	Future Shop, Best Buy, The Brick, Dumoulin, The Source (Circuit City)
Finding the interest rate for a one-year fixed rate mortgage (Banking**)	553	461	Toronto Dominion, Desjardins, ING Direct, Scotia Bank, RBC, CIBC, Bank of Montreal, National Bank
Finding the lowest price of a certain tool (Home Renovation)	586	448	Canadian Tire, Home Hardware, Home Depot, Rona
Finding the airfare cost for two adults to a specific destination at a given departure and return dates (Travel**)	581	505	Expedia.com, Travelocity.ca, Destina.ca, Exitravel.com

* denotes the websites that was added in the French study; ** denotes industries with intangible end product (i.e., services).

finding a piece of information on the assigned website (see Table 1 for tasks). Another purpose of assigning a specific task was to ensure sufficient interaction with the website, hence better control and variable measurement. After completing the task (one task on one website per participant, i.e., between-subject), participants returned to the window to click the continue button, which started the questionnaire. When participants submitted their questionnaires, data were coded automatically and saved. Compiling the data sets of the twelve industries (tasks) resulted in a final sample of 7,253 responses used in the analysis (and 5,882 responses for the second study used in testing H11). The time elapsed between opening the initial window and moving to next step (task accomplishment time) was recorded (time was not available for the auto manufacturer task due to technical difficulties).

In the questionnaire (see appendix for items), the first item asked the participant to respond to the question concerning the task. The difference in task accomplishment time for participants that successfully entered the task correct response and those who did not was small and insignificant (3.40 vs. 3.25 min.; $F = 1.57$, NS). We hence conclude that participants generally spent enough time interacting with the assigned

website, and, while searching for the required information, expended equal effort to learn and navigate on the website. The next set of items reflected the latent variables. Site usability elements' subscales were identical or similar to those in the literature (Bressolles, 2004; Loiacono et al. 2002; Szymanski and Hise, 2000; Wolfenbarger and Gilly, 2003; Yoo and Donthu, 2001) and were pretested (α 's > 0.90). Three items reflected the attitude toward the site (I like this Web site, I think this is a good Web site, I think it is a pleasant Web site; $\alpha = 0.96$) and three items reflected positive behavioral intentions (I will visit this Web site again in the future, this Web site is my reference to my needs of [industry specific phrase], I will recommend visiting this Web site to a friend, family member, or colleague; $\alpha = 0.92$). The last set of items pertained mainly to site experience (was it the first time you visit this website) and demographics. Matching the obtained demographics with those of the census leads to conclude that the sample is roughly representative of the adult consumer population (for English and French Canadians).

3.2 Model Validation

We used confirmatory factor analysis (LISREL 8.51), which has a distinctive advantage over other methods in that it accounts for all covariance in data, and thus allows the simultaneous examination of correlations, shared variance, path coefficients, and their significance (Bollen, 1989). In validating the model, we randomly divided the data into two equal portions, used one portion (50% of sample) to test the model (calibration sample), and cross-validated the model on the other portion (validation sample). A maximum likelihood rotation was performed and LISREL calculations were based on the covariance matrix. Discriminant and convergent validity of latent variables are further confirmed when individual items load high (> 0.5) on intended factor and low (< 0.4) on other factors. All items, except one (Q14 with a loading of .38 on intended factor, see Appendix), clearly met this criterion. As fit indices were satisfactory, this item was retained to insure face validity. The model obtained from the calibration sample showed good fit to data (CFI = 0.97, GFI = 0.93, AGFI = 0.90, RMSEA = 0.064 with 90% confidence interval of [0.062-0.065]). The root mean square error of estimation RMSEA is below the cutoff value for models with acceptable fit (0.08). The chi-square index was significant and large; Bentler (1991) indicates that this index inflates for larger samples. Average variance extracted (AVE) of each latent variable was well above the threshold value of 0.50 (Fornell and Larcker, 1981) with the smallest AVE at 0.66 for interactivity and the highest at 0.89 for attitude. The latent variables showed discriminant validity because the AVE of each variable was greater than the shared variance with other variables (with the exception of AVE of intention which equaled its shared variance with attitude) (Fornell and Larcker, 1981) and because clearly none of the confidence intervals of variable covariance (e.g., $\Phi \pm$ two standard errors) included the value of 1 (Bagozzi and Yi, 1988).

For cross-validation (simultaneous invariance check for the calibration with the validation sample), parameters should be estimated simultaneously because in multi-group SEM models the fitting function represents a weighted combination of model fit across groups (Bollen, 1989). The accompanied model fit the data well (CFI = 0.97, GFI = 0.93, RMSEA = 0.062 [0.061-0.063]). We checked for the invariance of

the structural model and found it to be invariant, as the change in chi-square between the constrained model (structural paths between latent variables set to be equal) versus the unconstrained model was insignificant ($\Delta\chi^2 = 13.1$, $\Delta df = 8$). This result insures the model predictive validity. The measurement model showed acceptable invariance as well ($\Delta\chi^2 = 31.4$, $\Delta df = 16$). Standardized coefficients of the invariant structural paths are shown in Figure 1. As a larger sample size contributes to type-I error (increases power), the model was applied on smaller randomly selected samples (n 's = 350) and the associated structural patterns were found to replicate the pattern one. Supporting the argument for the moderating role of ease-of-use (H7b), a model that regarded ease-of-use as an exogenous variable (i.e., a variable that load directly on attitude and do not moderate usability elements' effects) showed clear misspecification highlighted by insignificant relations between site information with the rest of variables.

As predicted, site information, graphical attractiveness, and interactivity associated positively with ease-of-use. Attitude toward the site (which associates positively to graphical attractiveness, site interactivity, and site trust) fully mediates the relationship between ease-of-use and behavioral intentions. Alternatively, attitude was influential in forming intentions (Fishbein and Ajzen, 1975), explaining 81 percent of its variance. No constrained structural paths were significant, indicating that all significant relations between the variables were already freed. All model parameters were significant, lending support to Hypotheses 1 through 8. As expected, the direct path from information to attitude was insignificant, while ease-of-use fully mediated the relationship between information and attitude. This reflects the importance of detailed, pertinent, and precise information of the site in determining attitude, although indirectly by improving ease-of-use.

3.3 Moderating Variables

To test for the moderation effects, LISREL univariate statistical test was applied (following Byrne, 1998, 259-341; Jöreskog and Sörbom, 2001, 277-296). This test individually examines relations invariance across groups. In a stringent test of the hypotheses dealing with relation invariance and unless differently stated, each group was first randomly divided into two portions (calibration and validation) to test relations invariance (similar to what was performed in testing the above model). The model solution was then obtained simultaneously for groups' calibration samples, and the model fit indices were examined. When the measurement model was not invariant, it was freely estimated; otherwise it was constrained equal across groups. The difference in chi-square for each of the structural paths, freely estimated versus constrained equal (i.e., $\Delta df = 1$), was then tested for significance at $p < .05$. In testing the hypotheses with latent variable means, the difference in the structured means based on the extended LISREL model was inspected for its significance (Byrne, 1998; Jöreskog and Sörbom, 2001, 299-310). However, group means' tests (mean calculated as items average) were performed and reported for comparison (same results were obtained following both methods).

Site Experience. Supporting H9a, the difference in the structured latent means of ease-of-use EOU for low versus high site experience consumers was significant as hypothesized ($\alpha=2.6$). (In line with the means difference results of EOU items; 4.59

vs. 4.98 min.; $F=84.3$, $p=.000$). Investigating the rest of structured means showed all usability elements to be significantly higher for consumers with high site experience. Structured means of attitude and intentions were also higher for these consumers. H9b was supported; as predicted, task accomplishment time for low experience (3.60 minute) was higher than that of the high experience consumers (2.51 minute) and the difference was significant ($F=76.66$, $p=.000$). Results support H9c and H9d; the invariance check of each path was associated with a significant change in chi-square. Differences in the accompanied standardized coefficients (provided in the brackets next to chi-square difference) were substantial and in the predicted direction ($\Delta\chi^2$ info-EOU = 7.2 [0.10]; $\Delta\chi^2$ trust-attitude = 7.4 [0.07]). Invariance checks were also performed for the rest of the relations and show the following results ($\Delta\chi^2$ EOU-attitude = 4.6 [0.05]; $\Delta\chi^2$ interactivity-EOU NS; $\Delta\chi^2$ interactivity-attitude = 6.7 [0.09]; $\Delta\chi^2$ design-EOU NS; $\Delta\chi^2$ design-attitude NS).

End Product Tangibility. Services websites (end product was intangible) included the insurance, banking, communication services, travel, and media industries; tangibles sites group comprised the rest of industries (57 percent of observations; Table 1). H10a is supported; structured latent mean for EOU of services was significantly lower than that of tangibles sites ($t_\alpha = 9.7$). (This result also met items' means test; 4.44 vs. 4.90; $F=136.3$, $p=.000$). H10b was also supported; the difference in task accomplishment time means for services versus tangibles sites was significant (3.45 vs. 3.17 min.; $F=6.83$, $p=.009$). Hypotheses 10c, d were supported with substantial standardized path coefficients' differences ($\Delta\chi^2$ interactivity-EOU = 10 [0.13]; $\Delta\chi^2$ interactivity-attitude = 13.4 [0.12]; $\Delta\chi^2$ info-EOU = 20.7 [0.11]). Invariance checks were also performed for the rest of the relations and show the following results ($\Delta\chi^2$ EOU-attitude = 6.5 [0.04]; $\Delta\chi^2$ design-EOU = 14.1 [0.04]; $\Delta\chi^2$ design-attitude NS; $\Delta\chi^2$ trust-attitude = 10.1 [0.06]).

Findings Replication and the Role of Culture. The input of the second study was used to test H11a (findings replications) and H11b (the moderating role of culture). All the hypotheses supported in the first study were also supported in the second study (results are summarized in the Appendix and standardized path coefficients appear in Figure 1). An invariance check for the French sample with the English sample was performed to examine the moderating role of culture (for the relations H1 through H8). Results show a moderating role for culture. While the paths from interactivity (to EOU and attitude) were significantly more influential for French-speaking consumers, the paths information-EOU and EOU-Attitude were stronger for English-speaking consumers. The rest of the paths were group-invariant.

4 Discussion and Implications

The application usability is a key to success: "on the Web, users experience usability first and pay later" (Nielsen, 2000, p. 11). To date, researchers have been reticent to theorize about the effect of the IT artifact usability elements on performance (Benbasat and Barki, 2007). The IT artifact's perceived usefulness and ease-of-use "have largely been treated as black boxes that very few have tried to pry open" (Benbasat and Barki, 2007, p. 212). This research investigated the link between the website

usability elements and attitudes and intentions toward the site, and examined the role of consumer site experience and end product tangibility. Enriching the literature of website usability, the findings imply that consumer decision to learn and use a website is affected by both the perceptions of ease-of-use and other elements associated to this important belief. Results however show that the influence of usability elements on consumer attitude and intentions is affected by customer site experience and the end product the website offers. According to both their direct and indirect structural weights, ease-of-use, information, and interactivity appear to be prominent elements in driving customers' attitude and intentions for informational tasks. Ease-of-use is a central factor in driving attitude and intentions that can be seen as a consumer belief of the website that is determined by the extent to which the website provides detailed, pertinent and precise information, offers features that enhance interactivity and allow personalized communication, and exhibits an attractive and aesthetic design. Findings further show a consistent convergence between a subjective measure (perceived ease-of-use) and an objective measure (task accomplishment time) of the cognitive effort encountered in a session.

Findings of hypotheses 9a and 9b collectively indicate that the cognitive effort required when accomplishing the online task is highest at the first interaction with the site. Findings of Hypotheses 9c, d support the notion that consumer needs from the website change according to site experience. Site information and interactivity were more influential for customers with low site experience, whereas site trust was more influential in determining attitude and intentions for customers with high site experience. Additionally, interactivity appears to have a stronger impact on the attitudes of customers with low site experience. Customers with high site experience notably perceived higher levels of site usability elements. Because site ease-of-use develops into a well structured construct for these customers, ease-of-use becomes a more feasible path for the indirect effects of usability elements on attitude and intentions (ease of use mediates these effects more strongly), resulting in higher levels of attitude and intentions. This provides an explanation for the process whereby learning the site contributes to locking-in customers.

Findings show that services sites were generally perceived as less easy to use and participants needed more time achieving tasks on these sites. This implies that the cognitive effort to accomplish the task was higher for services sites. The complexity of services appears to extend to their websites. In addition, both site interactivity and graphical attractiveness appear to be more influential for services than for tangibles sites. In contrast, site information and site trust were more influential for tangibles than for services sites.

Developers should benefit from the findings, including the notion that ease-of-use, a focal factor in determining the decision to learn and use the application, is closely related and affected by other usability elements of the website. Usability elements are a result of the actual ones. For example, perceived interactivity mediates the relation between actual or delivered interactivity and the attitude toward the site (Wu, 2005). Similarly, research shows that website features can be controlled by increasing or reducing the quantity of some elements and that such manipulation impacts performance measures (Coyle and Thorson, 2001). As usability elements are manageable, developers of retailing and other utilitarian websites can implement results to improve usability perceptions hence customers' attitude and intentions toward the website.

Findings indicate that the focus should be on enhancing the site ease-of-use, information, and interactivity because these factors were prominent in driving consumers' attitude and behavioral intentions.

Findings further indicate that a resource allocation approach in website design can benefit from considering the differences in requirements for customers with different levels of site experience and by considering the product offered at the website (services vs. tangibles). Internet technology advances render it possible to track customer site visit history and to deliver personalized pages with different content and features to each customer (Kalczynski, Senecal, and Nantel, 2006). The findings regarding the role of site experience favors a dynamic rather than static website structure. The focusing should be on site information and interactivity elements for first-time visitors, and on trust building for returning customers. Results also imply that more difficult applications should be introduced in later interactions, once the visitor has learned and better mastered the website. Alternatively, developers of services websites should pay particular attention as the findings indicate that services sites are perceived as less easy to use and require more task accomplishment time than tangibles sites. The findings indicate that developers of services sites should focus on the site interactivity, ease-of-use, as well as graphical design. Additional measures such as implementing the service design onto the website design (Fitzsimmons and Fitzsimmons, 2004) might be required to improve the usability of these sites.

4.1 Limitations and Future Research

This research considered different websites spanning various industries to reduce the influence of attitude toward the organization, its brand strength and loyalty. Tasks varied according to industry and were informational rather than transactional. It should be noted that for transactional tasks, site trust is expected to be more influential. Participants were actual consumers randomly selected from a large consumer panel, and the final samples were deemed representative. Less Internet or computer savvy customers however participate less in panels, indicating that this segment might have been underestimated. Nonetheless, customers of particular interest to e-commerce organizations are the ones that use the Internet regularly. A similar discussion applies to customers with particular privacy and security concerns. This research focused on examining usability elements including ease-of-use and did not consider other site beliefs suggested in the literature, such as usefulness and enjoyment. While usefulness was considered to be captured by usefulness (Venkatesh and Agarwal, 2006), usefulness and enjoyment (and their antecedents) can delineate the topic of future work. This research also focused on utilitarian sites in a goal-oriented environment. Future work can verify the hypotheses on hedonic sites and environments. A hedonic website mainly provides self-fulfilling rather than instrumental value, is connected to leisure activities, and anticipates prolonged rather than productive use (van der Heijden, 2004). Examples are virtual communities, social networking, and gaming sites (e.g., secondlife.com, facebook.com, yahoogames.com). For instance, the literature suggests enjoyment to be prominent in shaping consumer attitude and intentions for hedonic sites (van der Heijden, 2004). Moreover, site enjoyment appears to be a concept that can be employed to enhance the learning and use of

e-commerce and other utilitarian websites and applications (Chang et al. 2005; Liu and Arnett, 2000). This topic forms a potential research avenue.

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Appendix

Appendix: Results Replications Using the Input from the Second Study (H12a)	
H1 through H8	Model fit indices (CFI= 0.97, GFI= 0.93, AGFI= 0.91, RMSEA= 0.061). Fornell and Larcker (1981) and Bagozzi and Yi (1988) criteria are met. All paths (H1-8) are significant (smallest t at 9.02 for trust-attitude). As-sociated path coefficients appear at Figure 1.
Site Experience (high site experience vs. low site experience)	
H9a	($t \alpha = 2.41$); EOU means (4.67 vs. 5.02, $F = 45.52$, $p = .000$)
H9b	(3.77 vs. 3.12 min., $F = 18.55$, $p = .000$) (In line with the results of the English study; however, navigation time is generally higher in the French study).
H9c	$\Delta \chi^2$ info-EOU = 4.6 [0.05]
H9d	$\Delta \chi^2$ trust-attitude = 3.88 [0.04]
End Product Tangibility (services vs. product-oriented sites)	
H10a	($t \alpha = 7.59$), EOU mean (4.61 vs. 5.02, $F = 82.81$, $p = .000$)
H10b	(3.74 vs. 3.32 min., $F = 8.76$, $p = .003$)
H10c	$\Delta \chi^2$ interactivity-EOU = 11.66 [.08]; $\Delta \chi^2$ interactivity-attitude NS.
H10d	$\Delta \chi^2$ info-EOU = 6.72 [0.05]

Appendix: Measure Subscales, internal consistency, items' means and SD*		M	SD
	<i>Site Graphical Design</i> ($\alpha = 0.913$)		
Q1	This Web site is pretty	4.22	1.40
Q2	This Web site shows creativity	4.36	1.43
Q3	This Web site is visually appealing	4.57	1.49
	<i>Site Ease-of-Use</i> ($\alpha = 0.939$)		
Q4	This Web site is easy to use	4.73	1.78
Q5	It is easy to find information on this Web site	4.66	1.69
Q6	It is easy to browse and find what you're looking for on this Web site	4.71	1.66
	<i>Site Information</i> ($\alpha = 0.921$)		

Q7	This Web site offers detailed information on products or services	4.80	1.55
Q8	The information on this Web site is pertinent	5.06	1.43
Q9	The information on this Web site is precise	4.90	1.48
	<i>Site Trust (Perceived Security/Privacy) ($\alpha = 0.950$)</i>		
Q10	Overall, I trust this Web site's security measures	4.65	1.49
Q11	This Web site guarantees that I can surf safely	4.59	1.50
Q12	I think that my private life is protected on this Web site	4.47	1.52
Q13	I trust this Web site not to use my personal information indiscriminately	4.52	1.61
	<i>Site Interactivity ($\alpha = 0.909$)</i>		
Q14	I can interact with this Web site and receive personalized information	4.57	1.52
Q15	This Web site personalizes my needs	4.31	1.46
Q16	This Web site has interactive features that help me with navigating	4.67	1.49
Q17	This Web site saves my preferences and offers me additional services or information based on these preferences	4.49	1.46
*Items are seven Likert-type strongly disagree/strongly agree; latent variables were measured in the order shown.			

Effects of Website Interactivity on Online Retail Shopping Behavior

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Abstract. Motivations to engage in retail online shopping can include both utilitarian and hedonic shopping dimensions. To cater to these consumers, online retailers can create a cognitively and esthetically rich shopping environment, through sophisticated levels of interactive web utilities and features, offering not only utilitarian benefits and attributes but also providing hedonic benefits of enjoyment. Since the effect of interactive websites has proven to stimulate online consumer's perceptions, this study presumes that websites with multimedia rich interactive utilities and features can influence online consumers' shopping motivations and entice them to modify or even transform their original shopping predispositions by providing them with attractive and enhanced interactive features and controls, thus generating a positive attitude towards products and services offered by the retailer. This study seeks to explore the effects of Web interactivity on online consumer behavior through an attitudinal model of technology acceptance.

Keywords: Web Interactivity, Technology Acceptance Model, Online Consumer Behavior, E-commerce, User experience.

1 Introduction

The explosive expansion of e-commerce has centered the focus of the retail industry on online sales growth and consumers' acceptance of online shopping. With the enormous potentiality still untapped and huge global scope of online retail shopping it becomes increasingly important for marketers and online retailers to focus on Internet user's attitudes, their shopping motivations and cater to their needs in order to induce Internet users to adopt the Web for retail usage. Online marketers can influence the decision making process of online customers not only by engaging in traditional and physical marketing tools but also by creating and delivering the proper online experience, the Web experience: a combination of online functionality, interactivity, information, emotions, cues, stimuli, and products/services. This study seeks to explore the effects of website interactivity on online consumer behavior through an attitudinal model of technology acceptance.

2 Online Consumer Behavior and Website Interactivity

Researchers have been continually seeking richer understanding of consumer attitudes and behavior over the last couple of decades. Clearly many motivations exist as shopping goals, but most typologies consider utilitarian (goal oriented) and hedonic (experiential) motivations as fundamental to understanding consumer shopping behavior because they maintain a basic underlying presence across consumption phenomena (Babin, Darden and Griffin, 1994; Childers, Carr, Peck and Carson, 2001). Ultimately, the degree to which online shopping fulfills utilitarian and/or hedonic consumers needs will affect the amount of shopping dollars that consumers choose to spend online (Wolfenbarger and Gilly, 2001). As more consumers turn to e-commerce, online retailers are striving to provide a stimulated online shopping experience using cutting edge interactive utilities and features through their respective websites.

Interactivity of a website is not only seen as offering utilitarian benefits due to saving time/effort, reducing risk, and increasing likelihood of finding a superior alternative; but it is also credited with providing hedonic benefit of enjoyment (Fiore, Jin and Kim, 2005; Koufaris, 2001). Some examples of website interactivity features which can cater to the needs of a hedonic online consumer can be real time image manipulation, product zoom in/out, 3D virtual tours, rotating 3D images, electronic dressing rooms, product customization (color, size, design etc.), real time image manipulation, recommendation agents, virtual models, virtual shopping assistances, intuitive search engines, interactive shopping carts, etc. On the other hand interactive features such as product search and review options, clear site navigation and layout, product comparison (from a single or multiple online stores), user ratings and reviews, single click checkout options, product tracking options, organized and intuitive shopping process, effective search engines, etc. can cater to the needs of a utilitarian online consumer. The above list of interactive features is not an exhaustive one but is relevant to our context. It is based on literature (Fiore et al., 2005; Haubl and Trifts, 2000; Kim and Kim, 2004) and guided research on various online content providers offering such interactive elements for numerous commercial online sites.

Exploratory research in marketing (Daugherty, Li and Biocca; Li, Daugherty and Biocca, 2001) has already suggested that such interactive utilities has the potential to improve consumer product knowledge and attitudes toward brands, while enhancing consumer purchase intentions (Jiang and Benbasat, 2004). The interactive nature of websites has also been credited with enhancing attitude toward the online store, desire to browse or return to the website, and online purchasing (Fiore et al., 2005; Li et al., 2001). However, in order to enjoy and experience the online shopping environments successfully one has to also be competent and skilled in browsing such interactive and media rich websites. The physical shopping environment is replaced by an electronic shopping environment or, in other words, by an Information Systems (IS) (Heijden, Verhagen and Creemers, 2003). Therefore, to understand consumer's online purchase intentions, we need to look at the interaction with the website both as a store and as a system (Koufaris, 2002). In this regard the present study plans to use a the classic framework of Technology Acceptance Model (TAM) to better understand the behavioral aspects of consumers' acceptance of such multimedia rich interactive retail websites.

3 The Tam Framework for Internet Usage

The TAM (developed in 1986) continues to be the most widely applied theoretical model of user acceptance and usage in the IS field (Venkatesh, 1999). TAM posits that technology adoption decisions (i.e., individual intentions to use the technology) are driven by an individual's affective response (attitude) toward the use of the innovation. Attitude, in turn, is premised to be determined by two salient beliefs about the innovation or technology: Perceived Usefulness (PU), the degree of which a person believes that using a particular system would enhance his or her job performance; and Perceived Ease Of Use (PEOU), the degree of which a person believes that using a particular system would be free of effort (Davis, 1989). Davis et al.(1992) introduced Perceived Enjoyment (PE) as a type of intrinsic motivation to the TAM, which is defined as the extent to which the activity of using the computer is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated. The validity, reliability and replicability of TAM have been done over numerous studies and contexts in the last decade.

Studies using TAM to predict broad Web/Internet usage contexts, online purchasing behavior, virtual store acceptance etc (Childers et al., 2001; Heijden et al., 2003; Moon and Kim, 2001); (Chen and Tan, 2004; Lee, Fiore and Kim, 2006; O'Cass and Fenech, 2003) have been conducted only in the past few years, and these studies by and large confirm the relevance and appropriateness of PEOU and PU in an online context, and find substantial evidence for the effects of intrinsic enjoyment (PE) on consumers surfing the Web (Heijden et al., 2003; Moon and Kim, 2001; Teo, Lim and Lai, 1999). Based on prior research findings and importance of the enjoyment construct influencing attitude and intention, the TAM framework has been extended to include the PE construct as shown in figure 1 (in the following page).

There is also evidence that online consumers not only care for the instrumental value of the technology, but also the more immersive, hedonic value (Childers et al., 2001; Heijden and Verhagen, 2004). PU and PEOU are seen as instrumental in achieving valued outcomes, while PE is regarded as having no apparent reinforcement other than the activity itself. These represent utilitarian and hedonic aspects of consumer experience, respectively (Lee et al., 2006). While some consumers may be shopping primarily for instrumental purposes, others may be primarily enjoying these interactive media, and thus both factors can ultimately affect their attitude toward using interactive forms of online shopping. The TAM model for its viability and robustness for examining consumer acceptance in various online contexts comes into our research framework to predict consumer's acceptance and usage of multimedia rich interactive online retail website.

Our present study concentrates on an extended TAM framework which was initially proposed by (Monsuwé, Dellaert and Ruyter, 2004) but was never conceptualized, analyzed or investigated in details. We have modified and amended the initial model, established the grounds for the logic and relationships of the antecedents based on theory and relevant literature and focused on the context of online purchase intentions, thus proposing a detailed TAM framework and using it to explain interactivity usage and resulting effects on consumer responses towards the online retailer.

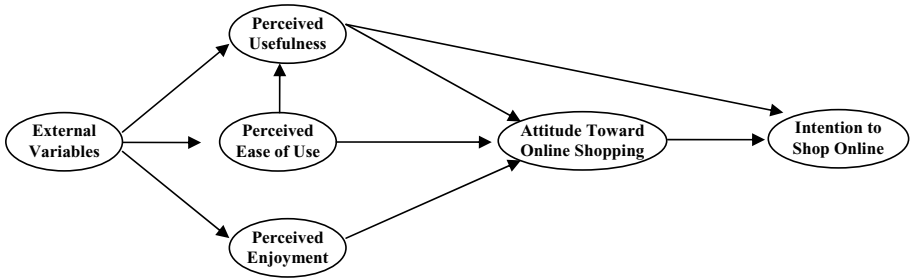


Fig. 1. Modified TAM for Online Shopping Context

4 Research Framework Discussion

We focus on the possible antecedents of the major constructs of TAM in order to understand what underlying factors can determine the constructs themselves and therefore define more specific drivers of consumer acceptance of intention to shop online. Due to space constraints we will briefly define the antecedents solely based on our research context. All of the antecedents and their relationships are well grounded in theory and prior literature and the references are provided for review.

4.1 Perceived Usefulness (PU)

In our research context PU refers to consumers perceptions that using the Internet as a rich interactive shopping medium enhance the outcome of their shopping experience. PU has also proven to significantly influence attitude toward an online retailer and have a significant impact on intentions to use the online retailer (Chen, Gillenson and Sherrell, 2002; Heijden, 2004; Koufaris, 2002; Lee et al., 2006; Monsuwé et al., 2004; O'Cass and Fenech, 2003; Sanchez-Franco and Roldan, 2005).

Determinants: We have identified two determinants of PU; Consumer Return on Investment (CROI) and Service Excellence (Mathwick, Malhotra and Rigdon, 2001; Mathwick, Malhotra and Rigdon, 2002). The perceived return on cognitive, behavioral, or financial investments made by the consumer is an extrinsic source of active value, termed CROI which can be measured in terms of economic utility (the perception of affordable quality) and utility derived from the efficiency of a retail experience. Hence time, effort and ease with which a product can be purchased is likely to be the prominent psychological dimensions of concern for a utilitarian shopper (Mathwick et al., 2002). Service Excellence is the consumers' appreciation of delivered promises and performed functions which can reflect the generalized consumer appreciation of a service provider to deliver on its promises through demonstrated expertise and task-related performance (Mathwick et al., 2001). Such services may include online feedback & support, prompt customer service, real time chat with customer support, refund/return policy clearly stated, online dispute resolution submission, follow up and update of product/service status, feedback emails, etc. which can provide positive shopping outcomes.

4.2 Perceived Enjoyment (PE)

PE results from the enjoyment, entertainment and playfulness of the online shopping experience, rather than the shopping task completion. Prior research on Internet shopping has found PE to have positive effects on consumer attitude towards online shopping and the online retailer (Childers et al., 2001; Heijden and Verhagen, 2004; Koufaris, 2002; Lee et al., 2006; Mathwick, 2002; Monsuwé et al., 2004).

Determinants: Based on prior research, we have identified three determinants of PE; Pleasure, Arousal and Escapism (Mathwick et al., 2002; Mathwick and Rigdon, 2004; Menon and Kahn, 2002; Monsuwé et al., 2004). If consumers are exposed initially to pleasing and arousing stimuli during their Internet shopping experience, they are then more likely to engage in subsequent shopping behavior; they will browse more, engage in more unplanned purchasing, and seek out more stimulating products and categories (Monsuwé et al., 2004). Online retailers can also create attractive, multimedia rich, interactive websites (i.e. hedonic online shopping environment) to entice consumers and provide them a compelling online shopping experience in such a manner that it may raise the state of psychological immersion in a person to keep them completely engaged in their focal activity in the online store. This refers to the escapism behavior of potential online consumers (Mathwick et al., 2001; Mathwick and Rigdon, 2004).

4.3 Perceived Ease of Use (PEOU)

In our research context, PEOU is considered as the consumer's perception that shopping on the Internet will involve a minimum of effort. Researchers suggest that customer's assessment of websites will likely be influenced not only by how effective the sites are, but also by how easy the sites are to use in helping customers accomplish their tasks (Zeithaml, Parasuraman and Malhotra, 2002).

Determinants: Based on prior research by Venkatesh (2000), three constructs have been identified as possible determinants for PEOU for our research context. They are defined as Control (conceptualized as computer self efficacy & facilitating conditions), Intrinsic Motivation (conceptualized as computer playfulness) and Emotion (conceptualized as computer anxiety). In our research context, internal control or self-efficacy can relate to an individual's perception of the availability of knowledge, resources and opportunities required to perform a specific behavior for online shopping. On the other hand, external control reflects the availability of resources needed to engage in an online shopping behavior, such as online user support, real time chat, graphical navigation tools, FAQ, step by step guide, online feedback, email support, virtual assistants etc. Computer playfulness describes an individual's tendency to interact spontaneously, intensively, openly, creatively, and imaginatively with computers (Serenko and Turel, 2005). In our research context, using rich interactive features, websites can be constructed to create a fun and appealing environment for such intrinsic playful consumers. Computer anxiety is a negative affective reaction toward computer use (Simonson, Maurer, Montag-Torardi and Whitaker, 1987). We do acknowledge that an overly complex website, too many step by step guides, surplus of findings, too many options to choose from, excess

product comparisons, failure in controlling high interactivity controls and options, excess of multimedia and pop ups diverting attentions, added suggestions, etc. can cause anxiety among the usual browsers. Higher levels of computer anxiety towards using the Internet as a shopping medium are assumed to cause low perceptions regarding PEOU of the online environment.

4.4 Attitude and Intention

Research has repeatedly shown that attitude toward the website positively influences behavioral intentions. These behavioral intentions can include intention to buy or purchase intention, intention to return to the online store, and intention to recommend online products (Jarvenpaa and Todd, 1997; Yoh, Damhorst, Sapp and Lazniak, 2003). Moreover, research has found that interactive features of the website are important factors in improving consumer attitude toward an online retailer, the desire to browse the website, and online purchase intention (Fiore and Jin, 2003; Li et al., 2001; Wu, 1999).

4.5 Trust as a Moderator

Prior research has suggested several possible moderating factors (demographic and personality characteristics, experience, trust, situational factors, product characteristics, technology factors, organizational factors etc.) that can influence the TAM constructs and their relationships, our research scope is limited to the trust moderator as it has proven to be a major influencing construct for online purchase intentions based on

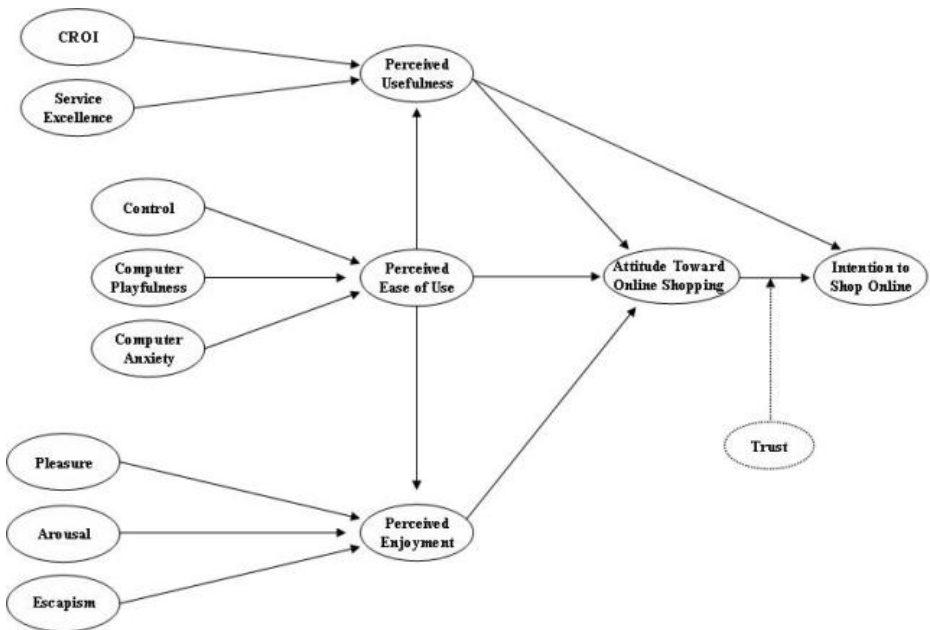


Fig. 2. Proposed Research Framework

prior research (Jarvenpaa, Tractinsky and Vitale, 2000; Monsuwé et al., 2004; Pavlou, 2003); (Everard and Galletta, 2006; Gefen, Karahanna and Straub, 2003). We assume that when it comes to the final stage of creating a positive intention based on the consumer's attitude, trust in the website becomes the major focal point of importance for the consumer to decide if he/she wants to go ahead with some possible transaction (or not) with the online retailer over the online medium.

4.6 Proposed Research Framework

Summarizing the above discussion we are basically proposing an extended TAM framework with possible behavioral antecedents of its major constructs, trust as a moderator between attitude and purchase intention, and applying it to the online shopping context. The proposed framework is shown in Figure 2.

5 Hypothesis Propositions

Consumers can shop for either hedonic or utilitarian motivations, and online shopping can also offer both hedonic and utilitarian environments (Babin et al., 1994; Childers et al., 2001; Hoffman and Novak, 1996; Huang, 2005; Jarvenpaa and Todd, 1997). Hedonic shoppers engage in browsing or non-purposeful exploration of products, enjoy the stimulation offered by product novelty and the process of exploring new and interesting shops and environments, enjoys the shopping experience for its own sake, consider shopping as leisure, prone to browse stores for information and many times lack purchase intentions, but tend to purchase impulsively (Babin et al., 1994; Lee et al., 2006). In contrast, utilitarian shoppers try to minimize time and effort when shopping, seeks convenience and thoughtfully considers and evaluates product-related information prior to purchase (Babin et al., 1994). Rich, interactive websites can not only provide hedonic aspects of pleasure or enjoyment (Fiore and Jin, 2003; Li et al., 2001) but also utilitarian aspects of saving time and/or effort, reducing risk, and increasing likelihood of finding a preferable alternative, convenience and rich information (Klein, 2003; Lee et al., 2006; Li et al., 2001). A well planned website with high-quality multimedia rich interactive options can portray both utilitarian and hedonic environments and thus not only can cater to online consumers original shopping dimensions but also may be able to influence them to enhance or traverse their motivations with the available interactive stimuli and utilities. Because such websites can evoke both affective and cognitive reactions, they are likely to be valued by both utilitarian and hedonic or experiential shoppers (Demangeot and Broderick, 2006). Since interactivity tends to have an effect on consumers' perceptions we are presuming that such multimedia rich interactive websites can influence consumers' original predisposition about their utilitarian or hedonic shopping motives. Based on the above discussion we propose:

Proposition 1: Online consumers predisposed with utilitarian shopping motivations are predicted to be more influenced by the multimedia rich interactive online retail environment to perform behavior more predictive of consumers with hedonic shopping motivations.

Proposition2: Online consumers predisposed with hedonic shopping motivations are predicted to generate more positive purchase intentions and utilitarian benefits in a multimedia rich interactive online retail environment since the environment would be better suited to their normal shopping behavior pattern.

Prior research has already shown that PU of the interactive media can be thought of as reflecting the more instrumental aspects of shopping, while PE embodies the hedonic aspect of shopping (Childers et al., 2001; Lee et al., 2006; Monswé et al., 2004; Teo et al., 1999). Although PEOU have been always associated with PU to portray more of a utilitarian viewpoint, studies (Heijden, 2004; Teo, 2001) have also shown PEOU to reflect intrinsic and hedonic characteristics. Our research plans to explore PEOU from both the perspectives, as prior research has shown it's determinants (Computer Playfulness as intrinsic motivation and Control as an extrinsic motivation) to cater to either dimensions (utilitarian or hedonic) and thus likely to impact attitude / intention to shop online through PU and/or PE (Koufaris, 2002; Moon and Kim, 2001; Venkatesh, 2000). In short, we expect PU and PE of the websites to play the stronger role in predicting intentions to shop online in utilitarian and hedonic web environments. Based on the above discussion we propose:

Proposition3: Perceived Usefulness of the multimedia rich interactive online retail environment will be a stronger predictor (than Perceived Enjoyment) of Attitude towards online shopping in a utilitarian shopping environment.

Proposition4: Perceived Enjoyment of the multimedia rich interactive online retail environment will be a stronger predictor (than Perceived Usefulness) of Attitude towards online shopping in a hedonic shopping environment.

The results of various TAM studies demonstrate that PU is the primary and “strongest” determinant of behavioral intention to use a technology, with PEOU and PE acting as secondary and “comparatively weaker” determinants (Davis, Bagozzi and Warshaw, 1992; Heijden, 2004; Venkatesh and Davis, 2000). Recent research (Heijden, 2004) has found that PE and PEOU as individual constructs have proved to be a stronger predictor of behavioral intention to use hedonic systems than PU. Websites can be constructed (and are already available) which can symbolize both utilitarian and hedonic environments through various levels of interactivity, navigation, enjoyment and convenience. Consumers with utilitarian motivations not only can converge on their instrumental motives and objectives, but also might enjoy the surrounding Web environment facilitating their original objective goals along with positive emotional arousals through pleasing and appealing interactive options. On the other hand, consumers with hedonic motivations not only can experience the enjoyment and playfulness aspects of the online website, but also can be motivated to achieve a probable purchase or a purchase intention with the various levels of instrumental facilities provided under the disguise of the various levels of playful and guided interactivity features. In this aspect we assume the later dimension of consumers will most probably have a stronger effect on purchase intentions. In other words, we assume that the combined effects of PE and PEOU will be a stronger predictor of intentions to shop online than the combined effects of PU and PEOU. Based on the above discussion we propose:

Proposition5: Perceived Enjoyment along with Perceived Ease of Use will be a stronger predictor of Intention to shop online than Perceived Usefulness along with Perceived Ease of use, in a multimedia rich interactive online retail environment offering both utilitarian and hedonic dimensions.

6 Research Methodology

To investigate online consumers' browsing patterns and purchase intentions in websites with variable levels of interactivity necessitates an experimental design. A 2 × 2 between-subject research design will be used, varying the level of interactivity of a website (low or high interactivity; controlled by us) and the predisposed shopping dimensions (utilitarian; hedonic) of the subjects. A pre-experiment survey will be conducted among the potential samples to ascertain their shopping dimensions and samples will be allocated specific website conditions for the actual experiment. They will be instructed to carry out an online shopping process (up to check out). Upon completion a post-experiment survey will be conducted to assess their perceptions and intentions towards the websites features. The constructs and scales used in our proposed framework are based on existing research.

7 Implications for Researchers and Practitioners

The proposed research framework attempts to address theoretical concepts which were deemed as essential future research directions by prominent researchers, such as exploring the effects of interactivity on online consumers purchase intentions (Stevenson, Bruner and Kumar, 2000; Teo, Oh, Liu and Wei, 2003); impact of the design characteristics of interactive shopping sites on online purchase behavior and usage indicators (PU and PEOU) (Childers et al., 2001); role of TAM and its antecedents in explaining interactivity usage and resulting effects on consumer responses towards the online retailer (Lee et al., 2006); investigating the antecedents of the TAM constructs in order to provide design-oriented advice (Benbasat and Barki, 2007).

The importance of interactivity in inducing experiential counters suggests that companies can reap greater benefits from Web technology by making better use of interaction attributes in website design. Keeping in mind for the future, with the advancement of Internet2 and Web2.0, rich interactive multimedia will reign in supreme in the online environment. If websites can be effectively designed to cater to both utilitarian and hedonic online shoppers, then online retailers can have a greater effect on people's attitude and purchase intentions through their websites.

8 Conclusion

Understanding the theoretical determinants of consumer purchase intentions based on their utilitarian and hedonic dimensions is an important step, and understanding the antecedents of the key constructs in TAM to help shed some predictive guidelines on

the behavioral facets of the two dimensions is crucial in assisting in the design and development of online stores with a high level of consumer acceptance to facilitate e-commerce.

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Trust-Building in Electronic Markets: Relative Importance and Interaction Effects of Trust-Building Mechanisms

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Abstract. We examine the relative and complementary effectiveness of trust-building strategies in online environments. While prior research has examined various antecedents to trust, we investigated two trust-building mechanisms more in depth: Web site trust and vendor reputation. We tried to understand the relative effectiveness of these two important mechanisms to provide online businesses with a clear recommendation of how to establish trust in an effective and efficient manner. Drawing from the literature on trust, we proposed vendor reputation to be more effective than Web site trust. Moreover, we examined a potential complementary effect of these mechanisms so as to provide online businesses with a deeper understanding of how to derive superior trust. We hypothesize a small such effect. The study proposes a laboratory experiment to test the model.

Keywords: Trust, reputation, Web site trust, interaction, relative effectiveness, electronic markets, electronic commerce.

1 Introduction

Trust has long been identified as an essential element of all social exchange relationships (Barber 1983; Barnard 1938; Deutsch, 1960). This is especially true for business relations, which rest upon the foundation of trust to be effective (Sitkin and Roth, 1993; Williamson, 1975). Trust is particularly important when two factors are present in a given transaction process: risk (uncertainty) and incomplete product information (information asymmetry) (Swan and Nolan, 1985).

Electronic commerce is a recent form of social exchange in which most transactions occur among social parties without any face-to-face contact. As in traditional social exchanges, trust has been regarded crucial for electronic market transactions (Ba, Whinston and Zhang, 1999; Benbasat, Gefen and Pavlou, 2008; Brynjolfsson and Smith, 2000; Pavlou and Gefen, 2004). Given the impersonal nature of electronic markets, trust can be considered even more difficult to establish in this environment (Ba and Pavlou, 2002; Lim, Sia, Lee and Benbasat, 2006).

The impersonal nature of electronic markets in general and the lack of face-to-face contact in particular imply higher risks associated with business transactions.

These risks mainly stem from incomplete security regarding seller authentication. Additionally, online marketplaces have less of an opportunity to provide buyers with product information than do traditional marketplaces, which most often have the product in demand on their shelves. This lack of product information is particularly critical regarding product quality, since the products cannot be physically examined prior to any transaction (Ba and Pavlou, 2002).

In an attempt to help online vendors overcome the difficulty inherent in establishing trust in an electronic market context, several studies have been conducted to identify potential antecedents to trust in this impersonal environment (e.g., Ba and Pavlou, 2002; Pavlou and Gefen, 2005; Pennington, Wilcox and Grover, 2003). While several such factors have indeed been found, the nature of trust in electronic commerce and the mechanisms to establish trust remain ambiguous (Lim et al., 2006).

While recent research has provided online vendors with a rich set of potential trust-building mechanisms, their relative importance remains unclear. Since trust-building is a difficult endeavor, it is important to provide online vendors with a clear understanding of potential differences in the effectiveness of trust-building strategies. Moreover, potential synergies among those factors might yield superior results regarding trust-building and might thus generate extraordinary returns on investment for online vendors. Thus, we attempt to answer the following questions:

1. *Do different trust building mechanisms (namely, Web site trust and vendor reputation) have different effects on vendor trust in an electronic-market context?*
2. *Do different trust-building mechanisms (namely, Web site trust and vendor reputation) interact so as to allow for superior trust?*

The remainder of this proposal is structured as follows: the next section reviews the literature on trust and how it develops in electronic markets. It then develops the theoretical foundations of the concept of value-adding interaction effects. Afterwards, our theory will be developed, followed by a quick overview over the study's task, design, and methods. The paper will then turn to the hypotheses and methods. Subsequently, the expected results and their implications will be discussed.

2 Literature Review

Due to the importance of vendor trust in online environments (Ba and Pavlou, 2002; Lim et al., 2006), a large number of studies have examined its antecedents and consequences (e.g., Ba and Pavlou, 2002; Lim et al., 2006; Pavlou and Gefen, 2004; Pavlou and Gefen, 2005; Pennington et al., 2003). While the consequences of trust have largely been clarified and mainly relate to its importance for purchasing intentions, actual purchase behavior, and price premiums (Ba and Pavlou, 2002; Lim et al., 2006; Pavlou and Gefen, 2005; Pennington et al., 2003; Schurr and Ozane, 1985), its antecedents or trust-building mechanisms are not yet well understood (Lim et al., 2006).

Important trust-building mechanisms include portal affiliation, satisfied customers' endorsements, vendor reputation, and Web site trust (Ba and Pavlou, 2002; Fuller, Serva and Benamati, 2007; Lim et al., 2006; McKnight, Cummings and Chervany,

1998; Pavlou and Gefen, 2004; Pennington et al., 2003). Portal affiliation has been studied as a promising mechanism to establish vendor trust (Lim et al. 2006; McKnight et al., 1998). It has been widely used by practitioners trying to influence consumer trust in online stores. Portal affiliation as a way to build trust is based on the concept of trust-transference, which posits that trust in an established vendor can be transferred to other vendors by virtue of their association. For example, an unknown vendor associated with Amazon.com could benefit from this link through trustworthiness being transferred from Amazon.com to the unknown vendor. Despite the potentially high practical importance of portal affiliation, studies so far have failed to show that it indeed has significant impacts on vendor trust (Lim et al., 2006).

Satisfied customers' endorsements are an important antecedent to trust in online vendors (Lim et al., 2006). Such endorsements refer to the display of one or more positive customer testimonials on a vendor's Web site and were supported, for example, by McKnight et al. (1998). They serve as an antecedent to trust by the means of unit grouping, which establishes group-based trust. Essentially, consumers who share common characteristics tend to trust each other so that the trust some people have towards a vendor can be transferred to other people who are similar (Lim et al., 2006).

Vendor reputation has also been studied as a potential antecedent to vendor trust and has been shown to explain a substantial amount of variance in trust (e.g., Ba and Pavlou, 2002; Fuller et al., 2007; Lim et al., 2006; Pennington et al., 2003). Higher vendor reputation is suggested to increase consumers' beliefs that the vendor has the ability to deliver products or services at the promised terms (Lim et al., 2006; Pennington et al., 2003). It also suggests a high level of integrity regarding potential problems with the contract fulfillment (Lim et al., 2006). Essentially, a vendor's reputation is the degree to which consumers believe that a vendor is honest and concerned about its customers. Reputation captures personal experiences, vendor history, and the social presence of the vendor, as well as its products and actions (Pennington et al., 2003).

System or Web site trust has been suggested to be another important determinant of vendor trust (McKnight et al., 1998; Pennington et al., 2003). Indeed, it has been found not only to be a highly significant determinant of vendor trust, but also to explain a substantial amount of variance in vendor trust (Pennington et al., 2003). The importance of Web site trust moreover becomes apparent from human factors research on automated systems positing that users are more likely to trust reliable systems, for example in the case of adaptive cruise control (Norman, 2006). Web site trust refers to the belief that the proper impersonal structures have been put into place, thus enabling a consumer to anticipate successful transactions with a vendor (Pennington et al., 2003).

Lim et al. (2006) examined the relative importance of portal affiliation and satisfied customers' endorsements as determinants of trust. The underlying commonality of these constructs is trust transference; both antecedents rely on trust being transferred from one entity to another. In the case of portal affiliation, trust is being transferred from one vendor to another, while in the case of satisfied customers' endorsements, it is being transferred through customers. Thus, both mechanisms differ in the proof source of trust, that is, trustworthiness is proven by other consumers in the case of satisfied customers' endorsements, while it is proven by other vendors in the case of portal affiliation

(Lim et al., 2006). Since portal affiliation provides much less specific information about an online store than do satisfied customers' endorsements, which usually mention specific events or experiences customers have had with a vendor, Lim et al. (2006) hypothesized and empirically verified that satisfied customers' endorsements are more effective than portal affiliation in enhancing vendor trust.

As we have just seen, several antecedents to trust in online stores have been examined. However, there is still no clear understanding as to what the strong determinants of trust are (Lim et al., 2006). While Lim et al. (2006) investigated the relative importance between portal affiliation and satisfied customers' endorsements, the result did not prove particularly insightful since portal affiliation by itself has not been positively related to trust.

Thus, the quest for a powerful determinant of trust as well as potential synergies among its antecedents remains. Several studies in the literature on organizational resources and activities have investigated potential synergistic effects among resources or activities and found superior results based on synergies (e.g., Milgrom and Roberts, 1995; Tanriverdi and Venkatraman, 2005). In the electronic commerce context, however, such research has been scarce in terms of formally proposed and tested hypotheses. This is surprising given the intense competition faced by many online vendors.

Since both vendor reputation and Web site trust have been found to be strong determinants of trust that individually explain a substantial portion of its variance, examining their relative and synergistic effects on trust appear to be important contributions. The next section will develop the theory regarding the relative importance of reputation and Web site trust as well as their potential synergies for trust-building.

3 Theory Development

Both Web site trust and vendor reputation are important determinants of vendor trust (e.g., Ba and Pavlou, 2002; Pennington et al., 2006). In the following paragraphs, we develop rationales for (1) their relative importance regarding vendor trust and (2) their potential interaction, thus leading to superior trust.

As Web site trust and vendor reputation have different underlying sources of their effects on vendor trust, the strength of their effects on trust might differ significantly. Specifically, Web site trust is not directly associated with a vendor itself, but with its impersonal structures that have been put into place to enable consumers to anticipate successful transactions with the store. This type of trust-building mechanism establishes vendor trust indirectly through the features of the store's Web site. Reputation, in contrast, as the extent to which consumers believe that a vendor is honest and concerned about them, more directly refers to the vendor itself and its operations. Reputation captures personal experiences, vendor history, and the social presence of the store as well as its products and actions. These direct firsthand experiences along with the vendor's history provide more specific information for potential consumers to form an impression about the store than do the more indirect features of the vendor's Web site. Indeed, a trust-effective Web site only says that proper impersonal structures are in place. It does not provide as much specific and historic information about the store itself. Therefore, in the case of Web site trust, it may be more difficult for consumers to form a favorable impression toward the store.

Vendor reputation and Web site trust may also interact and hence complement each other, thus enabling superior trust. The concept of synergy is defined in the strategy and economics literature in terms of super-additive value (Tanriverdi and Venkatraman, 2005) and stems from the interaction of two or more variables. Both trust-building mechanisms could create super-additive value synergies if their interaction effect on trust is greater than the sum of their individual effects: Interaction effect (Web site trust, Vendor reputation) > Effect (Web site trust) + Effect (Vendor reputation).

To evaluate potential synergistic or interaction effects, it helps to think of one mechanism to be of limited value without the other (Shocker, Bayus, and Namwoon, 2004). For example, computer hardware is of very limited value without computer software, and vice versa. It then becomes reasonable that trust in a vendor's Web site is of limited value when personal experiences, vendor history, and social presence are low. For instance, if a potential consumer trusts a store's Web site and the vendor's ability to deliver, the consumer might still lack a perception of trust regarding the vendor's honesty and concern for its customers. Consequently, the potential consumer might keep searching for other vendors who also satisfy the other dimension of trust, given the low search costs on the internet (e.g., Grover and Ramanlal, 1999; Oh and Lucas, 2006). The vendor would thus have foregone the consumer's business, although it invested into Web site trust. Therefore, if an online store achieves high levels in one dimension, it might become more valuable to the vendor to also achieve high levels in the other dimension.

Given their similarity, we expect a small interaction between Web site trust and reputation (Porter, 2008). Thus, testing for the relative importance between the two individual effects remains an important issue since many vendors might want to invest in only one of the two antecedents to trust, given the costs for establishing both Web site trust and a good reputation. Moreover, many of those vendors intending to invest in both trust-building mechanisms might want to invest in one of them first and wait for monetary returns before investing in the other. Those vendors will then have to know which antecedent to invest in first, that is, which of the two has the greater effect on vendor trust.

4 Overview of Tasks, Design, and Methods

This study will use vendor trust as the single dependent variable, which will be regressed on two independent variables: Web site trust and vendor reputation. The independent variables will have two conditions each. These are high and low Web site trust as well as high and low vendor reputation. Vendor trust will be captured using a five-point likert-scale.

Human subjects participating in this study will be given all possible combinations (four) of conditions of the independent variables (see Figure 1) and will then be asked for their vendor trust for each of these combinations. For example, a participant might be asked how likely she would buy a specific product (e.g. a toaster) from an online store with low Web site trust on the one hand, but high reputation on the other hand. The specific design of this study will be elaborated upon in the method section.

		System/Website trust	
		low	high
Vendor Reputation	high	Rating of vendor trust on a scale ranging from 1 (very low) to 5 (very high).	Rating of vendor trust on a scale ranging from 1 (very low) to 5 (very high).
	low	Rating of vendor trust on a scale ranging from 1 (very low) to 5 (very high).	Rating of vendor trust on a scale ranging from 1 (very low) to 5 (very high).

Fig. 1. General design of the tasks

5 Hypotheses

For reasons of completeness, we will test for the individual effects of the two independent variables first, although their relationship with vendor trust has been well documented in the literature (e.g., Ba and Pavlou, 2002; Pennington et al., 2003). Thus:

H1: Vendor reputation will be positively associated with vendor trust.

H2: Web site trust will be positively associated with vendor trust.

Given the different underlying sources of trust for vendor reputation and Web site trust, we expect their effect sizes on trust to differ significantly. Specifically, as mentioned before in the theory development section, Web site trust is not directly associated with the vendor itself, but establishes vendor trust indirectly through the features of the store’s Web site. Reputation, in contrast, captures direct and firsthand experiences of consumers along with the vendor’s history and thus provides more specific information for potential consumers to form an impression about the store. Hence, it may be more difficult for consumers to form a favorable impression toward the store in the case of Web site trust. Therefore, we argue:

H3: Vendor reputation will be more effective than Web site trust in improving potential customers’ trusting beliefs in an online store.

Given the low search costs on the internet (Grover and Ramanlal, 1999; Oh and Lucas, 2006), we expect Web site trust and vendor reputation to be complementary to each other, that is, to interact. As mentioned before in the theory development section, it appears reasonable that trust in a vendor’s Web site is of limited value when personal experiences, vendor history, and social presence are low. Thus, we propose:

H4: The effect of vendor reputation on vendor trust will be higher for correspondingly high levels of Web site trust.

However, as mentioned before, we expect an only small interaction between Web site trust and vendor reputation. Thus, testing for the relative importance between the two individual effects remains an important issue.

6 Methodology

6.1 Participants

We plan for 240 voluntary participants. The study will employ a questionnaire to exclude those prospective participants whose disposition to trust is either very high or very low so as to control for participant's disposition to trust. We plan for an age range of 18 to 25 to control for possible age effects and will have the same number of males and females participate. All participants will then be tested at the same day to control for potential external effects. The ethics committee will be asked to approve the experimental protocol and we will obtain a written consent from each participant prior to conducting the tasks.

6.2 Design and Tasks

We will conduct the experiment using a randomized complete block design with two blocks including the control group. The research instrument will be a Web site that participants will visit and the data will be collected through a questionnaire that the participants are to fill out and then submit. The participants will be instructed to open carefully designed Web sites. After viewing the Web sites, they will be asked to answer the questionnaire involving their opinion regarding vendor trust. The instrument will consist of 20 different vendor Web sites: one per each combination of conditions of the two independent variables, for example high Web site trust and low vendor reputation, for five different products, that is, five replications.

Essentially, participants will visit four different Web sites per each of the five products. Those four Web sites will reflect the four different combinations of the conditions of the independent variables (see Figure 1). The Web sites will use vendor feedback rating, which is a well-established measure for vendor reputation (e.g., Ba and Pavlou, 2002; Pavlou and Gefen, 2005), to differentiate between high and low levels of reputation. The feedback rating will be shown to the participants on a scale from one star to five stars per each Web site, where more is better. Consistent with Pennington et al. (2003), five different seals, for example "Verisign" or "SafeShopping", will be used to differentiate between high and low levels of Web site trust. The different seals will be shown to the participants, where a Web site having more seals is more trustworthy. Web site trust will thus be varied by varying the number of seals shown on a site. The validity of these measures will be established using a manipulation check, as elaborated upon later in the text. The four different Web sites are described below.

- High vendor reputation and low Web site trust: This Web site will exhibit only two out of five possible different seals, but four out of five possible stars for feedback rating.

- High vendor reputation and high Web site trust: This Web site will exhibit four out of five possible different seals and four out of five possible stars for feedback rating.
- Low vendor reputation and high Web site trust: This Web site will exhibit four out of five possible different seals, but only two out of five possible stars for feedback rating.
- Low vendor reputation and low Web site trust: This Web site will exhibit only two out of five possible different seals and only two out of five possible stars for feedback rating.

The participants will visit the full set of four Web sites five times, once for each product. We will replicate the experiment using the following products: a plasma TV, a toaster, a stereo, a notebook, and a hand calculator. All products are gender-neutral. They are also brand-neutral to account for the possible trust transference of brand names to vendors.

The subjects will have to rate their perceived vendor trust on a likert-type scale ranging from 1 (Fully disagree) to 5 (Fully agree) for each combination of conditions of the independent variables. The following three items, which are adapted from Pennington et al. (2003), will have to be answered:

“Do you agree or disagree with the following statements:

1. This vendor very much appears to be one who would keep promises and commitments (would deliver goods as expected).
2. I feel very confident buying this product from this vendor.
3. I am very suspicious of this vendor.”

The participants will also fill out questionnaires pertaining to the perceived Web site trust and vendor reputation per each Web site so as to enable a manipulation check. This allows us to compare the participant’s perceptions of the levels of Web site trust and reputation of each Web site with our own conceptualization of the Web site. For the manipulation check, the participants will have to rate vendor reputation and Web site trust on a likert-type scale ranging from 1 (Fully disagree) to 5 (Fully agree). The following items, which are adapted from Pennington et al. (2003), will have to be answered for Web site trust and vendor reputation. The first three questions refer to Web site trust, while the subsequent items are meant to capture vendor reputation:

“Do you agree or disagree with the following statements:

1. Based on the appearance of this Web site, I very much believe this is a legitimate vendor.
2. I am very suspicious of this Web site.
3. On this Web site, I very much believe the proper technology has been put into place that would assure me of an error-free transaction (this Web site is functional).
4. This vendor has a very good reputation for being concerned about its customers.

5. This vendor has a quite bad reputation in the market.
6. The reputation of this vendor is very good.”

6.3 Procedure

On arrival for their session, the voluntary participants will receive information on the experimental protocol and they will provide a codified consent. Afterwards, the participants will receive instructions on how to complete the tasks and to respond as quickly and accurately as possible to the survey items. Eventually, they will evaluate vendor trust, in counterbalanced order, with ten participants randomly assigned to each of the 24 permutations of the four conditions of vendor trust. When visiting those Web sites, they will also answer the appropriate questionnaires for the manipulation check. Finally, the participants will be debriefed.

Subsequently, the data will be analyzed using structural equation modeling, which allows us to test for significant differences in the effects of the two predictors by imposing constraints on the model (Byrne, 2006). Regarding the interaction effect of vendor reputation and Web site trust, we will conduct a test of simple slopes to further understand the interaction if the interaction main effect turns out to be significant. This follow-up test will then allow us to determine how exactly the effect of vendor reputation on vendor trust varies for different levels of Web site trust.

7 Expected Results

Based on the grounding of our study in existing literature and the logical deduction of the hypotheses, we expect all of our hypotheses to be supported (see Table 1). Specifically, we expect the following results for our hypotheses:

Table 1. Expected support for hypotheses

<i>Hypothesis</i>	<i>Supported / not supported</i>
Hypothesis 1	Supported
Hypothesis 2	Supported
Hypothesis 3	Supported
Hypothesis 4	Supported

A support for all of our hypotheses implies the following effects:

- H1: A positive effect of vendor reputation on vendor trust.
- H2: A positive effect of Web site trust on vendor trust.
- H3: A higher effect of vendor reputation than Web site trust on vendor trust (see Figure 2).
- H4: A small positive interaction effect (see Figure 3).

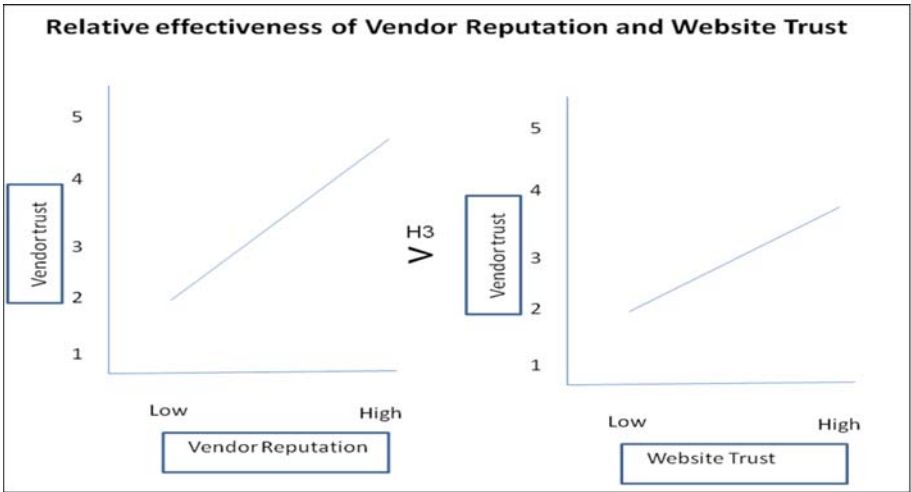


Fig. 2. Results expected for Hypothesis 3

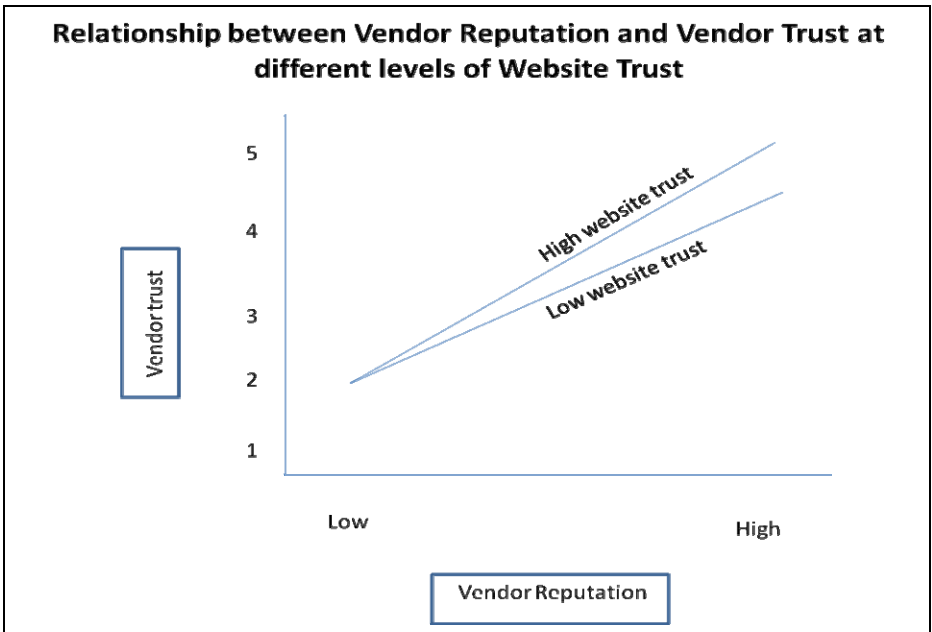


Fig. 3. Results expected for Hypothesis 4

Two aspects deserve mentioning. First, regarding the expected results for hypothesis 4, please note that the lines in figure 3 are not exactly parallel, but exhibit a small difference, that is, the slope for vendor reputation is slightly steeper for high

Web site trust. Second, we will provide the percent of variance explained along with the significance level for each hypothesis.

8 Conclusion

Given our expected results, this study will extend the literature on trust in two important ways. First, people feel different levels of trust for different trust-building mechanisms. Specifically, by the means of our study, it will have been found that firms should focus more on reputation than on Web site trust if they are not implementing both mechanisms simultaneously. This finding enables online sellers to better leverage their investments in trust-building mechanisms. This is particularly true if firms decide to implement only one mechanism and thus forego the benefits of the interaction effect due to the cost associated with its implementation.

Second, if vendors have enough monetary capital at hand to implement both trust-building mechanisms, they can leverage a small interaction effect of Web site trust and vendor reputation that will lead to greater trust than the sum of the two individual effects. In conclusion, the study refines existing literature on trust and raises awareness of the importance of a deeper understanding of existing trust-building mechanisms.

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Pricing Strategy in Online Retailing Marketplaces of Homogeneous Goods: Should High Reputation Seller Charge More?*

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Abstract. There are two conflicting streams of research findings on pricing strategy: one is high reputation sellers should charge price premium, while the other is high reputation sellers should charge relatively low price. Motivated by this confliction, this study examines pricing strategy in online retailing marketplace of homogeneous goods. We conduct an empirical study using data collected from a dominant online retailing marketplace in China. Our research results indicate that, in online retailing marketplace of homogeneous goods, high reputation sellers should charge relatively low price, because the consumers of high reputation sellers are more price sensitive than the consumers of low reputation sellers.

Keywords: Pricing strategy, price sensitivity, seller reputation, online retailing marketplace, homogeneous goods.

1 Introduction

Online retailing marketplace of homogeneous goods is a major proportion in electronic commerce. For example, according to a prediction by eMarketer (<http://www.emarketer.com/>, a market research and statistics company), the most frequently transacted goods types in American online marketplaces may be computer hardware and software, books, toys and electronic games in the year of 2010. In China, five most frequently transacted goods types on Taobao (<http://www.taobao.com>, a dominant online marketplace in China) are clothes, cell phones, commodities, PC and accessories, and laptop computers (iResearch 2008). Except clothes, these goods are all homogeneous goods with little quality and value variance.

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A key decision for sellers to make in online retailing marketplaces is to set the goods price (Oh and Lucas 2006). How should sellers price their goods to maximize their revenue? It is commonly suggested that high reputation sellers charge relatively high price, because consumers are likely to pay price premium to high reputation sellers for the benefits of low transaction risks (Ba and Pavlou 2002; Lucking-Reiley, Bryan, Prasad and Reeves 2007). Researchers have also illustrated that consumers are less price sensitive when they perceive their sellers as high reputation sellers (Ba, Stallaert and Zhang 2007; Kim and Xu 2007).

However, contrary to these common suggestions, Baylis and Perloff (2002) examined prices of a digital camera and a flatbed scanner from online retailers, and found that high reputation online retailers (the reputation is rated by Bizrate, Gomez and other shopping comparison websites) charge relatively low prices, and low reputation online retailers charge relatively high prices. Baylis and Perloff (2002) explained that there are both informed and uninformed consumers in online marketplaces. Online retailers of low reputation target only uninformed consumers, thus they charge relatively high price, while online retailers of high reputation target both uninformed and informed consumers, thus they charge relatively low price (Baylis and Perloff 2002). This price discrimination strategy can be explained by economics models, such as price dispersion model (Salop and Stiglitz 1977; Salop and Stiglitz 1982) and “tourists and the natives” model (Carlton and Perloff 2000).

Since these two streams of research findings contradict with each other, they may confuse both researchers and practitioners on the pricing strategy of homogeneous goods in online retailing marketplaces. Should high reputation sellers charge relatively high price or relatively low price? To answer this research question, we need to examine consumers’ price sensitivity in online retailing marketplace of homogeneous goods. Based on the answer to this question, we may propose some suggestions on the pricing strategy when seller reputation is given.

We conduct an empirical study to analyze the pricing strategy in online retailing marketplaces of homogeneous goods. We analyze the characteristics of online retailing marketplace of homogeneous goods, and propose several hypotheses. Then we verify our hypotheses using data collected from Taobao. We examine the relationship between consumers’ experience and their sensitivity to price, and also the relationships between consumers’ experience and their sensitivity to seller reputation. We also examine whether the high reputation sellers’ consumers are more price sensitive. Based on all these findings, we discuss seller’s pricing strategy in online marketplace of homogeneous goods.

This paper is organized as follows: in the next section, we review related theories, and propose our research hypotheses. Following this theoretical section, we introduce our research methodology, including data collection and analysis method. Afterwards, we present our research results. Finally, we conclude this paper with a discussion section.

2 Theoretical Background

2.1 Online Retailing Marketplace

Online marketplace is an “independently owned, IT-enabled intermediary” which connect sellers and consumers (Bakos 1991; Soh, Markus and Goh 2006).

Accordingly, online retailing marketplace is the online marketplace where goods are retailed rather than auctioned. In online retailing marketplaces, sellers publish goods offerings (including price and quality information) on the marketplace platform; consumers search, browse and compare goods offerings, and purchase goods from sellers. Examples of online retailing marketplace include Amazon.com and Taobao.com. Besides, eBay, the most prevalent online auction marketplace, has also cut its “Buy-It-Now” fees in the August of 2008 to encourage retailing in its marketplace.

2.2 Search Costs in Online Retailing Marketplace

It is commonly recognized that online marketplace sharply reduces consumers’ search costs compared with conventional marketplace (Brynjolfsson and Smith 2000). In online marketplace, consumers only have to do a few clicks to search, browse and compare goods offerings from different sellers (Bakos 1997; Clemons, Hann and Hitt 2002; Zhang, Fang and Sheng 2006). However, online retailing marketplace also increases the difficulty for consumers to make purchase decisions. There are mainly two reasons: “overloaded” goods offerings and insufficient quality information.

On one hand, online retailing marketplaces usually have “overloaded” goods offerings for consumers to choose. Two characteristics of online marketplace make its goods offerings becoming “overloaded”. First, online marketplace attracts plenty of sellers for its low set-up costs and operation costs. Sellers do not have to set up a “brick-and-mortar” storefront and hire clerks to conduct transactions (Zhang 2006). Therefore, it is easy for any participant to start a business in online retailing marketplaces. Second, inventory in online retailing marketplace is distributively held by all the sellers. This distributive nature of inventory allows online retailing marketplace to have a massive content storage and almost infinite number of listings (Zhang 2006). For example, there were more than 460 thousands online game card offerings, more than one million brand new cell phone offerings and even more than 18 million female clothes offerings on Taobao (the data were observed on 13-February-2009). Even when consumers search for some specified goods, they can still find hundreds or even thousands of goods offerings. For example, if consumers search “Nokia N73” in “Cell Phone > Nokia > N73” category, they still can get more than 6,000 offerings. Obviously, the information in the thousands of goods offerings are beyond the information processing capability of online consumers. Without the help from some IT facilities, consumers may not be able to make optimum or even reasonable purchase decisions based on so abundant information.

On the other hand, the insufficient goods quality and seller trustworthiness information in online marketplace also increase the difficulty for consumers to make purchase decision (Andrews and Benzing 2007; Snijders and Zijdemans 2004). In online retailing marketplace, consumers can only examine goods quality via electronic quality cues (such as item descriptions, pictures, videos and other multimedia information posted by seller and other consumers) (Josang, Ismail and Boyd 2007; Kauffman and Wood 2006). They lose the opportunity of examining goods via traditional cues, such as observation, touch, taste and trial.

In online retailing marketplace, sellers and consumers are usually strangers before transactions (Resnick and Zeckhauser 2002). It is difficult for consumers to know

whether sellers are trustable. Sellers can hide their behaviors under the mask of a meaningless electronic ID, and also can easily cheat and exit from the marketplace (Kalyanam and McIntyre 2001). Furthermore, the separation of payment and delivery also offers great chances for sellers' opportunistic behavior (Andrews and Benzing 2007). These uncertainties involve consumers into great risks of online transactions. Before making purchase decisions, consumers have to carefully evaluate and compare sellers' trustworthiness as well as transaction risks. Thus, even though alternative goods offerings are just a few clicks away, it still costs much for consumers to find a proper goods offering from an "endless" goods offering list.

2.3 IT Facilities in Online Retailing Marketplace

Because the goods offerings in online retailing marketplace are "overloaded" and quality information is insufficient, consumers may have to pay high search costs if they hope to browse and compare all the goods offerings. To maximum their utility, consumers should be able to (1) accurately verify seller trustworthiness and goods quality, and (2) efficiently narrow down the search range of goods offerings. Online retailing marketplace also offers IT facilities in these two perspectives.

IT facilities for verifying seller trustworthiness and goods quality include reputation system, peers' forum, third party certification and escrow services. Reputation system is the most frequently adopted IT facility in online marketplace in signaling seller trustworthiness (Josang, Ismail and Boyd 2007). The reputation system calculates a reputation score for each seller based on consumers' ratings on the seller's performance, and then new consumers can identify trustworthy sellers through comparing sellers' reputation scores. They also can further verify sellers' trustworthiness and goods quality by the detailed information obtained from peers' reviews (from reputation system or peers' forum). Besides, consumers also can use third party services, such as third party quality certification (Dewally and Ederington 2006) and escrow service (Antony, Lin and Xu 2006; Hu, Lin, Whinston and Zhang 2004), to verify and guarantee sellers' trustworthiness and goods quality.

Online retailing marketplace also adopted several IT facilities in helping consumers to narrow down the search range of goods offerings. These IT facilities include basic search engines, advanced search engines, goods categories, search results sorting mechanisms, and goods comparison mechanisms. Generally, consumers can search their desired goods offerings by keywords via basic search engines. They also can search goods with specified characteristics using advanced search engines, and filter the search results using goods categories. Furthermore, consumers also can sort the search results of goods offerings according to price or seller reputation (or other criterion), and then selectively view the goods offerings of low prices or the goods offerings from high reputation sellers. They also can compare the goods offerings of interests via goods comparison mechanisms.

Obviously, it requires knowledge and skills for consumers to use these IT facilities. Consumers' abilities and experiences of using these IT facilities will influence their search costs and perceived difficulties in making purchase decisions, and then influence their browse and purchase behavior.

2.4 Experienced and Inexperienced Consumers

Traditional price dispersion studies modeled consumers as informed and uninformed consumers (Salop 1977; Salop and Stiglitz 1977; Varian 1980). Informed consumers are efficient searchers and have low search costs. They know the whole distribution of prices and the lowest available price, so that they can directly purchase the goods of lowest price without searching any of the stores (Varian 1980). Uninformed consumers are inefficient searchers and have high search costs (Salop 1977). They randomly visit stores, and then purchase from a store with goods price lower than their reservation price (Salop 1977). Similarly, in online retailing marketplace, we also can classify consumers as experienced and inexperienced consumers, according to their abilities and experiences of using IT facilities. We use the terms of “experienced” and “inexperienced” rather than “informed” and “uninformed”, because there are no definitely informed or uninformed consumers in real online marketplace.

Generally, consumers who have conducted more transactions in the online retailing marketplace are more likely to be experienced consumers, while new registers in the online marketplace are usually inexperienced consumers. On Taobao, more than 40 percent of online consumers in each year are new registers.

Compared with inexperienced consumers, experienced consumers are more familiar with the transaction platform and IT facilities in online retailing marketplaces. They are more likely to use accurate keywords, adopt advanced search engines, filter the search results via goods categories and sort the goods offerings according to goods price or seller reputation. Therefore, experienced online consumers are more likely to know the range of goods prices and seller reputations, and also the lowest goods price and the highest seller reputation. Contrarily, inexperienced consumers are less likely to possess the skills. If inexperienced consumers do not possess these skills, it is nearly impossible for them to know the range of goods prices and seller reputations when they face thousands of goods offerings. They may randomly browse the goods offerings in their search results, and choose one to purchase when the goods price is less than their reservation price. Moreover, because inexperienced consumers are less likely to know the distribution of seller reputation (they may be even unfamiliar with the reputation system), they are also less likely to be sensitive to seller reputation too.

In summary, experienced consumers are more likely to have the ability to choose goods of low prices and from high reputation sellers, while inexperienced consumers are less likely to have the abilities. Therefore, we hypothesize:

Hypothesis 1: In online retailing marketplace of homogeneous goods, experienced consumers (vs. inexperienced consumers) are more likely to browse and purchase low price goods.

Hypothesis 2: In online retailing marketplace of homogeneous goods, experienced consumers (vs. inexperienced consumers) are more likely to browse and purchase goods from high reputation seller.

2.5 Price Sensitivity and Seller Reputation

As we discussed in the previous subsection, experienced consumers selectively browse and purchase goods offerings from high reputation sellers, while inexperienced consumers randomly browse among all of the goods offerings (Salop 1977; Varian 1980). Therefore, high reputation sellers can attract both experienced and inexperienced consumers, while low reputation sellers can only attract inexperienced consumers. Combining this consideration with hypothesis 1 (i.e. experienced consumers are more price sensitive than inexperienced consumers), we can infer that, on average, the consumers of high reputation sellers are more price sensitive than the consumers of low reputation sellers. There are several empirical evidences which can support this inference. For example, Baylis and Perloff (2002) observed the prices of digital cameras and flatbed scanners from online retailers, and found that low reputation online retailers charge relatively high prices, while high reputation online retailers charge relatively low prices. In a field experiment, Jin and Kato (2006) found that low reputation sellers target less experienced consumers and claim high quality to seize more revenues.

Notice that there are also some studies about online auction marketplace indicated that consumers are likely to pay price premium to high reputation sellers for the benefits of low transaction risks (Ba and Pavlou 2002; Lucking-Reiley, Bryan, Prasad and Reeves 2007). However, these conclusions were generated based on empirical data from online auction marketplace, and these conclusions may not match in our research context, i.e. online retailing marketplace of homogeneous goods. There are several reasons. First, the goods in online auction marketplace, such as arts (Highfall and O'Brien 2007), collections (Jin and Kato 2006; Kauffman and Wood 2006; Resnick, Zeckhauser, Swanson and Lockwood 2006) and second hand goods (Wolf and Muhanna 2005), are usually of large quality variance. Comparatively, the quality variance of homogeneous goods in online retailing marketplace is quite low. In the case of low goods quality variance, reputation has relatively weak or even no effects on final price (Lee, Im and Lee 2006; Ruiz 2004; Wan and Teo 2001). Second, studies in online auction marketplace overlooked the competition between sellers (Ba and Pavlou 2002; Kim and Xu 2007; Lucking-Reiley, Bryan, Prasad and Reeves 2007). Compared with online auction marketplace, online retailing marketplace of homogeneous goods is a high competitive marketplace. As we observed in Taobao, there are usually hundreds or even thousands of sellers who are retailing the same goods. In such a situation, a slight increase in price may drive away lots of consumers, especially experienced consumers.

Conclusively, in online retailing marketplace of homogeneous goods, we predict that the consumers of high reputation sellers are more price sensitive than the consumers of low reputation sellers on average:

Hypothesis 3: In online retailing marketplace of homogeneous goods, the consumers of high reputation sellers are more price sensitive than the consumers of low reputation sellers on average.

Based on hypothesis 3, we may suggest that high reputation sellers should charge relatively low price (because their consumers are more experienced and price sensitive on average), and low reputation sellers should charge relatively high price

(because their consumers are inexperienced and less price sensitive). We will verify our hypotheses using field data collected from Taobao, and then we will discuss sellers' pricing strategy based on the empirical findings.

3 Data

3.1 Data Collection and Variables

We use field data collected from Taobao to verify our hypotheses. Taobao is the largest online retailing marketplace and the second largest marketplace in China. It has more than 80 million registered users. Its annual revenue (RMB43.3 billion) in 2007 overran the revenue summation of local Carrefour and Walmart. Moreover, the online marketplace platform of Taobao is similar to other prevalent online marketplaces, such as eBay and Yahoo! Kimo. These representative characteristics of Taobao may enhance the generalizability of our study.

We use World of Warcraft (WOW) game 600 points card as the representative of homogeneous goods. World of Warcraft is a popular online game developed by Brizzard. Its game card in online marketplace is actually a game fee recharging service. There are several advantages in using this type of goods. First, the game card is virtual goods and almost completely homogeneous. There is no quality variance among individual cards. The only difference between cards from different sellers is the seller characteristics (location, services, and reputation). Second, because game card is virtual goods, no shipment fee will be charged. Therefore, sellers' geographical distribution will not influence consumers' purchase decision. Third, the services related to game cards are also quite simple. There are usually two types of services related to game cards retailing. The first one is a type of guarantee service from Taobao. The content of the guarantee service is that Taobao will return payment to consumer with priority when there is a dispute in a transaction. The second service is thunder delivery, which requires sellers to deliver the goods within specified time duration (for example, 2 hours). We can easily observe and control these services in our study. After controlling these factors, the only differences between goods offerings are goods price and seller reputation.

We used a spider program to collect data from Taobao on 11-November-2008. We have collected 2502 goods offerings of "WOW Game Card 600 Points". At the first step, we collected information of all the goods listings. From the listings, we collected goods id, goods name, goods price (*PRICE*) and goods services (dummy variables, *GGUARANT* and *GTHUNDER*). After the first step, our spider program "clicked into" each goods description page. From each item description page, we collected the number of hours since the item was posted (*CURRTERM*), the number of visitors (*NVISIT*) and the number of sales (*NSALE*) in the current sale term and the seller's reputation score (*RP_TOTAL*). As suggested in several empirical studies (Livingston 2005; Melnik and Alm 2005), reputation has a decreasing marginal effect on transaction outcomes, thus we used the natural logarithm of seller's reputation score plus 1 ($LN_RP = \log(RP_TOTAL + 1)$) to measure sellers' reputation. Before conducting any analysis, we removed 10 extremely abnormal data points (for example, there was one consumer who has purchased thousands of cards at the highest price from a new seller). Finally, we have 2492 data points in total.

We also collected data on consumer experience. In the end of each goods description page, Taobao lists the purchase records in the latest one month. The purchase records include consumer name, range of consumer “reputation score”, quantity of purchased goods, price and whether the transaction is successful. Consumers’ “reputation score” is similar to sellers’ reputation score, which is rated by sellers after each transaction. It commonly equals to the number of transactions the consumer has made in the marketplace. We collected the latest 50 purchase records for each goods offering (for the goods offerings which have less than 50 purchase records, we collected all the purchase records), and calculated the average range of consumers’ reputation score for each goods offering. Totally we collected 1,459 pieces of consumers’ “reputation score” data (the other 1,033 goods offerings have never been transacted in the latest one month before 11-November-2008). We use the average low bound of consumers’ reputation score (*AVELOWRP*) as a proxy variable of consumer experience.

The variables we collected are described in Table 1, and a simple descriptive analysis of our data is illustrated in Table 2.

Table 1. Descriptions of Variables

Variables	Descriptions
<i>NVISIT</i>	The number of visitors who have browse the goods description page in the sale term
<i>NSALE</i>	The number of goods pieces which have been sold in the sale term
<i>PRICE</i>	Price of the goods
<i>RP_TOTAL</i>	Total reputation score (equals to number of positive ratings minus number of negative ratings) of the seller
<i>LN_RP</i>	Natural logarithm of <i>RP_TOTAL</i> plus 1
<i>CURRTERM</i>	The number of days since the listing of the goods offering was posted
<i>GGUARANT</i>	Whether the seller has join the consumer protection program; 1 means yes.
<i>GTHUNDER</i>	Whether the goods will be automatically delivered immediately; only for virtual goods; 1 means yes.
<i>AVELOWRP</i>	Average low bound of consumers’ experience score.

Table 2. Descriptive Statistics

	N	Minimum	Maximum	Sum	Mean	S.D.
<i>NSALE</i>	2492	0	244	8626	3.46	13.21
<i>NVISIT</i>	2492	0	320	12059	4.84	18.48
<i>PRICE</i>	2492	26.5	30	67364.50	27.03	0.60
<i>RP_TOTAL</i>	2492	0	137989	8869054	3559.01	9751.58
<i>LN_RP</i>	2492	0	11.83	14198.46	5.70	2.59
<i>CURRTERM</i>	2492	0	14	12348	4.96	3.41
<i>GGUARANT</i>	2492	0	1	615	0.25	0.43
<i>GTHUNDER</i>	2492	0	1	201	0.08	0.27
<i>AVELOWRP</i>	1459	0	501	50475	34.60	33.72

3.2 Analysis Method

To verify hypothesis 1 and hypothesis 2, we conducted a regression on consumer's experience (LN_EXP , equals to natural logarithm of $AVELOWRP$ plus 1). The independent variables include seller reputation (LN_RP) and goods price ($PRICE$). To verify hypothesis 3, we conducted regressions on the number of visits ($NVISIT$) and the number of sales ($NSALE$) separately. We examined the regression coefficient of the interaction term between goods price and seller reputation on these two dependent variables. We controlled the length of sales term ($CURRTERM$) and seller services ($GGUARANT$ and $GTHUNDER$) in these two regression models. Furthermore, we also controlled the number of visits ($NVISIT$) in the second regression model. To avoid the scale of variables influence the regression coefficients of the interaction term, we standardized all the variables in the regression models (Aiken and West 1991).

We used linear regression method in our study for the convenience of examining and interpreting interactions between variables (Aiken and West 1991). Furthermore, because the dependent variables ($NVISIT$ and $NSALE$) in our study are count variables, we also used Poisson Regression method to test the robustness of our regression results (Greene 2008). Poisson regression method is used in the situation when dependent variable is a discrete variable, which in most cases will equals zero, and in other cases will takes a positive value (Greene 2008).

4 Results

We illustrate our regression results in Table 3. The regression results in the second column show the relationship between goods price, seller reputation, and consumers' experience. We find that the regression coefficient of goods price ($ZPRICE$) is significantly negative ($-0.206, p < 0.01$). This means that the consumers of low price goods are on average more experienced than the consumers of high price goods. Thus, hypothesis 1 is supported. We also find that the regression coefficient of seller reputation (logarithm transformed, ZLN_RP) is significantly positive ($0.327, p < 0.01$). This indicates that the consumers of high reputation sellers are on average more experienced than the consumers of low reputation sellers; in other words, experienced consumers are more likely to purchase from high reputation sellers. Therefore, hypothesis 2 is also supported.

Column 3 (linear regression) and column 4 (Poisson count regression) show the results of regression on the number of visits, and column 5 (linear regression) and column 6 (Poisson count regression) show the results of regression on the number of sales. Because the regression results of these four models are quite similar, we discuss them together. First, we find that the regression coefficients of goods price ($ZPRICE$) on both the number of visits and the number of sales are significantly negative, and the regression coefficients of seller reputation (logarithm transformed, ZLN_RP) on both of the two dependent variables are significantly positive. These results indicate that consumers are more likely to browse and purchase goods of low price and from high reputation sellers. Second, more importantly, the regression coefficients of the interaction term ($ZLN_RP * ZPRICE$) in all the four models are significantly negative. This indicates that price has stronger negative effects on the number of visits and the

Table 3. Regression Results

DV	<i>ZLN_EXP</i>	<i>ZNVISIT</i>	<i>NVISIT</i>	<i>ZNSALE</i>	<i>NSALE</i>
Model	LS	LS	Poisson Count	LS	Poisson Count
<i>C</i>	0.000	-0.072***	0.738***	-0.049**	0.495***
<i>ZCURRTERM</i>		0.060***	0.278***	0.079***	0.421***
<i>GGUARANT</i>		0.162***	0.509***	0.036	0.407***
<i>GTHUNDER</i>		0.181**	0.540***	0.322***	0.698***
<i>ZNVISIT</i>				0.489***	0.183***
<i>ZLN_RP</i>	0.327***	0.063**	0.149***	0.059***	0.251***
<i>ZPRICE</i>	-0.206***	-0.159***	-1.625***	-0.085***	-0.943***
<i>ZLN_RP*ZPRICE</i>		-0.085***	-0.570***	-0.070***	-0.447***
N	1459	2492	2492	2492	2492
R2	0.164	0.037	0.104	0.291	0.115
Adjusted R2	0.163	0.034	0.102	0.289	0.112
F-Statistic	142.178***	15.696***		145.767***	
LR-Statistic			8981.798***		11781.020***

Notes: * means significant at 0.1 level, ** means significant at 0.05 level, and *** means significant at 0.01 level (double-tailed).

“Z” before each variable name means the variable in the regression is standardized.

number of sales for high reputation sellers than for low reputation sellers. In other words, consumers who browse or purchase goods from high reputation sellers are more price sensitive than consumers who browse or purchase goods from low reputation sellers.

In the left part of Figure 1, we plot the regression lines of the linear regression model on the number of visits (column 3) at low and high levels of seller reputation (i.e., at the mean plus and minus one standard deviation). The figure illustrates that price has negative effect on the number of visits both in the cases of low seller reputation (the slope is -0.073 , $p < 0.01$) and high seller reputation (the slope is -0.244 , $p < 0.01$). However, the impact of goods price on the number of visits when seller has high reputation is stronger than when seller has low reputation. We also plot the regression lines of linear regression on the number of sales (column 5) at low and high levels of seller reputation in the right part of Figure 1. The figure shows that, when sellers have low reputation, consumers are insensitive to goods price (the slope is -0.015 , *n.s.*); when sellers have high reputation, the number of sales is negatively influenced by goods price (the slope is -0.156 , $p < 0.01$). Therefore, consumers who purchase from high reputation sellers are more price sensitive than consumers who purchase from low reputation sellers. In summary, the regression results indicate that the consumers of high reputation sellers are more price sensitive than the consumers of low reputation sellers when they browse or purchase goods. Hypothesis 3 is supported.

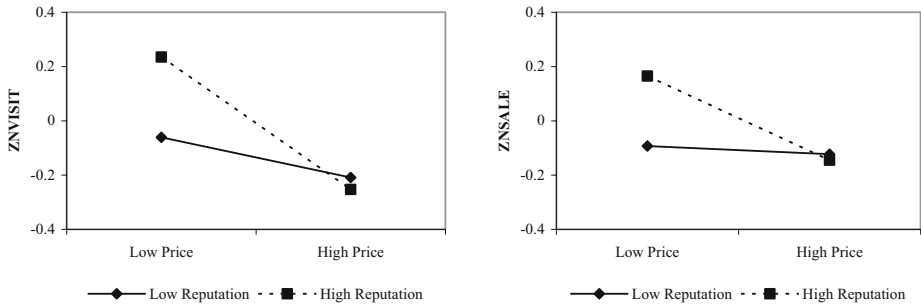


Fig. 1. Interaction effects between goods price and seller reputation on number of visit and number of sales

5 Discussions

In this paper, we verified consumers' price sensitivity in online marketplace of homogeneous goods, using sales data of WOW game cards collected from Taobao. We found that (1) low price goods offerings attract experienced consumers; (2) high reputation sellers attract experienced consumers, and (3) the consumers of high reputation sellers are more price sensitive than the consumers of low reputation sellers. Based on our findings, we may suggest that high reputation sellers should charge relatively low price to attract experienced consumers, while low reputation sellers should charge relatively high price because their consumers are inexperienced and less price sensitive.

Our study deepens the understandings on the effects of seller reputation in online marketplace. It is commonly recognized that the consumers of high reputation sellers are less price sensitive, so that they are likely to pay price premium to high reputation sellers (Ba and Pavlou 2002; Lucking-Reiley, Bryan, Prasad and Reeves 2007). Contrarily, our study reveals that, in online retailing marketplace of homogeneous goods, the consumers of high reputation sellers are more price sensitive than the consumers of low reputation sellers. The contradiction is possibly because of the differences between online auction marketplace and online retailing marketplace. Previous findings were usually derived from online auction marketplace. Goods in online auction marketplace are usually heterogeneous, and goods prices are unknown before auction is finished. These characteristics increase the difficulty for consumers to compare goods offerings in online auction marketplace. Differently, online retailing marketplace of homogeneous goods is a high competitive marketplace. If a high reputation seller try to increase the goods price to seize price premium, experienced consumers can easily switch to other high reputation sellers who offer the same goods with lower price. Therefore, sellers in online retailing marketplace of homogeneous goods should be cautioned if they hope to increase goods price to seize price premium.

Although existing studies usually stressed the reduced search cost and transparent marketplace characteristics of online marketplace (Bakos 1997; Brynjolfsson and Smith 2000), our study illustrates that there are still search costs in online retailing

marketplace of homogeneous goods. The search costs are caused by “overloaded” goods offerings, insufficient quality information, and consumers’ knowledge and skills in using IT facilities in online marketplace. Consumers thus can be discriminated by their search costs. Experienced consumers (with low search costs) are more sensitive to both seller reputation and goods price than inexperienced consumers (with high search costs). When existing studies of online marketplace treated the marketplace as a whole (Bakos 1991; Soh, Markus and Goh 2006), our findings suggest that researchers in future may dive into the inside of online marketplace (e.g., by considering the different consumer segments in online marketplace). It will be more insightful to study the online marketplace from a deeper perspective.

Our study is quite preliminary in examining pricing strategy in the online retailing marketplace. There are some other factors which may influence consumers’ price sensitivity as well as sellers’ pricing strategy, such as the homogeneity of goods, goods value, the proportion of experienced consumers, the convenience of IT facilities, the level of market transparency and the competition in the marketplace. Future research should also examine the effects of these factors on consumers’ price sensitivity, and discuss pricing strategy in different settings.

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Secure Mobile Support of Independent Sales Agencies

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Abstract. Sales agents depend on mobile support systems for their daily work. Independent sales agencies, however, are not able to facilitate this kind of mobile support on their own due to their small size and lack of the necessary funds. Since their processes correlate with confidential information and include the initiation and alteration of legally binding transactions they have a high need for security. In this contribution we first propose an IT-artifact consisting of a service platform that supports multi-vendor sales processes based on previous work. We then analyze use cases of sales representatives of independent sales agencies using this system and derive their security requirements. We then propose a security extension to the IT-artifact and evaluate this extension by comparing it to existing solutions. Our results show that the proposed artifact extension provides a more convenient and secure solution than already existing approaches.

Keywords: Independent sales agencies, mobile services, security, design science.

1 Introduction

Sales agents depend on mobile support systems for their daily work. In the food industry for example sales agents use highly integrated mobile devices that allow order processing and barcode scanning to improve the productivity significantly (Walker and Barnes 2005). Usually these systems are connected to a customer relationship management (CRM) or enterprise resource planning (ERP) system at the vendor's site. Solutions that support the mobile workforce with online access to the corporate network typically require sophisticated techniques and mechanisms, as business transactions have inherently strong requirements with respect to security (Haller, Robinson, Walter and Kilian-Kehr 2002). Large companies with central IT management and a strategic commitment are able to facilitate this kind of mobile support. Due to their size and their common processes, these companies can choose from a broad range of systems to support them (Benz, Ritz and Stender 2003). In addition they can undertake the necessary steps to build a proper infrastructure for authentication and access management and secure the mobile access to their backend (Karjoth 2003).

Independent sales agencies (ISA), on the other hand, are not able to facilitate this kind of mobile support on their own. According to (Kokemüller, Kett, Höß and Weisbecker 2008) these agencies have an average of 4.1 employees not counting the owners of the agency. Additionally, 96% have no more than 5 field workers with the average being 1.7. Therefore, most independent commercial agencies clearly qualify as micro-sized enterprises. Due to their small size and lack of the necessary funds they are not able to build and maintain the required infrastructure (Kokemüller et al. 2008). Yet ISAs would largely benefit from mobile support such as mobile access to last minute information, the ability to perform documentation duties and transactional access to distributed backend systems. Furthermore, 93% of those agencies operate for more than one supplier (Kokemüller et al. 2008) causing the need to support multi-vendor sales processes. Therefore, there should be a demand for a system that supports multi-vendor sales processes, provide the necessary amount of security and is yet affordable to small size enterprises. Due to the integration of multiple legacy systems of different vendors such a mobile support system has to address a highly heterogeneous environment while still being reasonable economic. To our knowledge solutions that satisfy these needs are currently not available on the market. Therefore, systems that solve the problems of typical small ISAs still bear large opportunities both in research and on the market. In this contribution we analyze the security requirements of such a system and discuss possible implementations to fulfill them.

The rest of the paper is structured as follows. We begin with an outline of our methodological approach. We then present a detailed description of the application scenario for a mobile support system. We continue with a use case analysis for sales representatives of independent sales agencies. Based on these use cases we derive security requirements of this system. We propose an extension to the mobile support system to fulfill these security requirements and evaluate it against other already existing approaches before we summarize our results.

2 Methodological Approach

Design science research contributions present novel IT-artifacts and suitable evaluation approaches that address the artifact's appropriateness to contribute to the problems' solution (Nunamaker, Chen and Purdin 1991). These two facets of rigorous design science-oriented research contribute to the foundations and the methodologies pool of Information Systems research, i.e. they contribute to its knowledge base (Hevner, March, Park and Ram 2004). In our work we follow this research paradigm. We first addressed the introduced problem (mobile support for independent sales agencies) with a system design providing a technological basis for mobile support of multi-vendor sales processes. This system represents an IT artifact instantiation that aims at contributing to the problem's solution, demonstrates the feasibility of the approach and has been presented in (Kokemüller et al. 2008).

In this contribution we take a close look at the mobile support component and its security requirements. We start by providing an extensive description of the problem domain by conducting a use case analysis for sales representatives of independent sales agencies. We then derive security requirements based on these use cases. We address these requirements by proposing a security extension to the IT-artifact, which

forms a new IT-artifact itself. This new IT-artifact is evaluated by comparing it to already existing solutions. This evaluation is provided in form of an informed argument based on the derived security requirements, which is according to (Hevner et al. 2004) a suitable descriptive method for the evaluation of an IT-artifact. Therefore, we follow the classic approach of design science-oriented research as we first developed an IT artifact and we second provide an evaluation of the artifact.

3 System Overview

Independent sales agencies are companies that represent one or more vendors. Their employees are sales representatives who offer the vendor’s products to the customers. These products vary from standard products that can be ordered from a catalog to highly individualized products manufactured to the specific needs of a customer (Dolmetsch 2000). Independent sales agencies can be categorized in two dimensions. One dimension is their territorial exclusivity or lack of it. Sales agencies that have territorial exclusivity are the only representation of a specific vendor in a particular territory. They may still represent more than one vendor in that territory if the products are not competitive but no other sales agency is permitted to represent the vendor in that territory. ISAs without territorial protection still possess customer protection. Therefore, they receive a commission if they provide at least a minor contribution to a transaction leading to a payment. The second dimension is the power of contract. ISAs who possess this power are able to act in the name of the vendor and

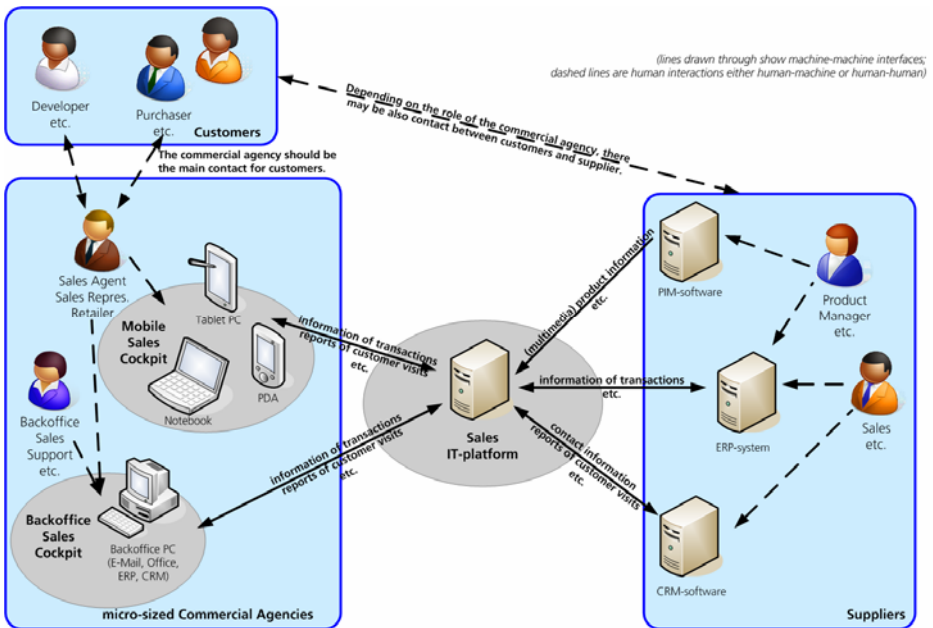


Fig. 1. Overview of the mobile support system and the participating parties

to execute a declaration of its intention. These are legally binding to the vendor. Both of the discussed dimensions can have different values for a particular ISA, depending on each vendor the ISA represents. Independent sales agencies generate revenue by receiving commissions for each transaction of the corresponding vendor that is legally connected to a payment. For ISAs with territorial exclusivity all revenue created in the granted territory yield to accrued commission

The project M3V (www.m3v-projekt.de) which is funded by the Federal German Ministry of Economy and Technology focuses on the design and development of a mobile multi-supplier sales information platform which electronically supports the sales processes between ISAs, their suppliers and their customers. This mobile support system is hosted by a service provider, who integrates the legacy systems of the vendors (Kokemüller et al. 2008). Figure 1 gives an overview of this scenario.

4 Collaborative Multi-vendor Sales Processes

Starting from the known processes we derived the central use cases the platform has to fulfill. In the following we present a short overview of these use cases. A more detailed description of the processes and use cases can be found in (Kett, Kokemüller, Höß, Engelbach and Weisbecker 2008).

Use Case 1: Management of customer data. The sales representatives should be able to manage the data of the customers. This data comprises of address data of the customer, the data of the contact persons and possibly personal remarks of the sales agent. While the personal remarks should only be accessible for the particular sales agent who wrote them, the address data should be readable for all members of the sales agency.

Use Case 2: Visit reports. To ensure the vendor that it provides a complete and thorough coverage of the assigned territory the sales agency produces a report after each visit to a customer. In this report the sales agency provides information about the topics tackled, possible leads that should be followed in the future and general information about the customer. These visit reports are important in the case of ISAs without territorial exclusivity, because all revenues generated where an involvement of this ISA can be documented yield to accrued commission for the ISA. Additionally visit reports are important in the case of ISAs with territorial exclusivity, to demonstrate their activity in the granted territory.

Use Case 3: Recall of the customer's history. For the preparation of a visit a sales representative should be able to check the history of the customer. This includes prior visit reports, to refresh the information on potential leads to pursue during the sales visit. The knowledge of current transactions such as outstanding payments or expected deliveries can also be very beneficial.

Use Case 4: Access to catalog data. Especially standard products can be held in catalogs. Vendors often grant different sales privileges on their products to different ISAs. The catalogs may differ in the assortment, the prices or the bargain limits. Therefore, the catalog of a specific ISA in the platform is unique and not shared between ISAs representing the same vendor. From the catalog the ISA creates a

request for quotation. This might include unstructured data to request a quote that exceeds the privileges granted.

Use Case 5: Unstructured requests for quotation. ISAs are often not able to provide a concise request for quotation. This is especially the case in regard to highly complex products, which might be specifically tailored for each customer. In order to create the request for quotation, the ISA composes an unstructured document describing the needs of the customer, requesting that the vendor might provide an elaborate quote.

Use Case 6: Creation of quotes. If a vendor has assigned power of contract to an ISA the sales representative can provide quotes to the customer, which when accepted will result directly in an order. As a consequence the details of the order are legally binding to the vendor.

5 Security Requirements

Having identified the relevant use cases for the presented scenario, we are now able to analyze their security requirements. For our analysis we used the confidentiality, integrity, and availability (CIA) triangle that forms the fundamental basis of IT security (Swanson 2001; Kesh and Ratnasingham 2007). We also added the security goal of accountability (Pfitzmann 2006) to our analysis. As the platform is used to perform transactions on sensible business data, confidentiality of the data transferred should be preserved at all times (Ghosh and Swaminatha 2001). Therefore, we can formulate a first general security requirement for the platform:

Requirement 1: The confidentiality of transferred data should be preserved at all times.

Since the mobile sales representatives are located outside the security domain of the service provider it is very important to make sure that access to this information service is appropriately secured (Schulz 2007). Therefore, access to the information service should only be granted to clients that have been securely identified and authenticated (Clarke and Furnell 2007). This leads to a second general security requirement.

Requirement 2: Access to the service platform should only be granted to clients that have been securely identified and authenticated.

We will now further elaborate the additional security requirements for each use case defined above.

5.1 Management of Customer Data

Since customer data is a vital asset of any sales agency, it is important that updates of the customer data are performed exactly as they are entered by the sales representatives using their mobile devices. Therefore, we can formulate a requirement for the management of customer data.

Requirement 3: The service platform should provide means to detect violations of the integrity of transferred customer data.

The availability of the service platform is not critical for this particular use case. It can be addressed sufficiently by synchronizing the data later on. Using synchronization might reduce the service quality, because updates are held back, until the sales representative has a connection to the platform. This could even lead to a possible delay of several hours before an update is performed. However, this is only a concern if another person needs to access this data in the meantime. As the sales representative is the main contact person of the vendor at the customer's site, this is possible but not very likely. Also the accountability of the performed transactions is, apart from the proper authentication addressed by Requirement 2, not mission critical for this use case.

5.2 Visit Reports

Visit reports are important documents to both, the vendor and the sales representative. They provide information on upcoming sales opportunities and document the customer's situation. Often quotes are generated based on the information that was initially part of a visit report. If this information is altered during the transmission from the sales representative to the service platform, this could lead to monetary losses of vendors or the sales agency due to missed business opportunities. As a consequence any violations of the integrity of these reports must be recognized by the service platform.

Requirement 4: The service platform should provide means to detect any violations of the integrity of visit reports.

Similarly, as visit reports can be documents that prove the involvement of a sales representative in a sales activity that leads to accrued commission, accountability of these reports is of major importance even beyond the proper authentication addressed in Requirement 2. Several levels of accountability are possible. First of all non-repudiation of the visit report should be provided by the service platform. This leads to another requirement.

Requirement 5 The service platform should provide means to ensure that the origin of the visit reports can not be reputed.:

In addition, a trustworthy documentation of the date and time the visit report was generated is desirable. This could be provided by the service platform. Optionally a proof of the location where the visit report was generated could also be offered by the service platform. Similar to the management of customer data use case, seamless availability of the service platform is not of major importance. A time spread between the generation of the visit report and its delivery reduces the service quality but does not circumvent the use case. However, if a trustworthy documentation of the time of the visit report generation is performed it will register the time of the synchronization and not necessarily the time of the actual generation. This should not pose a significant problem, since the documentation of these reports is rather a matter of dates than of actual time.

5.3 Recall of the Customer's History

The access to the customer's history is crucial to the sales representative in the preparation of a visit. Naturally, the integrity of the accessed data is of major importance. Therefore, the service platform should provide means to detect violations of the integrity of the data, which leads to another requirement.

Requirement 6: The service platform should provide means to detect any violations of the integrity of the customer's history.

Apart from the proper authentication addressed in Requirement 2 no further form of accountability is required for this use case. Obviously, availability of the customer history is a prerequisite for this particular use case. The sales representative needs this information when requesting it, whether it is in the back-office or at the parking lot at the customer's location. The lack of this information circumvents this use case. Therefore, the service platform should provide means to ensure that the customer data is available to the sales representative.

Requirement 7: The service platform should provide means to ensure that the customer data and history is available to the sales representative.

Furthermore, since updates to the customer history could occur while the sales representative is already on the road, the service platform should undertake steps to keep the data as up-to-date as possible.

5.4 Access to Catalog Data

This use case has similar security requirements as the recall of the customer data and history. It is important that changes to the data during transmission can be detected and therefore the service platform should provide the necessary means for it.

Requirement 8: The service platform should provide means to detect any violations of the integrity of the catalog data.

Also no form of accountability beyond the proper authentication is mandatory. The availability of the service platform that is required by this use case is dependent on the frequency of catalog changes. If the catalog data remains rather static, synchronization at the office should be sufficient. A high volatility of the catalog data, however, would require periodic updates and therefore a high degree of availability. This leads to a conditional requirement.

Requirement 9: In case of a high volatility of the catalog data the service platform has to ensure the availability of up-to-date catalog data.

5.5 Unstructured Requests for Quotation:

The security requirements of this use case are similar to those of the generation of visit reports. The sales agent composes an unstructured document describing the needs of the customer, requesting that the vendor might provide an elaborate quote. Obviously changes to the content of the request could have significant negative implications. Therefore, alterations during transmissions have to be detected.

Requirement 10: The service platform should provide means to detect any violations of the integrity of requests for quotation.

Furthermore, as requests for quotations are clearly documenting sales activity that influences commissions, accountability of these requests is of major importance and the service platform should document them. The service platform should document the content and time of the request in a way that can not be repudiated and provides a reliable proof of the sales representative's activity. The availability of the service platform is not crucial; as a time delay of a few hours does not circumvent the use case. Nevertheless it certainly lowers its service quality.

5.6 Creation of Quotes

If a vendor has assigned power of contract to an ISA, the sales representative can create a legally binding contract with the customer. Naturally, integrity and accountability of such a contract are necessities. Therefore, the service platform should provide means to detect violations of the integrity of created quotes.

Requirement 11: The service platform should provide means to detect any violations of the integrity of created quotes.

Also, non-repudiation of the quotes should be provided by the service platform. Furthermore, documentation of the time the quote was authored is essential, to prove the involvement of the ISA prior to the transaction. This leads to another requirement.

Requirement 12: The service platform should provide means to ensure that the origin and time of the quotes can not be reputed.

The required availability of the service platform is dependent on the degree of service integration and time criticalness of the particular case. If the contract includes commitments that are based on time critical information, then the ordering process is usually time critical as well. Delivery dates are for examples based on production capacities or stockings. In this cases race conditions have to be avoided.

Requirement 13: In the case of time critical information, the platform must ensure that transactions will only be started if they can be committed immediately to the backend systems.

6 Security Extension of the IT-Artifact

In order to fulfill the requirements we are now proposing a security extension to the IT-artifact. Parts of this proposal consist of traditional security measures that are prevalent on the market and widely used for similar systems. Where these measures provide acceptable security we encourage the continuance of their usage. For example Requirement 1 can easily be met by using Secure Socket Layer (SSL) or Transport Layer Security (TLS). On top of these traditional methods we propose the usage of SIM¹ cards that are capable of creating electronic signatures. The technology for such

¹ Subscriber Identity Module.

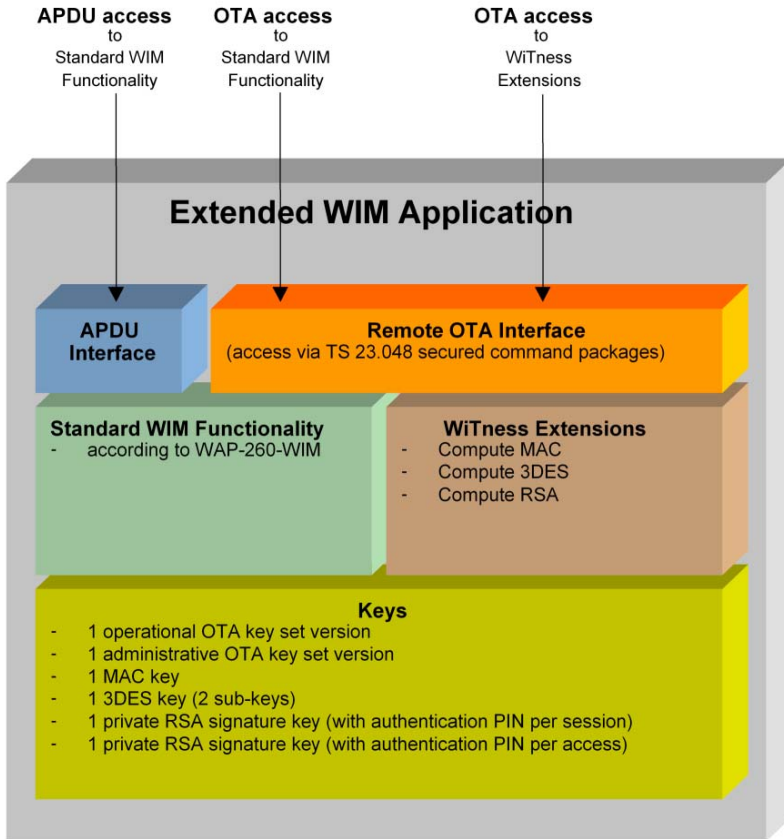


Fig. 2. Overview of the architecture of the witness prototype sim card

SIM cards exist but have not gained much market penetration so far. For example the WiTness project (Project Wireless Trust for Mobile Business 2002) sponsored by the European Union has developed such a SIM card that is capable of creating RSA signatures (Rivest, Shamir and Adleman 1978). Figure 2 gives an overview over the architecture of such a SIM card. These SIM cards could be used to provide a reliable authentication method (Requirement 2) and a suitable solution for the requirements regarding integrity and non-repudiation (3, 4, 5, 6, 8, 10, 11, 12).

The availability Requirement VII could be fulfilled by storing the data on the client device and using periodic synchronization updates. This would ensure that the data is up-to-date if the mobile device is able to connect to the service platform and at the same time ensure that the sales representative can recall recent customer data even in areas without a mobile connection. For the Requirements 9 and 13 synchronization is unsuitable. On the contrary, the service platform should only allow transactions to be performed if it can ensure that they are committed to the backend systems immediately in order to avoid race conditions. Table 1 provides an overview of the used methods and technologies and their fulfillment of the security requirements.

Table 1. Overview of the used security methods and technologies and their fulfillment of the security requirements

Security Goal	Security Technology		
	SSL / TLS	Electronic Signatures	Synchronization
Accountability		2 ² , 5, 8, 12	
Availability			7
Confidentiality	1		
Integrity		3, 4, 6, 8, 10, 11	

7 Evaluation

To evaluate our proposed security extension, we now compare our proposal against alternative solutions.

To achieve Requirement 2 one or more of three fundamental approaches could be used (Mayes and Piper 2005): something the user knows (password), something the user has (token) and something the user is (biometric). Usually passwords or external security token are used to allow this functionality (Karjoth 2003; Clarke and Furnell 2007). However, users tend to either choose weak passwords (Yan, Blackwell, Anderson and Grant 2004; Brown and Callis 2004), or choose related passwords for several or even all accounts (Adams, Sasse and Lunt 1997), which makes the authentication system vulnerable to cross-service attacks (Ives, Walsh, and Schneider 2004). External token, on the other hand, are expensive and stored on extra hardware that has to be connected to the device, needs to be carried around and can easily be lost (Clarke and Furnell 2007). Also, these token are usually proprietary solutions, which are only of use for one particular service. The use of a two factor authentication with a service independent security module present on the client device in combination with an authentication secret or biometric identification seems preferable.

Electronic signatures are a suitable solution for the requirements regarding integrity and non-repudiation (3, 4, 5, 6, 8, 10, 11, 12). These signatures are ideally performed by the same security module. If advanced electronic signatures with qualified certificates are used for signing the transactions this would also lead to reliable forensic evidence, which will be treated like handwritten signatures in any European court (Dumortier, Kelm, Nilsson, Skouma and Van Eecke 2003).

There are several different ways to implement security modules. It could either be a software component running on the mobile phone, some external security token that can be connected to the mobile phone or as in our proposal the SIM-card that is already present in a mobile phone.

However, if the legal reliability of advanced electronic signatures is desired (i.e. for the creation of quotes, see Requirements 11, 12), a secure signature creation device (SSCD) is mandatory, eliminating the possibility of a software solution. In this case using a SIM-card as SSCD instead of an external hardware token seems to be the better solution from a usability perspective (Roßnagel 2004).

² The SSCD can be used as an authentication token.

8 Limitations

Introducing new technologies to ensure the integrity and accountability of the data will also lead to switching costs (Farrell and Shapiro 1988; Anderson 2001) that have to be incurred by the sales agency and its employees. Exchanging the SIM cards will induce additional costs for the mobile operator. These costs can be directly charged to the sales agencies increasing their switching costs or have to be compensated by an increase in mobile communication traffic caused by the new applications. In (Roßnagel and Royer 2005) and more detailed in (Roßnagel 2009) the profitability of such an exchange has been researched. The authors conclude that - given a promising service use case - the investment into such a technology can be profitable for mobile operators.

Since several sales agencies and vendors, who might compete with each other, are using the mobile support system, a fine grained access control is necessary. This is especially important, because customers can have business contacts to several ISAs present in the system. However, this is beyond the scope of this paper. Instead we focused on the mobile services.

9 Conclusion

In this contribution we have presented a mobile support system for independent sales agencies that provides multi-vendor support. We further analyzed the security requirements of this system based on identified use cases for sales representatives. Based on these requirements we proposed a security extension using signature capable SIM cards. Since several of the use cases have direct financial implications, even going as far as legally binding contracts when quotes are created, a trustworthy documentation is important. In these cases the usage of advanced electronic signatures with qualified certificates would be beneficial. In order to achieve these signatures, a SSCD is necessary. From a usability perspective, using a SIM-card instead of an external hardware token seems to be a more convenient solution. Consequently, SIM-card based signatures would provide means to ensure accountability and integrity. Therefore, they offer usable yet secure measures.

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People-to-People Lending: The Emerging E-Commerce Transformation of a Financial Market

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Abstract. This paper provides an overview of the concept of people-to-people (P2P) lending, a relatively new e-commerce phenomenon that has the potential to radically change the structure of the loan segment of the financial industry. P2P lending creates a marketplace of individuals and a social fabric through which these individuals interact. It provides efficient information transfer, thus perhaps creating more perfect markets. P2P lending requires information systems support to make it function, and to provide a social network mechanism that may be crucial for its success. We discuss different P2P lending marketplace models, and how information systems support the creation and management of these new marketplaces, and how they support the individuals involved. We conclude by providing some important research questions and directions, and issues for which further investigation is called.

Keywords: Electronic commerce, information technology support, lending, social networking.

1 Introduction

People-to-people (P2P) lending, an emerging alternative to traditional institutional lending, is a relatively new e-commerce phenomenon that has the potential to radically change the structure of the loan segment of the financial industry. Just as eBay enabled yard sales to cross state and country borders, this new P2P lending finance model through the Internet allows lending and borrowing money among strangers to scale up dramatically. For members of Lending Club, for instance, lenders make fractions of loans that are aggregated to form a complete loan for a borrower. Lending and borrowing money among strangers is certainly not a new phenomenon, but traditionally the process is managed by finance middlemen, such as banks and credit card companies. As the Internet shrinks the world, potentially the finance middlemen can be bypassed and replaced with a more efficient market provided by IS support including e-commerce tools. P2P lending institutions can indeed revolutionize the way loans work because they can provide not only the

middleman functionality, but also the marketplace itself. Clearly e-commerce tools and IT innovation are changing the way we conduct many types of transactions. P2P lending is facilitated through these types of tools and systems. Despite its recent fast growth in fame as well as money raised, P2P lending remains a field understudied in academia. We seek to improve our understanding of the challenges associated with establishing and managing P2P lending marketplaces, and their design issues.

This paper's goals are twofold:

1) To provide an overview of the concept of a P2P lending marketplace: we describe the several types of P2P marketplaces. We discuss P2P lending marketplaces based on comparison analysis of P2P lending through two different lenses. Through a business lens, we compare P2P lending models along two business strategy-related dimensions. Through an information system (IS) lens, we look at the supporting/enabling roles of IS in P2P lending.

2) To offer a launch point for future research: we pose some interesting, highly relevant questions worth exploring, as well as significant IS-relevant issues emerging from P2P lending environments including regulatory issues.

Our paper is organized as follows. We first describe the P2P lending process and model. This includes a typology. Next we discuss the roles of IT for P2P lending platforms, followed by issues surrounding P2P marketplaces. We conclude by providing some important research questions and directions.

2 People-to-People Lending

2.1 The People-to-People Lending Model and Marketplaces

The term people-to-people (P2P; also person-to-person, peer-to-peer, or social) lending describes lending and borrowing activities that occur directly among individuals. P2P lending connects people with money to invest to people needing money, allowing them to bypass traditional financial services middlemen. In contrast, the lending model of traditional financial institutions, such as a bank, can be described as institution-to-people. Banks, for example, pool the supply of money (e.g., saving accounts and other investments) on the one hand and lend it out to a pool of loans on the other. In this traditional model, the "lenders" usually invest in financial instruments such as a saving account or CD, often with a fixed return rate, and are only indirectly connected to any lending activities. The "borrowers" receive their loans out of the money pool that the bank has available. In P2P, a lender can choose the borrowers to whom he/she wants to lend money.

P2P lending is not a new phenomenon. Lending among family members or within communities has existed long before the rise of lending institutions. The emergence of the Internet revived the concept of P2P lending; in addition, it allowed moving P2P lending from the family, friend, and community domain to a larger scale, eliminating geographical limits. P2P lending marketplaces, a type of electronic marketplace, facilitate many activities associated with lending and borrowing. In contrast to traditional financial institutions, P2P lending marketplaces are primarily facilitators of lending activities. P2P lending marketplaces do not pool the supply of money as

banks do, but instead provide technologies and mechanisms to help people connect to each other, and handle regulatory issues. For example, they allow lenders to search and locate loan requests and facilitate a series of transactions from transferring money to borrowers' accounts, collecting payments, imposing penalties, to handling default through collection processes.

2.2 Types of People-to-People Lending Marketplaces

A typology helps to group entities into groups (also called types) by similarity (Bailey 1994). Typologies help to reduce complexity by describing these types according to their common characteristics, thus helping researchers analyze and compare the types' similarities and differences (Bailey 1994). Examining existing P2P lending marketplaces shows that they differ on several dimensions such as the motive for lending (for-profit versus altruistic motives), focus of interest group (e.g., offering loans to students, people with disabilities, entrepreneurs in developing countries, or no focus), degree of separation between lenders and borrowers (e.g., lending to family members versus lending to strangers), mechanism to determine interest rate (auction-based versus price setting), or focus of specific region (e.g., cross-nation versus one-nation). A major challenge of creating typologies is to find the dimensions on which to group the entities into a typology that supports meaningful analysis while remaining parsimonious. We choose to categorize P2P lending marketplaces along two dimensions that characterize the participants they support: (1) motive (purpose or reason) for lending, and (2) the degree of separation among participants. We chose these two dimensions because the behaviors of lenders and borrowers tend to differentiate the most along these dimensions, hence the challenges and opportunities faced by P2P marketplaces are likely to differ the most at the extremes of these dimensions. Therefore, we expect the resulting typology to best expose interesting research questions. In this section, we explain the two dimensions, how the behaviors of P2P marketplace participants differ, and some unique challenges P2P marketplaces face.

Motive for Lending

The dimension *motive for lending* describes why lenders lend money to others. The two main motives can be classified as economic and philanthropic. The motive influences several aspects of the lending process, e.g., the selection of borrowers, the level of risk taking, and the determination of interest rates. People lending with economic motives invest in loans because they want to earn profit and expect an adequate return on their investment. These lenders regard P2P lending as an alternative investment instrument alongside others such as securities. The expected risk and return dictate their selections of borrowers and loans. Prosper and Lending Club are both examples of P2P lending marketplaces that support economic motive lenders.

Other P2P lending marketplaces focus on supporting people who want to help others to overcome adverse circumstances. Often these P2P lending marketplaces focus on target borrower groups with common problems. For example, Kiva's goal is to help entrepreneurs in the third world by providing startup funds, and people's motivation to lend is primarily altruistic. Lenders select loans based on reasons other

than expected return, e.g., they may focus on supporting women who don't have ready access to credit.

Degree of Separation

The dimension *degree of separation* describes the relationship between lenders and borrowers. The closest relationship between a lender and borrower is kinship or family. The next close one may be friendship or acquaintance. The one on the opposite end of the spectrum is stranger. With increasing degrees of separation, lenders and borrowers are less connected by common ties: friends, acquaintance, community, region, culture, country, globally. P2P lending marketplace Virgin Money, for example, focuses on supporting lending and borrowing activities among family and friends. Conversely, Lending Club and Prosper focus on matching people within the U.S. who are unrelated. Kiva matches lenders and borrowers globally.

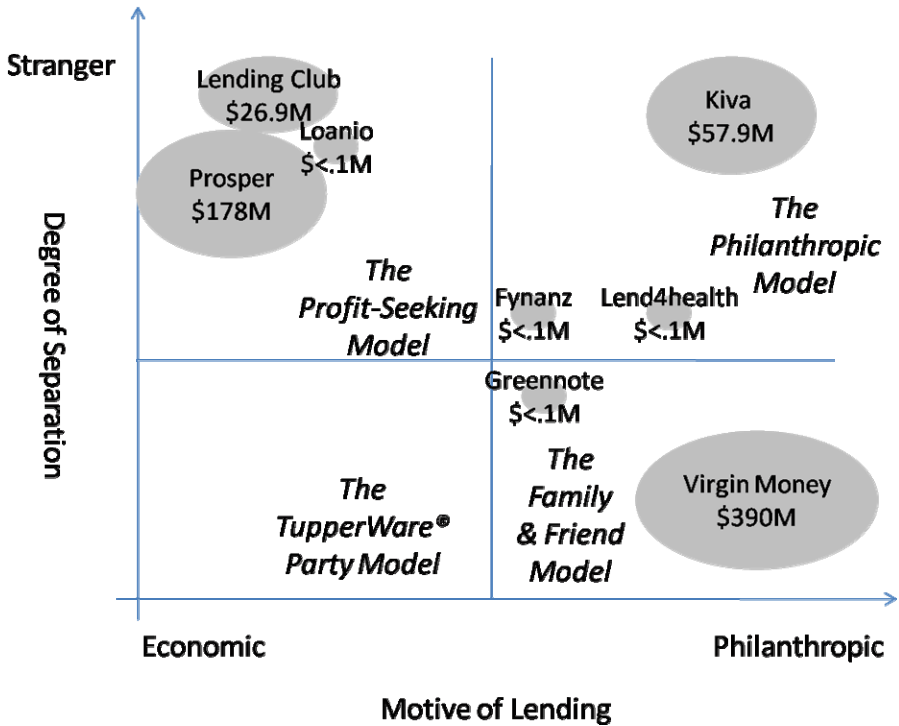


Fig. 1. Types and Size of P2P Lending Marketplaces¹

¹ Sources: <http://www.wiseclerk.com/group-news/tag/virgin-money/lend4health.blogspot.com>. The size of the ovals representing US P2P lending marketplaces reflects the size of cumulative loan volume in January 2009 since launch, which cannot be compared directly due to different time spans. Pertuity Direct (omitted) pools money and is not P2P lending per definition.

The degree of separation is likely to influence the social pressure a lender can apply to a borrower as well as the ability to evaluate a borrower's trustworthiness and ability to pay back the loan in time, thus making risk assessment difficult. In general, social pressure and the ability to evaluate trustworthiness would be greater with decreasing degree of separation and less with increasing degree of separation. When lending to a family member or friend, a lender tends to know the borrower well enough to evaluate whether he/she is likely or able to pay back the loan. Also, the lender can directly contact the borrower if any repayment problems occur. The borrower might feel more social pressure, because he/she knows the lender personally and thus feels an obligation to fulfill the repayment promise. Conversely, if a lender doesn't know the borrower, it will be difficult for the lender to evaluate the borrower's level of trustworthiness and to accurately assess risk and appropriate interest rate. Also, a borrower might feel less obligated to repay. This certainly may discourage lenders. This brings unique challenges to P2P lending marketplaces as they must provide mechanisms to facilitate match-making, to increase social pressure, and to help lenders evaluate borrowers' trustworthiness.

Categorizing current P2P lending marketplaces in the United States along the aforementioned two dimensions shows that there are four types of P2P lending marketplaces (Figure 1): the Profit-Seeking Model, the Philanthropic Model, the Family & Friend Model, and the Tupperware Party Model. Current US P2P lending marketplaces mainly fall in one of the four categories although these models can overlap. For example, loans at Prosper are primarily between strangers, although family and friends are also able to bid on listings and get in lender-borrower relationships. Next, we describe these four models in more detail and illustrate the similarities and differences within each category through examples.

2.3 The Profit-Seeking Model

In the Profit-Seeking Model, the lenders consider lending money to strangers as an investment that will return profit. Prosper and Lending Club are popular examples. Both companies have experienced considerable growth since they were established. Prosper, launched in February 2006, attracted more than 890,000 members in its first three years and generated \$179 million in 29,000 loans. Lending Club generated \$28 millions in more than 3,300 loans (as of February 18, 2009) since its launch in June 2007.

Potential borrowers post requests for loans in listings on the P2P lending marketplace's Web site. Individuals willing to lend their money then make bids. Currently there are two price-setting mechanisms. Prosper employs an auction-style price mechanism. The borrower specifies the maximum interest rate he/she is willing to pay. Lenders then specify the bid amount they want to lend and the minimum interest rate they require. On popular listings when the sum of the bids exceeds the requested amount, lenders might bid down the maximum borrower rate. As of October, 2008, 66% of the loans were bid down by an average of 4%. Conversely, listings on Lending Club have a fixed interest rate. Lending Club determines the interest rates taking into account the borrower's credit grade as well as other factors that reflect a borrower's credit risk. Both Prosper and Lending Club generate revenue by collecting fees on funded loans from borrowers and assessing servicing fees to lenders.

Credit Grade (Credit Score)	Number Of Loans	Average Borrower Rate on Loan
AA (760-)	3530 (12.2%)	9.8%
A (720-759)	3323 (11.5%)	12.5%
B (680-719)	4397 (15.2%)	15.4%
C (640-679)	5646 (19.5%)	18.0%
D (600-639)	5156 (17.8%)	21.2%
E (560-599)	3298 (11.4%)	25.6%
HR* (520-559)	3524 (12.1%)	25.6%
NC**	143 (0.2%)	22.3%

* H = High Risk
 ** NC = Non Credit - discontinued February 2007

Fig. 2. Average Interest Rates based on Borrower Credit Grade for Prosper (as of October 27, 2008)

The value proposition of P2P lending for borrowers is that they are able to obtain loans with lower interest rates than bank loan rates. The average interest rates by credit grade on Prosper for 36-month personal loans are listed in. For Lending Club, the rate for personal loans by borrowers with the best credit grade is 7.37% (as of February 18, 2009), while the bank rate for personal loans is over 13% on average (Sviokla, 2009).

The value proposition for lenders is that P2P loans offer an alternative investment option. Market forces predict that interest rates increase with assessed risk. Borrowers with low credit ratings will incur higher interest rates and higher default rates. Lenders create portfolios of loans and each person's overall interest earned depends upon his/her portfolio. A reliable number of the average return on investment (ROI)

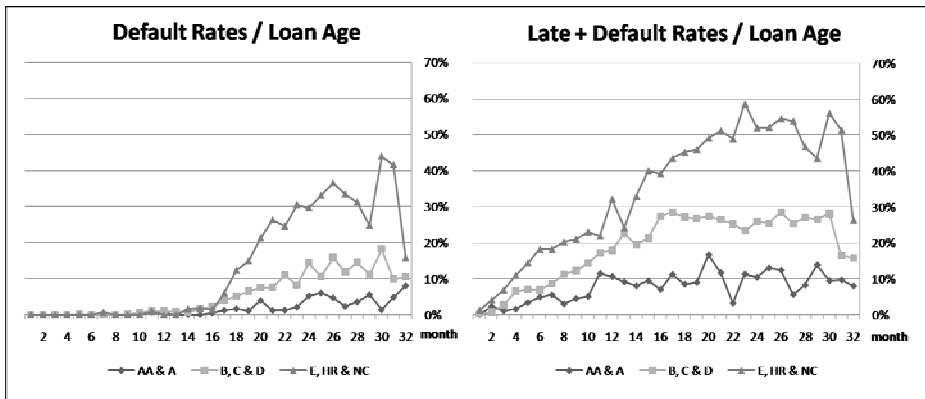


Fig. 3. Default Rates and Late Payments/Default Rates by Credit Grade and Loan Age (Prosper, October 27, 2008)

of a P2P lending marketplace is not available until a larger number of loans mature. As the current high default rates (Figure 3, left diagram) indicate, historic default rates from credit companies might not be good predictors for P2P lending marketplaces. In addition, the sum of defaults and late payments is considerably higher (Figure 3, right diagram). Since late payments might turn into defaults, the true default rates of P2P lending at Prosper are likely to be higher. Lending Club's default rates tend to be lower than Prosper, perhaps due to Lending Club's stricter requirements for borrowers (Lending Club requires a minimum credit score of 660).

2.4 The Philanthropic Model

P2P lending marketplaces following the Philanthropic Model focus on lending money to improve borrowers living conditions. These P2P lending marketplaces often focus on target borrower groups with particular problems, such as people who need student loans, health care loans, or business loans in developing countries. Examples include Kiva (developing countries), Fynanz (student loans), and Lend4health (health problems).

At this point in time, we can only speculate about lenders' appetites for risk and interest rate for this model. Often times borrowers only need to repay the principals with no interest. Philanthropic investors might be willing to take more risks and invest in risky borrowers to help them independent of risk. Kiva, for example, describes its loans as providing progress support. A loan on Kiva might help a woman in a small village in Africa buy chickens to start an egg business. Kiva wants to differentiate its purpose from that of facilitating donations. It enables real loans to entrepreneurs who are expected to repay their loans. Kiva wishes to support progress which in some sense is a more positive idea than donating money. Thus far, Kiva has been quite successful, reporting that a loan is made every 22 seconds (Kiva Impact This Week, February 6, 2009, <http://www.kiva.org/app.php?page=businesses>).

2.5 The Family and Friend Model

The key characteristic of the Family & Friend Model is that the "marketplace" facilitates loans that often have already been negotiated between lenders and borrowers who are already acquainted. Technically, this is not strictly a marketplace, but it does facilitate the legal aspects of lending. Virgin Money is one example. The advantage for both the borrower and lender is to be able to formalize and document the loan, thus reducing disagreements and disputes. The borrower and lender agree on the interest rate and payback plan together. Virgin Money offers several services such as creating the loan documents, organizing the payment process, and facilitating the payments of borrowers.

2.6 The Tupperware Party Model

The Tupperware Party Model refers to lending among family members and friends based on economic motives. At a "Tupperware party," the host/hostess wants to earn money and primarily asks family members and friends to buy products and services.

Tupperware parties bring the customers to the marketplace provided by the supplier. Currently there is no strict example of this model. P2P lending marketplaces that facilitate families and friends only for economic motives might be neither socially acceptable nor viable. Additionally, other P2P marketplaces, such as Prosper, already allow lenders to bid on family members' or friends' listings. In such cases, Prosper facilitates the loan; the borrower does not have to make embarrassing requests to family members and friends.

3 Supporting Roles of IT and Resulted Characteristics of P2P Lending

IS research is interested in how IT supports and shapes business operations and the resulted artifacts. In this section, we examine how IT supports and shapes P2P lending. The IT support is discussed from three aspects: market maker, investment strategy enabler, and community builder.

3.1 Market Maker

A fundamental function of a P2P lending marketplace is to provide a secure and efficient marketplace for borrowers and lenders to trade. A series of transactions on P2P lending marketplaces are routinized through information systems. These include user authentication, account verification, credit checking, credit reporting, loan creation and processing, funds transfer, and settlement. Using the databases and search engines on P2P Web sites, lenders can search through loan requests and borrower profiles. They can use filtering systems to automatically match loan requests according to pre-specified criteria. The use of electronic information systems increases effectiveness and reduces transaction costs (Bakos, 1997). Routinized processes also increase standardization, improving security, and subsequently, trust. IT has remarkably reduced the cost of providing large amount of rich data. The effects are reduced uncertainty and better decision support. Rich data about loans, lenders, and borrowers also improve market transparency and attract lenders.

The use of IT for transaction support results in several features of P2P lending. First, the Internet has extended the reach of P2P lending to a wide geographical area. Just as eBay has enabled people from every corner of the world to come to the sale in one's backyard, P2P lending is allowing lenders and borrowers across a country or continent to trade. Second, by expanding the borrower and lender pools, lenders can micro-manage their money through making multiple small loans, each as low as \$25. Third, information systems make self-service available 24/7. Moreover, by cutting out the intermediary such as a banker, consumers obtain direct control over the terms and conditions of their financial relationships (*Lessons from the P2P Community*, 2008). Fourth, without the traditional intermediaries, operation costs are expected to be lowered.

3.2 Investment Strategy Enabler

Complex investment strategies often depend on accurate and timely information. Large borrower pool, low transaction cost, and direct control over loans only partially provide the condition for a diversification strategy, the information necessary for decision support is the missing part. Information about borrowers' financial stability and credit is especially important to lenders who manage a diversified loan portfolio. Information of borrowers' social capital, such as network and region, is important to lenders who take the social aspects into consideration. Because most P2P lending models, with the exception of the family-and-friend model (e.g., Virgin Money), involve lending to strangers, lenders depend on every information scrap to assess risk and returns of potential loan opportunities. Research has shown that lending decisions are based on information such as a borrower's economic status (credit grade, debt-to-income ratio), social status (endorsement of loan request by friend), and the detail of the loan request (Greiner and Wang, 2007). Some P2P lending sites provide additional information or a means of direct contact. For instance, Prosper allows a potential lender to contact a borrower directly to ask questions.

Another strategy-enabler is automatic profiling and matching tools. Ideally, the availability of more complete and timely information about individuals in the marketplace should yield more market efficiency, where interest rates adjust to reflect the positions of both borrowers and lenders. Yet, substantial interest rate dispersion exists in P2P lending marketplace (Garman, Hampshire, and Krishnan, 2008). Electronic markets and information do not necessarily reduce search cost. Information overload and equivocality lead to high search cost and price dispersion (Grover, 2006). When the number of alternatives exceeds the limit one can process, decision performance suffers (Keller and Staelin, 1987). Empirical results show that the information-load effect remains more or less constant for 10 to 25 alternatives (Malhotra, 1982). For P2P lenders, for each lending decision, there are hundreds of alternatives from which to choose. For instance, on Prosper, the daily average numbers of listings in 2007 for the following credit grades are: AA and A: 137; B, C, and D: 701; and E, HR, and NC: 1495. P2P lending marketplaces need to support lenders in setting up search strategies and help find loans that fit the strategies. Lending Club offers a portfolio management tool that reflects lenders' risk and relationship preferences (*Lessons from the P2P Community*, 2008). Zopa, a major P2P lending market in the UK, has implemented SAS credit scoring systems to score borrowers and assign them to one of four credit categories. Zopa then matches lenders to borrowers based on a risk-return profile (*Social Leader Zopa Scores with SAS*, 2007).

A direct result of the execution of investment strategies is that lenders gain much more control over where their money goes, a critical feature separating P2P lending from the traditional financial markets. P2P Lenders can choose why and to whom they lend their money, and they are actively doing so. The level of loan micromanagement is high. Based on data collected from Prosper for the period between October 2005 and July 2008, the average amount bid by lenders on individual loans was about \$90, whereas each lender lent about \$3000 in total on average. So, on average, each lender invested in about 33 different loans. This may lead to a high level of portfolio diversification. On the one hand, this might reflect a lack of confidence in borrowers' payback; on the other hand, the numerous lending

opportunities with a wide range of interest rates offer lenders a myriad of choices of risk and return management. The scale reached by the aggregated loan requests and the rich information about them lay the foundation of the micromanagement strategy, which itself contributes to finer diversification and risk management.

3.3 Community Builder

More or less, P2P lending models build on and promote the idea of social lending and 'help each other as a community.' P2P often involves some type of connection between the borrower and lender, e.g., a hometown, college, or occupation. The social bond is believed to not only attract funding but also encourage responsible behavior (*Lessons from the P2P Community*, 2008), so that both lenders and borrowers benefit. IT provides community support to many P2P lending marketplaces in the form of groups, rating systems, forums, blogs, and affiliations. Lending Club allows borrowers to specify geographical, company, school, and association affiliations on their loan listings. The icon of a particular affiliation will show color if a lender and borrower are affiliated.

The rich data provided at P2P marketplaces help to build community. Prosper, Lending Club, and Kiva all have blogs where members share their experiences. Kiva posts stories and pictures of borrowers together with payment progress updates. Stories and pictures put a human face on financial transactions. The stories of borrowers and payment progress serve more than a surveillance mechanism. Lenders on Kiva do not earn interest. Their goal is to support entrepreneurs in developing countries to get their businesses off the ground. Progress reports keep the lenders posted about the impacts they have made on borrowers they have chosen to help, yielding a high level satisfaction for being part of Kiva, a warm and altruism community. One Kiva lender says this is a major source of motivation for her to actively lend money to the many entrepreneurs in need, and whether they are paying back or not is not really important to her.

Communities help cultivate trust, a key factor to the success of P2P lending marketplaces. It is believed that groups are motivated to discipline members who are cheating, because misbehavior of a single member could potentially harm other members and the community as a collective. Furthermore, members feel obligated to the group to behave (Hogg, 1993). Therefore, lenders are more willing to lend to people who belong to a group. Also, a group's reputation can serve as a proxy for its individual members' trustworthiness (Ba, 2001). Those who belong to a high rating group have better chances to get funded (Greiner and Wang, 2007). Hence, borrowers are motivated to join groups with good reputations and maintain the high reputations. On Prosper, groups are evaluated based on the repayment history of loans associated with the group. Groups that outperform an expected default rate receive higher ratings. Group members are thus interested to see that their fellow members fulfill their payment obligations.

4 Research Agenda

P2P lending is an under-researched area. To our knowledge, there is only one forthcoming article in any major peer-reviewed Information Systems (IS) or business

journal (Berger and Gleisner 2009) so far. Research in P2P lending presented at IS conferences looked at the operation and effectiveness of P2P marketplace Prosper (Kumar, 2007), trust-building mechanisms (Greiner and Wang 2007), factors determining the success of loan listings (Klaft 2008), behavior of risk-averse lenders (Iwakami and Ito 2008), P2P lending marketplace Zopa UK (Ortega and Bell, 2008), and the potential of P2P lending to create a more competitive credit market (Garman et al. 2008). An online search for working papers will bring up more non-peer reviewed studies (see www.ssrn.com).

The Structuration Model of IT described in Orlikowski and Robey (1991) provides a framework for a research agenda that addresses interesting questions about P2P lending. The model considers structuration a continuous process of the interactions of three interdependent forces: Institutional Properties, Information Technology, and Human Actors. Four types of influence in organizational structuring are described: a. IT as a product of human actions; b. IT as a medium of human actions; c. conditions of interaction with IT (institutional properties impact human actors); and d. consequences of interaction with IT (to the institution). In Table 1, we list IT-related research questions in each of the four types of influences. In our discussion, Institutional Properties refer to the characteristics of P2P lending organizations and those outside these organizations that have impacts on them, such as regulation authorities, partners, and competitors. IT refers to the information systems and tools that support the P2P marketplace, e.g., the transaction support systems, rating systems, and community support tools. Human Actors refer to those who directly interact with IT. These include the lenders and borrowers, and workers of the P2P lending organizations.

In addition to the research questions in Table 1, there are many exciting ones that do not directly involve IT artifacts. A few are listed:

- How can P2P lending increase market efficiency and reduce price dispersion?
- How does P2P lending impact on traditional financial markets?
- What can traditional financial institutions learn from P2P lending?
- How does the environment (e.g., interest rate development, crisis) influence P2P lending?
- Who are the different stakeholders and what are their interests/goals in P2P lending (marketplaces, borrower, lenders, partners, government, P2P competitors, traditional credit institutions)?
- How do the P2P industry and P2P models evolve?
- What are the key challenges and key success factors of P2P lending marketplaces?
- Are P2P lending models viable?
- How have P2P lending institutions developed?
- How will P2P lending institutions evolve?

Table 1. Research Questions Organized around the Structuration Model of IT

Type	Research Questions
a. IT as a product of human actions	<p>How to design effective member support software (such as search engines, filters, and community support tools) for borrowers and lenders?</p> <p>How do regulations influence IT in P2P lending?</p> <p>How do lenders and borrowers appropriate the IT features (e.g., search engines, filters, user forums) offered by P2P marketplaces?</p> <p>How do user appropriations influence IT in P2P lending?</p>
b. IT as a medium of human actions	<p>How do information characteristics (e.g., information overload, information quality, ambiguous or conflicting information) affect lenders and borrowers' behavior/strategy?</p> <p>How can IT help to improve the information characteristics (e.g., reducing information overload, increasing information quality) to support lenders and borrowers?</p> <p>How do IT characteristics (e.g., availability of a forum, chat, blog, community building) affect lenders and borrowers' behavior/strategy?</p> <p>How do currently available IT features limit or facilitate lenders' decision processes?</p> <p>How can IT support effective portfolio and listing management?</p> <p>How can IT support different types of lending and borrowing behaviors/strategies?</p> <p>How can IT support lenders and borrowers to effectively share their experiences and expertise?</p>
c. Conditions of interaction with IT (institutional properties impact human actors)	<p>What is the "P2P culture" among borrowers and lenders?</p> <p>What norms, shared values, knowledge develop in P2P that govern the lending exchanges?</p> <p>What are the shared meanings and collective knowledge that lenders and borrowers draw from when interacting with P2P lending IT (lending and borrowing)?</p> <p>How do the culture, norms, shared values, and collective knowledge influence lender and borrower activities?</p>
d. onsequences of interaction with IT to the institutional properties	<p>How can IT support finding lenders or borrowers violating shared norms and rules (e.g., verifying borrower identification, fraud, deception)?</p> <p>How can IT be used to develop norms and a stock of collective knowledge on P2P lending?</p> <p>How do unfaithful appropriations of IT affect the values and norms of P2P lending?</p>

5 Conclusion

P2P lending marketplaces continue to grow dramatically. The Harvard Business Review declared P2P lending to be one of the top 20 breakthrough ideas for 2009 (Sviokla 2009). Offering loans to those who don't have access to traditional credit, championing social causes, aggregating lenders explicitly, creating relevant communities of lenders and borrowers, and so on are certainly differentiators of these new marketplaces from traditional ones. Traditional financial institutions have yet to enter this new realm. We expect P2P lending to grow and evolve. There is much to learn about how to structure the P2P lending marketplaces, how to structure communities, and how to support all the participants.

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Forecasting U.S. Home Foreclosures with an Index of Internet Keyword Searches

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Abstract. Finding data to feed into financial and risk management models can be challenging. Many analysts attribute a lack of data or quality information as a contributing factor to the worldwide financial crises that seems to have begun in the U.S. subprime mortgage market. In this paper, a new source of data, key word search statistics recently available from Google, are applied in a experiment to develop a short-term forecasting model for the number of foreclosures in the U.S. housing market. The keyword search data significantly improves forecast of foreclosures, suggesting that this data can be useful for financial risk management. More generally, the new data source shows promise for a variety of financial and market analyses.

Keywords: Risk management, financial forecasting, internet keyword search, mortgage foreclosures.

1 Introduction

Acquiring current information on the concerns of customers, potential customers, and market participants often requires expensive survey research. This type of data can be quite valuable to many types of organizations for planning and market analysis [17]. The growing interest in behavioral financial models has also encouraged an interest in this type of information [15, 18]. A relatively new source of data has become freely available from the internet search company, Google. Its “Google Trends [9]” and “Google Insights [8]” programs provide current and historical data on monthly and weekly keyword search volumes worldwide and by geographic regions. This paper presents a simple, short-term forecasting model for U.S. home foreclosures, finding that forecasts are significantly improved by the addition of keyword search data as an independent variable.

The rising number of foreclosures in the U.S. has become a key metric in understanding the current economic recession and the implications for future economic growth. In assessing what went wrong with the risk management models designed to evaluate the U.S. housing market, the former Chairman of the U.S. Federal Banking system commented that improved models would need to incorporate data that would signal when basic consumer attitudes have changed from feelings of euphoria to periods of fear [10]. Keyword search data, not currently used in standard risk or financial management models, may provide one source of signals on changes in attitudes, concerns, and interests.

Google researchers have recently reported success in using the keyword search statistics to detect outbreak of flu by tracking the increase in volume of searches in Google on the keyword “flu” [6]. The logic of the research hypothesis is that as individuals around the world start to experience flu symptoms, they will turn to their computers to get information on their ailment. The Google researchers demonstrate that the search statistics can identify the risk of a flu outbreak up to two weeks faster than the current best detection system, a surveillance program managed by the U.S. Centers for Disease Control (CDC) and Prevention.

As noted on the Google site, the pattern of search volume also seems to match with some seasonal patterns. One financial example describes how search volume on “internal revenue service”, the tax collection agency for the U.S., increases each year around April 15, the deadline for filing taxes [7]. This example suggests that internet user’s interests in financial services or information seem to be reflected by the type of searches they undertake. Of course, this data is limited to internet users and hasn’t been collected with the statistical rigor characteristic of some market research, but the data is feely available, very current, and extensive. In a more formal study, a researcher was able to duplicate with statistical significance the results of a market survey identifying green technology investment opportunities using the Google search data [21].

1.1 Risk Management Models

Credit information systems play a critical role in housing finance. Countries with extensive information systems have broader and deeper housing markets [20]. Inferior information quality negatively affects risk management [16]. A lack of good information and the resulting poor econometric forecasts of the risk of foreclosure for the subprime mortgage market were critical issues in the development of the recent financial crises [3]. Some lenders developed forecasts for the probability of foreclosure based on historical transactions, data prior to the housing boom of the mid 2000s and the expansion of mortgage availability. Since lenders were compensated based on the number of loans which they then sold off in secondary markets, they had an incentive to ignore or understate future risks.

Many of the standard information system analytical tools are used in current risk management models that evaluate the potential of default for mortgage holders. Monte Carlo simulation has been extensively applied [2, 11]. Given the large amount of internal data generated by banks, data mining tools have been developed to make risk management more effective [4, 13, 22]. Honohan [12], however, criticizes these models as being “too mechanical, albeit sophisticated.” Nevertheless, as early as 2003 a statistical analysis of subprime lending resulted in a conclusion that lenders and regulators need to train their attention and understanding on this growing segment of the credit market given the risk of default [5].

2 Research Objective

As with internet users who experience flu symptoms and so search the internet for information, it is proposed that homeowners in the U.S. who begin to feel financial

strain will likewise search for financial information. As the strain increases, owners will begin to face the prospect of foreclosure. They may no longer be able to meet their mortgage payments, defaulting on their loan, with the result that a financial institution takes ownership of the house. This scenario suggests the following research hypothesis:

H1: Keyword search volume on the term “foreclosure” will be positively correlated with actual U.S. home foreclosures and will provide useful data for forecasting.

More generally, a finding that the keyword search data can be used to forecast foreclosures also suggests many other applications where trends in internet user’s interests might be beneficial.

3 Sources of Data

The U.S. market research firm Realtytrac releases a monthly summary of total U.S. home foreclosures by aggregating government data [16]. This data is commonly referenced in the press when discussing the U.S. foreclosure crises and appears to be the best and most current available data on this financial market. Realtytrac has been collecting this data since January 2005 and provides much geographic detail for the foreclosure data to subscribers of their service.

To encourage the use of their advertising programs, Google Inc. provides a website allowing users to type in a keyword and get a graph and an index of the volume of weekly searches (www.google.com/trends) back to 2004 for terms with significant volume. Figure 1 was created by typing in the word “foreclosure”. Letters in boxes on the graph refer to specific news events associated with changes in search volumes. The graph was generated in April, 2009 in response to a reviewer’s comments and so contains more data than was used in the analysis.

Rather than providing actual search volume, Google “normalizes” the data to create an index that the website suggests will make the data more useful for analysis. This data can be downloaded in a .csv format, compatible with Excel. Two types of indexes are available: relative and fixed. Both indexes involve dividing all the data by the volume of data for one point in time. With the fixed index, all volumes are divided by the first week for which data is available, usually the first week of January 2004. With the relative index, the first week of the period selected by the user becomes the base period for the index. The fixed index was used for this study.

The Google Trends keyword search index is available as a weekly time series, but the Realtytrac foreclosure data is only available on a monthly time period. In order to match the periodicity of the data, the weekly index was averaged for each month to create a monthly approximation of the keyword search data.

Basic descriptive statistics for the data appear in Table 1. The minimum number of actual foreclosures occurred in March 2005 while the minimum number of searches was in December of that year. Actual foreclosures fell again a few months later in 2006, suggesting a possible lagged relationship in the data. The Pearson Correlation between the two variables is 0.931, significant at the 0.01 level based on a two-tailed test. Month by month, the search index tracks very closely to actual foreclosures.



Fig. 1. Graphical Results of Typing the Word “Foreclosure” Into Google Trends (Letters in boxes refer to specific news reports: Box A, a news report in ReportonBusiness.com that “US homes in foreclosure soared 79% in 2007”; Box B a report from WTOL that “US foreclosure filings surge 65% in April”; Box C, a report in Forbes that “US foreclosure filings more than double in 2Q”; Box D, a report from KTVN that “US foreclosure filings up by 71% in 3Q”; Box E, a report in the Greater Baton Rouge Business Report that “Foreclosure rates up 25% year-over-year”; Box F, a report in the Tort Deform: The Civil Justice Defense Blog about Obama’s foreclosure plan).

Table 1. Descriptive Statistics for Actual U.S. Home Foreclosures and the Keyword Search Index of Foreclosures

Monthly Data from January 2005 to December 2008

	Search Index	Actual Foreclosures
Minimum	0.7	62,422
Maximum	2.765	303,868
Mean	1.4526	156,266
Pearson Correlation: 0.931, significant at 0.01 level using a two-tailed test.		

4 Results

The output of a regression model with actual U.S. home foreclosures as the dependent variable appears in Table 2. There are three independent variables. First, the dependent variable, foreclosures, is lagged by one month. The logic of the model is to see if the keyword search index will be an improvement over a simple forecast using just the lagged dependent variable. The second independent variable, a difference variable, is the month-to-month change in the search volume index. The logic is that an increase in searches suggests an increase in concern about foreclosure. The keyword search index is also included as a five-month trailing average, calculation of which reduces the number

Table 2. U.S. Home Foreclosures Forecast by Previous Month Foreclosures, Current Search Volume Index, and Previous Search Volume Index

Dependent Variable: Actual U.S. Home Foreclosures			
R = .968; R-Square = .937; Adjusted R-Square = .933; Number of Observations = 42			
Independent Variables	Estimated Coefficient	t-statistic	Significance
Constant	-4313.121	-0.500	0.620
Previous Month Foreclosures	0.679	5.675	0.000
Monthly Difference in Search Index	36144.291	2.674	0.027
Prior five-month Moving Average of Search Index	42847.12	2.304	0.011

Table 3. U.S. Home Foreclosures Forecast by Previous Month Foreclosures and Previous Search Volume Index

Dependent Variable: Actual U.S. Home Foreclosures			
R = .964; R-Square = .929; Adjusted R-Square = .925; Number of Observations = 42			
Independent Variables	Estimated Coefficient	t-statistic	Significance
Constant	-1415.058	-0.158	0.876
Previous Month Foreclosures	0.712	5.693	0.000
Prior five-month Moving Average of Search Index	37700.599	2.257	0.030

of observations available for the regression. The data for the regression begins in June rather than January allowing for enough data to calculate the five-month trailing average.

As the table indicates, the two variables based on search index volume are significant at better than the 0.05 level, providing good evidence that as homeowners get close to foreclosure they begin to signal their distress by searching on the internet for related information. Variations using a different number of months to calculate the prior moving average index yielded about the same results, with the five-month indexing having a slightly better significance.

Since the equation in Table 2 uses the current month search index to calculate the difference variable, it provides a very short-term forecasting horizon. The search index data comes out almost real-time while the market research data is released two

weeks after the end of the month. This is about the lead-time that the Google researchers demonstrated in their study of flu outbreaks.

To increase the forecasting horizon, the difference variable is removed from the model. The results are summarized in Table 3 for an equation using only previous month foreclosures and the prior five-month moving average of the search index. This equation will forecast up to six weeks ahead the release of the actual foreclosure data. The significance for the five-month moving average of search index volume degrades somewhat, but it is still significant at better than the 0.05 level.

The research hypothesis the search index is positively correlated with future foreclosures is supported, suggesting that mortgage holders begin to search for information on foreclosure as they approach defaulting on their mortgages. It seems that this data does improve the forecast for foreclosures over a simple model using a lagged dependent variable.

Since this model is simply a weighted average approach to forecasting the estimated coefficients have no specific economic meaning except that they represent the weights used to combine them into the forecast. For example, based on table 3 a forecast of foreclosures next month would be 71.2 percent of current month foreclosures plus 27700.599 times the prior five-month moving average of the search index.

5 Limitations of the Approach

This simple model merely creates a weighted average of keyword searches and previous actual foreclosures to forecast in an autoregressive style without taking account of structural issues in the market. For example, rule changes in the U.S. financial industry during early 2009 designed to delay foreclosures will probably result in lower actual foreclosures than forecast. However, the forecast may indicate how many foreclosures might have happened without the policy change.

No attempt is made to compare this model with sophisticated models developed for the credit industry that may rely on other data or more detailed efforts at financial modeling. The goal of this effort is just to demonstrate that the keyword search data provides an interesting proxy variable that might be useful in model development. Further work could be done to integrate this data into a more sophisticated model.

Changes in keyword search for “foreclosures” may be the result of factors other than internet users facing foreclosure and looking for information. For example, since a large proportion of sales in the U.S. are homes that have gone through foreclosure, buyers may be searching for information, increasing searches but not increasing actual foreclosures. Also, over most of the time period for the model estimation foreclosures were rising, however there were a few periods in the early part of the data when foreclosures were falling.

6 Conclusion

A keyword search index for the term “foreclosures” significantly improves the short-term forecasting for U.S. home foreclosures in a simple, short-run model. This result

indicates that the Google Trends data can provide useful input for financial forecasting and risk management models. It also suggests that the search data may be useful for analysis in a broader set of applications.

Finding that a five-month moving average works well to forecast foreclosures suggests some mortgage holders at risk of default may be searching for information on the internet well before they fall into foreclosure. Future research on the foreclosure market could focus on examining in more detail how early the search data signals a problem. As the former chair of the U.S. Federal Reserve Bank, Alan Greenspan, recently suggested, credit models would benefit from data that could signal a change in consumer attitudes and concerns.

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Organizing Equity Exchanges

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Abstract. In the last years equity exchanges have diversified their operations into business areas such as derivatives trading, post-trading services, and software sales. Securities trading and post-trading are subject to economies of scale and scope. The integration of these functions into one institution ensures efficiency by economizing on transactions costs.

Using balanced panel data from major equity exchanges over the period 2005-2007, we examine empirically the presence of economies of scale in securities trading. Moreover, we analyze the impact of vertical integration of trading, clearing, and settlement, the impact of the size of an exchange, and the impact of diversification on the profitability of exchanges. The evidence confirms that a large number of transactions leads to low costs per trade. The evidence shows that the profitability of equity exchanges is highest for vertically integrated exchanges and that diversification and size have a negative impact on their profitability.

Keywords: Trading and Post-Trading, Economies of Scale, Integration of Securities Trading, Diversification.

1 Introduction

Until recently, equity exchanges in Europe used to operate their business facing almost no competition. In most of the markets a domestic consolidation has taken place several years ago and mainly one national exchange has remained. In the last years the exchanges moved towards more consolidation on an international level. The mergers of NYSE / Euronext, London Stock Exchange / Borsa Italiana, and NASDAQ / OMX are the result of this trend. One of the most stated reasons for this consolidation were economies of scale.

Depending on the choice of statistics, the rankings of equity exchanges are totally different: The largest stock exchange by its own market capitalization is the Deutsche Börse Group, while the NYSE Euronext is the largest exchange by share trading value. The organization of equity exchanges is also very diverging. There are significant differences in governance, covered markets, and range of products. While e.g. the NYSE Euronext is providing equity trading services for different markets, the Hong Kong Stock Exchange is providing trading, clearing, and settlement services for one single market.

The contribution of this paper is to identify the most important factors that affect the organization of efficient securities trading and post-trading. Through a regression analysis the positive effect of the size of an exchange on the per trade costs is shown. Moreover, the positive effect of vertical integration of trading and post-trading and the negative effect of size and diversification on the profitability of equity exchanges is shown. These findings may help industry practitioners to identify future strategies. They may also help to find the best way to organize trading, clearing, and settlement from a macro-economic view which is heavily discussed by institutions like the European Central Bank or the European Commission since a long time.

This paper is organized as follows. First, the economies of trading, clearing, and settlement are described. It is followed by a review of respective literature. The next section shows the current status of the trading and post-trading industry. Then, economies of scale in securities trading are analyzed empirically. The next section evaluates the impact of size, diversification, and vertical integration on the profitability of an exchange. The paper closes with a conclusion.

2 Economies of Trading and Post-Trading

2.1 Trade Execution, Clearing, and Settlement

The securities trading value chain consists of a variety of complementary trading, clearing, and settlement activities. The first function is the execution of the transaction. In case of an exchange, the orders to buy or sell a security are directed to a central marketplace. In the dominating electronic exchanges, the orders are routed to a central computer which matches buy and sell orders based on matching algorithms (Pirrong 2008). Clearing and settlement covers all processes that occur after a trade has been executed to finalize the transaction. The actions involve the post-trade transfer of cash and securities (Schwartz and Francioni 2004). The need arises after any trade, regardless of whether the parties trade over an exchange or over the counter, and whether the trade involves domestic or international securities. Clearing of a securities transaction confirms the legal obligation from the trade. Clearing involves the calculation of mutual obligations of market participants and determines what each counterpart receives. Central counterparty (clearing) is not included in the definition of clearing. A central counterparty (CCP) is an entity that interposes itself between the transactions of the counterparties in order to assume their rights and obligations, acting as buyer to every seller and seller to every buyer. The original legal relationship between the buyer and the seller is thus replaced by two new legal relationships: between the CCP and the buyer and between the CCP and the seller. The substitution of the original counterparty by a new contractual counterparty is called a contract novation. The CCP thus bears the counterparty risk and guarantees the clearing and settlement of the trade (Wendt 2006). Following the clearing stage the next operation is settling a trade. Settlement is the exchange of cash or assets in return for other assets or cash and transference of ownership of those assets and cash. A central securities depository (CSD) is the organization that performs this function.

2.2 Network Effects

The execution of orders is subject to network effects due to the nature of liquidity (Domowitz and Steil 1999). Liquidity plays an essential role in financial markets where order flow attracts order flow (Hassan and Schmiedel 2002). It is cheaper to execute orders in markets with large numbers of other orders. There are a variety of formal models that demonstrate that trading of financial instruments is subject to network economies, which cause average implicit trading costs to decline with the number of traders (for more details see Pirrong 2008). These trading costs include the bid-ask spread and the price impact of trades. Clearing and settlement are also subject of network effects. Network effects arise in clearing because the greater the number of transaction counterparties that use the services of a CCP, the greater the probability that a transaction by a given party will be accepted by the CCP, and therefore the greater the utility for that party to buy the CCP services (EU Commission 2006).

2.3 Economies of Scale and Scope

Economies of scale occur when firms achieve per unit costs savings by producing more units of a good or service. Such effects arise when it is possible to spread fixed costs over a higher output. The providers of trading, clearing, and settlement can achieve significant economies of scale, as the set-up costs for a transaction platform have a substantial portion of fixed costs and thus the average costs fall with an increasing transaction volume (Serifsoy and Weiß 2007). For the provision of a trading infrastructure high investments in IT infrastructure are necessary. These investments are largely independent from the number of transactions. Securities clearing services are also subject to economies of scale. In particular the clearing houses have to create the necessary software and IT infrastructure. The maintenance and operation of the clearing systems does not vary strongly with the number of transactions processed. Additionally, there are economies of scale in the main function of a clearing house - the bearing of risk. There are additional costs if there is more than one clearing house. Multiple clearers have to manage the risk between the clearing houses and thus have to maintain costly communication links to the other clearing houses (Chlistalla and Schaper 2008). The costs of settlement are also largely fixed. Like trading and clearing, settlement requires the creation of a software and IT infrastructure which involves a large fixed component (Schmiedel, Malkamäki, and Tarkka 2006). The interlinkage of multiple settlement systems also leads to high costs (Schaper 2008b).

Economies of scope occur when firms achieve cost savings by increasing the variety of goods and services that they produce (joint production). There are strong scope economies in trading, clearing, and settlement. These scope economies influence the efficient organization of trading, clearing, and settlement (Pirrong 2008). If multiple products are cleared within one clearing house the gains and losses can be netted across the customer's positions. Through netting the costs of collateral can be reduced.

2.4 Diversification

Besides providing trading, clearing, and settlement services some equity exchanges are providing other services and products (Serifsoy 2007). For example Deutsche Börse, Euronext, and OMX Group are achieving significant revenues from the development and operation of IT for other exchanges. They sell their trading systems and sometimes even operate the systems for other exchanges. Beside this, most exchanges are providing trading services for non-equities products. In case of some exchanges the revenues of these services are notable. As for example SIX and the Deutsche Börse Group are operating the European Derivatives Exchange EUREX. Both are achieving larger revenues from derivatives than from equities trading.

3 Literature Review and Hypothesis

3.1 Literature Review

To date, there are only a small number of studies on the effect of economies of scale on trading and post-trading. There are also only singular studies about the effects of vertical integration and diversification on the profitability of exchanges:

Malkamäki (2000) shows empirically the existence of economies of scale in securities trading by estimating the cost function of exchanges for the years 1996-1998. He illustrates that scale economies exist only in the very large stock exchanges but that there are significant scale economies with respect of the processing of trades.

Schmiedel, Malkamäki, and Tarkka (2006) investigate the existence of economies of scale in depository and settlement systems. The evidence from 16 settlement institutions for the years 1993-2000 indicates the existence of significant economies of scale. The degree of these economies differs by size of the institution and region. While small settlement service providers reveal a high potential of economies of scale, larger institutions show an increasing trend towards cost effectiveness. For clearing and settlement systems in countries in Europe and Asia substantially larger economies of scale are reported than those in the US system.

Serifsoy (2007) analyses technical efficiency and factor productivity of exchanges by analysing 28 stock exchanges from 1999-2003. His findings suggest that exchanges that diversify into related activities are mostly less efficient than exchanges that remain focused on the cash market. Moreover, his findings show no evidence that vertically integrated exchanges are more efficient.

Pirrong (2008) analyses the economics of securities trading, clearing, and settlement from a micro analytic perspective. He shows theoretically the existence of economies of scale in trading and post-trading. Moreover, he demonstrates that especially in clearing strong scope economies exist. He also illustrates the impact of economies of scale and scope on the organization of these services and shows that the integration of trading and post-trading is the modal form of organization in financial markets.

In literature mostly isolated factors like the effect of size, diversification, or integration on the efficiency of exchanges where analyzed empirically. The contribution of this paper is the analysis of the most important business drivers of equity exchanges: size, diversification, and vertical integration on the main output of an exchange, the matching of orders. Moreover, we analyze the effects of size, diversification, and vertical integration

on the profitability exchanges by means of a regression analysis. These findings may generate recommendations for the organization of equity exchanges.

3.2 Hypotheses

From the previous discussion and literature review the following hypotheses are derived and will be challenged in the following sections. The reverences indicate associated literature to related research already stated in the previous sections.

- H1 Large exchanges provide securities trading at lower costs per trade than small exchanges. *Malkamäki (2000); Serifsoy and Weiß 2007*
- H2 Vertically integrated exchanges are able to achieve a higher profit ratio than non integrated exchanges. *Pirrong (2008)*
- H3 Large exchanges achieve a lower profit ratio than small exchanges. *Nielsson (2009)*
- H4 Diversified exchanges achieve a lower profit ratio than non diversified exchanges. *Serifsoy (2007)*

4 Current Status of the Trading and Post-Trading Industry

One major trend in the equity trading, clearing, and settlement industry is the consolidation via vertical and horizontal integration. Horizontal integration involves mergers of institutions or systems providing similar services in different markets, such as the merger of trading systems. Vertical integration involves mergers of

Table 1. Listed equity exchanges (ordered by market value) and corresponding clearing and settlement institutions

Trading	Clearing	Settlement	Market	Market Value 2008 in EUR
Deutsche Börse Group			Germany	13,782,600,000
Hong Kong Exchanges and Clearing			Hong Kong	9,816,312,314
NYSE Euronext	National Securities Clearing Corporation (US), LCH.Clearnet (Europe)	Depository Trust Company (US), Euroclear Group (Europe)	US, France, Netherlands, Belgium, Portugal	5,200,748,596
NASDAQ OMX Group	National Securities Clearing Corporation (US), EMCF (Europe)	Depository Trust Company (US), Nordic CSD (Europe)	US, Sweden, Norway, Finland, Denmark, Iceland, Estonia, Latvia, Lithuania	4,469,629,459
Australian Securities Exchange			Australia	3,646,297,500
London Stock Exchange	LCH.Clearnet	Euroclear Group	UK	3,346,071,414
BME Spanish Exchanges			Spain	1,899,745,478
TMX Group	Clearing and Depository Services		Canada	1,737,730,531
Singapore Exchange			Singapore	1,669,790,945
Bursa Malaysia			Malaysia	732,998,350
Hellenic Exchanges Group			Greece	562,474,793
Johannesburg Stock Exchange			South Africa	343,893,133
New Zealand Exchange	Austraclear		New Zealand	88,846,192

Vertically integrated

Table 2. Net profit ratios of equity exchanges from 2005-2007

Exchange	Net Profit Ratio 2005 (Rank)	Net Profit Ratio 2006 (Rank)	Net Profit Ratio 2007 (Rank)	Average Profit Ratio (Rank)
Dubai Financial Market	0.97 (01.)	1.01 (01.)	1.17 (01.)	1.05 (01.)
Hong Kong Exchanges and Clearing	0.58 (05.)	0.71 (03.)	0.86 (02.)	0.72 (02.)
Hellenic Exchanges Group	0.59 (03.)	0.73 (02.)	NA	0.66 (03.)
Singapore Exchange	0.49 (09.)	0.58 (06.)	0.85 (03.)	0.64 (04.)
Australian Securities Exchange	0.58 (05.)	0.59 (05.)	0.72 (04.)	0.63 (05.)
Bursa Malaysia	0.59 (03.)	0.58 (06.)	0.72 (04.)	0.63 (05.)
TMX Group	0.54 (07.)	0.62 (04.)	0.61 (09.)	0.59 (07.)
Wiener Börse	0.52 (08.)	0.48 (10.)	0.65 (06.)	0.55 (08.)
BME Spanish Exchanges	0.64 (02.)	0.45 (11.)	0.53 (09.)	0.54 (09.)
Philippine Stock Exchange	0.37 (12.)	0.52 (09.)	0.65 (06.)	0.51 (10.)
Istanbul Stock Exchange	0.26 (15.)	0.58 (06.)	0.51 (11.)	0.45 (11.)
Taiwan Stock Exchange	0.34 (13.)	0.40 (13.)	0.57 (08.)	0.44 (12.)
Oslo Børs	0.40 (10.)	0.45 (11.)	0.46 (12.)	0.44 (12.)
New Zealand Exchange	0.34 (13.)	0.39 (14.)	0.42 (15.)	0.39 (14.)
SIX Group	0.24 (19.)	0.39 (14.)	0.46 (12.)	0.36 (15.)
Deutsche Börse Group	0.26 (15.)	0.36 (16.)	0.42 (15.)	0.35 (16.)
London Stock Exchange	0.38 (11.)	0.32 (19.)	0.32 (16.)	0.34 (17.)
Johannesburg Stock Exchange	0.25 (17.)	0.33 (17.)	0.28 (18.)	0.29 (18.)
Euronext	0.25 (17.)	0.33 (17.)	NA	0.29 (18.)
Osaka Securities Exchange	0.20 (20.)	0.24(22.)	0.43 (14.)	0.29 (18.)
OMX Group	0.17 (22.)	0.25 (21.)	0.23 (20.)	0.22 (21.)
Tokyo Stock Exchange	0.09 (23.)	0.27 (20.)	0.26 (19.)	0.21 (22.)
Mexican Exchange Group	0.19 (21.)	0.18 (23.)	0.15 (21.)	0.17 (23.)
NYSE Euronext	0.03 (25.)	0.09 (24.)	0.15 (20.)	0.09 (24.)
NASDAQ Group	0.07 (24.)	0.08 (25.)	NA	0.07 (25.)

Vertically integrated

institutions providing different, but integrated services, which are processed along the securities trading value chain within a single entity or group of entities (Serifsoy and Weiß 2007). The organization of equity exchanges is very diverging. The majority of the listed equity exchanges are operating their captive clearing and settlement entities beside the provision of trading (see Table 1). Eight exchanges of the listed exchanges operate clearing and settlement operation as division or wholly owned subsidiary of the exchange. In three cases (NYSE Euronext, NASDAQ OMX, and London Stock Exchange) the exchange has an ownership stake or governance role, or both, in the clearing and settlement entities. Only two exchanges are exclusively focusing on trading. Two of the exchanges offer their trading services for more than one country. The table also shows the market value of the listed equity exchanges¹.

¹ The markets were selected according to the Dow Jones Global Exchanges Index (Dow Jones Indexes 2007). Only exchanges primary focussing on equities were selected. The market value is calculated on the basis of the equity prices from Reuters from 2008-08-11.

The two exchanges with the highest market value are vertically integrated exchanges, the Deutsche Börse Group and Hong Kong Exchanges and Clearing (having a higher market value than the other eleven exchanges together).

Beside of the market (shareholder) value, the net profit ratio (= net profit / revenues) is an important goal for a profit oriented company (Groppelli and Nikbakht 2006). The average net profit ratio of equity exchanges over the years 2005-2007 was 44 percent². The net profit ratio of most of the vertically integrated exchanges is significantly higher than the ratio of the non-(vertically) integrated (see Table 2). If ratios could not be calculated they are marked as 'NA' (not available). Of those exchanges focusing purely on trading services, only the TMX Group and the Istanbul Stock Exchange are performing above average. While the vertically integrated exchanges had an average net profit ratio of 51 percent, the non- integrated exchanges only had a ratio of 32 percent.

The larger exchanges (handling more than 100 million transactions in 2007) have an average profitability of only 34 percent, while at the same time the smaller exchanges have an average profitability of 49 percent. The largest exchanges, NYSE Euronext and NASDAQ, are showing the lowest profitability with an average ratio of 8 percent.

5 Empirical Evidence of Economies of Scale

5.1 The Model and Data Sample

The cost structure of securities trading is significantly depending on the scale of an exchange (Pirrong 2008; Malkamäki 2000). This is due to the large fix costs for the implementation of the trading software and the respective communication infrastructure. The matching of orders is one of the main outputs of an exchange. The costs per trade can be seen as indicator of how efficient the exchange is providing their main services, the matching of orders (Malkamäki 2000). Due to the dominant trading on electronic trading systems the main factor that affects the costs of the exchanges is the number of transactions (X). The value and the number of shares are not affecting the costs directly (Malkamäki 2000). Vertical integration (VER) of an exchange is modeled as a dummy variable (indicating 1 for vertical integration otherwise 0). Some exchanges are diversifying (DIV) and are providing other services than equities processing, such as IT-services, which needs to be considered. DIV is a dummy variable indicating 1 for diversification of an exchange and 0 for no diversification. The following function for the costs per trade (CPT) indicates the main factors of an exchange (i) for the period (t).

$$CPT_{i,t} = \alpha + \beta X_{i,t} + \gamma DIV_{i,t} + \delta VER_{i,t}$$

For the testing of H1 we analyzed 26 exchanges for the years 2005-2007 (78 observations). Some observations could not be used for the regression (marked as not available 'NA' in the tables, single exchanges did not report cost data and are not

² The data derives from the annual reports of the exchanges. In the table listed exchanges as well as not listed but for profit exchanges are included. The exchanges Euronext and OMX are listed separately as recent mergers are not reflected in all analysed annual reports.

included in the table 3). There are no direct measures available for inputs of stock exchanges. The two most important input prices for the operation of stock exchanges are the costs of the trading system and labor costs (Malkamäki 2000). As some exchanges do not publish cost information in detail, we use the annual costs of the exchange as proxy for the input of the exchanges. We adjust the costs with a diversification factor. In case of diversified exchange, the output proxy 'number of

Table 3. Costs per trade and number of trades of selected equity exchanges

Exchange	Costs per Trade 2005 in EUR	Number of Trades 2005	Costs per Trade 2006 in EUR	Number of Trades 2006	Costs per Trade 2007 in EUR	Number of Trades 2007
Australian Securities Exchange	4.01	25,214,700	2.65	37,037,600	1.33	65,933,000
BME Spanish Exchanges	5.22	17,352,719	4.05	23,792,036	2.81	34,862,613
Borsa Italiana	2.39	47,318,500	3.74	57,594,000	NA	NA
Bursa Malaysia	2.19	14,667,694	1.56	20,453,305	0.96	36,981,597
Deutsche Börse Group	7.25	87,736,373	5.56	109,018,187	5.07	145,019,545
Euronext	4.65	78,275,700	3.65	105,258,000	NA	155,036,400
HELENIC Exchanges Group	2.46	9,153,685	3.07	11,128,589	NA	11,615,994
Hong Kong Exchanges and Clearing	5.05	24,701,110	2.62	45,020,850	1.03	118,842,305
Istanbul Stock Exchange	1.46	44,802,600	0.81	45,937,800	0.80	48,538,400
Johannesburg Stock Exchange	10.41	5,064,042	7.80	7,953,510	6.17	11,553,803
London Stock Exchange	3.66	66,289,209	1.25	94,799,532	1.60	160,989,634
Mexican Exchange Group	6.11	1,710,300	7.26	2,476,200	2.26	3,562,027
NASDAQ OMX Group	0.32	1,076,715,321	0.27	1,317,633,583	NA	1,644,895,464
New Zealand Exchange	13.17	606,256	15.73	542,233	16.72	577,316
NYSE Euronext	1.47	912,855,200	1.30	1,264,244,400	0.57	2,320,574,400
OMX	6.13	5,457,700	4.73	8,825,600	3.69	12,108,600
Oslo Børs	4.98	21,514,890	3.79	31,666,924	3.76	48,505,407
Philippine Stock Exchange	4.45	871,499	3.27	1,286,760	2.15	2,634,729
SIX Group	8.87	17,954,199	3.66	24,475,270	2.74	35,339,296
Taiwan Stock Exchange	0.59	134,955,600	0.47	162,924,000	0.19	213,203,300
TMX Group	1.72	58,635,400	1.05	92,139,085	0.99	127,253,300
Wiener Börse	2.02	3,306,620	4.28	6,500,000	5.23	11,300,000

Vertically integrated

equities transactions’ is only one part of the output of these exchanges. Thus an adjustment of costs data was done. The analysis of the annual reports shows that in average 44.5% of the business is related to equities trading and post-trading (the analysis of the main cost factor of an exchange ‘staff’ comes to a similar relation). In Table 3 the adjusted costs per trade of the largest equity exchanges for the years 2005 to 2007 are listed, as well as the number of equity transactions³.

Though vertically integrated exchanges are providing a different scope of services the average costs per trade of the vertically integrated exchanges are five percent lower than the expenses from the other exchanges: 3.84 EUR per trade versus 4.05 EUR per trade. If there were economies of scale as stated in section 0 one should expect decreasing costs per trade when the number of transactions is increasing. This seems to be the case as the number of transactions leads to a reduction of costs per trade (see Fig. 1). The effect is stronger for the vertically integrated exchanges.

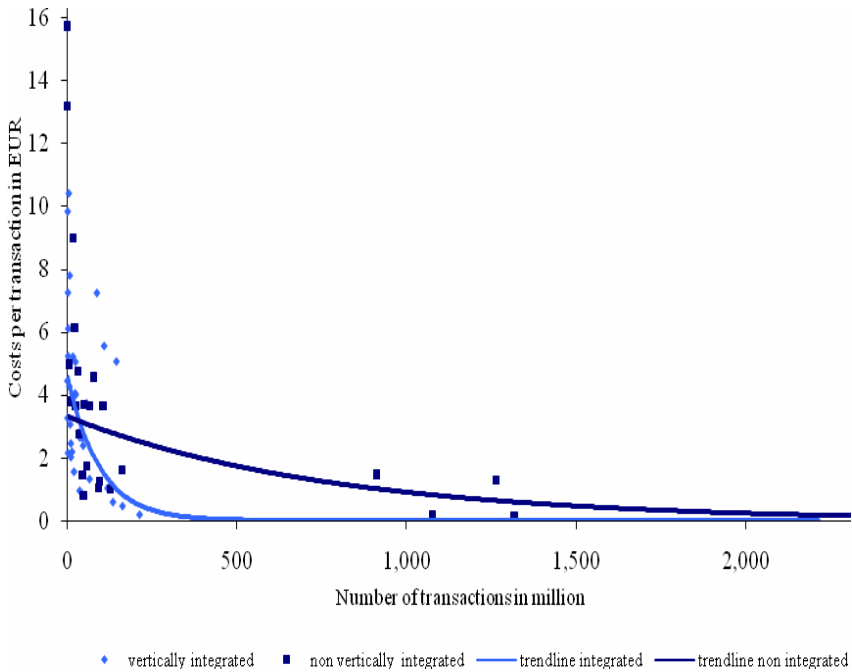


Fig. 1. Average costs per trade of equities exchanges (2005-2007)

Considering the size of the exchanges and the integration of trading, clearing, and settlement is not sufficient to explain the costs per trade. Additionally, the

³ The largest equity exchanges were selected according to the World Federation of Exchanges (2008) report. Only exchanges which published these informations are listed. The costs and number of trades are from the annual reports of the exchanges or from the World Federation of Exchanges report (2008).

diversification has a dominant impact on the costs per trade. Therefore we introduce the dummy variable for the diversification of an exchange (DIV).

5.2 Empirical Results

The analyzed data supports the hypotheses that the size of the exchanges leads to lower costs per trade. It also shows that diversification and vertical integration lead to higher costs per trade. Table 4 provides estimates for the variables number of transactions (X), diversification of an exchange (DIV), and vertical integration of an exchange (VER). The dependant variable in the regression is costs per trade of the exchanges. It shows that the regression with X, DIV, and VER (see column 4) has a higher coefficient of determination than the regression with either only X (column 1), DIV (column 2), or VER (column 3).

Table 4. Regression on cost per trade

Independent Variables	(1) Parameter (t-statistics)	(2) Parameter (t-statistics)	(3) Parameter (t-statistics)	(4) Parameter (t-statistics)
Intercept	3.764 (11.650) ^{***}	2.758 (8.332) ^{***}	2.711 (5.662) ^{***}	2.252 (4.607) ^{***}
X	-0.0000022 (-2.946) ^{***}			-0.000002 (-2.823) ^{***}
DIV		2.555 (3.891) ^{***}		2.948 (5.019) ^{***}
VER			1.208 (1.915) [*]	1.229 (2.236) ^{**}
Adjusted R ²	0.117	0.196	0.044	0.384
F-Statistics	8.681 ^{***}	15144 ^{***}	3.668 [*]	13.075 ^{***}
N	58	58	58	58

^{***} Significant at the 1 percent level ^{**} Significant at the 5 percent level ^{*} Significant at the 10 percent level.

The results support hypotheses H1 that the number of transactions has a negative effect on the costs per trade. This means that large exchanges are providing their services at lower costs per trade. Moreover, we see that diversification and vertical integration lead to higher costs per trade.

6 Organization of Exchanges

6.1 The Model and Data Sample

For the organization of an exchange not only economies of scale need to be considered. As most of the exchanges are profit oriented and some even listed companies, the net profit ratio (NPR) is an important indicator for the success of the management of an exchange (see Table 1 and Table 2). In the following figure the net profit ratio in relation to the size of the exchanges is plotted.

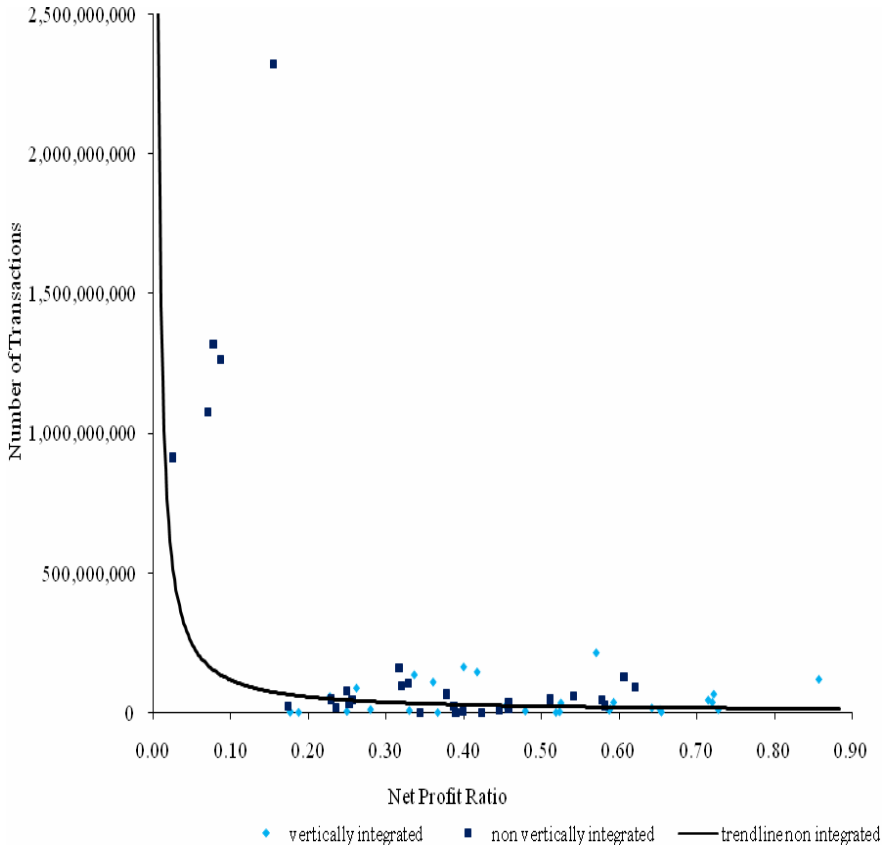


Fig. 2. Net profit ratio of equities exchanges (2005-2007)

The net profit ratio of the exchanges shows that the vertically integrated exchanges are the most profitable exchanges. Vertical integration is modeled as a dummy variable (VER) indicating 1 for vertical integration and 0 for no integration. At the same time the large exchanges seem to be less profitable than the smaller ones. The size of the exchange is measured by the number of transactions (X). The core competence of an exchange are trading and post-trading services. Additional services, like IT-services, do not belong to the core competence of an exchange (Serifsoy 2007). One could therefore expect a negative effect of diversification (DIV, modeled as a dummy variable) on the profitability of the exchanges. The relation is matter of the next equation.

$$NPR_{i,t} = \alpha + \beta X_{i,t} + \gamma VER_{i,t} + \delta DIV_{i,t}$$

6.2 Empirical Result

In the following the hypotheses H2, H3, and H4 are tested. Table 5 provides estimates for the variables number of transactions (X), vertically integration (VER), and diversification (DIV). The dependant variable in the regression is the net profit ratio. The table shows that the regression with X, DIV, and VER (see column 4) has a higher coefficient of determination than the regression with only X, DIV, and VER (see column 1, 2, and 3).

Table 5. Regression on profit ratio

Independent Variables	(1) Parameter (t-statistics)	(2) Parameter (t-statistics)	(3) Parameter (t-statistics)	(4) Parameter (t-statistics)
Intercept	0,452 (20.087) ^{***}	0.334 (8.312) ^{***}	0.477 (17.014) ^{***}	0,429 (12.533) ^{***}
X	-0.00000022 (-4.163) ^{***}			-0.00000018 (-3.525) ^{***}
DIV		-0.186 (-2.989) ^{***}		-0.139 (-3.142) ^{***}
VER			0.169 (3.329) ^{***}	0.091 (2.286) ^{**}
Adjusted R ²	0.211	0.098	0.121	0.375
F-Statistics	17.333 ^{***}	8.931 ^{***}	11.085 ^{***}	13.209 ^{***}
N	61	73	73	61

^{***} Significant at the 1 percent level ^{**} Significant at the 5 percent level.

The results support the hypotheses that larger exchanges are less profitable than smaller ones (H3). They also support the positive effect of vertical integration for the profitability of exchanges (H2). The negative effect of diversification for the profitability is supported as well (H4).

7 Conclusion and Outlook

Equity exchanges have been diversifying their operations into related business areas. Securities trading and post-trading are subject to scale and scope economies. The integration of these functions in one institution ensures efficiency by economizing on transactions costs. Our analysis confirms that large exchanges are providing trading services at lower costs per trade than smaller ones. Whereas integration of trading and post-trading and diversification lead to higher average costs per trade.

Size and diversification have a negative influence on the profit ratio of equity exchanges, while vertical integration has a positive impact. This is supported by the market capitalization of the exchanges that seem to be higher in case of vertical

integration (see table 1). Reasons for this effect might be among others economies of scope, the reduction of technical and organizational interfaces, and the market power.

We see that large exchanges provide trading at the lowest per trade costs, but vertically integrated exchanges realize the highest profits. These results are also confirmed by the current strategies of the exchanges which show a trend towards more verticalization of securities trading, with for example the merger of the LSE with the Bora Italiana (which includes post-trade services) in 2007 and the integration of trading and post-trading at the SIX Group in 2008.

The organization of exchanges is important for the different stakeholders: The users, the operators, the shareholders, and the regulators. Especially in Europe the vertical integration of trading, clearing, and settlement is discussed controversially (EU Commission 2006; Schaper 2008). Our findings show, that the largest exchanges are providing trading at the lowest costs per trade. This means that from a macroeconomic perspective horizontal consolidation has to be considered as a suitable approach to improve the explicit costs per trade. On the other side competition is important for the development of innovations in the area of trading, clearing, and settlement. As for example new trading venues like Chi-X established the trading of European securities using the existing domestic infrastructures for the settlement instead of using links or agent banks (Chlistalla and Schaper 2008).

From the shareholders perspective the best way to maximize the profit of the exchange seems to be the integration of the securities trading value chain and to focus on single markets rather than providing trading services for different markets.

Naturally, the potential for monopoly behavior of vertically integrated exchanges needs to be considered properly which possibly is one of the most difficult issues and deserves a dedicated monitoring.

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The Impact of New Execution Venues on European Equity Markets' Liquidity – The Case of Chi-X

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Abstract. With the Markets in Financial Instruments Directive in effect since November 2007, new trading venues have emerged in European equities trading, among them Chi-X. This paper analyzes the impact of this new market entrant on the home market as well as on consolidated liquidity of French blue chip equities, newly tradable on Chi-X. Our findings suggest that owing to this new competition the home market's liquidity has enhanced. This is apparently due to the battle for order flow which results in narrower spreads and increased market depth. These results imply that overall liquidity in a virtually consolidated order book is in the French case higher than without the new competitor.

Keywords: Electronic Market, Trading, Liquidity, Fragmentation, Exchanges.

1 Introduction

Following intensive discussions and circumstantial preparations across the financial industry, a new era began for European equity trading in November 2007 when the Markets in Financial Instruments Directive (MiFID) became applicable across Europe. By establishing a single market and a homogenous regulatory regime for investment services across the European Economic Area, MiFID has been expected from its origins to trigger fundamental changes in the European equities trading landscape. Indeed, there is consensus among traders that by the time of its first anniversary, MiFID has been successful in its main objective: to lead to more competitive equity markets in Europe (Jeffs and Fairless 2008). Its consistent classification of execution venues (i.e. equal treatment of multilateral trading facilities (MTFs) and regulated markets, which implies the abolition of formerly existing concentration rules that obliged investment firms to route orders exclusively to stock exchanges) is the central enabler for the emergence of new electronic trading venues. Examples of such MTFs include Chi-X, Turquoise and NasdaqOMX. From a technical perspective, the high degree of electronification found in European equity markets and their trading participants favors competition. The creation and operation

of new trading venues is facilitated once a trading system has been developed or acquired and the burdens of participating in these markets have been lifted, as nowadays traders' physical presence at the trading venue is not required anymore.

MiFID's best execution requirements oblige investment firms to make adequate provisions including processes and IT systems for order routing to achieve the best possible result for the client. Against this background, new technologies like e.g. Smart Order Routing systems (SOR) enable investors to efficiently make use of liquidity available in more than one market. Though not mandated by MiFID, SOR is one possibility to access multiple liquidity pools, i.e. exchanges or MTFs, to identify the best destination and apply proprietary algorithms to optimize order execution (Hallam and Idelson 2003). SOR engines continuously gather real-time data from the respective venues concerning their order book situations, i.e. current quoted volumes and prices. Based on this information, they slice incoming orders and decide where to route individual suborders in respect of the best prices available in that logical second.

The new regulatory environment triggered by MiFID has also increased fragmentation among execution venues in Europe¹. So far, equity trading mainly focused on a stock's home market, while other trading venues had very little market share although blue-chip stocks have been cross-tradable in European exchanges for some ten years already.

UK-based Chi-X Europe is one of the new market entrants and has gained a considerable market share in European blue-chip stocks, which amounted to 5.8% of all European equities trades in November 2008 (Fairless 2009). Chi-X launched its fully electronic trading system in March 2007 and currently serves 13 European markets. German and Dutch stocks from the DAX-30 and AEX-25 index were the first to be made available for trading, with the other markets following successively and two future markets currently being under investigation. Business commenced rather sluggishly in the beginning as new members needed to be connected first in order to be able to trade.

While there is convincing evidence that competition for equity trading flow has increased in 2008 (cf. FFI or OrangeLFI), its impact on market liquidity remains unclear and needs to be investigated. Liquidity is known to be the most important determinant of market quality. It has an effect on the transaction costs for investors, and it is a decisive factor for order flow among execution venues. In view of MiFID's best execution requirements, academics and practitioners are reasoning that the test for MiFID is whether competition will increase liquidity and efficiency or whether the benefits of competition for investors will be lost to the increase in fragmentation. This paper contributes to this discussion by an analysis of the impact of new execution venues on the liquidity of incumbent European equity markets. We analyze the cost of a round-trip trade of a certain size (denominated in Euros) as indicator for overall liquidity for a set of French blue-chip stocks before and after the entry of a new competing execution venue, Chi-X, both for the home market and for a virtually

¹ A number of concepts have recently been developed that shed light on fragmentation and market shares in European equity trading: The *Fidessa Fragmentation Index* (FFI) reports on a weekly basis the post-trade fragmentation, i.e. market shares of selected European exchanges (see <http://fragmentation.fidessa.com/>). Equiduct's *Liquidity Fragmentation Index* (OrangeLFI) calculates a stock's pre-trade fragmentation, i.e. the theoretical market share based on where an order should have been routed (see <http://www.equiduct-trading.com/>).

consolidated market consisting of both order books. Against the background of initial sluggish trading contingent upon a too little number of connected members, we chose French stocks for our analysis. Chi-X had positioned itself a competitor of Euronext Paris for stocks in the French blue-chips index CAC-40 since September 28, 2007 – i.e. six months after going live with the first market.

The remainder of this paper is structured as follows: The next section surveys the relevant literature on market fragmentation and competition between markets. The market structures of both Euronext Paris and Chi-X are presented followed by a description of our dataset and methodology. The subsequent section reports our findings, while the last section provides conclusions.

2 Related Literature

Our work as outlined in the introductory section addresses and contributes to two topics in academic literature: firstly in a general way the impact of market fragmentation and competition between markets on quoting behavior in dealer markets as well as on overall liquidity in order driven markets, and secondly in a more concrete way the topic of empirical market liquidity event analyses where market liquidity before and after the emergence of a new competitor is compared. This section will outline some of the studies relevant to our research purpose and their findings.

In one of the first papers on the effects of market fragmentation Hamilton (1979) analyses the off-board trading of NYSE-listed stocks on regional exchanges and in the third market, the over-the-counter (OTC) trading of listed securities among institutional investors and broker/dealers for their own accounts. When studying the NYSE specialist bid-ask spreads (the prices of marketability) and the daily returns variance, Hamilton finds the competitive effect of several markets to reduce both the NYSE specialist spreads and the daily stock variances by more than the fragmentation effect tends to increase them, although this net effect is not seen to be large.

Barclay, Hendershott and McCormick (2003) study the competition between Nasdaq market makers and electronic communication networks (ECNs) in US equities. Their results show that informed trades more likely occurred in an ECN and that the lower bound for permanent price effects was 50 percent higher for ECNs than for Nasdaq market makers. Their conclusions suggest the majority of aggregated price discovery to occur in ECNs.

The quotation behavior of dealers at the Nasdaq market is also focused by Bessembinder (2003). His hypothesis of competitive quotes helping increase a dealer's market share on Nasdaq is analyzed after the introduction of new trading platforms such as SuperSOES and SuperMontage. As a result, SuperSOES is shown to increase the size elasticity, and SuperMontage to increase even both the size and price elasticity of dealer market share. A positive effect from the market participants' perspective represents the fact that market centers tend to provide greater price improvements and faster executions when they post competitive quotes.

The competitive impact of ECNs on the Nasdaq is studied in Fink, Fink and Weston (2006) and found to have a positive effect on market liquidity as the development of these alternative trading platforms is associated with tighter quoted,

effective, and relative bid-ask spreads, greater quotation depths and less concentrated markets. On the other hand the increase in ECN trading may have caused some traditional market makers (wholesalers and national retail dealers) to exit the market for market making as their profits tend to decrease with lowered bid-ask spreads.

Battalio, Hatch and Jennings (2004) examine a sample of actively traded, multiply listed US equity options against the background of growing competition for order flow in actively traded options during August 1999, followed by the introduction of payment for order flow thereafter and the launch of the International Securities Exchange in May 2000. They document substantial reductions in quoted and effective spreads between June 2000 and January 2002.

In their study, Boehmer and Boehmer (2002) examine the change in liquidity for 30 AMEX-listed exchange-traded funds (ETFs) upon being traded under unlisted trading privileges on the NYSE. The evidence presented indicates a substantial increase in liquidity following the NYSE entry.

The bid-ask spreads and volumes in options markets during the competition for listings in 1999 between the CBOE, the American Stock Exchange (AMEX) and the Pacific Exchange (PCX) are examined in DeFontnouvelle, Fische and Harris (2003). Their findings indicate that effective and quoted bid-ask spreads decrease significantly after multiple listing, and that spreads generally maintain their initial lower levels one year later. Consequently, they reject that economies of scale in market making cause the decrease in spreads and support the view that inter-exchange competition reduces implicit transaction costs.

Foucault and Menkveld (2008) investigate the competition between Euronext and EuroSETS, which is operated by the London Stock Exchange (LSE), in the Dutch stock market. They compute the consolidated limit order book to be deeper and the Euronext depth to be larger after the entry of EuroSETS. They trace back the increased Euronext depth to the fact that Euronext responded to the EuroSETS entry with a fee reduction on limit order submission.

The case of the ECN Island reducing its market transparency in September 2002 is addressed in Hendershott and Jones (2005). Before this event, the trading of ETFs in the US was concentrated on Island. With a higher degree of market fragmentation after this event, Island's effective and realized spreads increased, while effective and realized spreads fell in other markets. The net effect is determined a substantial increase in overall effective and realized spreads and therefore a worsening in overall ETF market quality.

As one can see from the outline above, the majority of studies support the hypothesis that the potential negative impact of market fragmentation on liquidity and overall market quality is overcompensated by the increase of liquidity resulting from a more competitive landscape.

3 Empirical Analysis

In this section our research approach will be presented. The basic characteristics of the Euronext Paris and Chi-X market structures will be examined first followed by the description of our dataset and resulting limitations. Eventually, we will elaborate on our hypotheses and methodology.

3.1 Euronext Paris and Chi-X Market Structures

Euronext Paris (ENP) is a centralized hybrid market (i.e. quote- and order-driven) using an electronic trading system, where securities that are liquid enough or securities with a designated liquidity provider are traded continuously following price-member-time priority. The stocks we study are constituents of the blue-chip index CAC-40 and thus are traded continuously without a designated liquidity provider. All orders are anonymous on the order book. The pre-opening starts at 07:15 CET and orders are collected for the opening auction at 09:00 CET. After the opening auction, continuous trading immediately commences and lasts until 17:30 CET. Finally, a closing auction at 17:35 CET closes the trading day. The minimum tick size (price increment) is .01 Euros for all stocks. In order to avoid extreme price fluctuations, ENP has a built-in safety measure in continuous trading. If a price exceeds a specified limit, this mechanism automatically interrupts continuous trading and subsequently an auction begins.

Chi-X is a trading platform operated by Instinet Chi-X Ltd., an independent subsidiary of Instinet Europe Ltd. It is authorized and regulated as an MTF by the UK's Financial Services Authority. Securities can be traded on Chi-X but cannot be listed. Trades on Chi-X are matched in price-time priority by a fully electronic proprietary matching. All Chi-X orders are anonymous on the order book. Chi-X's trading day starts with a pre-market continuous trading period from 07:35 to 09:00 CET. During that time, orders are matched and unexecuted orders are automatically transferred to the subsequent continuous trading session which lasts from 09:00 to 17:30 CET. The opening auction period lasts from 08:00 to 09:00 CET with the opening price being established at 09:00 CET onwards using the primary market opening price which is passed back upstream as a trade correction from 09:00 CET (Chi-X 2007). For the purpose of price continuity, Chi-X conducts price tolerance checks for orders. Those orders that breach the price checks will automatically be rejected by the system. Stocks are traded in their official local currency, i.e. Euros for our CAC-40 stocks. The minimum tick size for Eurozone stocks depends on a respective stock's price range and varies between .001 Euros for a share price of less than one Euro to .005 Euros for a share price that equals at least 10 Euros.

As presented above, both market structures exhibit similar market design characteristics for our sample of CAC-40 stocks in a way that they are traded continuously in an electronic order book and trading is organized order-driven. Both exchanges feature visible as well as non-displayed order types whereby the latter imposes a limitation in our dataset which will be addressed in the next subsection.

3.2 Dataset

On September 28, 2007 Chi-X commenced to provide trading services for French instruments with an initial selection of 19 stocks, all of them constituents of the CAC-40 blue chip index. That range of tradable instruments was extended by another 18 CAC-40 stocks on October 12, 2007. Those 37 French stocks will form our sample instruments, split up into panels A and B.

For these 37 instruments, order book data of the ENP and Chi-X markets have been retrieved from a Reuters Data Scope Tick History terminal. Those data include

quoted prices and respective volumes for the first ten limits on each side of the electronic order book, i.e. the ten highest bid and ten lowest ask limits. Time stamps provided in our data are based on milliseconds, and each change in the order book within the first ten limits generates an update in the dataset.

Although ENP and Chi-X both feature non-displayed order types in their market models, publicly available order book data lack this hidden liquidity. Thus, we can measure the change in displayed liquidity following the Chi-X market entry, not the change in overall (hidden and displayed) liquidity. The change in displayed liquidity could therefore underestimate or overestimate overall liquidity changes when e.g. order flow has been shifted from displayed to hidden. Moreover, we do not have any secured information on volatility interruptions, but this is not a severe issue in our case (as will be shown in the next subsection on methodology).

3.3 Methodology

For our study on the impact of a new competitive market on liquidity we have selected two sample periods for each panel. The first period includes the last 60 days before a respective stock was made available for trading on Chi-X and thus we will refer to it as our pre-entry period. These data will be applied to retrieve a robust estimate for the Euronext liquidity level before the Chi-X market entry. The second period includes the 30 days following the entry of Chi-X and will be referred to as post-entry phase. For all 37 sample stocks we have checked if any of them have dropped out and been replaced in the CAC-40 index during any of the sample periods.

For our purposes we use limit order book snapshots. The snapshot data contain the ten best bid and ask quotes and the number of shares offered at these quotes, sampled every five minutes in both ENP and Chi-X. We also aggregate these data across both markets and create a snapshot of the consolidated limit order book. Time triggered auctions, i.e. opening and closing auctions, are excluded from computations as we intend to study continuous trading only. Additionally, we excluded the first and last five minutes within each continuous trading session to avoid typical distortions. The duration of event-triggered auctions in ENP induced by a violation of price continuity is only a few minutes and therefore the probability of capturing a snapshot coincidentally in an auction seems to be negligible. Besides, given our setup of order book snapshots and the number of observations, a single snapshot has very little weight in our dataset and thus a snapshot captured involuntarily during an auction period potentially has little bias on our results.

In order to illustrate possible changes in order book liquidity before and after the Chi-X entry we will apply three variables, namely (i) the relative quoted spread, i.e. the ratio of the bid-ask spread and the midpoint, (ii) the value at the top of the book, i.e. the number of shares at the top of the book for both sides multiplied by the associated quote and (iii) the Exchange Liquidity Measure (XLM) for a value of 100,000 Euros as developed in Gomber, Schweickert and Theissen (2004). We use the third measure to capture order book depth, i.e. the order book liquidity beyond the best bid and ask. The XLM measures the execution costs of a round-trip transaction and uses the information about all the orders in an order book to calculate the weighted average price at which an order of given size (Euro-denominated in our case) could be executed immediately at time t . Denote these prices by $P_{B,t}(V)$ and

$P_{S,t}(V)$ where the index (B, S) indicates the type of the transaction (buyer-initiated or seller-initiated) and V denotes the order size. Let MQ_t denote the quote midpoint at time t . Execution costs for a buy and a sell order in basis points are calculated by

$$XLM_{B,t} = \frac{P_{B,t}(V) - MQ_t}{MQ_t} \cdot 10,000$$

$$XLM_{S,t} = \frac{MQ_t - P_{S,t}(V)}{MQ_t} \cdot 10,000$$

For the execution costs of a round-trip transaction at time t both measures are added up. A similar measure has been suggested in Irvine, Benston and Kendal (2000), as they considered spreads not to be sufficient measures for market liquidity. For the XLM, we will assume round-trip transactions of $V=100,000$ Euros.

In our setup we estimate the means of these variables, changes in these means, and test for the statistical significance of these changes applying panel data techniques. For testing the significance of changes in the means we assume that a dependent variable $y_{i,t}$ for stock i and day t can be expressed by adding up a stock-specific mean μ_i , an event effect δ_i , potential control variables $X_{i,t}$ and an error term $\varepsilon_{i,t}$:

$$y_{i,t} = \mu_i + \delta_i \cdot I_{[t \text{ in post-entry period}]} + \beta' X_{i,t} + \varepsilon_{i,t}$$

$$\varepsilon_{i,t} = \xi_t + \eta_{i,t}$$

where $I_{[t \text{ in post-entry period}]}$ is an indicator variable which equals 1 if t lies within the post-entry period. The error term consists of a factor common to all stocks and a stock-specific term. We will compute the changes within the quartiles of our two panels A and B as

$$\mu_p = \frac{1}{N_p} \sum_{i \in I_p} \mu_i$$

$$\delta_p = \frac{1}{N_p} \sum_{i \in I_p} \delta_i$$

where p is the quartile index, N_p is the number of stocks in the respective quartile and I_p contains the indices of the stocks in quartile p . δ_p will indicate the impact of the Chi-X entry on a respective dependent variable.

4 Results

Table 1 presents the mean daily turnover in the stocks from panel A and panel B, respectively. We observe that the set of stocks that were made available for trading at the earlier date (panel A) exhibits a significantly higher mean daily turnover than the stocks from panel B. We clustered the stocks within each panel according to their

Table 1. Quartiles (by daily turnover in million Euros) in panels A and B²

Quartile	Panel A			Panel B		
	RIC	Instrument	Mean	RIC	Instrument	Mean
Q1	SOGN	SOCIETE GENERALE	266.0	VLLP	VALLLOUREC	82.1
	TOTF	TOTAL	263.0	SCHN	SCHNEIDER ELECTRIC	82.0
	BNPP	BNP PARIBAS	238.0	CAGR	CREDIT AGRICOLE	80.8
	AXAF	AXA	170.0	ALSO	ALSTOM	73.2
	FTE	FRANCE TELECOM	169.0	LAFP	LAFARGE	69.2
Q2	SJOB	SAINT GOBAIN	149.0	CAPP	CAP GEMINI	51.7
	SASY	SANOFI-AVENTIS	143.0	EAD	EADS	51.5
	LYOE	SUEZ ENVIRONNEMENT	128.0	VIE	VEOLIA ENVIRON.	50.8
	ALU	ALCATEL-LUCENT	113.0	EDF	EDF	50.1
	CARR	CARREFOUR	102.0	BOUY	BOUYGUES	43.6
Q3	RENA	RENAULT	97.9	ACCP	ACCOR	42.0
	DANO	DANONE	90.9	UNBP	UNIBAIL-RODAMCO	38.9
	VIV	VIVENDI	87.4	PRTP	PPR	37.9
	SGEF	VINCI (EX.SGE)	76.7	DEXI	DEXIA	33.9
	LVMH	LVMH	65.5	AIRF	AIR FRANCE -KLM	33.5
Q4	OREP	L'OREAL	63.4	PERP	PERNOD RICARD	32.0
	AIRP	AIR LIQUIDE	59.1	GAZ	GDF SUEZ	27.7
	PEUP	PEUGEOT	52.7	ESSI	ESSILOR INTL.	18.6
	STM	STMICROELECTRONICS	39.6			

mean turnover into four quartiles (Q1 to Q4) in order to obtain subgroups as homogenous as possible for later comparisons³.

As mentioned earlier, XLM captures the depth of the order book. Calculating the XLM for a volume of 100,000 Euros requires the order book to exhibit sufficient depth to theoretically fill a round-trip order of that size. Typically, this is not the case at all times, leading to a number of instances where XLM cannot be computed due to insufficient order book depth. We were unable to compute XLM(100,000) during the pre-entry phase for ENP in 11.1% (panel A stocks: 4.9%, panel B stocks: 17.7%) of our observations and during the post-entry phase in 13.6% (panel A stocks: 5.9%, panel B stocks: 21.8%) of the observations.

When examining two execution venues, the possibility for arbitrage situations exists. Arbitrage is defined as “the simultaneous purchase and sale of the same, or essentially similar, security in two different markets for advantageously different prices” (Sharpe and Alexander 1990). In a perfect world without transaction costs, an arbitrage situation would instantly be resolved by traders simultaneously buying at the one market and selling at the other, thereby realizing a riskless profit. However, when virtually consolidating the order books of two markets during an arbitrage situation, no orders are matched. The result thus is the hypothetical situation of a crossed order book, i.e. a situation where the highest bid is lower than the lowest ask price. Computing the XLM in such a situation will result in an XLM<0, which is economically not justifiable. Consolidated order books exhibit on average 49.9% of negative XLMs (panel A stocks: 56.3%, panel B stocks: 43.2%), which is a strong indicator for aggressive quoting behavior of the new entrant.

Following the comprehensive discussion of appropriate standard errors for panel data regressions found in Petersen (2009) for testing of significances of changes in the means (of pre- and post-entry), we apply Rogers standard errors which control for

² RIC = Reuters Identification Code.

³ The basic characteristics of our dataset are presented in Tables A1 and A2 in the Appendix.

commonalities across stocks, heteroscedasticity, and non-zero stock-specific autocorrelation to our model as described in the methodology section. First, we ran our regressions in a univariate setup without any controls and found the event to have a significant impact on ENP market liquidity for most stocks. As liquidity changes might be associated with factors other than the Chi-X market entry, we isolate its effect on market liquidity by running our regression with control variables price level (defined as the average daily midpoint quote), traded volume and volatility (defined as the standard deviation of midpoint quotes over a respective trading day). Only the findings from the multivariate approach will be presented in the following. Table 2 reports the changes for the liquidity variables relative spread, XLM(100,000), and quoted value at best bid and ask in the quartiles of panels A and B for the incumbent market ENP.

Here, *Change Q_i (δ_i)* denotes the regression coefficient (as denoted in the previous section) associated with the Chi-X market entry for stock quartile i . *Rel. Change* reports a variable's change relative to its pre-entry level. With the control variables described before, our findings for the liquidity changes are more heterogeneous than in the univariate setup, particularly across panels A and B. Liquidity in terms of relative spread and XLM, which denotes the transaction costs of a round-trip trade, improves statistically significantly (by 19.11 percent and 16.58 percent respectively at the maximum) for stocks in panel A except for quartile 2, while the quoted volumes at the best bid and ask experience only slightly positive changes after the Chi-X entry. These facts should be interpreted as a more aggressive quoting behavior in the incumbent market ENP induced by its new competitor's market entry. As quoted volumes remain mostly unchanged, aggressiveness here relates mainly to the quotes themselves rather than their associated numbers of stocks posted in the central limit order book. Nevertheless, these changes result in reduced trading costs for investors investing in those stocks. For stocks in panel B our findings are different. As described before, stocks included in panel B have been made available for trading on Chi-X a few weeks later than those in panel A and in general exhibit less trading activity. As reported in table 2, when controls for price level, traded volumes and volatility are included, Chi-X entry induced changes are not statistically significant for ENP with only a few exceptions. While for quartiles 2 to 4 relative spreads and XLMs are found to decrease, this does not hold for the first quartile. For stocks included in quartile 1 relative spreads and XLMs even increase after the event (although not significantly). Surprisingly and in contradiction to our findings for panel A, the (visible) volumes posted at the best bid and ask decrease in the post-event period for all quartiles in panel B, although changes are not statistically significant.

Consolidating over ENP and Chi-X electronic order book snapshots in the post-period resulted in large part in crossed order book situations. In consequence those situations should have been eliminated from our dataset when measuring post-entry period market liquidity in a hypothetical consolidated order book as spreads and XLM values turn to be negative. Therefore we refrain from reporting regression results for the consolidated order book. Nevertheless, we presented evidence that liquidity in the incumbent market ENP has significantly increased for the majority of stocks in panel A after the Chi-X market entry. These findings can be combined with the fact that consolidated order books are crossed in many cases due to an apparently aggressive

Table 2. Liquidity changes with controls for volume, price level and volatility for Euronext Paris

	Panel A			Panel B		
	Relative spread	XL M	Depth BA	Relative spread	XL M	Depth BA
Change Q1 (Ø1)	-0.51 *	-0.91 **	8.97	-0.07	0.41	-5.06 *
Rel. Change Q1	-11.32%	-13.30%	5.50%	1.44%	5.83%	-10.17%
Change Q2 (Ø2)	-0.58	-1.09	-2.44	-0.47	-0.21	-1.71
Rel. Change Q2	-9.36%	-11.26%	-4.35%	-9.71%	-6.58%	-1.02%
Change Q3 (Ø3)	-1.36 **	-1.85 **	1.18	-0.92	-0.41	-4.95
Rel. Change Q3	-19.11%	-16.58%	-0.35%	-9.01%	-2.01%	-7.14%
Change Q4 (Ø4)	-1.06 *	-1.51 **	12.13	-1.05	-1.92	0.12
Rel. Change Q4	-14.65%	-14.08%	14.45%	-9.97%	-10.47%	-1.02%
Change All Quartiles	-0.81 **	-1.34 **	8.48 *	-0.66 *	-0.55	-3.08 **
Rel. Change All Quartiles	-13.66%	-13.87%	2.78%	-6.97%	-3.20%	-5.51%
R2	0.28	0.18	0.54	0.05	0.11	0.24
No. of Observations	1216	1216	1216	1216	1216	1216

* / ** significant at 95 / 99 percent level

quotation behavior from traders on the new competitor Chi-X. Necessarily, it appears that overall liquidity available to investors has increased even more in those stocks, when they make use of appropriate technologies to access both markets and route their order flow at best conditions.

5 Conclusions

With the introduction of MiFID, equities trading in Europe moved from national concentration rules to a fragmented and competitive landscape of trading venues that have investors adopt new technologies such as SOR systems in order to efficiently make use of liquidity available in more than one market. This paper contributes with an analysis of the impact of new execution venues on the liquidity of incumbent European equity markets.

We investigated the impact of new competitive equity market entrant Chi-X on the incumbent market's liquidity as well as on the liquidity consolidated in a hypothetical order book for a set of French blue-chip stocks from the CAC-40 index. In order to derive general results we formed homogeneous groups of stocks by arranging them by their daily turnover. Consequently, we applied a regression approach to determine the significance of the competitor's entry on the incumbent's market liquidity. In summary, our findings are heterogeneous across the groups of stocks, but suggest that the emergence of the new competitor generates a significant stimulus for the liquidity of the most actively traded stocks in the CAC-40 index while this does not hold true for stocks with lower trading turnover. This can be attributed to a positive liquidity effect in the incumbent market after the event on the one hand and an aggressive quoting behavior from investors trading in the new marketplace on the other hand. One potential explanation for our heterogeneous findings is that trading activity in the new market Chi-X appears to be focused on the top liquids of the CAC-40 stocks and thus the competitive pressure and resulting liquidity improvement for the incumbent market ENP is limited to those stocks. This implies that the mere emergence of a competitor does not have an impact on the incumbent's liquidity as long as the trading activity in the new market is relatively low.

This field of research may be extended into two dimensions: First, Chi-X has expanded into other European markets and it is to be determined if similar findings could be documented for those markets, too. Hypothetically speaking, the impact of a new competitor on the incumbent's liquidity might be positively correlated with the concentration of stock trading before the market entry. Second, besides Chi-X other MTFs have been established in Europe, for instance Turquoise, and it might be of interest to analyze their liquidity impact.

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Appendix

The following two tables report the basic characteristics of our dataset where qVolBB and qVolBA represent the value at the top of the book's bid and ask side respectively. XLM and relative spread are denoted in basis points, qVolBB and qVolBA in '000 EUR and volume represents the number of shares.

Table A1. Descriptive statistics for the stocks in panel A

	pre-Entry					post-Entry					
	min	max	median	mean	SD	min	max	median	mean	SD	
Q1	XLM	4.96	14.48	7.85	7.97	1.71	3.94	9.99	7.05	6.91	1.32
	Relative Spread	2.93	10.24	5.27	5.36	1.19	2.68	6.86	4.70	4.75	0.98
	qVolBB	54.29	309.37	112.79	124.79	50.84	57.79	342.34	126.20	131.67	47.72
	qVolBA	52.38	448.06	114.91	125.05	52.75	55.21	337.89	128.39	131.43	51.59
	Volume	1,308,275	28,876,199	8,898,096	9,689,307	5,435,985	2,259,545	46,964,691	8,385,150	8,548,450	5,912,812
Q2	XLM	5.14	23.28	10.52	11.59	3.98	4.91	21.40	8.81	10.28	4.37
	Relative Spread	3.57	18.04	6.64	8.09	3.66	3.17	17.70	5.59	7.33	4.38
	qVolBB	43.22	582.23	90.58	135.50	107.38	32.29	424.46	92.74	129.60	93.17
	qVolBA	37.98	535.80	94.16	135.95	103.73	47.34	480.04	101.52	137.43	92.51
	Volume	1,084,911	116,170,333	5,138,585	9,355,473	12,357,243	1,210,844	41,587,734	4,910,076	7,174,101	6,487,202
Q3	XLM	5.71	19.57	11.72	11.98	2.43	6.79	17.52	9.76	9.99	1.92
	Relative Spread	3.50	12.39	7.27	7.46	1.63	3.71	13.89	5.93	6.04	1.36
	qVolBB	28.83	210.60	68.17	76.60	27.15	38.63	244.16	69.31	76.33	30.36
	qVolBA	38.48	225.43	66.51	72.20	22.06	36.03	166.20	67.78	75.63	25.66
	Volume	533,928	14,270,761	2,548,933	3,303,105	2,223,462	703,891	13,419,742	2,269,470	3,032,305	2,157,156
Q4	XLM	5.13	22.68	13.28	13.26	2.92	6.54	17.06	11.16	11.40	2.49
	Relative Spread	2.93	14.63	8.52	8.47	2.39	3.80	12.07	6.41	7.23	2.40
	qVolBB	33.77	327.14	60.01	92.57	66.40	33.69	323.53	62.79	105.95	81.74
	qVolBA	28.15	303.97	62.12	89.78	61.21	35.25	342.70	62.18	105.06	84.26
	Volume	471,507	14,511,912	1,669,533	2,529,652	2,143,166	452,228	20,677,472	1,462,309	2,548,646	2,927,529
All Quartiles	XLM	4.96	23.28	10.76	11.09	3.48	3.94	21.40	8.87	9.55	3.23
	Relative Spread	2.93	18.04	6.64	7.28	2.69	2.68	17.70	5.59	6.29	2.84
	qVolBB	28.83	582.23	85.27	108.14	73.50	32.29	424.46	85.39	111.14	70.87
	qVolBA	28.15	535.80	83.31	106.59	71.79	35.25	480.04	85.39	112.77	72.19
	Volume	471,507	116,170,333	4,271,302	6,413,581	7,803,556	452,228	46,964,691	3,842,466	5,472,045	5,455,570

Table A2. Descriptive statistics for the stocks in panel B

	pre-Entry					post-Entry					
	min	max	median	mean	SD	min	max	median	mean	SD	
Q1	XLM	5.95	26.38	11.85	12.47	3.59	4.85	20.40	12.80	13.20	2.77
	Relative Spread	3.59	18.29	7.21	7.66	2.34	2.66	12.10	7.63	7.77	1.76
	qVolBB	35.21	142.41	60.99	65.37	20.42	24.76	138.45	54.57	60.38	21.68
	qVolBA	29.22	142.69	59.07	64.06	19.98	27.88	128.47	54.27	57.54	18.18
	Volume	204,189	20,332,035	1,320,584	2,249,137	2,568,278	330,489	10,784,938	1,212,677	2,040,620	2,230,651
Q2	XLM	6.90	27.62	14.01	14.90	4.07	7.21	23.27	13.69	13.92	3.46
	Relative Spread	3.58	15.21	7.84	8.17	2.23	3.85	11.30	7.23	7.38	1.68
	qVolBB	25.17	134.34	56.84	59.05	15.23	27.16	98.91	54.38	56.04	13.55
	qVolBA	33.18	114.57	56.30	59.22	15.25	27.63	111.66	56.56	58.61	14.82
	Volume	542,793	8,684,514	1,856,401	2,154,809	1,320,405	742,909	12,070,193	1,612,004	2,356,490	1,257,616
Q3	XLM	8.79	27.45	15.85	16.30	3.74	9.06	27.69	15.32	15.98	3.61
	Relative Spread	4.93	19.72	9.15	9.74	2.77	4.69	13.81	8.52	8.86	1.98
	qVolBB	27.06	116.88	57.73	61.44	18.43	21.42	130.56	48.85	54.88	20.78
	qVolBA	30.87	157.39	57.28	60.55	18.39	30.29	183.97	51.56	56.23	23.11
	Volume	187,769	5,940,314	1,273,588	1,619,830	1,270,323	247,427	9,055,829	1,284,867	1,718,704	1,537,569
Q4	XLM	8.80	37.63	18.42	18.74	5.31	6.78	26.62	16.57	16.78	3.35
	Relative Spread	5.48	21.33	9.79	10.19	2.63	3.79	14.39	9.08	9.11	1.84
	qVolBB	20.63	82.85	47.88	48.43	12.56	20.96	83.44	44.79	46.93	12.69
	qVolBA	19.44	112.46	47.04	48.75	13.46	26.10	78.55	45.53	48.26	11.87
	Volume	161,283	5,146,900	756,054	965,774	833,144	223,706	1,829,738	828,908	847,880	435,139
All Quartiles	XLM	5.95	37.63	14.55	15.25	4.61	4.85	27.69	14.45	14.77	3.58
	Relative Spread	3.58	21.33	8.41	8.80	2.68	2.66	14.39	8.04	8.19	1.94
	qVolBB	20.63	142.41	56.45	59.79	18.19	20.96	138.45	51.76	55.41	18.58
	qVolBA	19.44	157.39	55.71	59.19	18.00	26.10	183.97	53.04	55.93	18.31
	Volume	161,283	20,332,035	1,341,871	1,834,233	1,756,635	223,706	12,070,193	1,304,678	1,840,151	1,779,156

System Latency in Linked Spot and Futures Markets

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Abstract. We examine the lead-lag effect between DAX index and DAX index futures under asymmetric latency in the exchange infrastructure. Using 1-min high frequency observations in 2006-2007, it is found that the market integration between stock index and stock index futures has significantly grown compared to prior research. While the degree of price discovery in the futures market decreased both markets react mostly contemporaneously towards new information. An event story of latency reduction on Xetra reveals that exchange latency is one important factor explaining this development. We find evidence that smaller asymmetric round-trip-times between Xetra and Eurex lead to a higher degree of market integration.

Keywords: Algorithmic trading, market microstructure, index arbitrage, latency, lead-lag effect.

1 Introduction

Low latency has become a key issue in trading. After the introduction of automated trading systems in the 1990s, all major exchanges have focused on providing fast, reliable, and direct market access to their customers during the last couple of years. The predominance of electronic trading systems in stock and derivatives markets is overwhelming. Today, latency on stock exchanges is no longer measured in seconds – exchanges around the globe have entered into a battle for milliseconds to attract algorithmic order flow. As evidence of this trend, permanently lower round-trip-times have been established. However, the diversity in performance may lead to asymmetric latency in linked markets. We provide new evidence on how low latency influences the link between DAX index and DAX index futures markets.

Linked markets as spot and futures markets have always been in the focus of financial research. The central question is how fast one market reacts towards new information and how well the two markets are linked. In perfectly frictionless and rational markets the price of stock index futures and its underlying stock index should reflect new information simultaneously. Otherwise, riskless arbitrage possibilities would occur. However, academic literature has documented substantial deviations from this theoretical model. There are two lines of research investigating the link of stock index and stock index futures. First, several papers analyze if the price

relationship can be described by the cost-of-carry model (e.g. McKinlay and Ramawamy 1988, Bühler and Kempf 1995). Second, researchers and practitioners have been interested whether one market leads the other (e.g. Stoll and Whaley 1990; Chan 1992; Grünbichler, Longstaff, and Schwartz, 1994). Prior literature provides evidence that the futures market leads the spot market. However, it is widely agreed that the futures lead varies across markets and do not last for more than half an hour. This thesis pursues the second question investigating the lead-lag relationship between DAX index and DAX index futures.

The purpose is to provide new insights into the nature of lead-lag relationships between stock index and stock index futures. In particular, it attempts to determine the influence of low latency and new high speed trading strategies. Grünbichler et al. (1994) affirm that the DAX index futures market leads the spot market by about 15 to 20 minutes. Their data sample contains transaction data from 1990 through 1991. At that time the DAX index futures contracts were electronically traded on the Deutsche Terminbörse (DTB) and the underlying DAX stocks were floor traded at the Frankfurt Stock Exchange (FSE). By comparing their results to lead-lag relationships between two electronically organized markets, Grünbichler et al. (1994) suggest that electronic trading¹ reinforces market integration.

After several improvements in market microstructure on the Frankfurt Stock Exchange and Eurex² (e.g. introduction of Xetra, new high-end bandwidth connections, innovative matching algorithms) it is high time a broader analysis of the lead-lag relation is carried out. Our research distinguishes from Grünbichler et al. (1994) in several ways. First, we consider 1-min high frequency return series. Due to a documented decreasing lead-lag effect in the 1990s (e.g. Fleming, Ostdiek, and Whaley, 1996), it became of paramount importance to use high frequency data. Second, we test directly for the influence of exchange infrastructure.

Grünbichler et al. (1994) and Frino and McKenzie (2002) examine the lead-lag effect with respect to the exchange infrastructure. However, there is an absence of prior research which analyzes the influence of latency reduction in the case where spot and futures are already electronically organized. Our paper fills this gap. DAX index futures and the underlying stocks of the DAX index are traded fully electronically on Eurex and Xetra, respectively. In order to assess the influence of asymmetric exchange latency on the lead-lag effect directly, we investigate the introduction of Xetra Release 8.0. Xetra Release 8.0 is a performance update which significantly reduced the end-to-end round-trip-times and thus, latency on Xetra. Our calculations provide evidence that lower latency results in a stronger market integration of spot and futures markets in the long term.

The remainder of this paper is organized as follows. Chapter 2 provides theoretical background and related work. Then, chapter 3 states and discusses the exchange

¹ Grünbichler et al. (1994) use the notion “screen trading” in order to define the fully electronic exchange infrastructure on DTB. We use the term “screen trading” for screen based interfaces providing order book information (e.g. IBIS). In contrast, we define “electronic trading systems” as fully electronic stock exchange infrastructure providing a trading engine for matching incoming buy and sell orders and direct market access via telecommunication lines.

² In 1998, the European Exchange (Eurex) was created through the merger of DTB and SOFEX (Swiss Options and Financial Futures Exchange). Since September 1998 trading takes place on the joint trading platform.

infrastructure on Xetra and Eurex emphasizing the latency differences. The different data samples are introduced in chapter 4. The empirical results are reported and discussed in chapter 5. Chapter 6 concludes.

2 The Theoretical Background

Lead-lag relationships between markets are already analyzed by a number of different researchers. While Fleming et al. (1996) and Stephan and Whaley (1990) examine the lead-lag effect between options and underlying cash indices, Shyy and Lee (1995) focus on the relationship between German Bunds traded on DTB and on LIFFE. In addition, a number of papers (e.g. Kawaller, Koch, and Koch, 1987; Stoll and Whaley 1990; Grünbichler et al., 1994) study the lead-lag relation between stock index and stock index futures for various markets, several time periods and with different methods. Garbade and Silber (1983) carry out the first study in this line of research. They analyze whether new information is reflected first in spot or futures prices for storable products.

Lead-lag relationship analyses are performed in the spirit of Granger (1969) and Sims (1972) causality models. However, it is possible to distinguish two different lines of research. The main difference between the Stoll-Whaley methodology (Stoll and Whaley, 1990) and the Engle-Granger causality approach (Engle and Granger, 1987) is the input data. While the first group of papers uses stock index and stock index futures return data for the analysis of the lead-lag relationship, the second line of research employs price data. Due to stationarity in return data we follow the approach proposed by Stoll and Whaley (1990).

2.1 Lead-Lag Effect

The forward pricing model can be used to describe the theoretical relation between an index futures and its underlying stock index (e.g. Cornell and French, 1982; Stoll and Whaley, 1990). This model is known as cost-of-carry relation.

However, prior literature has reported significant deviations from the cost-of-carry model. It is well documented that the futures market tends to lead the stock market but some authors also find support for the hypothesis of a bi-directional relationship³. Fleming et al. (1996) affirm the results of Stoll and Whaley (1990) that the integration between the S&P 500 index and the corresponding futures has grown over time and the lead of the futures market has weakened. Prior papers have proposed four reasons for this development:

³ Stoll and Whaley (1990) examine the relationship between the S&P 500 and MM spot and futures markets. They find the futures market lead the spot market by about 5-10 minutes and some evidence for a bi-directional relationship. FTSE 100 index and spot and futures are investigated by Abhyankar (1995) and Frino and McKenzie (2002). While Abhyankar (1995) reveals a one hour futures lead in the late 1980s, Frino and McKenzie (2002) report a 5-min FTSE futures lead for 1999. Frino et al. (2000) investigate the Australian market from 1995 through 1996. Their analysis shows that the SPI futures returns lead the AOI returns by about 20 minutes. In addition, they provide evidence a feedback from the stock market into the futures market. For the DAX German market Grünbichler et al. (1994) affirm that the DAX index futures market leads the spot market by about 15 to 20 minutes in 1990-1991.

- (1) Higher efficiency in index arbitrage trading (Stoll and Whaley, 1990)
- (2) Improvements in exchange infrastructure (Grünbichler et al., 1994; Frino and McKenzie, 2002)
- (3) Lower transaction costs in the underlying cash market (Abhyankar, 1995)
- (4) Less nonsynchronous trading in the underlying stocks (Shyy et al., 1996)

Grünbichler et al. (1994) and Frino and McKenzie (2002) are the only other authors which examine the lead-lag effect with respect to the exchange infrastructure. They provide evidence that the introduction of electronic trading systems significantly reduces the tendency of the futures market to lead the stock market. While Grünbichler et al. (1994) follow an argumentative approach by comparing lead-lag relation between the DAX and the S&P 500 index, Frino and McKenzie (2002) examine the transfer of FTSE 100 stock futures contracts from the floor to the new electronic trading platform, called CONNECT.

2.2 Latency

Besides explicit transaction costs and market liquidity trading speed and thus, latency in stock exchange networks has become one of the competitive factors for stock exchanges worldwide. All exchanges are improving their systems to cut network latency. During the last couple of years trading has fundamentally changed. New technologies in information and telecommunication technologies have led to the introduction of electronic trading worldwide. At the same time new trading strategies like program trading became popular. Stoll (2006) refers to the term “program” as the fact that computers generate the trading instructions in individual stocks. A more general term for program trading is algorithmic trading⁴. Those strategies are built on direct and fast market access. Thus, their emergence has further stimulated the introduction and improvement of electronic trading systems. Today, all major exchanges run on electronic systems (Jain 2005). Nevertheless, it is important to recognize their diversity.

Imagine a situation, in which an index arbitrage trader observes an arbitrage possibility, that is, the index futures contract trades at a substantial discount to its fair value and its price lies outside the non-transaction range. Then, index arbitrageurs buy the futures contract and sell the underlying index stocks. The time between the trading decision and the execution of the desired trade determine the trading profit. Due to trading activities in futures and underlying cash markets, the markets may move away. Thus, traders with low latency access to the market possess a competitive edge. Bühler and Kempf (1995) assume that the traders demand a risk premium to bear the execution lag. Easley, Hendershott, and Ramadorai (2008) emphasize the importance of low latency in situations where simultaneous trades in multiple securities are necessary. Other academic papers (e.g. Bessembinder, 2003; Boehmer, 2005) underline the execution speed as a dimension in trading decisions. Following their

⁴ In literature “program trading” and “algorithmic trading” are often used interchangeably. While the term “program trading” emerged in the 1980s, “algorithmic trading” became a fashionable term in the late 1990s.

results we suppose that the risk value depends on the latency of the cash and the futures market. Hence, a significant improvement in the cash market infrastructure cutting network latency reduces the execution risk. Riordan and Storkenmaier (2008) show that the latency reduction of Xetra Release 8.0 improve the market liquidity As a result trading in the spot market becomes more attractive and the feedback of the stock market into the futures market should increase.

3 The Market Mircostructure

3.1 Xetra and DAX Index

The DAX is a German blue-chip index of the 30 largest Prime Standard Segment stocks listed on the Frankfurt Stock Exchange in terms of market capitalization and order book turnover. To date, its constituent shares make-up nearly 74% of the turnover on the Frankfurt Stock Exchange and about 80% of the market capitalization on the German equity market as a whole (Deutsche Börse, 2008a).

Deutsche Börse has focused on the development of an attractive environment for algorithmic trading to meet the customers' demand of high market liquidity, low network latency, and small explicit transaction costs. In 2007, the Automated Trading Program (ATP) started allowing discounts of up to 49% for electronically generated order flow which exceeds 9,000 million Euro per month. The other improvements are related to one of the following categories: hardware, software or network. Continuous improvements of hardware components in combination with software driven evolutions like memory based matching have significantly reduced host processing times to about 20 milliseconds at the beginning of 2007 (Deutsche Börse 2007). The introduction of co-location (proximity services) in the 4th quarter of 2006 allows Xetra members to place their trading infrastructure within the Deutsche Börse trading environment to further reduce network latency. In June 2007, already 34 speed sensitive exchange customers used this service (Deutsche Börse 2007). Furthermore, two general network upgrades cut down the round-trip-times on Xetra. On December 4th, 2006 the bandwidth was upgraded to 512 kbit/s for all market participants and since April 16th, 2007 even 1 Mbit/s or 1 Gbit/s options are available. For example, the speed difference between a 1 Mbit/s and a 1 Gbit/s connection averages 1.5 milliseconds. Finally, Xetra Release 8.0 was a major step forward to enhance bandwidth efficiency. The release was introduced on April 23rd, 2007 and optimized broadcast of market information in order to boost the network performance and reduce the system load. The following three measures are directly associated with this release (cf. Deutsche Börse, 2008c):

- Only changes in the order book caused by new orders or quotes are broadcasted via the network and not the entire order book inventory.
- It became possible to split the data stream in sub-streams for different categories e.g. DAX or other indices, that is, the customers can now select the necessary data streams.
- New compression algorithms allow for more effective data compression.

This results in reduced network latency. To date, trading on Xetra allows for average end-to-end round-trip-times in Frankfurt of 13 milliseconds. However, these benchmarks are only reached with a 1 Gbit connection and a co-located trading engine in Frankfurt.

3.2 Eurex and DAX Index Futures

Eurex is a fully integrated, electronic exchange trading platform allowing participants decentralized market access on a global scale. Markets makers provide additional liquidity to the market. As order type market orders, limit orders, stop orders and combination orders are available to the market participants. The price / time matching algorithm is the same as specified for Xetra.

Eurex faces the same challenges in exchange infrastructure as the Xetra system. Participants have shown a fast growing demand for high-speed exchange services combined with high trading capacity. In order to accelerate trading speed and throughput, and to upgrade system capacity, Eurex has initiated a program called "Eurex Technology Roadmap" in the first quarter of 2006. The network latency was reduced significantly through. For example, the global average round-trip-time decreased from 280 milliseconds in January 2005 to 28 milliseconds in May 2008. New services like co-location and Enhanced Trading Solution (ETS) allow round-trip-times of 12 milliseconds and 5 milliseconds, respectively (Deutsche Börse, 2008b).

3.3 Institutional Differences in Latency

To put our results in perspective, it is necessary to assess infrastructure evolution on Xetra and Eurex. Traders always prefer to trade in the market where they are able to react faster to new market information. However, the lead-lag effect is not primarily a function of network latency but rather depends on the latency differences between Xetra and Eurex. Frino and McKenzie (2002) provide support for the hypothesis that the introduction of electronic trading systems influences lead-lag relationships.

Xetra and Eurex operate on similar trading platforms. Xetra was actually developed on the basis of the DTB electronic trading system. We identify as latency influencing factors propagation, serialization, and switching delay, interfaces, and order matching time. These performance determining factors vary between Eurex and Xetra and the participant's choice of connection. By using proximity services, it is for example possible to minimize the propagation delay (Deutsche Börse, 2007b). We assume that speed-sensitive traders like index arbitrageurs always choose the fastest available connection. Consequently proximity services do not directly influence the lead-lag relationship because they were available at the same time on both exchanges. In contrary, today's one time higher standard bandwidth connection (smaller serialization delay) on Eurex may affect the lead-lag effect directly. Another important point to consider is the interface and broadcast transmission performance. Several improvements developed by Deutsche Börse were first introduced on Eurex and later on Xetra. In order to underline Eurex's function as latency benchmark, Figure 1 compares the end-to-end round-trip-times on Eurex and Xetra (cf. Deutsche Börse, 2007, 2008b). We present different connection possibilities for both exchanges. It is evident that end-to-end round-trip-times have decreased significantly on both exchanges and that the latency difference between the exchanges has been reduced.

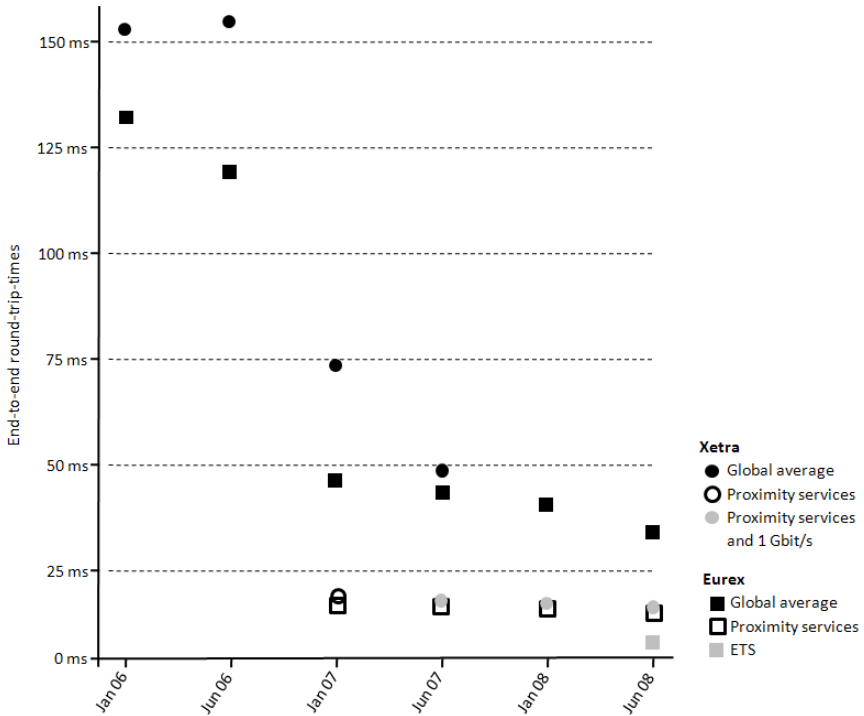


Fig. 1. Decreasing end-to-end round-trip-times on Xetra and Eurex

There is an absence of prior research that investigates the lead-lag relationship between stock index and stock index futures where both the spot and the futures market are electronically organized. To gain additional insight in the lead-lag effect we analyze the impact of a latency reducing event on Xetra directly. On the basis of the prior discussion, we sum up our hypothesis:

The introduction of Xetra Release 8.0 on April 23rd, 2007 should increase the feedback of the stock market, reduce the lead of the futures market, and enhance the contemporaneous reaction of both markets towards new information under the assumption that the latency difference between Xetra and Eurex is constant in the event window.

4 The Data

DAX index and DAX index futures data for our analysis are provided by the Securities Industry Research Centre of Asia-Pacific (SIRCA). During our research period the DAX index is calculated once per second. The DAX index futures trade and quote (TAQ) data contain all transactions time stamped to the nearest 100th of a second. Due to smaller trading times on the spot market, we restrict the data samples to the trading hours of Xetra, that is, from 9:00 a.m. to 17:30 p.m.

Table 1. Trades statistics, descriptive statistics, and Dickey-Fuller test for nonstationarity of 1-min DAX index and DAX index futures returns data

Panel A: Trade statistics				
Parameter	Data 1		Data 2	
	10/23/06 to 04/22/07		04/24/07 to 10/17/07	
	DAX index	DAX futures	DAX index	DAX futures
Trading days	125	125	125	125
TradeCount		4.768.208		6.103.161
Turnover		1,073E+11		1,380E+11

Panel B: Summary statistics of 1-min return series				
Observations	59.540	59.503	59.733	59.730
Mean	1,757E-06	1,850E-06	7,719E-07	8,284E-07
Median	4,640E-06	0,000	2,700E-06	0,000
Variance	8,924E-08	8,629E-08	1,404E-07	1,395E-07
Range	2,437E-04	9,270E-03	0,012	0,016
Skewness	-0,240	-0,119	-0,047	0,035
Kurtosis	18,768	19,100	12,475	19,803

Panel C: DF test for nonstationarity				
Type DF statistic:				
Single Mean	-245,66	-250,43	-245,69	-249,46

We calculate two data samples. While the first one covers 125 trading days prior to the introduction of Xetra Release 8.0 (October 23rd, 2006 to April 22nd, 2007), the second data sample consists of 125 post-event trading days (April 24th, 2007 to October 17th, 2007). In a first step, we compute 1-min return series of the DAX index futures transaction data. Therefore we use the nearest transaction price available prior to the end of a 1-min interval. While the first data sample consists of almost 4.8 million transaction prices, the post-event sample comprises over 6 million futures trades (see Table 1, Panel A). We calculate 1-min DAX index futures returns directly of the time stamped index values. To control for possible bias at the beginning and at the end of the trading day, we exclude the first and the last five minutes of a trading day. Consistent with Stoll and Whaley (1990) and Gründbichler et al. (1994) we follow each futures contract during the period it is the nearby

contract. This period begins on the expiration date of the prior contract and ends on the day prior to the expiration date of the next contract. Table 1 gives an overview of some descriptive statistics of the calculated DAX index and DAX index futures time series. Panel B summarizes the results for the DAX index and DAX futures return series. Consistent with Frino and McKenzie (2002) the Dickey-Fuller (*DF*) tests indicate that the DAX index and DAX index futures return time series are stationary (Table 1, Panel C). Autocorrelations are calculated from the established 1-min DAX index and DAX index futures return series for lags one through ten, that is, for 10 minutes of trading time. As stated the first and last five minutes of the trading day are excluded from the analysis. To assure that only intraday returns are used to compute the autocorrelations further 11 minutes at the beginning and the end of the trading day are lost. In contrast to prior research (e.g. Grünbichler et al., 1990) both DAX index return times series do not exhibit significant, positive autocorrelation coefficients⁵.

The decline in autocorrelations of DAX index returns has an important consequence for the lead-lag analysis. According to Stoll and Whaley (1990) positive autocorrelations in index return series may be introduced by infrequent trading in the underlying index stocks. In order to control for stale index prices in lead-lag analysis they propose to adjust the index return by using return innovations in lead-lag regressions. Since our index return series exhibit no significant autocorrelations, we incorporate the DAX index values directly in the regression framework.

5 The Lead-Lag Effect under Asymmetric Latency

In this chapter we focus on the lead-lag relationship between the DAX index and DAX index futures. First, we perform multiple regression frameworks to characterize the relationship in the two different data samples. Then, we use a dummy regression model to test the impact of Xetra Release 8.0 directly.

5.1 Lead-Lag Regressions

To investigate the causal relationship between the DAX index $R_{S,t}$ and DAX index futures $R_{F,t+k}$ we use the following regression framework:

$$R_{S,t} = \alpha + \sum_{k=-n}^n \beta_k R_{F,t+k} + \gamma z_{t-1} + u_t \quad (1)$$

where β_k are the lead-lag coefficients, z_{t-1} is the lagged difference between the log DAX index futures and spot price levels, and u_t is an error term. As proposed by Fleming et al. (1996), we integrate an error correction term z_{t-1} adjusting for the log-run equilibrium between DAX index and DAX index futures prices.

The estimated coefficients for equation (3) and t values are reported in Table 2. As depicted, the estimates for Data 1 at the lead one and lead two period of the futures

⁵ Further information is available from the authors on request.

Table 2. Lead-Lag Regression of 1-min DAX index returns $R_{s,t}$ on leads and lags of 1-min DAX index futures returns $R_{F,t}$

Parameters	Data 1 10/23/2006 to 04/22/2007			Data 2 04/24/2007 to 10/17/2007		
	Estimates	t Value		Estimates	t Value	
Days	125			125		
#obs	59,533			59,730		
R-Squared	0,7325			0,7775		
α	-1,26E-06	-2,66	***	-1,34E-06	-2,32	**
γ	2,56E-04	2,73	***	2,40E-04	2,25	**
$\beta(-10)$	0,00113	0,41		0,00161	0,62	
$\beta(-9)$	-0,00801	-2,97	***	0,00067	0,26	
$\beta(-8)$	-0,00159	-0,59		0,00013	0,05	
$\beta(-7)$	0,00045	0,16		-0,00502	-1,73	*
$\beta(-6)$	-0,00158	-0,56		0,00366	1,23	
$\beta(-5)$	0,00028	0,10		-0,00236	-0,58	
$\beta(-4)$	-0,00094	-0,34		0,00633	2,02	**
$\beta(-3)$	-0,00420	-1,34		-0,00017	-0,06	
$\beta(-2)$	0,00792	2,35	**	0,00905	3,13	***
$\beta(-1)$	0,13915	33,94	***	0,11133	33,13	***
$\beta(0)$	0,86278	190,71	***	0,87973	174,53	***
$\beta(1)$	0,00907	2,69	***	0,00744	2,25	**
$\beta(2)$	-0,00287	-0,94		0,00162	0,63	
$\beta(3)$	0,00676	1,92	*	0,00152	0,54	
$\beta(4)$	0,00107	0,36		-0,00578	-2,28	**
$\beta(5)$	-0,00202	-0,74		-0,00285	-0,94	
$\beta(6)$	0,00043	0,16		0,00021	0,08	
$\beta(7)$	-0,00210	-0,73		0,00747	3,00	***
$\beta(8)$	0,00139	0,50		-0,00200	-0,78	
$\beta(9)$	0,00049	0,19		-0,00052	-0,22	
$\beta(10)$	0,00037	0,14		0,00283	1,16	

Notes: The regressions model is as follows:

$$R_{S,t} = \alpha + \sum_{k=-n}^n \beta_k R_{F,t+k} + \gamma z_{t-1} + u_t$$

Parameter estimates are calculated from 1-min time series data for all days of the sample. The first and last five minutes of the trading day as well as overnight returns are excluded from the analysis. The t values are calculated using Hansen's (1982) Generalized Method of Moments (GMM) approach. * denotes significance at the 10% level, ** at the 5% level and *** at the 1% level.

market, the contemporaneous coefficient, and the lead one period of the stock market are significant at the 1% significance level. The contemporaneous coefficient β_0 is by far the largest one, 0.8628, indicating that the DAX index and DAX index futures market react most of the time simultaneously towards new information. Nonetheless, the large, positive coefficient β_{-1} , 0.1392, together with its t value, 33.94, suggests that the one period lagged futures return has explanatory power with respect to the current periods spot market return. The economic significance of these two variables is considerable. Around 86% and 14%, respectively, of the current spot market return can be elucidated by these two variables. The lead two futures market period is also significant and positive, 0.0079. But the effect is small compared to the lead one period of the futures market returns. Coefficient β_1 is also positive and significant, but small in its relative magnitude, 0.0091. Nonetheless, it supports the hypothesis that the spot market occasionally leads the futures market.

The second lead-lag regression employing Data 2 confirms the results obtained by carrying out the analysis with Data 1. A large contemporaneous coefficients indicates that the spot and futures markets mostly react simultaneously towards new information. However, the economic significance of lead one and two DAX index futures returns contributes only about 12% to the current period DAX index return for Data 2 compared to 15% for Data 1. Consistent with this decline the contemporaneous coefficient β_0 increases from 0.8628 for Data 1 to 0.8797 for Data 2. The results suggest that the comovement of both markets has strengthened after the introduction of Xetra Release 8.0. However, it is worthwhile to note, that the lead two futures return has increased from 0.0079 to 0.0091 in the post-event sample. But the relative magnitude of this development is small compared to the other estimates. In addition, there is no indication that Xetra Release 8.0 has reinforced the feedback of the stock market into the futures market. Comparing the results of the two regression analyses we can only provide an indication for a possible change in the nature of the lead-lag effect. With respect to the variance in the data samples only dummy regressions can provide statistically correct insights.

5.2 Dummy Regressions

To test the impact of Xetra Release 8.0 directly Data 1 and Data 2 is pooled to one data set covering the period from October 23nd, 2006 to October 17th, 2007. It is worthwhile to not that we exclude the event date on April 23rd, 2007 from our analysis. We introduce an intercept and a slope dummy in equation (3) and obtain:

$$R_{S,t} = \alpha_1 + \alpha_2 D_t + \sum_{k=-n}^n \beta_k R_{F,t+k} + \sum_{k=-n}^n \gamma_k D_t R_{F,t+k} + \delta z_{t-1} + u_t \quad (2)$$

where the coefficients γ_k capture the impact of the event on the lead-lag effect in relation to the base group. The dummy variables D_t take zero during the pre-event period and one, respectively. In my analysis the null hypothesis H_0 is that the event has had no influence on the lead-lag relationship between DAX index and DAX index futures.

Table 3 presents the estimated coefficients of the dummy regression. Consistent with our hypothesis we find a significant, negative coefficient γ_{-1} , -0.0278, indicating

Table 3. Dummy regression to determine the impact of Xetra Release 8.0

Pooled Data: 23-Oct-2006 to 17-Oct-2007				
Parameter	Estimates	t Value		
Days	250			
#obs	119.273			
R-Squared	0,7600			
α_1	-1,22E-06	-3,28	***	
α_2	-1,58E-07	-0,48		
δ	2,46E-04	3,60	***	
Order i	Estimates		Estimates $\gamma(i)$	
	$\beta(i)$	t Value	t Value	
-10	0,00113	0,41	0,00047	0,12
-9	-0,00801	-2,97	0,00868	2,31 **
-8	-0,00159	-0,59	0,00172	0,45
-7	0,00045	0,16	-0,00547	-1,34
-6	-0,00158	-0,56	0,00524	1,29
-5	0,00028	0,10	-0,00265	-0,53
-4	-0,00094	-0,34	0,00728	1,75 *
-3	-0,00420	-1,34	0,00403	0,93
-2	0,00791	2,35	0,00113	0,25
-1	0,13915	33,64	-0,02782	-5,23 ***
0	0,86279	188,91	0,01694	2,46 **
1	0,00907	2,69	-0,00164	-0,35
2	-0,00287	-0,95	0,00449	1,13
3	0,00676	1,91	-0,00523	-1,15
4	0,00107	0,36	-0,00685	-1,76 *
5	-0,00202	-0,74	-0,00083	-0,21
6	0,00043	0,16	-0,00022	-0,06
7	-0,00210	-0,73	0,00957	2,53 **
8	0,00139	0,50	-0,00340	-0,90
9	0,00050	0,19	-0,00102	-0,29
10	0,00038	0,14	0,00245	0,68

Notes: The dummy regression model is specified as follows:

$$R_{S,t} = \alpha_1 + \alpha_2 D_t + \sum_{k=-n}^n \beta_k R_{F,t+k} + \sum_{k=-n}^n \gamma_k D_t R_{F,t+k} + \delta z_{t-1} + u_t$$

Parameter estimates are calculated from 1-min time series data for all days of the sample. The first and last five minutes of the trading day as well as overnight returns are excluded from the analysis. The *t* values are calculated using Hansen's (1982) Generalized Method of Moments (GMM) approach. * denotes significance at the 10% level, ** at the 5% level and *** at the 1% level.

that the lead of futures market has weakened after the latency reduction on Xetra. Thus, the explanatory power of the futures market drops by about 3%. The corresponding t value of -5.23 provides strong evidence for the rejection of H_0 that the introduction of Xetra Release 8.0 has no influence on the lead-lag effect. In addition, the contemporaneous coefficient γ_0 shows that the simultaneously reaction of the spot and futures market increased by about 2% after the latency on Xetra was reduced. However, the dummy regression does not allow the conclusion that the feedback from the spot market into the futures market strengthened. The estimate γ_1 is not significant. The other significant coefficients γ_t at higher orders are economically not meaningful. two percentages directly⁶. However, the latency reduction by a new introduced electronic trading system is likely more significant than the broadcast optimizations introduced by Xetra Release 8.0. The different turnover in Data 1 and Data 2 can be explained by the higher mean of the DAX futures index price in the post-event data sample. That's why we conclude that there is no support for the hypothesis that the futures market shows a different trading activity in the two time periods. Additionally, we vary the window length of the dummy regression. The investigations suggest that the event window needs to be at least 150 trading days for detecting a significant influence of Xetra Release 8.0. However, the introduction of Xetra Release 8.0 seems to affect the lead-lag relationship between DAX index and DAX index futures only in the long term.

6 Conclusion

In this paper we study the lead-lag effect between DAX index and DAX index futures under asymmetric exchange latency. Exchange infrastructure and thus, latency has undergone dramatic changes in the last couple of years. Today, electronic trading systems have become predominant and algorithmic trading strategies are responsible for a significant fraction of order flow. In order to attract algorithmic traders Deutsche Börse has significantly reduced the end-to-end round-trip-times on Xetra and Eurex. Our research supports the hypothesis that low latency trading in linked markets provides a higher degree in market integration. Our results provide new evidence for the nature of the lead-lag effect in the German market and rising market integration over time. While Grünbichler et al. (1994) reveal that the DAX index futures market leads the underlying spot market by 15-20 minutes in 1990/1991 our analysis suggest that both markets mostly react simultaneously towards new information. In 2006/2007, 86-87% of the current spot market return can be explained by the contemporaneous futures return.

By studying the introduction of Xetra Release 8.0 in an event story we reveal secondly that latency reductions on Xetra affect the link between the markets. Xetra Release 8.0 is a performance update introduced in April 2007. It reduced the asymmetry in latency between Xetra and Eurex. We provide evidence that Xetra Release 8.0 reinforces market integration and leads to a weaker tendency of the futures market to lead the stock market. Due to a high variance in latency differences

⁶ We also perform the dummy regression (4) with 5-min return data. The results indeed show no significant influence of Xetra Release 8.0.

between the markets, there is no proof for a short term influence of Xetra Release 8.0 on the lead-lag effect between DAX index and DAX index futures. Although the thesis leaves open the influence of other factors as lower transaction fees and market transparency, it seems fair to conclude that latency reduction in one market improves the simultaneous reaction of both markets to new information. An important reason might be that a decrease in network latency enables algorithmic traders to react faster to new market information and reduces the execution risk of orders.

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Quantifying Users' Interconnectedness in Online Social Networks – An Indispensable Step for Economic Valuation

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Abstract. Online social networks have been gaining increasing economic importance in light of the rising number of their users. Numerous recent acquisitions priced at enormous amounts have illustrated this development and revealed the need for adequate business valuation models. The value of an online social network is largely determined by the value of its users, the relationships between these users, and the resulting network effects. Therefore, the interconnectedness of a user within the network has to be considered explicitly to get a reasonable estimate for the economic value. Established standard business valuation models, however, do not sufficiently take these aspects into account. Thus, we propose a measure based on the PageRank-algorithm to quantify users' interconnectedness in an online social network. This is a first but indispensable step towards an adequate economic valuation of online social networks.

Keywords: Online social networks, economic valuation, centrality measures, PageRank.

1 Introduction

Thanks to a variety of online social applications, including blogs, user-generated content sites like YouTube.com and countless online communities across the World Wide Web (WWW), people are connecting and communicating more and more online with one other (Bernoff and Li, 2008). Along with these changes, formerly passive information users are becoming actors, which create the content of the WWW themselves. In this context, online social networks (OSN) are currently of particular interest. Therefore, networking platforms such as MySpace.com and Facebook.com have spurred enormous attention among researchers and practitioners. The active use of OSN enjoys great popularity both in private and corporate context. According to a

recently published study conducted by the European Interactive Advertising Association (EIAA), 42% of all European Internet users participate in OSN (EIAA, 2008). Moreover, Emarketer.com states that 37% of US adult and 70% of US teenage Internet users used OSN every month in 2007 (Williamson, 2007). With the growing number of users, this technical and social phenomenon generates an increasingly important economic impact. Thus, media and IT companies have been acquiring OSN for considerable amounts to adapt their business models to the new environmental conditions and to reorganize their companies for the future. In 2005, for example, the media company News Corp. acquired the OSN MySpace.com for US\$ 580 million (BBC, 2005). Two years later, Microsoft paid US\$ 240 million for a 1.6% minority interest in the OSN Facebook.com (Hofmann and Knahl, 2008). The extrapolated value of this company thus amounts to staggering US\$ 15 billion. However, the enormous purchase prices for OSN are also being considered critical and experts compare the situation with the speculative dotcom bubble before the turn of the millennium. Martin Sorrell for instance, CEO of the WWP Group is seriously questioning the valuation of Facebook.com at US\$ 15 billion (Lambrecht, 2008).

What makes the economic valuation of OSN difficult is that the value of OSN is largely determined by the value of its users, the relationships between these users, and the resulting network effects. For instance, with a growing number of individual contacts, the attractiveness of an OSN increases for every single user, i.e. a well-connected user might use an OSN more actively, and attracting new contacts within and beyond the network. Furthermore, the loyalty of a user strongly depends on the integration into the OSN, since every additional contact raises the barrier to leave the network (Algesheimer and von Wangenheim, 2006). Consequently, the interconnectedness of each user in the OSN has to be considered explicitly to get a reasonable estimate for the company value. Currently, established standard business valuation models do not sufficiently consider this aspect. Thus, the important question of how OSN can be valued using well-founded valuation methods while considering the interconnectedness of its users has not been answered yet. Therefore, the focus of this paper is quantifying users' interconnectedness in OSN which is a first but indispensable step towards an adequate economic valuation of OSN.

The paper is structured as follows: First, we define OSN, derive requirements which an adequate measure for quantifying a user's interconnectedness in OSN has to fulfill, and briefly review existing centrality measures. Then, we propose a new quantitative measure based on the PageRank-algorithm, before we illustrate the application of the measure by an example. The last section summarizes the results and points out areas for further research.

2 Background

2.1 Definition of Online Social Networks

Aroused by the web 2.0 boom, OSN have evolved into a new, mostly free of cost mass medium where users¹ present themselves to a wide public. They voluntarily reveal parts of their privacy and establish or maintain connections with other users.

¹ The terms customer and user are used synonymously.

Besides the exponential growth of OSN, the way they are perceived has changed over the last years. OSN are not simply forums in which individuals congregate. They rather “create substantial value for the individuals who participate in them, the organizations that sponsor them, and the larger society in multiple ways” (Agarwal, Gupta and Kraut, 2008). In the following we define – according to Boyd and Ellison (2007) – OSN in particular as “web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system”. Thereby, the aspect of networking, i.e. establishing and maintaining relationships between users, plays a decisive role. Currently, there are a lot of OSN both for business (e.g. Doostang.com, LinkedIn.com) and private purposes (e.g. Facebook.com, MySpace.com) aiming at different target groups. While the culture that emerges around OSN varies, the maintenance of individual contacts and most of the key technological features are fairly consistent (Boyd and Ellison, 2007). Furthermore, the community idea is actively lived over forum and group functions and network structures are observable (Xu, Zhang, Xue and Yeo, 2008).

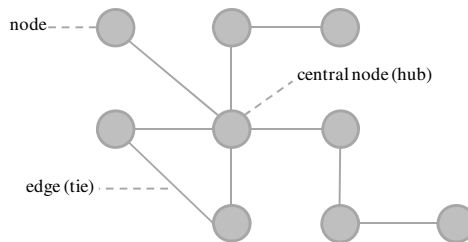


Fig. 1. Visualization of Network Structure

In social network analysis this network structure is perceived as a set of actors, which are represented by nodes, and a set of edges (ties) linking pairs of nodes (Adamic and Adar, 2003; Bampo, Ewing, Mather, Stewart and Wallace, 2008; Wasserman and Faust, 1994). The edges represent connections between actors and describe social interactions or relationships. The nodes and edges are usually presented by a graph (Hanneman and Riddle, 2005), as shown in Figure 1.

2.2 Economic Valuation of Online Social Networks

A plethora of articles and books on the valuation of companies in general has been published (Brealey and Myers, 2008; Koller, Goedhart and Wessels, 2005). However, according to the predominant view in literature standard business valuation approaches are very restricted in their ability to value young, fast growing companies in a dynamic environment, such as Internet companies (see e.g. Golotto and Kim, 2003). For OSN, the economic valuation is even more difficult, since users, relationships between users, and the resulting network effects represent a major part

of the company value. Hence, the value of each user per se and the importance of a user within the OSN have to be considered explicitly to get a reasonable estimate for the company value. Established standard business valuation models do not comprehensively take these aspects into account yet. However, in recent years new approaches have been developed, which consider the value of customers as the most important factor for a company's valuation (see e.g. Bauer and Hammerschmidt, 2005; Gupta, Lehmann and Stuart, 2004). Nevertheless, these valuation approaches have a major drawback concerning the application to OSN: network effects resulting from relationships between users are ignored. This is crucial, since a user, providing no direct financial returns to a company, might have – if considered isolated – a low (or even no) value. Yet, he or she might affect many other users by interacting with them and hence, for instance, motivate them to stay members of the network (Kiss and Bichler, 2008).

In general, network effects and in particular the importance of relationships between users within a social network have been an extensively and well-researched field in (social) network analysis. Network effects are thereby characterized by dependencies between the increasing utility that a user derives from consumption of a good and the growing number of other agents consuming this good (Katz and Shapiro, 1985, 1994; Shapiro and Varian, 1998). Bass (1969) thereby differentiates between innovators, i.e. agents adopting an innovation independently of others in a social system, and adopters. Individual utility models of the diffusion of innovations state that people adopt new technologies if benefits from adoption and use exceed the costs (Rogers, 2003). Besides the social component that influences this utility – e.g. number of other users of an innovation – normative models play a decisive role (Kraut, Rice, Cool and Fish, 1998). Especially adopters are influenced by the pressures of the social system that increase with the number of previous adopters (Bass, 1969). An individual's social influence in the adoption process is likely to be highly dependent on the position in a social network (Kraut et al. 1998, Rice and Aydin 1991).

The spread of a certain behavior or innovation in a social network, however, is not always invoked by a group of well-connected hubs (Watts, 2007). Only if a critical mass of users is exceeded (Arthur, 1989; Morris and Ogan, 1996), new users are attracted and a stronger interconnectedness of the users leads to so-called lock-in-effects (Farrell and Shapiro, 1989; Shapiro and Varian, 1998). A central position of an individual nevertheless positively affects his or her influence in and value for a network. The OSN XING.com, for instance, reports that well-connected users have (due to network effects) a higher retention rate (i.e. they are less inclined to leave the network), attract new users to a greater extent and lead to a higher activity among users (XING, 2006). So, the number of users and their interconnectedness are crucial issues when valuating OSN (Algesheimer and von Wangenheim, 2006).

Besides these general analyses, particularly social network analysts have focused on describing networks of relations for instance by tracing the flow of information through them and discovering the effects of these relations and networks on people and organizations (Wasserman and Faust, 1994; Berkowitz, 1982). Granovetter (1973), for example, analyzed the strength of relationships (ties) between people in detail, classifying them to be strong, weak or absent. He remarks, that strong ties have greater motivation to be of assistance and are typically more easily available.

However, weak ties provide people with access to information and resources beyond those available in their own social circle (Granovetter, 1973; Granovetter, 1983) and bridge cliques of strong ties (Constant, Sproull and Kiesler, 1996). Hence, OSN allow users to draw on resources from other users of the network and to leverage connections from multiple social and geographically dispersed contexts (Haythornthwaite, 2002). Furthermore, Watts and Strogatz (1998) found that almost all social networks are scale-free, i.e. they have a structure with many nodes with only few connections and some hubs creating short cuts between nodes which otherwise would be far away from each other. Thus, even though there might be gaps between individuals within large OSN, i.e. there are no direct links among all participants, well-connected users tie together sub-networks. So, the different roles and characteristics of users concerning their integration have to be taken into account adequately when valuating OSN.

A number of experiments, constructing paths through social networks to distant target individuals (e.g. Dodds, Muhamad, Watts, 2003; Garfield, 1979; Korte and Milgram, 1970) and current studies (e.g. Leskovec and Horvitz, 2008) confirm the so-called “small world” effect regarding modern networks such as the Internet and OSN. This phenomenon goes back to Stanley Milgram (1967), who provided first empirical support for the notion that everyone is just a few steps apart in the global social network. Therefore, it is not sufficient to consider only parts of the OSN (sub-networks) when investigating a user’s integration in the OSN. In fact, the complete network and all users and relationships have to be taken into account when analyzing the interconnectedness of the users for valuation purposes.

It is remarkable that despite the extensive research in network theory – to the best of our knowledge – no approach for the economic valuation of OSN, which adequately takes into account the users’ interconnectedness in the network has been developed so far. Therefore, this paper focuses on quantifying users’ interconnectedness in OSN, which is a first but indispensable step towards an appropriate economic valuation of OSN. In the following, we derive three requirements an adequate measure has to fulfill. They will be used to evaluate common centrality measures regarding their ability to quantify a user’s interconnectedness for the economic valuation of OSN. They will also serve as guidelines when proposing an adapted quantitative measure.

As argued above, the number of direct contacts (“neighbors”) plays an important role for the interconnectedness of a user:

R.1 [*Consideration of direct contacts*]. A user’s direct contacts have to be taken into account adequately when quantifying his or her interconnectedness.

With regard to OSN, a connection to a user with many contacts might be more valuable than to a user with only one or no further contact (Kiss and Bichler, 2008). Hence, the interconnectedness of a user’s direct contacts (i.e. his or her indirect contacts) has to be considered when quantifying the user’s interconnectedness:

R.2 [*Consideration of indirect contacts*]. The interconnectedness of a user’s contacts (indirect contacts and their network) has to be considered adequately when quantifying his or her interconnectedness.

To enable the application of the measure in real-world scenarios we additionally state one more requirement:

R.3 [*Feasibility*]. The measure should be based on determinable input data, its computational complexity should be manageable, and from an economic point of view it is required that the measurement can be accomplished at a high level of automation.

3 Method

3.1 Discussion of Common Centrality Measures

The quantification of interconnectedness in networks in general has attracted attention not only in social network analysis but also in many other fields (e.g. biology, physics). In the context of social networks, the most common so-called centrality measures are presented in Freeman's article "Centrality in Social Networks" (Freeman, 1979). These measures can be used to quantify the importance of a certain node within a network. In the following, we provide the definition of each of the three measures and analyze their ability to quantify a user's interconnectedness for the economic valuation of OSN on the basis of the requirements R.1-R.3.

Degree Centrality

The basic idea of degree centrality is that a node with many direct connections to other nodes is central to the network (Sparrowe, Liden, Wayne and Kraimer, 2001). Thus, this measure is based upon the number of a node's direct contacts. For a node $i \in \{1, \dots, n\}$, degree centrality is defined as

$$C_D(i) = \sum_{\substack{j=1 \\ j \neq i}}^n a_{ij},$$

where $n \in \mathbb{N}$ is the number of nodes in the network and $a_{ij} \in \{0, 1\}$ is an element of the adjacency matrix which is 1 if and only if there exists an edge between the nodes i and j (otherwise it is 0) (Freeman, 1979). Degree centrality considers direct contacts (R.1) and is easy to compute from network data (R.3). However, indirect contacts are not considered at all. Therefore R.2 is not fulfilled.

Betweenness Centrality

Betweenness centrality quantifies the ability of a node to reach other nodes in the network. Freeman (1979) defines it as the frequency with which a node falls between all unordered pairs of other nodes on the shortest paths connecting them. For a node $i \in \{1, \dots, n\}$ within a connected network, betweenness centrality is defined as

$$C_B(i) = \sum_{\substack{j=1 \\ j \neq i}}^n \sum_{\substack{k=j+1 \\ k \neq i}}^n \frac{g_{jk}(i)}{g_{jk}},$$

where $g_{jk} \in \mathbb{N}$ is the number of shortest paths linking j and k and $g_{jk}(i) \in \mathbb{N}$ is the number of these paths containing node i . Betweenness centrality does not take into

account direct or indirect contacts adequately for the economic valuation of OSN as all connections between users are important in OSN (not only the shortest paths). In figure 2, for example, the values for betweenness centrality are 0 for node 1 and 2, although both nodes have direct and indirect contacts. Furthermore, the values are the same for node 1 and 2, although node 2 has more direct contacts. In conclusion, neither R.1 nor R.2 is completely fulfilled. As there exist adequate algorithms to overcome computational performance problems R.3 is fulfilled.

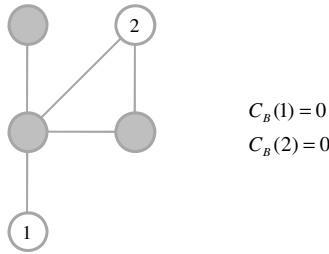


Fig. 2. Betweenness Centrality (Example)

Closeness Centrality

The concept of closeness centrality considers a node as central, if it is at short distance to all other nodes in the network. For a node $i \in \{1, \dots, n\}$ closeness centrality is defined as the reciprocal value of the sum of shortest distances from a node to all other nodes in the network and can be denoted as

$$C_c(i) = \frac{1}{\sum_{\substack{j=1 \\ i \neq j}}^n d(i, j)}$$

where $d(i, j) \in \mathbb{N}$ is the minimum length of any path connecting i and j (Freeman, 1979). It accounts for direct contacts (R.1). However, indirect contacts are not considered

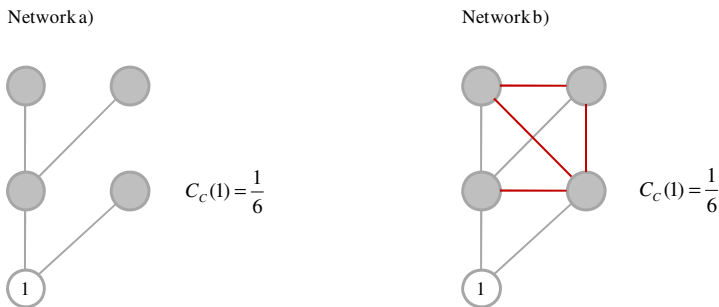


Fig. 3. Closeness Centrality (Example)

adequately (R.2) as the interconnectedness of a user's direct contacts is not taken into account consistently. In figure 3, for instance, closeness centrality returns the same values for node 1 in network a) and b), although the interconnectedness of the contacts of node 1 in network b) is much higher (additional edges). Therefore R.2 is not completely fulfilled. Although closeness centrality is relatively difficult to calculate, adequate algorithms for computing distances in a network exist. So R.3 is fulfilled.

3.2 A New, PageRank Based Centrality Measure for Online Social Networks

None of the centrality measures discussed so far fulfills all requirements (R.1-R.3) for the economic valuation of OSN. Particularly indirect contacts are not considered adequately (R.2). But with regard to OSN, a connection to a node with high interconnectedness (i.e. with many direct and indirect contacts) is – as already discussed – more valuable than a connection to a sparsely connected node. However, measures accounting for this fact have been already developed in the context of Web search engines: Brin and Page (1998), the founders of the Google Internet search engine, developed the popular PageRank-algorithm to rank the importance of Web pages – a problem very similar to the quantification of a user's interconnectedness in OSN. In the following we discuss PageRank as a possible centrality measure and adapt it to the context of OSN.

PageRank is based on a graph where Web pages are nodes and (directed) edges represent the links between them. PageRank uses the link structure as an indicator of an individual page's value relative to other pages by interpreting a link from page A to page B as a vote by page A for page B. At the same time, it analyzes the page that casts the vote. Brin and Page (1998) define the PageRank for a page i as

$$PR(i) = c \cdot \sum_{j \in B_i} \frac{PR(j)}{N_j} + c \cdot E(i), \quad (1)$$

such that c is maximized and $\|PR\|_1=1$ ($\|PR\|_1$ denotes the L_1 norm of PR). In formula (1), N_j is the number of outgoing links from page j . B_i denotes the set of pages pointing to i and $E(i)$ corresponds to an additional source of rank over the Web pages. The factor c is used for normalization, so that the total rank of all Web pages is constant (Brin and Page, 1998). The first part of formula (1) can be interpreted as the behavior of a "random surfer" clicking on successive links at random. It corresponds to the standing probability distribution of a random walk on the graph of the Web. However, if a real Web surfer gets into a loop of pages, he is unlikely to continue there forever. Instead, the surfer will jump to an arbitrary page. This behavior is modeled by the second part of formula (1). Methodically PageRank is a variant of eigenvector centrality. The idea of eigenvector centrality is that the centrality of node i is a function of the centralities of all nodes connected to i . Therefore, in the first part of formula (1) node i inherits a proportion of rank from all nodes pointing to it, i.e. all nodes connected to i by ingoing edges. To calculate the proportion which node i inherits from each node j in B_i , node j 's rank is divided by the number of j 's outgoing edges. Hence, node j contributes equally to the ranks of all pages it points to. In the

second part of formula (1), $E(i)$ represents an additional source of rank for node i and can be used to adjust page ranks individually.

Due to these characteristics PageRank is appropriate regarding our requirements for the quantification of interconnectedness in OSN. However, a general difference between interconnectedness in the WWW and in OSN exists: While relationships in the WWW are directed (ingoing and outgoing edges), relationships in OSN are usually seen as symmetric (undirected). Therefore, the PageRank-formula has to be adapted: B_i (set of nodes connected to i by ingoing edges) is substituted by F_i (set of nodes connected to i). Furthermore, to assure that requirement R.2 is fulfilled and to avoid a decrease of the interconnectedness score inherited from node j as the number of j 's contacts grows, the dominator N_j needs to be removed. The adapted formula is denoted as

$$S(i) = c \cdot \sum_{j \in F_i} S(j) + c \cdot E(i), \tag{2}$$

such that c is maximized and $\|S\|_1=1$. F_i represents the set of user i 's direct contacts. The first part of formula (2) shows the interconnectedness score, which a node i inherits from its contacts. Due to the summation over F_i , all direct contacts contribute to $S(i)$. Furthermore, the (adapted) PageRank $S(i)$ of a node is calculated recursively. Thus, a node *ceteris paribus* inherits a higher interconnectedness score from a well-connected node than from a sparsely connected one. Therefore, direct (R.1) and indirect contacts (R.2) are considered consistently and adequately. As in the original PageRank-formula, $E(i)$ represents an additional source of rank and can be used to account for further individual parameters (besides direct and indirect contacts) influencing a node's interconnectedness (e.g. group memberships, etc.) in an OSN. However, $E(i)$ can be set equal to 0 if an additional source of rank is absent or ignored. As the computation of the adapted PageRank can be traced back to the problem of finding an eigenvector (cp. following example), the computational complexity can be reduced to $O(n^2)$ which is feasible with today's computing power (R.3).

4 Illustration of the New Centrality Measure and Discussion of the Results

For the purpose of illustration, the adapted PageRank is calculated for an exemplary OSN, consisting of nine nodes ($i=1, \dots, 9$). The graph and the corresponding adjacency matrix A are shown in figure 4:

To calculate $S(i)$ for all nodes i , formula (2) can be written as

$$S = c \cdot A \cdot S + c \cdot E, \tag{3}$$

where S is the vector of the adapted PageRank $S(i)$ and A the adjacency matrix with elements $a_{ij}=1$ if there exists an edge between the nodes i and j (otherwise $a_{ij}=0$). E represents the vector assembling the additional source of rank $E(i)$ on the nodes' interconnectedness.

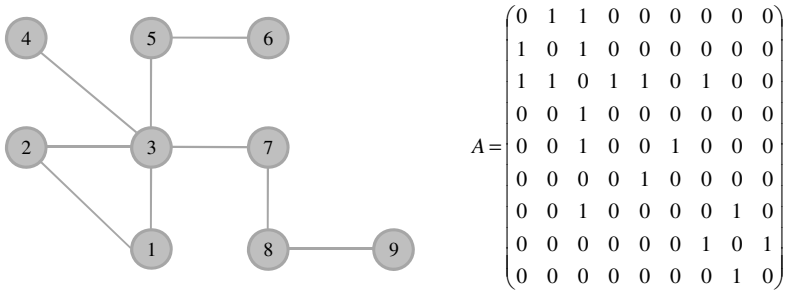


Fig. 4. Illustration of the Exemplary OSN

Solving equation (3) leads² to the following vector of adapted PageRank values³:

$$S^T = (0.40307, 0.40307, 0.63691, 0.24685, 0.29048, 0.11258, 0.29985, 0.13676, 0.05300)$$

Table 1 summarizes the results, illustrating each node i 's centrality position in the network in descending order.

For the purpose of illustration of R.2, nodes 4, 6, and 9 are considered in detail. All of these nodes have one direct contact (see figure 4). Nevertheless, their interconnectedness score $S(i)$ differs. This effect is due to the influence of indirect contacts, i.e. interconnectedness of a user's direct contacts. For example, node 4 is directly connected with node 3, which is the node with the highest interconnectedness in the network. Node 6, in comparison, is connected to node 5, which is less

Table 1. Values of the New, PageRank based Centrality Measure (Example)

<i>Node i's centrality position</i>	<i>Node i</i>	<i>Adapted PageRank S(i)</i>
1	3	0.63691
2	1	0.40307
	2	0.40307
4	7	0.29985
5	5	0.29048
6	4	0.24685
7	8	0.13676
8	6	0.11258
9	9	0.05300

² For details regarding the general procedure for solving such kind of equations see e.g. Brin and Page (1998).

³ E is considered to be the zero vector in this example.

connected. Hence, the interconnectedness score of node 6 is lower. Accordingly, node 9 has the lowest interconnectedness score in this example, since its only direct contact – node 8 – has a lower interconnectedness score than the other nodes' direct contacts.

Table 2 summarizes the evaluation of centrality measures regarding the requirements R.1-R.3. The table shows that the new, PageRank based centrality measure is the only one which fulfills all requirements sufficiently.

Table 2. Evaluation of Centrality Measures Regarding the Requirements R.1-R.3

<i>Requirement</i>	<i>Degree centrality</i>	<i>Betweenness centrality</i>	<i>Closeness centrality</i>	<i>Adapted PageRank</i>
R.1 <i>Consideration of direct contacts</i>	yes	no	yes	yes
R.2 <i>Consideration of indirect contacts</i>	no	no	no	yes
R.3 <i>Feasibility</i>	yes	yes	yes	yes

5 Summary

The increasing economic relevance of OSN and numerous acquisitions priced at enormous amounts revealed the need for adequate valuation models. However, standard businesses valuation approaches are restricted in their ability to value OSN. A major drawback concerning the application to OSN is that the network effects resulting from relationships between users are not taken into account. Thus, we focused on a first but indispensable step towards an adequate economic valuation of OSN: the quantification of the users' interconnectedness in OSN. For this purpose a set of requirements was derived. As neither of the common centrality measures we discussed fulfills all these requirements, we propose a new centrality measure based on PageRank, an algorithm accounting for the importance of Web pages in the context of Web search engines. An exemplary network was used to illustrate the application of the adapted PageRank-algorithm. Although the findings are promising, an evaluation of the adapted PageRank-algorithm using empirical datasets is essential. Hence, we are currently working on an evaluation using publicly available social network datasets as well as empirical data provided by a German OSN. However, the integration of the users into the network is only one aspect regarding the economic valuation of OSN. Additional aspects, such as the users' activity (e.g. frequency of login, forum and chat contribution) should be considered, too. Therefore, the adapted PageRank-algorithm needs to be further enhanced. Moreover, it is important to integrate the measure for users' interconnectedness into economic valuation approaches, e.g. based on customer lifetime values.

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Enhancing the Quality of Financial Advice with Web 2.0 – An Approach Considering Social Capital in the Private Asset Allocation

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Abstract. Although theoretically necessary, social capital is not considered within the process of asset allocation for private investors. Both the lack of appropriate practical valuation concepts and the effort of providing and processing the required information as input for a valuation were obstacles to include social capital in this process. However, first theoretical financial models for the evaluation of social capital recently have become available. Moreover, the fast growth of business community websites and the technological progress in Web 2.0 tools that allow and acquire the active involvement of users, facilitate the provision and processing of valuation relevant information. In this paper we focus on the second aspect and propose a social software-based concept that allows for an integration of social capital in the asset allocation process.

Keywords: Web 2.0, Social Software, Data Management, Strategic Asset Allocation, Social Capital, Private Investor, Financial Advice.

1 Introduction

Within the scope of the private asset allocation in typical advisory processes in the financial services sector, information is mainly considered with respect to the *current* income and *existing* assets of a specific customer. Information about *expected* income and *expected* asset components is already regarded considerable less frequently. Generally not considered at all are assets that are more difficult to quantify monetarily, such as human or social capital. Nonetheless, it is beyond dispute in literature that an optimization of the asset allocation for the financial capital of an investor requires the consideration of the total capital (e. g. Bodie, Merton and

Samuelson, 1992; Boscaljon 2004). Total capital not only includes financial capital but also other capital types such as human or social capital. Total capital has to be considered due to the notion that the risk properties in particular of these two types of capital can have a significant influence on the allocation of the financial capital of a private investor. Moreover, these risk properties cannot be easily changed in contrast to the risk properties of financial capital, where one can decide easily on an appropriate mixture of risk-free and risky investments. Apparently, if human and social capital are not considered, this can lead to systematically wrong investment advice. Therefore, taking both types of capital additionally into account can enhance the quality of output of the advisory process as well as in the long term also augment customer satisfaction. Thus, the inclusion can become a competitive advantage for a financial services provider.

So far, the effort of information provision and processing has been disproportionately high with respect to the integration of human and especially social capital within the asset allocation process of a private investor. However, the fast growth of business community websites (e. g. LinkedIn or XING) providing for rich information about customers and their social networks and new technical possibilities of standardized data extraction from social networks – such as the ones implemented in the scope of the OPENSOCIAL project – now ease an economic and practical implementation. Nonetheless, the necessary effort in subsequent analysis tasks remains still high, which limits – for the time being – a profitable implementation to the private banking customer segment, which disposes of an annual income well above average and usually constitutes a high-margin customer segment.

The objective of this paper is to propose and discuss a conceptual approach from a design science oriented perspective (Hevner, March, Park and Ram, 2004) for an integration of social capital in a generic advisory process for financial services provider based on existent social software-based data sources. Thereby, specific emphasis is devoted to an adequate operationalization of information provision and processing. This contains the identification and measuring of appropriate indices for characterizing individual social networks, e. g. the number of ties an actor disposes of, the strength of the individual ties etc. what is recognized in literature under the topic of *social network analysis* (SNA). The paper is organized as follows. First, the relevance of social capital within in the scope of the asset allocation based on a formal theoretical model is illustrated. Subsequently, a concept for including social capital within an advisory process of a financial services provider is proposed. We conclude with a summary.

2 Social Capital within the Asset Allocation

First, we describe and determine our understanding of social capital with respect to the objective of this paper. Based on this, we discuss in the relevance of social capital in the scope of the asset allocation of private investors.

2.1 Definition of Social Capital

(Coleman, 1988) and (Gabbay and Leenders, 1999) understand social capital as the set of present and future facilitations and limitations that arise from the network of a

person and can positively influence the way he can act. Thus, social capital is described as a resulting from the tightly knit structure within a group. A similar and complement definition comes from (Burt, 1992) who derives a person's social capital from his individual network position. In the scope of this paper we follow primarily the definition of (Burt, 1992) even though there are also some aspects of the definitions of (Coleman, 1988) and (Gabbay and Leenders, 1999) taken into account. All named authors formulate a qualitative value expression based on which it is not possible to quantify monetarily the individual value of social capital. Determining this value is indeed a challenging task due to the central property of this type of capital: Social capital is part of a relation *between* two actors. Hence, it is difficult to delimit, to locate and finally to value (Burt, 1992, p. 9). Indeed, there are some contributions on the valuation of social capital, but they usually refer to social capital on an organizational level (e. g. Kazienko and Katarzyna, 2006) and not on an individual level.

Still, without an appropriate measurement and valuation it is not possible to consider social capital in the scope of the asset allocation. A starting point to measure and value social capital is the individual network structure of an actor, also called the *social network structure* (SNS). The SNS describes how an actor is connected within his social network to other actors. This includes a measurement of the absolute number of ties an actor disposes of and the characterization of the strength of each tie as well. The objective is to evaluate if an actor's network position is favorable or unfavorable with respect to the attainment of his personal and professional targets from a structural point of view (Burt, 1992, p. 11ff.). The (potential) benefits resulting from the SNS are called *social resources* and are the core of a valuation of social capital. The benefits are based on the access to resources of other actors, e. g. capital and knowledge, to which he maintains relations. Moreover, relations contain benefits themselves, e. g. in terms of information about and control over other actors (Burt, 1992, p. 13ff.). However, the influence of the SNS at a given point in time can also limit the actions of an actor (Gabbay and Leenders 1999, p. 3ff.). Obligations can arise from the SNS that can have different negative consequences. Fostering and maintaining (social) relations demand for time and money (Bourdieu, 1983, p. 193). Given scarce resources an actor can be hindered to create new useful relations because he is still engaged in his existing relations. Moreover, strong individual social relations can limit the available options of action of an investor as far as these relations stand in conflict with other relations and cause therefore negative consequences, respectively.

The SNS of a private investor is typically characterized by the simultaneous existence of influences that facilitate and limit the way how a person can act (Gabbay and Leenders, 1999, p. 4). A person is not necessarily able to avoid these limitations in each situation, e. g. by a one-sided termination of a relation rated as useless. Such a termination of a relation can cause a sustainable loss in confidence and reputation of the considered actor in his network. Moreover, it can evoke sanctions (Gargiulo and Benassi, 1999, p. 303).

The simultaneous existence of facilitations and limitations with respect to the way a person can act stems from the difference between SNS and social capital. The SNS provides a certain amount of resources that influence the actions of a person in the scope of a *specified context*. If the required resources match with the resources that

are provided by the SNS, social capital does have a positive effect to a person's actions *in this context*. Otherwise, limitations result because a person invests into social relations without receiving any benefits with respect to the specific context (Gabbay and Leenders, 1999, p. 3f.). The SNS and the context of a person usually change over time, what influences the value of social capital, too (Gargiulo and Benassi, 1999, p. 317ff.). Consequently, each valuation of social capital on an individual basis has to evaluate the usefulness of the SNS for differing contexts at different points in time. This circumstance increases the complexity of determining social capital's influence and includes the necessity to compare the resources provided by a certain SNS with the needs of the facilitations resulting of a specific working context.

2.2 Considering Social Capital in the Asset Allocation

The determination of an adequate asset allocation strategy is the primary output of financial advice for private investors. Within the consulting process, the individual preferences of the investor with respect to the expected return, the related risk and the cash availability at different point in times should be considered. However, there are additional influence factors that should be taken into account. For a theoretically sound recommendation it is important to consider the complete income and assets of an investor. These comprise also the human capital – generally understood as present value of the future expected income – and social capital, in particular.

Consequently, linking human capital and portfolio theory is an issue that different contributions focus on (e. g. Bodie, Merton and Samuelson, 1992; Boscaljon 2004; Spremann and Winhart, 1997). For instance, the normative model of (Bodie, Merton and Samuelson, 1992) shows amongst others the importance of considering human capital in order to explain an investor's consumption and asset allocation decision making behavior during his life cycle. Because younger people usually have a higher human capital than people that are near retirement, human capital specifically has a substantial influence on the asset allocation decisions of an investor who is at the beginning of his working life. Moreover, this effect is augmented and diminished by the individual riskiness of his human capital, respectively. An entrepreneur usually has a high but very risky human capital while a civil servant has a lower but quite certain human capital. These effects typically imply a counter-balancing of the risk influence of human capital by an appropriate asset allocation strategy in the financial capital. The mentioned contributions can be taken as indications that financial services provider should adapt their consulting process, which is generally focused just on the age and the income of an investor. This includes that the proposed proportions of risky investments of private investors are usually too low during the early employment phase.

Whereas the integration of human capital in the scope of the asset allocation has been granted a certain focus in literature, social capital has remained widely unconsidered so far. This is due to the properties of social capital already described that lead to some challenges with respect to the measuring and valuation of social capital. The coherence between human and social capital is already qualitatively postulated, e. g. by the contributions of (Burt, 1997) and (Lin and Huang, p. 191ff.). A first empirical based approach that allows a quantitative measurement of social capital

is proposed by (Seibert, Kraimer and Liden, 2001). There, the positive influence of social capital is modeled on the one hand by a higher salary profile – leading to a higher human capital – and on the other hand by a less risky human capital, since unemployment is less probable and the time span without job is shorter compared to a person that does not possess social capital *c. p.* Evidently, social capital has a multiplier effect on human capital and, thereby finally also on the financial capital (Bourdieu, 1983, 191). Thus, an indirect measurement of social capital seems to be promising. By indirect measurement we point to the issue that, in essence, we propose a more precise way of determining the value and risk properties of human capital by making use of the concept of social capital. Of course, if the absolute value of social capital is also of interest, which is not the case in the asset allocation process, one can separate the social capital effects on human and financial capital from non-social capital effects. However, this is not our focus here.

An approach to evaluate social capital recently proposed can be found in (Kundisch and Zorzi, 2008), which is an extension of the model of (Spremann and Winhart, 1997). The scenario calculations provided by the authors suggest that social capital may influence an investor's asset allocation beyond the already known effects of human capital. Therefore, a consideration of social capital seems advisable, at least as far as there is evidence of its existence justifying the additional effort of collecting and processing the necessary data sets. (Kundisch and Zorzi, 2008) build their model also on the assumed positive relationship between social capital and human capital proposed by (Seibert, Kraimer and Liden, 2001). Specifically, they model the influence of social capital on human capital using two parameters:

1. a short-term oriented parameter that represents the current influence on the risk of human capital (RHC) and
2. a long-term oriented parameter that represents the sustainability of a premium on the salary that is attributable to social capital (POS).

Being the first-of-its kind model to determine social capital, we will adopt their view and focus on the determination of these two parameters in the following by making use of Web 2.0 tools and business community websites such as LINKEDIN or XING. Many business community websites make standardized application programming interfaces (APIs) available that allow an easy extraction of data about persons, their relationships to others etc. that characterizes an actor's network. What still remains is an adequate processing of these data. Therefore, we consider in the following a concept how these findings can be operationalized to the practical consultancy in the financial services sector.

3 Challenges and Implications to the Consultancy

The practical challenges arising from the consideration of social capital in the scope of the consultancy in the financial services sector are due to the costly provision and processing of the necessary information. As presented in the previous section social capital cannot be measured directly. Thus, appropriate methods for describing and characterizing a person's SNS are needed. Moreover, concepts are necessary that allow for an efficient matching between the SNS and the specific context a person

acts in. Firstly, we discuss basic approaches in the field of SNA that are appropriate with respect to the objective of this contribution. Secondly, we propose a concept for providing and collecting information in order to determinate the influence of social capital to an investor's asset allocation.

3.1 Social Network Analysis

SNA is defined by (Wellmann, Wetherell and Plakans, 1994, p. 645) as:

“Most broadly, social network analysis (1) conceptualises social structures as a network with ties connecting members and channelling resources, (2) focuses on the characteristics of the individual members, and (3) views communities as personal communities, that is, as networks of individual relations that people foster, maintain, and use in the course of their daily lives.”

Most contributions to the subject of SNA focus on a quantitative structural consideration and analysis of networks. Hence, there are also tight links towards the social capital theory which contains extensive literature that focuses on structural characteristics of networks (e. g. Burt, 1992; Hansen, 1999).

So far, there are a couple of various (statistical) approaches for the evaluation and description of networks. Typical measures used to evaluate the favorableness of specific network structures consider different forms of centrality of persons and different measures that capture the distance between different persons within networks, respectively. This mainly happens by considering structural, quantitative network properties (many general contributions to the subject network analysis, which can be transferred in part to the field of SNA, are listed in e. g. (Brandes and Erlebach, 2005). These approaches allow propositions with respect to the individual access to information and knowledge of persons and the way how they can influence the creation of information and knowledge. Besides the network position it is mainly the strength of the ties that has a considerable influence on the current information flows within a company (Hansen, 1999). The structural perspective is based on the assumption that facilitations and limitations that arise from a person's SNA are primarily dependent on the network position of the considered person. If a person disposes of a favorable network position this is equal to the fact that this person has access to resources that support him with respect of the fulfillment of his professional tasks and targets. However, this does not include any specification of the type of resources.

An approach that reaches beyond a structural consideration of networks is formulated by (Cross, Parker, Prusak and Borgatti, 2001). They propose a (qualitative) questioning of persons in order to identify effective and ineffective ties between persons within a company. Thereby, an effective tie is characterized from the perspective of the considered person by the following four dimensions: *Knowledge* (Knowing what another person knows and therefore knowing who is the right contact that can be addressed), *Access* (Having an access to information and knowledge of other persons all-time), *Engagement* (Willingness of other persons to support and to pay actively attention), and *Safety* (Existence of a certain level of confidence that encourages a productive learning relationship). This approach has advantages compared to methods that just focus on structural network properties, since it takes a multi-dimensional view on relations. However, if the financial advisor goes

thoroughly through these formulated criteria by (Cross et al., 2001) together with the investor one-by-one for each relation the process will incur prohibitive costs.

In the scope of this contribution, we propose a modified approach that primarily builds on structural network properties but considers also non structural aspects by specifying the nature of resources that are accessible to a person and matching them to his needs arising from his professional context. In doing so, we comply with the knowledge dimension of (Cross et al., 2001). Moreover, our proposed approach leaves the opportunity to look also at the other three criteria.

3.2 Integration of Social Capital within a Consultancy Process

In order to generate sound advice, a financial advisor needs an adequate and sufficient data base. Such a data base has to include personal information and information about the income and wealth of an investor at a specific point in time. Moreover this comprises also the collection of information with regard to the valuation of an investor's human and social capital. Obviously this denotes a considerable challenge because the required information is uncertain. In addition, the data for the valuation of human and especially social capital is mostly qualitative in nature and there are dependencies between both types of capital. Therefore the valuation of human and social capital cannot be dealt with separately. From a practical point of view this denotes no limitation since the result of a consultancy process should be a recommendation about the optimal ratio of risk-free and risky investments. The data collection identifying an optimal ratio of risky investments considering an investor's human and social capital can be accomplished in four steps (see Figure 1):

- Step 1: Identification of an anticipated salary profile as an extrapolation of the salary today and an assessment of the risk properties of the human capital without taking into account social capital.
- Step 2: Identification of the current context a person is acting in (2a) and the current SNS (2b) to determine influence of social capital on the risk properties of the human capital in the short term (2c). In this step the basis to determine the parameter RHC is created.
- Step 3: Determination of the sustainability and development of a person's context and matching with the anticipated SNS to determine the long term influence of social capital on human capital. In this step the basis to determine the parameter POS is created.
- Step 4: Determination of an adapted salary profile and the risk properties of an investor's human capital (4b) using the parameters RHC and POS (4a).

Step 1: An anticipated individual salary profile is considered as starting point for collecting data. Therefore the current salary statement (for graduates the average starting salary chart) in combination with terms of the working contract concerning future salary enhancements, bonuses and other extraordinary payments can be used as an appropriate estimator. Moreover available empirical salary profiles including their deviation that are dependent on the job and position of an employee may be used complementarily. This allows for the identification of a salary profile of an average (model) investor that is representative for the considered (real) investor and therefore for the identification of a salary premium the considered investor currently enjoys.

Moreover, the general (and social capital independent) riskiness of the human capital (current risk properties of human capital) for the type of profession and position of the investor can be determined based on empirical salary profiles. At least in the German financial services market, some of the established financial services providers already possess these data.

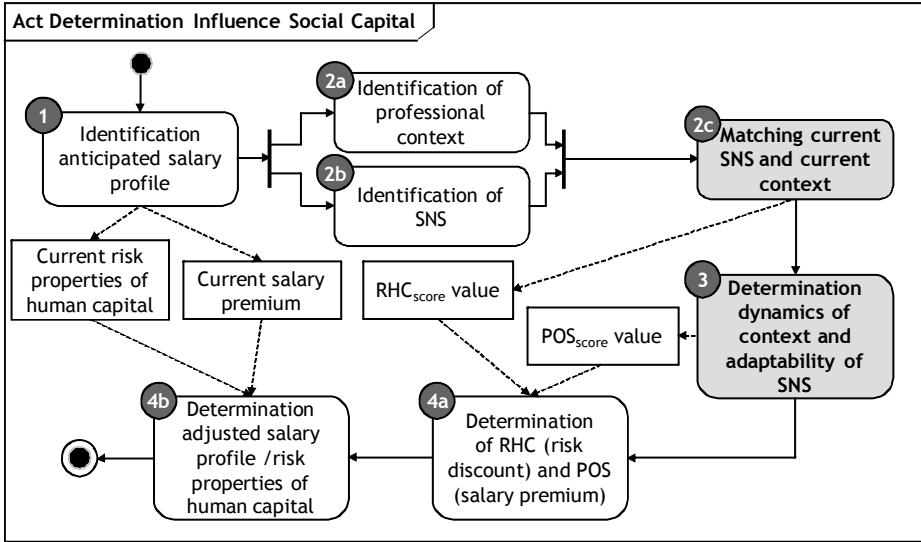


Fig. 1. Identification of social capital’s influence to an investor’s asset allocation

Step 2a: In order to describe the context an investor is acting in, we propose the consideration of the necessary resources an investor needs accomplishing his central working tasks. The central working tasks or projects can be determined based on a direct interview of the investor. The terms of the working contract or the job description may also provide for some hints here.

Step 2b: The identification of the resources that are provided by the SNS can be extracted from business community websites, e.g. XING (www.xing.com) or LINKEDIN (www.linkedin.com). Typically, members of such community websites describe themselves in terms of interests, personnel abilities, job descriptions, professional experience etc. If the investor is connected within a business community website to other actors, we interpret this as an indicator of the resources provided by the SNS of this investor. The semi-structured information that can be found within the individual address books of members of such websites can already be conveniently extracted by proprietary software tools or using standardized APIs. Moreover, it is also possible to combine and integrate the information provided by different communities as far as these websites use a standardized syntax to tag the data and offer a standardized API. A widespread API in this context is defined in the OPENSOCIAL project (<http://www.opensocial.org>). OPENSOCIAL aims at facilitating the data exchange between different web-based social applications. Many important players in the industry, such as XING, MYSPACE, LINKEDIN, FRIENDSTER, are already

participating in this initiative. Apparently, this allows for a fast and convenient transfer of semi-structured information into an application that supports the matching process.

Step 2c: In order to determine the parameter RHC, a matching between the current context and the current SNS is necessary. The basis for such a determination is visualized schematically in Figure 2. This can also be used as a preliminary proposal for the design of a corresponding front-end of a consultancy application. On the left hand side in Figure 2 there is a drill-down schedule with the central working tasks that can be regarded as an investor’s context. If a specific resource is needed (e. g. project management skills, project valuation expertise) to successfully accomplish a task, on mouse click a keyword search is automatically triggered on the right hand side. The corresponding result set of this search is depicted in the upper right part of figure 2. On mouse click on the keywords in the result set, the corresponding actors can be visualized (here, three contacts are exemplarily listed). Based on the number of relations found in the data that match with the keywords, the system suggests a valuation on the ordinal scale that ranges between “++” (= very good match between context and resources) and “--” (= very bad match between context and resources). This valuation can be modified by the consultant together with his client based on the additional criteria of e. g. (Cross et al., 2001). The individual valuation can be aggregated using an adequate scoring model to get an overall valuation of the matching between the context and the SNS. If there is a good match, this is interpreted as an indicator for a positive short term influence of social capital and therefore for a less risky human capital. The result of this step is a score value RHC_{score} .

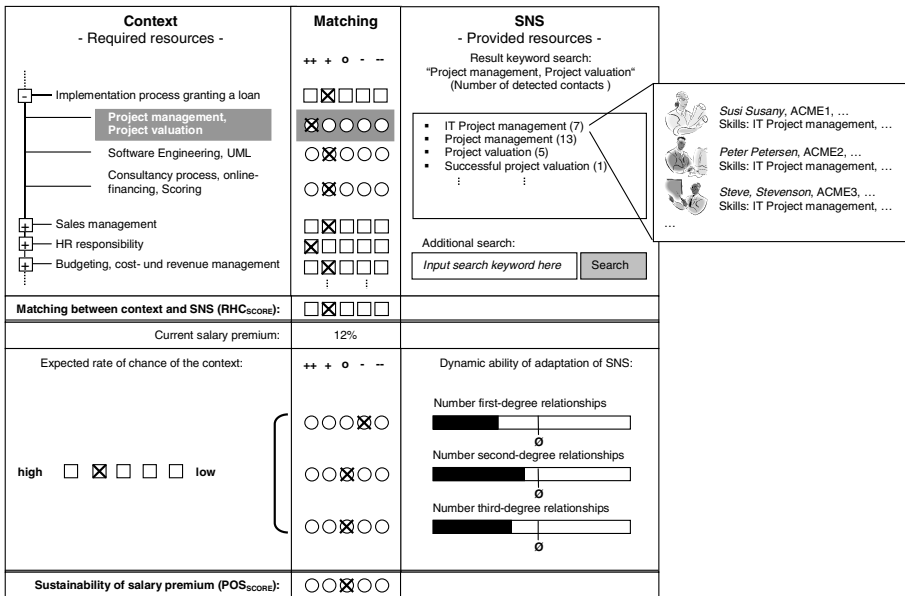


Fig. 2. Schematic matching between context and SNS

Step 3: Starting point for the identification of the proposed long term influence parameter of social capital is the current salary premium that has already been determined in step 1. This premium may have to be corrected before an extrapolation into the future. The anticipation how an investor is able to adapt his SNS dynamically to a changing context – if such an adaptation is necessary – can be interpreted as whether he will be up to his professional challenges in the future and if a sustainable salary premium can be expected from this point of view. First, the rate of change of context in the future has to be determined. An interview of the investor seems to be the best method to accomplish this task. Moreover, empirical career paths can also provide for some hints here. This is visualized in the lower left box of Figure 2. At the lower right box of Figure 2 structural properties of a network, e. g. the number of first-degree, second degree, third degree relationships are described. They can serve as rough estimators for the dynamic ability to adapt the SNS. This procedure is based on the assumption that the larger an individual SNS is the easier it is for the investor to generate a good matching with respect to his professional context. As soon as the rate of change of the context is assessed on the one hand and the number of relationships of a private investor is assessed being below or above average on the other hand, additional information that may help specifying the salary profile may be derived. E. g. if the structural indices show below average values and the expected rate of change is high, this is an indicator that the current salary premium might be too high and is not sustainable. In analogy to Step 2c, the parameter POS_{score} is determined using a scoring model.

Step 4: The translation of the score values of RHC_{score} into a risk discount and for POS_{score} into an adjusted salary premium is currently done using a table that simply assigns percentage values to score values (Step 4a). The validation and further development of this process is still a topic for further research. With RHC and POS as percentage values, the risk properties of the human capital and the salary profile can be determined (Step 4b) as described in (Kundisch and Zorzi, 2008). Based on the information collected in this way and further information the optimal ratio of risk-free and risky investments under consideration of human and social capital can be determined (not shown in Figures 1 and 2.).

It should be emphasized that this process causes substantial effort both for the customer as well as for the financial service provider. Therefore, only if there is strong evidence that social capital might have a relevant influence on the human capital, this process should be started. So what can be considered as evidence in this sense? Generally speaking, two issues have to be fulfilled: The investor has to earn a lot in absolute terms and at the same time he has to earn a salary well above the average of his peers.

4 Conclusion

Social capital can be a substantial proportion of a private investor's total capital. Therefore, if neglected this can lead to systematically wrong recommendations with respect to an asset allocation strategy. A precondition for considering social capital within the consultancy process is the individual measurement and valuation of a private investor's social capital. In this contribution an operationalization for this task

is proposed utilizing information provided by current social software web sites and lending from SNA and social capital literature. However, this approach can be only understood as first attempt because easily accessible information about social networks has just become available recently. Still, there are some limitations that should be mentioned. First, the concept is based on the assumption that a person's social network is (approximately) completely represented within the considered business community websites. If this is not the case, the deduced figures may be distorted and thus result in wrong recommendations. Second, it is not for sure that the concept leads indeed to an increase in customer satisfaction and therefore indirectly to a competitive advantage from the perspective of a financial services provider. A customer might even feel some disutility since he has to invest time upfront and the hardly separately noticeable benefits may turn out sometime later in the future. Apart from this economical consideration it has to be mentioned that an implementation of the presented approach needs also a consideration of further aspects, such as privacy issues that are not discussed in this contribution. Consequently, the research in the field of the valuation of individual social capital is still in its infancy. As next important step the further development of the prototype is planned, that shall be validated in laboratory experiments. Simultaneously an empirical survey is under way in order to expand the understanding of a monetary valuation of social capital and its influence on human capital on the level of an individual person.

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Web 2.0 in SME Networks - A Design Science Approach Considering Multi-perspective Requirements

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Abstract. As small and medium sized enterprises (SMEs) face new challenges in a complex and dynamic competitive environment, they need to cooperate due to their restricted resources and limited capacities. At this, Enterprise 2.0 is seen as a supporting approach. To this date, there is a lack of academic publications concerning recommendations for the application of Web 2.0 artifacts in SME-networks. This paper aims at bridging this gap by suggesting a conceptual base following the design science approach. Based on technical and organizational requirements resulting from exploratory interviews with representatives of SMEs participating in a regional SME-network, we transfer the requirements in a prototypic concept. This developed artifact provides a basis for a field test to evaluate the concept and for further research.

Keywords: Web 2.0, Enterprise 2.0, SME-Networks, Design Science.

1 Introduction

The idea of building networks between organizations to gather benefits in an enterprises' value creation is not new and can be described through the logics of scales and scopes (Jarillo, 1988). Hence, several economic theories (e.g. resource-based view, transaction cost economics) explain the phenomenon of cooperation (Tatarynowicz, 2008). Thereby cooperation enables businesses to access and operate on an extended resource base (Human and Provan, 1996). This aspect is especially relevant for small and medium sized enterprises (SMEs) as they need to cooperate to compete with new challenges in a complex and dynamic competitive environment with respect to their restricted resources and limited capacity for innovation (Street and Cameron, 2007). Since SMEs represent 90 % of all U.S. Enterprises and 99 % of all European Enterprises, they are of high social and economic importance within the U.S. and

Europe (European Commission, 2003). From a technological point of view, Web 2.0 tools as software-oriented Web 2.0 artifacts¹ are seen as adequate tools for SMEs to increase productivity as well as proximity to the market (De Saulles, 2008a; Wyllie, 2008). The advantages of Web 2.0 tools in use of SMEs are beyond dispute, as Web 2.0 artifacts can improve the performance of SMEs in the following three areas:

- internal communications and information/knowledge sharing
- external communications with customers, suppliers and partners
- marketing to prospective customers

Applying Web 2.0 technology in an organizational context is referred to the term of Enterprise 2.0. The term focuses on Web 2.0 platforms that are used “within companies or between companies and their partners and customers” (McAfee, 2006). However, the implementation of Enterprise 2.0 in SMEs is considered useful and necessary (De Saulles, 2008b; Farrell, 2006) but expandable, as the implementation of Web 2.0 artifacts remains exceptional.

From an organizational point of view, SMEs are often aligned in a patriarchal way. Thus, entrepreneurial initiatives are often driven by one or two individuals and decided by the SMEs’ owners (Scherer, 1997). Consequently, generally not all employees can participate in innovation processes (Masurel, van Montfort and Lentink, 2003). Hence, by following a traditional organizational structure, innovative potential to solve problems in an enterprise might be unconsidered.

At present, results considering a concept to support the challenges of SME networks by using the Web 2.0 approach including technical and organizational perspectives are not published in the information system research landscape. This paper aims at bridging this gap by presenting actual results of a qualitative research approach. Our work aims at depicting Web 2.0 artifacts that have to be implemented within a network of SMEs by means of an incremental qualitative approach considering organizational and technical perspectives. The paper is structured as follows: Section 2 outlines our research approach. In Section 3, we give an overview of related work. General characteristics of SMEs and Web 2.0, as well as how SMEs are using Web 2.0 in practice are shown in section 4. Thereby we emphasize the need for an integrative consideration of organizational and technical aspects in the software development process of Web 2.0. In section 5, we present a use case starting with depicting the results of expert interviews conducted with SME-managers of the “WirtschaftsForum Neuwied e.V.”, a SME-network in consideration. Thereby we gather organizational and technical requirements for the development of the Web 2.0 platform. Based on these results, recommendations for an incremental software development process considering organizational and technical requirements towards an integrative Web 2.0 conceptualization are given. The paper closes with a final section comprising summary and outlook.

2 Methodological Approach and Research Design

Research in Information Systems is widely dominated by two research paradigms: the behavioural science paradigm on the one hand and the design science paradigm on

¹ In the following the term “Web 2.0 artifact” comprises Web 2.0 applications (e.g. blogs) also named Web 2.0 tools as well as Web 2.0 concepts (e.g. tagging).

the other hand (Hevner, March, Jinsoo, and Ram, 2004). In our work, we follow the design science approach. Design science “creates and evaluates IT artifacts intended to solve identified organizational problems” (Hevner et al., 2004, p. 77). Our present work within the project KMU 2.0² (SME 2.0) is located in the early phase of the design science cycle, as we identify the requirements to create the artifact to solve the relevant problems.

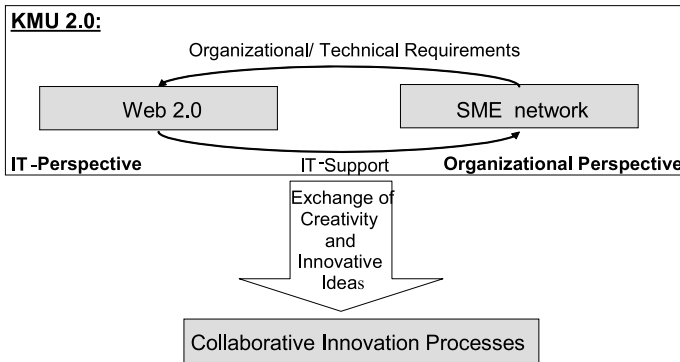


Fig. 1. KMU 2.0 Research Framework

We could observe that SMEs perceive potentials by using Web 2.0 technology in a cross-organizational context. Thereby Web 2.0 provides possibilities to meet the needs for efficient collaboration as well as to gain economical benefit. In this regard, we introduce the term SME 2.0 to focus on Web 2.0 applications that are targeted at the necessities of SME-networks (Von Kortzfleisch, Mergel, Manouchehri and Schaarschmidt, 2008). Thereby SME 2.0 “can’t just to be about a wiki here, a blog there forever” (Hoover, 2007) it rather has to be embedded in the specific context of the particular SME-network (Koch and Richter, 2007).

3 Related Work

This section summarizes main results of actual studies which are considering the state of the art in practice (CoreMedia and Berlecon Research, 2007; McKinsey and Company, 2008; The Economist Intelligence Unit, 2007). In a nutshell there is a trend that Web 2.0 is becoming familiar within the companies and that all companies plan to spend more on it. Primarily large companies and enterprises that are deriving business value from Web 2.0 are extensively using it. Thereby Web 2.0 tools are integrated into business activities both outside the company to improve customer services and relations and inside the company to optimize internal information and knowledge management. However, not all companies are using Web 2.0. While some companies are dissatisfied with existing Web 2.0 tools and abandon the use of them,

² KMU 2.0 is funded by the German Federal Ministry of Education and Research (BMBF). For further information see www.kmu20.net

for some companies the term Web 2.0 is not known and its benefits are not clear: Web 2.0 comprises a multitude of technologies, applications and services that provide different functionalities and services that are hardly to differentiate. As no common definition of Web 2.0 exists, just a few people really know what it means. Managers do not understand the economical benefit that Web 2.0 can bring to their company and do not encourage the use of it within the enterprise. Besides, some companies suspect a lack of security by using Web 2.0.

3.1 Web 2.0 and Enterprise 2.0 in the Context of SMEs

In the following section, we depict State-of-the-Art in Web 2.0 and in Enterprise 2.0 as well as the challenges of applying Web 2.0 in SMEs.

3.2 Web 2.0 and Social Software - State-of-the-Art

Web 2.0 is a phenomenon representing a second-generation approach to the World Wide Web (WWW) which is different from the previous way of passive content consumption by the users. The term was first introduced by O'REILLY and comprises a "business revolution in the computer industry caused by the move to the internet as platform" (O'Reilly, 2006) which allows users to participate in the process of creating and sharing content. Thus internet content of Web 2.0 is not just to be read, listened to or observed. Web 2.0 is created to actively communicate and participate on the Internet (McAfee, 2006a; O'Reilly, 2005). Web 2.0 tools as software-oriented Web 2.0 artifacts are web-based applications afforded by upcoming so called Web 2.0 technologies³ (Alby, 2007).

The term Social Software describes developments and applications that are associated to Web 2.0 (Szugat, Gewehr and Lochmann, 2006). Social Software is not a synonym to Web 2.0 but a subsection of Web 2.0. It covers software systems that support human communication, interaction and collaboration in networks. With the efficient sharing of knowledge and information the security aspects increases in importance. Artifacts such as weblogs, wikis, Social Tagging or Social Networking visualize relationships, persons and information (Burg and Pircher, 2006). To categorize Social Software artifacts, a framework considering the different functions of the tools is reasonable. According to PLEIL, Web 2.0 functions are (Pleil, 2006): Authoring, Sharing, Collaboration, Networking and Scoring. Figure 2 gives a brief overview on current Web 2.0 tools and principles, a brief description of the artifact and the according functionalities.

3.3 Enterprise 2.0 - State-of-the-Art

MCAFEE describes how Social Software can be used in the context of an enterprise to enhance the collaboration among employees and to uncover tacit knowledge as well as common practices among employees. After publishing this report MCAFEE defined Enterprise 2.0 as the "use of emergent Social Software platforms within companies,

³ Examples for Web 2.0 technologies are: Asynchronous JavaScript and XML (AJAX), Really Simple Syndication (RSS) or ATOM Syndicat Format (ASF) [AL07].

Artifact	Description	Function(s)
Weblog	Web-based communication medium, that is determined by the following characteristics: <ul style="list-style-type: none"> ● chronology (time stamp for entries) ● actuality (reference to actual events and subjects) ● interaction (comment-function for readers) internet-relation (links to continuative information, links to other blogs, “trackbacks”) 	Authoring, Sharing
Wiki	Collection of websites, that can be edited by every user	Authoring, Sharing, Collaboration
Social Tagging	Collective indexing or tagging of existing context to ease the indexing of content	Sharing, Scoring
Social Networking	Maintenance and building of contacts	Networking
Podcast	Broadcast or broadcast series of audio or video content	Sharing

Fig. 2. Web 2.0 artifacts (own creation referring to (Kolo and Eichner, 2006; Duschinsky, 2007)

or between companies and their partners or customers“ (McAfee, 2006a) and describes the six components of Enterprise 2.0 with the acronym SLATES (search, links, authoring, tags, extensions, signals).

- Search: Search refers to the easy retrieval of information on the internet.
- Links: Links are an indicator for important information. Users are supposed to publish and link content on the internet.
- Authoring: Employees publish content with authoring tools such as wikis or blogs.
- Tags: Employees place tags on content, thereby categorizing the information on the internet.
- Extensions: Extensions describe the recommendation or proposal of similar articles or contributions that may be relevant for the user.
- Signals: To automatically inform users about new content using syndication methods is called signals (McAfee, 2006b).

Social Software applications may not be forced into given structures. The structures are the result of the publication and linking of content as well as the assignment of tags. With Web 2.0 the knowledge is available through the internet. Within the enterprise, the knowledge is contained in wikis and blogs and available for all employees.

3.4 The Challenge of Applying Web 2.0 in SMEs

Even though companies perceive an increasing benefit by using Web 2.0, its adoption is affiliated with primarily non-technical barriers and challenges. Applying Web 2.0 in SMEs thus requires considering the specific characteristics of SMEs to gain an understanding of how Web 2.0 is actually used in SMEs practice. In general, the SME

sector is very dynamic. While many new enterprises start up every year only forty percent of them survive for ten years (Levy and Powell, 2005). This is caused by the specific management structure of these companies: SMEs are considerably influenced by the personality of the company's owners and their attitude to do business (Masurel et al., 2003; Levy and Powell, 2005): "A real small firm has two arms, two legs and a giant ego" (Burns, 2001). The strategic horizon tends to be short with focus on a survival strategy and a reactive decision style due to limited resources (Levy and Powell, 2005).

Thus, planning and implementing Information Technology (IT) tends to take a short-term perspective. IT is used to manage day-to-day operations rather than to support management activities. As SMEs mostly have no IT department or expertise, the SME's owner is the only person with authority and (limited) knowledge to identify IT-opportunities and to adopt them. Implementing IT often occurs in an ad hoc fashion and highly depends on the owner's personality, experience and skills (Levy and Powell, 2005; Street and Cameron, 2007).

Given this context, the adoption of Web 2.0 in SMEs practice differs in some points from the study results outlined previously. While an intensive SMEs' usage of the internet can be observed, the utilization of Web 2.0 remains exceptional. Internet is mainly used for e-mail communication with customers and suppliers as well as collecting information. However there is an increasing use of complex online applications for customer service and purchase. In the next two years rising internet activities for customer communication are expected. Contrary to this, Web 2.0 has no direct business relevance for some SMEs. Although they perceive improvements in customer relations or an optimization in gathering information, SMEs consider the potential of success of Web 2.0 with skepticism. A SMEs' minority believe that Web 2.0 will impact their business since they are not able to evaluate its potential. Additionally a SMEs' majority perceives risks by using Web 2.0 within their company (e.g. legal risks, risks of abuse) (DeSaulles, 2008a; DeSaulles, 2008b, Social Computing News Desk, 2007).

4 Towards a Concept to Support SME Networks in Cooperation – A Use Case

4.1 Use Case Background

The project KMU 2.0 is based on field research within a specific network, the "WirtschaftsForum Neuwied e.V.". The research project KMU 2.0 explores new management strategies for collaboration in SME-networks enabled by Web 2.0 applications and referring to innovative and cooperative solutions for daily work life problems (e.g. worker's health protection or work-life balance issues). This comprises an analysis of concepts and models of self-organization and information technology (IT) in the context of Web 2.0, assuming

- An employee's confidence in using Web 2.0 applications in private life and thus a motivation to participate on a Web 2.0 platform in work life.
- A high potential for creativity and innovation offered by heterogeneous groups.

Given this context, we examine the capability of Web 2.0 applications to integrate employees from different SMEs participating in a cross-organizational network in order to profit from their collaborative creativity. The project raises the question whether the use of specific Web 2.0 applications foster the exchange of creativity and innovative ideas within a network of SMEs. Thereby we focus on the generation of new forms of innovation processes among the cooperating participants enabled by Web 2.0. This requires an incremental research approach gathering organizational and technical requirements for Web 2.0-based cooperation in order to develop and implement a Web 2.0 platform within a network of SMEs.

The “WirtschaftsForum Neuwied e.V.” was founded in 2002 and is a regional network of SMEs in the north of Rhineland-Palatinate, Germany. It consists of roughly 100 SMEs primarily from the industry and business sector employing about 8,000 individuals. With regard to its members who vary in enterprise sizes, represent different branches and offer diverse products and services, the “WirtschaftsForum Neuwied e.V.” is heterogeneous in structure. It thus focuses on non-competitive activities (e.g. daily work life problems) and aims at fostering knowledge transfer between its members and enhancing collaboration and business relations. To gather first requirements for the development of a Web 2.0 platform, which will be implemented into the “WirtschaftsForum Neuwied e.V.”, explorative interviews have been conducted with six executives of the cooperating SMEs. These companies represent the six project’s value partner who act as lead users, test the Web 2.0 platform and distribute it among the members. With regard to the results of our State-of-the-Art analysis, the interviews were directed at collecting organizational and technical requirements for the development of a Web 2.0 platform that meets the specific needs of cooperating SMEs. Since this qualitative research design is an accepted approach to gather first requirements in the software development process (Pohl, 2008), we first focus on exploratory interviews to gain a broad overview and first insights in our subject area (Corbin and Strauss, 2008). Therefore the explorative interviews describe general facts and relations to generate hypothesis that have to be validated in further empirical studies. Within our research project they thus provide general information about the SMEs and their collaboration with the “WirtschaftsForum Neuwied e.V.” as well as requirements, benefits and objectives of using Web 2.0 in this context.

4.2 Requirements of a Regional SME Network Towards Web 2.0 Artifacts

In general, the interview results confirm the actual use of Web 2.0 in SMEs’ practice. However, we could observe that Web 2.0 is perceived as instrument to optimize cooperation within the “WirtschaftsForum Neuwied e.V.”. The companies’ expectations to join the network are not entirely met at present. All interviewees express a high need to obtain general information on the WirtschaftsForum members. As a general survey of the member structure, which comprises information about branches, business areas and services provided, is not available yet, the enterprises perceive a lack of possibilities to represent their company and to exchange services within the network. In this regard we decided to focus on the development of a closed Web 2.0 platform first that fulfills these needs and will be refined during our project.

Further requirements highly depend on the company’s own strategy and thus have to be analyzed within the course of our project.

In total, 83 requirements were extracted from the interviews. While analyzing the interview content, we could identify five dimensions of requirements, which allowed us to structure the requirements according to:

- Who-is-doing-what: The platform that gives a general overview about the member structure of the SME-network (cp. Figure 3).
- Design: Configuration, design and usability aspects.
- Data security: Meeting the high security needs of SMEs (cp. Figure 4)
- Extensions: Options to extend the platform.
- Behavioral: Aspects comprising rules and ethical code that constitute the overall behaviour of the platform participants.

These requirements aim partly on technical aspects of the prototype (e.g. ease of use), partly on organizational aspects (e.g. gaining economical benefit) and partly on hybrid aspects. We identified hybrid aspects as organizational requirements, which can be supported by technology (e.g. initiation of contacts). By assigning the Web 2.0

					Web 2.0 functionalities				
dimension	requirement	category	focus	aim (of the requirements)	Authoring	Sharing	Collaboration	Networking	Scoring
“Who-is-doing-what”	Overview on structure of WirtschaftsForum members: Who is part of the WirtschaftsForum? Who are the particular contacts?	A	hybrid	SME; individual		X			
	Information about the particular companies: What do the companies do? What services do they offer?	A	hybrid	SME; individual		X			
	Profile of the companies	A	hybrid	SME	X	X			
	Structural presentation of member-companies	A	hybrid	SME	X	X			
	Platform for bundling local services (of WirtschaftsForum)	A	hybrid	SME	X	X	X	X	
	Search for business partners	A	hybrid	SME	X	X	X	X	
	Directory service for WirtschaftsForum	A	hybrid	SME; individual		X			

Fig. 3. Requirement Dimension “Who-is-doing-what” (extract)

dimension	requirement	category	focus	aim (of the requirements)	Web 2.0 functionalities				
					Authoring	Sharing	Collaboration	Networking	Scoring
"Data security"	Avoid circulating of untruth and false information (resilience of information)	A	hybrid	SME; individual	✗				
	Avoid disclosing too much personal data	A	hybrid	SME; individual	✗				
	Avoid unintentional dependency concerning data management	A	technical	SME; individual				✗	
	Securing the validity of information	A	hybrid	SME; individual		✗			
	Reducing unauthorized manipulation of information	A	hybrid	SME; individual		✗			
	Data security/ data protection	A	technical	SME; individual	X	X	X	X	X
	Login complying to aspects of data security and data protection	A	technical	SME; individual	X	X	X	X	X
	Differentiation between sensitive/ nonsensitive information	B	hybrid	SME; individual					X
	Management of measures and constraints, e.g. through an impartial administrator as a supervisor concerning users' behaviour	A	hybrid	SME; individual	X	X			X

Fig. 4. Requirement Dimension "Data Security"

functionalities (Authoring, Sharing, Collaboration, Networking, and Scoring) to the particular requirements and dimensions, we could schematically identify the Web 2.0 tool that fulfils these requirements.

The requirements can be categorized according to the aim of their use. Either they aim at supporting individual use, the SMEs' use or both. Furthermore we categorized the requirements according to importance A (must have within the first prototype) and B (further implementation). As a result we could identify the relevant requirements for

each iterative phase of our incremental development process. Requirements that cannot be realized by technical means are categorized by “0”. These requirements are thus important for the organizational management of the SME-network. Analyzing the dimensions, we summarized that a social network tool is the Web 2.0 tool fulfilling most of the A-requirements and providing the most technical possibilities to expand the platform. Thereby we follow the principle of spare use of applications implying that the use of different applications with same or similar functions is avoided.

4.3 Recommendations

As most of the members of the “WirtschaftsForum Neuwied e.V.” are not familiar with Web 2.0 concepts or Web 2.0 tools, the academic project partners decided to conceptualize a prototypic Web 2.0 platform in an early stage of the project. This decision was made, so that the Forum members have a “playground” to try out and to learn the Web 2.0 concepts by using them. The information and requirements we obtained from the interviews showed that a prototype fulfilling all requirements at once is neither realizable nor reasonable. As most of the interviewed persons are not common with Web 2.0 concepts or Web 2.0 tools, they probably change their requirements during testing the prototype and identify more requirements during the testing phase.

By analyzing the interview recordings we could identify three groups of requirements: technical requirements, organizational requirements and hybrid requirements concerning inseparable technical and organizational perspectives. Hence, to transfer these requirements into an integrated conceptualization considering all groups of requirements, an iterative proceeding is necessary. In such a manner, Web 2.0 artifacts can be implemented in sustainable way into the SME-network. Towards an integrated conceptualization, we recommend the following steps:

1. Requirements survey: information gathering by structured interviews to obtain first user requirements, extracting the requirements of the interviews by analyzing the quintessence.
2. Classification of the requirements: To structure the requirements, we recommend several dimensions, to classify the requirements. The recommended dimensions are:
 - A) Main content requirements (in the given case “Who-is-doing-what”)
 - B) Design
 - C) Data security
 - D) Extensions
 - E) Behavioral.

After having allocated a requirement, we recommend to identify the associated Web 2.0 functionalities as well as the requirement group (technical, organizational, hybrid). The web 2.0 functionalities provide a basis for prioritizing the technical requirements:

3. Prioritization of the (technical) requirements to obtain a first set of requirements for the first prototype (A: first prototype, B: further implementation).
4. Implementation of A-requirements in a first prototype according to the identified Web 2.0 tool.
5. Train the users for basic functionalities. Thereby present the economical benefits the companies have by participating on the platform.
6. Testing the prototype in a two-tier procedure: First, the lead users (in our case: a heterogeneous group of 6 so called-value partners) test the prototype. Then, the entire Forum will test the prototype. Accompanying, the lead users act as opinion formers.
7. Requirements survey: In a second round, further requirements are surveyed, that result from the testing stage.
8. Implementation of B-requirements and after-testing requirements.
9. Testing the extended prototype and monitoring of the user behaviour (e.g. clicking paths).

With this set of recommendations we aim at suggesting a sustainable concept to implement Web 2.0 in a SME-network. The concept is going to be evaluated in cooperation with “WirtschaftsForum Neuwied e.V.”.

5 Summary and Outlook

Small and medium sized enterprises (SMEs) face new challenges in a complex and dynamic competitive environment. To compete with these challenges, SMEs need to cooperate due to their restricted resources and limited capacities. Enterprise 2.0 is seen as an approach to solve the current problems that SMEs have to solve.

As there is a lack of academic publications concerning recommendations for the application of Web 2.0 artifacts in SME-networks, we presented a conceptual base following the design science approach. The approach bases on technical and organizational requirements resulting from interviews with representatives of SMEs participating in a regional SME-network. With the aid of several analyzing dimensions, we identified technical, organizational as well as hybrid requirements and transferred them in a prototypic iterative concept. We will apply this concept and evaluate it in cooperation with the “WirtschaftsForum Neuwied e.V.”.

This leads us to further research questions: can Web 2.0 newbies in the SMEs handle the prototype? Is sustain “learning” of Web 2.0 artifacts possible? How do individuals accept or decline the Web 2.0 artifacts? Do the users apply the prototypic Web 2.0 platform to solve their work life problems? Is this concept unchanged portable to other SME-networks? After having implemented the first prototype, the next step is to train the users and evaluate the acceptance of the prototype. Furthermore, according to the recommended concept, further requirements are going to be surveyed.

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Mashups: An Approach to Overcoming the Business/IT Gap in Service-Oriented Architectures

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Abstract. For quite a long time already, great importance has been attached to the concept of Service-Oriented Architectures for future IT-architectures. However, a major challenge in implementing this concept lies in the gap between the functional department and IT department. Mashups, an architecture also based on services, try to avoid this gap by letting the user himself integrate the services. The following article analyzes similarities and differences between both architecture approaches, and explains to what extent and in which cases Mashups could complement a Service-Oriented Architecture.

Keywords: Mashups, Service-Oriented Architecture, Business/IT Gap.

1 Introduction

Since the midst 1990's, science and practice have been dealing with the concept of Service-Oriented Architecture (SOA) (Natis, 2003). However, even though great importance has been attached to this concept for IT-architectures, effective usage in practice has been rather low (Legner and Heutschi, 2007). One of the main problems for this is the recurring gap between functional knowledge and technology. It is also referred to as the Business/IT Gap (Josuttis, 2007). This divergence is generated by the fact that the people involved, the future users and the IT-staff, have a different understanding of terms and work at cross-purposes.

One solution of bridging this gap is the Business Process Execution Language (BPEL). BPEL allows for the orchestration of services that run fully automatic afterwards (Farahbod et al., 2004). In order to enable human process interaction in BPEL, two more specifications have been added. WS-Human Task describes general functions that embed humans. WS-Bpel4People specifies the application of WS-Human Task directly in BPEL (Russell and van der Aalst, 2007). In order to present the business process graphically, the Business Process Modelling Notation (BPMN) acts as specification language for the graphical description. Since BPMN is graph-oriented while BPEL is primary block-structured, the translation between the languages is quite difficult (Ouyang et al., 2006) and comprises several problems (Recker et al., 2006). Furthermore, the use of BPMN is complicated due to large range of functions (Recker, 2008).

Mashups are another architecture specializing in the integration of services (Jhingran, 2006). They are applications of the Web 2.0 concept (O'Reilly, 2005) and deal with the simple integration of services and content by the user. Both architectures are service-oriented, but Mashups place particular emphasis on the participation of users - a typical feature of Web 2.0 (Cañas et al., 2007). Given the problem described in the beginning, the question arises whether the service orientation of SOAs is sufficient in practice or whether the user should be integrated more actively into the process design. One way of overcoming the Business/IT Gap could be the use of Mashups. First approaches have already been discussed in the literature (Hierro et al., 2008; Schroth and Janner, 2007), focussing on a global, user-centred SOA. This article argues for a different approach, namely to use Mashups complementarily or rather as a part of SOA. In order to be able to identify the potentials of usage, a structured comparison of Mashups and SOAs is required. Contact points and areas of differences have to be examined. The final aim of this article is to find out whether Mashups can be used as a part of SOA in order to integrate users actively into the exercise.

For this purpose, Mashups and possible categories of Mashups will be introduced in the second section. Afterwards, a definition of Service-Oriented Architectures will be given. Section three and four analyze the similarities of and differences between the two types of architectures and provide a summary of the results. The article ends with a conclusion and a short outlook.

2 Mashups and Service-Oriented Architectures

2.1 Mashups

In connection with the Web 2.0, Mashups integrate Web services, data and other content (Floyd et al., 2007). These elements of a Mashup can frequently be obtained free of charge from the internet. Thus, Web services and data formerly separated from each other are integrated into the user's own applications. A simple example for a Mashup is iGoogle (<http://www.google.com/ig>), illustrated in figure 1, where components from different sources can be aggregated into a personally customized Web site (Guo et al., 2008). Furthermore, the integration of several Web services presents us with the possibility of combining applications and data originally separated, which leads to new benefits for users (Jhingran, 2006).

Mashups are Web 2.0 applications and therefore characterized by typical features of the Web 2.0 (Cho, 2007). Mashups use "the web as a platform"; that is to say they are a Web application to gain access to services over the internet (Jhingran, 2006). Furthermore, Mashups are a typical example of the Lightweight Programming Model (LPM). In order to guarantee an efficient distribution in the Web, the applications and services should avoid complex designs and concentrate on simplicity and loosely linked systems. With regard to Mashups this indicates that the administration and creation of Mashups should be designed simply, so the users can easily access to technology. To achieve this, standardized interfaces and intuitive programming languages are used. Despite their simplicity, Mashups as Web 2.0 applications have to offer the user-friendliness of desktop applications and have to undergo continuous development.

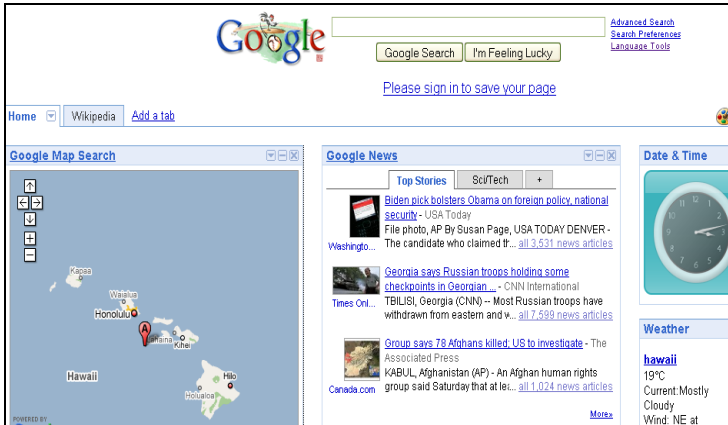


Fig. 1. Extract of an iGoogle Web site

According to the definition given in the beginning of this section, Mashups integrate and combine services, data and other content. This description is very general as these tasks can also be performed by other technologies. It is therefore reasonable to specify this definition even further. The user is supposed to be actively integrated into the application, as it is a characteristic of Web 2.0. In this case, it implies that the user creates and assembles the Mashups on his own. This form of user participation is described as user-driven or “user-centred micro-orchestration“ (Cañas et al., 2007; Grumann, 2006).

In this process, the user should be able to integrate and combine the desired data and services according to his own wishes. Until recently, these possibilities rarely existed, as earlier applications mostly had to be implemented and administered by IT-experts. Furthermore, these experts were needed for the adaptation of applications to the user’s demands. Now, due to the concrete integration of users into this process, Mashups enable the applications and information to be developed by users for users. However, in this context it is important that the necessary data and services are available in the required granularity (Grumann, 2006).

2.2 Mashup Categories

Regardless of the differing opinions about the specifications of Mashups in the literature (Guo et al., 2008; Kulkarni, 2007), it is possible to deduce a classification scheme. In this paper we distinguish Mashups on the basis of the functional range, the target group and the location of the technical implementation.

The *functions of Mashups* can be divided in *presentation level*, *data level* and *logic based Mashups* (Dornan, 2007; Kulkarni, 2007). *Presentation level Mashups* provide layout and information in various ways as Web services. In enterprises, these Mashups resemble customized portals; comparable to iGoogle. *Data level Mashups* concentrate on the extraction and combination of data from different sources and integrate them into the user's own internet site. Well-known examples are Web pages combining online maps with further data, e. g. Healthmap.org. *Logic based Mashups*

are the most complex type and contain services combined with application logic. They are currently used in price-comparison websites like Kayak.com, which use Web services to send inquiries to online travel agencies and book flights afterwards.

The *user groups* are differentiated into *consumer* and *enterprise Mashups*. Up to now, Mashups are mainly used for private applications. However, more and more businesses use Mashups as internal software architecture. These enterprise Mashups focus on the individualization of software by staff members (Grumann, 2006; Proto, 2007). Ideally the employees are able to integrate internal and external resources into their Mashups. Therefore, safety aspects during data processing play an important role in this area (Vikram and Steiner, 2007). In 2007 IBM released the IBM Mashup Center, a software that claims to meet the requirements described above. Among other things, employees with limited IT-skills shall be enabled to mix information from different data sources (IBM, 2008).

The technical realization can be done in two places: directly on the client or on a server. *Client-side Mashups* integrate services and content on the client, mostly in a Web browser (Ort, Brydon and Basler, 2007b). In contrast, *server-side Mashups* are created on a server. This internal server also functions as a proxy between the client and the respective providers, so the actual work is relocated from the client's web browser to the server. This version is advantageous because it offers an improved handling of safety requirements (Ort, Brydon and Basler, 2007a).

In order to be able to make a meaningful comparison between Mashups and SOAs, the same requirements should be applied to functional range and target groups in both architectures. Consequently, Mashups of the following categories are used: functional range *data* or *logic based*, target group *enterprise* and technical conversion *server-side*.

2.3 Service-Oriented Architectures

Even though SOAs have been under discussion for a long time, there is still no generally accepted definition in the literature. On the one hand, SOA can be regarded as a method (Jardim-Goncalves et al., 2006), and on the other hand, as a system architecture (Krafzig et al., 2008). Moreover, an SOA is generally characterized by its ability to enable different applications to exchange and process data independent of the underlying system software and the chosen programming language. Therefore, complete applications or parts are offered as services that can be used without coding efforts. This form of integration is described as a loose linkage of services. The enclosure in services creates independence from platforms and programming language, and enables the integration of legacy-applications in services. The integration of individual components into an SOA is done through standardized interfaces.

At present, using Web services is the most common way of implementing an SOA because the standardization of certain aspects (addressing, security, transactions, and policy) is well advanced. However, Web services are only one possible solution for the implementation of an SOA (Santillo, 2007).

There are approaches how to integrate the functional departments into the SOA's process design. The Business Process Execution Language (BPEL), also known as BPEL for Web Services (BPEL4WS), is the basic element. It offers various possibilities of orchestrating services (Farahbod et al., 2004). However, this combination has to run fully automatically, meaning that in practice all parameters needed for a process have to

be calculated beforehand. If important information is missing, the user cannot enter it while the process is still running. Unfortunately, this is a great limitation, as automatic processes rarely exist in practice (Zimmermann et al. 2005).

In July 2005, IBM and SAP published a white paper addressing this problem entitled “BPEL4People”. The paper reveals that “Human Interaction” should be seen as a major part of running processes. Suggestions are given on how to implement these human interactions in processes in BPEL. In the meantime, two more specifications have evolved from these: *WS-Human Task* describes functions to integrate people. *WS-BPEL4People* describes the application of WS-Human Task directly with BPEL (Russell and van der Aalst, 2007). This alteration enables people to take part in processes supported by Web services or even activate them. However, it is not the intention of BPEL4People to involve staff members more strongly in the development of processes or applications as such. Currently, nearly all products on the market are able to execute proprietary implementations of the BPEL4People idea. In the near future, it will probably offer a standardized implementation based on the specifications available at the present time.

BPEL is a purely XML-based description of Web service cycles and cannot be depicted graphically. Accordingly, it is complex and difficult to apply (Zimmermann et al., 2005). Since 2005 the specification language BPMN – Business Process Modelling Notation – is being used to graphically model business processes. The BPMN standard defines how a BPMN diagram should be translated into BPEL. The problem is that the ability of expression is not the same in BPMN and BPEL. BPMN models are usually under-specified and details that are relevant for the execution are ignored. Furthermore, the translation of a BPMN model into a BPEL scheme will in some cases lead to semantic deviation. BPMN, for example, is graph-oriented while BPEL is primarily block-structured. This makes translations between the languages quite difficult (Ouyang et al., 2006) and leads to several problems (Recker et al., 2006). In addition, the application of BPMN is not easy, as it has a large number of functions (Recker, 2008). A further limitation is the fact that translations between BPMN and BPEL can only go in one direction, even when using the WSBPEL version 2.0. This means that BPEL definitions can be obtained out of the BPMN, but due to missing language elements it is not possible to create a BPMN model from a BPEL definition (Giner, Torres and Pelechano, 2007).

3 A Comparison of Mashups and Service-Oriented Architectures

3.1 Similarities between Mashups and Service-Oriented Architectures

SOAs and Mashups are both service-orientated and are often associated with each other in this context (Cañas et al., 2007). The following similarities can be derived from this basic idea.

Both architectures are based on the encapsulation of services and data. Therefore, they are independent of system software and programming languages. Unfortunately, this independence only works in theory, as both Mashups (Palfrey and Gasser, 2007) and SOAs (IBM, 2006) show a dependency in practice. Furthermore, in both cases encapsulation relies on the usage of loosely connected and widely distributed

services. The result is a high degree of agility, so that services can be renewed and completely replaced during running requests in a simple way. This enables a quick adaptation to new circumstances (Schroth and Janner, 2007).

The foundations for this linkage of dispersed services and data are well-defined standardized interfaces. These interfaces do not only guarantee the integration of components into Mashups and SOAs. They also lead to a reduction of programming work, because components are developed separately from the architectures. It is therefore easy to reuse the services, e. g. in another composition for other purposes. It is also possible to combine separate services into one new service and make it available separately. In the case of SOAs, this is done by so called complex services (Yu and Lin 2005). Mashups use widgets for the bundling of services and data. These widgets are reusable fragments of Mashups and small applications for a specific task (Hoyer et al., 2008). Both SOAs and Mashups allow an additional level of abstraction by combining services.

Even though neither Mashups nor SOAs require standards in definition, a lot of the services used are Web services (Santillo, 2007; Jhingran, 2006). Whereas SOAs mainly use WS*-Web services with SOAP as transmitting standard, the present development of Mashups tends towards RESTful Web services (see also the next section).

3.2 Differences between Mashups and Service-Oriented Architectures

The main differences between Mashups and SOAs result from the fact that Mashups originate from the area of the Web 2.0 while SOAs have its source in the business process management and refer to the realisation of the similarities described above.

The design of both architectures is based on the encapsulation of services and their combination. However, Mashups and SOAs are realised differently. Mashups, as a Social Software (Cho, 2007), involve the user more strongly in the development process. Thus, people are an essential element of value proposition. In order for the user to be able to create and adapt Mashup applications according to his needs, the services have to provide the required degree of freedom with regard to structure and content. This process is carried out by user-friendly interfaces, most of which rely on human-oriented documentation (Pautasso, 2008). However, SOA applications are used to connect separated business functionalities and their applications. Accordingly, emphasis is not laid on the user, but on the connection of applications; e. g. realized via the BPEL (Farahbod et al., 2004). In this professional application, the composition of static control and governance processes is determined in advance (Weill and Ross, 2004). Thus, the approach to implement an SOA or a Mashup is different. Additionally, the concrete realisation of both architectures also varies.

Figure 2 shows an abstracted process, where the functional department is integrated into the design process of an SOA. At the beginning, the functional department analyses their processes. Afterwards, the functional department, in cooperation with the IT-department, describes these processes with Business Process Modelling, e. g. graphically with the BPMN. In doing so, BPM is supposed to be the bridge between IT and Business (White, 2004). Due to the rich and partially complicated BPMN language, communication difficulties between the IT and the functional department can occur during this step. The next step is the translation into

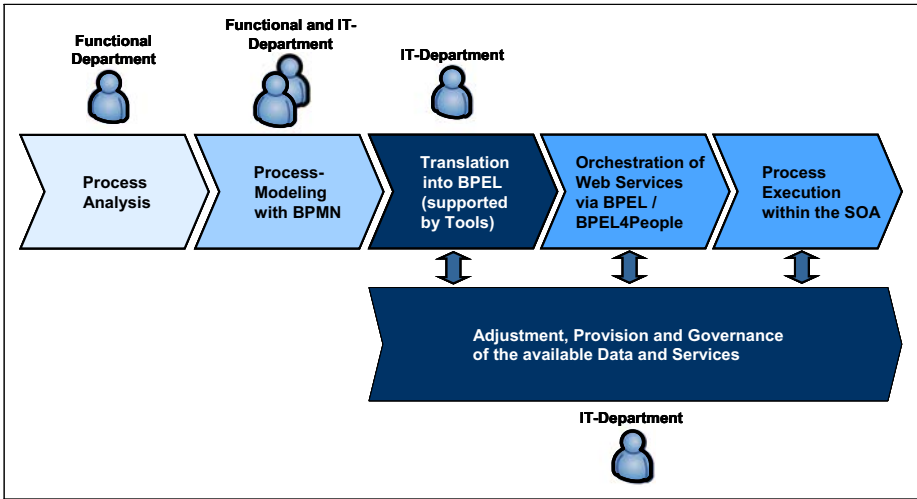


Fig. 2. Integration of the functional department into the process design within an SOA

BPEL, or BPEL4People. Even though it is presently supported by several tools (Ouyang et al., 2006), it is still subject to the restrictions described in the section “*Service-Oriented Architectures*”. After the successful translation of the processes, the services are orchestrated via BPEL in the fourth step. Finally, the services are executed in the SOA. To safeguard an unobstructed procedure of the SOA, the services have to be provided and controlled by the IT department at least starting from the step of translation. It can be summarised that the IT department is deeply integrated into the process design within an SOA in this scenario.

The process design within a Mashup architecture, shown in figure 3, is fundamentally different from the process in an SOA. The functional department combines services and data on its own with the help of a Mashup Building Platform. This solves the problem of communication between specialists and IT-department, as well as the problem of translating from BPMN into BPEL and the respective time-consuming process. On the other hand, process analysis and modelling with BPMN enable a structured examination of processes and correlations. In the end, this leads to an improved understanding of the business processes (Melão and Pidd, 2000). This approach is not included in the process presented in figure 3. As described in the section before, in Mashups the services chosen can be aggregated through widgets. Other than with the complex services in SOAs, this can be done using drag-and-drop in a graphic development environment (Proto, 2007). Widgets thus convert the used interfaces into a graphical visualisation.

The IT-department’s main function is therefore the reprocessing of data and services for the specialist department. It is also responsible for its adaptation, control and maintenance. Once they are reprocessed, the workload of the IT-department is reduced.

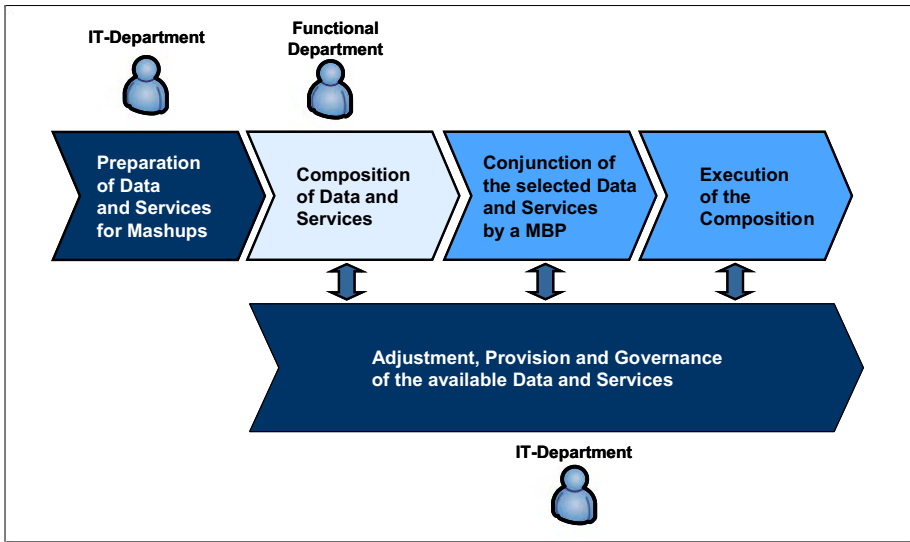


Fig. 3. The process design within a Mashup architecture

The processes shown in figures 2 and 3 lead to further differences between the two architectures. A semantic interoperability is needed in the process of selecting services with SOAs (Vetere and Lenzerin, 2005). In the interaction, machines are not able to react to mistakes occurring in the semantics between the services and correct them. Consequently, it has to be guaranteed that all services involved in an application interpret data semantically in the same way. Mashups, on the other hand, design contents of functions with the goal of integrating people directly via the user-interface. The user, as the developer of the application, interprets the data and is thus able to correct possible semantic mistakes between services (Schroth and Janner, 2007).

Another technical difference between SOAs and Mashups can be found in the transmission standards used. The World Wide Web Consortium (W3C) has established standards for SOAs, such as SOAP for message exchange, WSDL for description and UDDI as a directory service for Web services. Web services based on SOAP as a message protocol are action-oriented, so-called WS-* or SOAP Web services (Snell, 2007). In contrast, Mashups are presently developing in the direction of a resource-oriented architecture, so-called Representational State Transfer (REST) Web services (Richardson and Ruby, 2007). In order to approach Web services as a resource, the REST-architecture uses simple HTTP-method calls such as GET, PUT, DELETE or POST. Both architectures, resource-oriented and action-oriented, revert to HTTP. However, SOAP Web services merely use HTTP for the transport of remote procedure calls (RPC). On the other hand, REST Web services directly apply the transmission protocol's methods. Because simple HTTP-methods are used for the integration of services into the Mashup, there is no room for misinterpretation. The exchange of messages via SOAP allows for more freedom within an SOA. However, this makes it more complex and renders the maintenance of interoperability more difficult (Schroth and Janner, 2007).

4 Summary

The similarities and differences found in previous sections are presented in the following table.

Table 1. Similarities and Differences between Mashups and SOAs

Feature	Mashup	SOA
Design of Architecture	Use of loosely linked and encapsulated services for the connection of dispersed applications	
	Well defined, standardized interfaces	
	Creation of assembled services	
	High degree of agility	
	User as the essential element of the value proposition	Connection of separate business functions
	Freedom of structure and content	Ex-ante restriction via control and governance processes
	Internal and external services	Mostly internal services
	For situational applications	For complex and standardized business processes
Design of Technology	Independence of system software and programming language	
	Integration through standardized interfaces	
	Reuse of components, little programming work	
	Web services as mainly used services	
	User (functional department) integrated directly into the developing process	Speciality department only integrated into the developing process in cooperation with the IT-department
	Orchestration of data and services by Mashup Building Platforms	Orchestration of data and services by BPMN and BPEL
	Semantic interpretation by the user	Semantic interoperability has to be guaranteed
	Trend towards REST Web services	SOAP Web services as de facto standard
Connection of services and data in widgets	Connection of services as complex services	

It can generally be stated that BPEL shows its strengths where long-lasting processes are to be implemented. BPEL, or rather BPEL4People, can thus be viewed as the instrument for automating stable and persistent business processes in an SOA. It is not BPEL's goal to write conventional applications. The aim is rather to line up a certain amount of services, which can be either inside or outside of a company in order to simulate a business process that is to be implemented (Emmerich et al., 2005). In an SOA the implemented business processes are standardized and more or less persistent. Mashups, on the other hand, are used to individualise and adapt applications as well as data (Hoyer et al., 2008). The focus here lies on the ad hoc combination and integration of services and data; hence one speaks in this context of situational applications (Jhingran, 2006; IBM 2008). This explains why Mashups are heavily discussed in the area of Business Intelligence (BI) and knowledge workers (Soriano et al. 2007, Proto 2007). In this regard Microsoft focuses on Mashups as BI tools not only for financial analysts, but also for engineers, geoscientists and operations. The Mashup aggregates and visualizes multiple data streams, e. g. in Exploration & Production (oil industry) it collects data from the Geographic Information System (GIS), the BI- and HR-system for tracking hurricanes to ensure personnel safety (Brulé and Hodges, 2007).

5 Conclusion and Outlook

As shown in the previous two sections, Mashups and SOAs both focus on the use of services. Differences are due to the architectures' diverging intentions and to the concrete realisation of the technology; therefore the two architectures are used in different application scenarios.

A main difference lies in the respective process design. The interactions between functional department and IT department are an essential part of an SOA if the business process is to be optimally reflected in an SOA. Because of this complex process, it is difficult to meet the high demand of small but individual solutions. This is where Mashups show their strengths: the user can combine and create small applications and data according to his needs. This is especially convenient for small, partial routine and individual tasks. In addition to higher demands on required interfaces and freedom of structure and content, Mashup Building Platforms that are easy to handle will become necessary. If the use of these platforms is still too complicated for the functional department, at least the IT department can create Mashups up to ten times faster than normal (Brulé and Hodes, 2007).

The user-driven integration and combination of services via Mashups could be a step towards involving the functional departments into the process design of applications and thus help to meet the problem of the Business/IT Gap. However, complex and standardized business processes will still have to be implemented through the cooperation of IT and functional departments, for example using BPEL4People. This is due to the fact that a staff member of the functional department will not be able to cope with simulating a complex business process with the help of a Mashup Building Platform. Additionally, it is often not desirable that every staff members is able to create and change a standardized business process according to his wishes. Even though Mashups offer a lot of freedom for the user, in a professional environment it is necessary to control the use with a governance structure. Only then Mashups as situational applications and SOA for standardized business processes can complement one another and lead to a better relationship between functional and IT department. The different intentions of SOA and Mashup clearly show that both architectures are not mutually exclusive, but complement one another.

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Online Reputation Systems in Web 2.0 Era

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Abstract. Web 2.0 has transformed how reputation systems are designed and used by the Web. Based on a thorough review of the existing online reputation systems and their challenges in use, this paper studied a case of Amazon's reputation system for the impacts of Web 2.0. Through our case study, several distinguished features of new generation reputation systems are noted including multimedia feedbacks, reviewer centered, folksonomy, community contribution, comprehensive reputation, dynamic and interactive system etc. These new developments move towards a relatively trustworthy and reliable online reputation system in the Web 2.0 era.

Keywords: Online reputation system, Web 2.0.

1 Introduction

As the Web becomes increasingly distributed with content being created on the edge, large numbers of individuals and organizations use Internet media to research/exchange information, and to conduct business transactions. The needs for establishing trust mechanisms online in order to facilitate individuals and organizations' online activities become apparent.

An online reputation system is the primary mechanism used by online markets to collect, distribute, and aggregate feedback about participants' past behavior and help people to decide whom to trust, and to encourage trustworthy behavior. It is argued that in order to effectively foster trust among strangers, it is important to track historic data, and establish the "shadow of the future" in an online environment (Resnick, Zeckhauser, Friednam, & Kuwabara, 2000). Among the traditional reputation systems, ebay's feedback forum is one of the most studied. ebay's system allows buyer and seller to rate each other and leave comments after each transaction, the cumulative feedback score is then visibly displayed along each user's screen name. Empirical evidences indicate that sellers with better reputations are more likely to sell their items on ebay (Resnick & Zeckhauser, 2002). In fact, the overall commercial success of eBay is largely attributed to the original design of its reputation system (Resnick et al., 2000, Dellarocas, 2003a, 2003b; Jøsang, Ismail, & Boyd, 2007).

While the importance of online reputation system is certainly evidenced by its adoption in electronic markets, the designs of existing online reputation systems are far from ideal. In fact, they have encountered various issues that potentially affect their usability and effectiveness (Malaga 2003). Some commonly identified problems associated with online reputation systems include: (1) Low incentive for providing rating; (2) Bias toward positive rating; (3) Lack of effective mechanisms against unfair ratings; (4) change of identities after reputation loss; (5) Quality variations over time; etc. (Jøsang et al., 2007). Those problems have become bottlenecks for the development of online reputation systems and severely diminished the value of those traditional systems.

Among all the efforts to remedy the drawbacks of traditional online reputation systems, Web 2.0 movement emerged from recent evolution of web technology has set promising prospects for next generation of online reputation systems. Initially a term coined by Tim O'Reilly(2007), Web 2.0 distinguishes itself from Web 1.0 through its empowerment of ordinary users to create, control, and share web contents, which contribute to collective intelligence (O'Reilly, 2007). From Google AdSense and Flickr to Wikipedia, blogging, and tagging (folksonomy), applications of Web 2.0 emphasize openness, community and interaction (Millard & Ross, 2006). The set of Web 2.0 principles has redefined how individuals and businesses should communicate, interact, and transact through the web, and hence revolved the design principle and future path for online reputation systems in particular.

This paper reviews the status quo of existing reputation systems and describes potential directions for future work in Web 2.0 era. First, reputation systems are defined and categorized according to their input, processing, and output. Weakness of reputation systems in pre-Web 2.0 era is then described. Afterwards, the paper discusses Web 2.0 and its impacts on the design of online reputation systems by a case study of Amazon.com's reputation system. The paper concludes with a summary.

2 Reputation and Reputation Systems

Reputation represents "the beliefs or opinions that are generally held about someone or something." (Oxford English Dictionary). What is interesting about reputation is that it is often characterized as context-specific, multifaceted, and dynamic (Windley, Tew, & Daley, 2007). That is to say, the same products, people or organizations can be viewed completely differently to the situation they get involved, the criteria or aspect they are judged by, and the time when they are judged. For instance, the same publisher's reputation can be evaluated differently according to buyers' gender groups and from several aspects including quality, price, and services of the publications etc. The publisher's reputation will also increase or decrease with users' further experiences.

In a web environment, online reputation systems are important mechanisms for identifying the credits of products, individuals, and organizations. These systems form "large-scale online word-of-mouth communities in which individuals share opinions on a wide range of topics, including companies, products, services, and even world events" (Dellarocas, 2000, 2003b). Typically, there are three major properties necessary for a reputation system to function: (i) authenticating the subject is who they claim to be, (ii) determining the subject is capable of performing some specific

service, and (iii) determining if the subject can consistently deliver the desired result (Lin, Lu, Yu, & Tai, 2006). Those properties can be partially derived from online communities' metadata about users, artifacts, and evaluations. Metadata of an online community also captures links between types of metadata. For instance, authors and creators can be linked to objects. Additionally, reviews and evaluations can also be linked to objects, as well as objects being linked to evaluations. The linking of data in this way can be useful to reveal patterns of behavior in online discussion groups as well as provide demographic information about participants and their product evaluations (Gleave & Smith, 2007).

3 Online Reputation Systems Overview

3.1 System Input

Online reputation system captures an individual or organization's reputation through either explicit or implicit information. Explicit information is information that is entered into an online system by a user by either rating scores or votes. The explicit information, once entered, can be summarized and used to generate reputation scores that reflect the past behavior of a participant based on certain modeling equations. Among reputation system using explicit information, ebay is one of the most successful and famous. Implicit information, however, is derived without the user's knowledge. Implicit reputation is related to network behavioral data, for example, how a user travels through a series of web pages and how much time a user spends in an online store. A number of social communities such as Facebook, MySpace, Friendster, and LinkedIn have used implicit social network data to build community member's reputation.

3.2 System Processing

Reputation information can be processed on either centralized servers or distributed networks.

Centralized reputation system requires reputation metadata under control of a central authority for the system. In those systems, information about the performance of a given product/service/participant is collected from other members in the same community who have had direct experience with that product/service/participant and is maintained on a central server. The central authority collects all the reputation measures and derives a reputation score for every product/service/participant, and makes all reputation scores publically available (Jøsang et al., 2007). The primary mechanisms for centralized reputation systems to generate reputation scores are e-rating and e-voting, both of which capture explicit information, and access statistics that capture implicit information of users.

E-rating is a mechanism to have users input their evaluation for quality of transactions for sellers and buyers in commerce exchanges or quality of content in knowledge exchanges. For commercial exchange, e-ratings show the histories of buyers and sellers and the evaluation of their transaction experiences on a given scale basis. For knowledge exchange, e-ratings let anyone with access to post messages and leave feedbacks.

Both eBay and Amazon use e-ratings to provide a public view of participants past behaviors. They have central trusted servers gather transaction information, and calculate participant reputation scores. In ebay's case, the site uses +1 for a positive feedback, -1 for a negative feedback, and 0 for neutral. The equation for ebay to compute reputation scores is simply a sum of all reputation rating inputs from past transaction. The e-rating systems have made it possible for complete strangers in different geographical areas to determine whom they would choose to do business with on the Web.

E-voting also called ballot box communication (BBC) is an enumeration mechanism that aggregates individual votes and offers limited choices of communication to all participating users. The goal of e-voting is to reveal the interests of the mass population and reflect a many-to-one voice (Xia, Huang, Duan, & Whinston, 2007). With simplified options like Yes/No and Good/Poor, E-voting lowers the cost of participation and reduce the time users need to spend on leaving input. This encourages more people to participate. Sites using e-voting include Flickr.com, YouTube.com, Digg.com, and del.icio.us. However, because e-voting systems rarely provide audit information about users and patterns of participation within a community, their results could be manipulated. Since little knowledge is captured about individual actions and backgrounds during the voting process, e-voting does not enhance the depth of participation either.

Access statistics can be gathered based on popularity by evaluating view rankings, number of visitors, and number of comments. Access statistics are often released in conjunction with e-rating and e-voting scores. While access statistics do not indicate the opinions of visitors on the quality of transactions in commerce change and that of content in knowledge exchange, they imply the popularity of a product or content. Those popularity statistics often imply market presence of an object, which is an important aspect of reputation, especially for digital products like music, movies, and information posts.

Decentralized reputation systems are lack of a central authority for reputation metadata control and computation. Since reputation information is distributed through the network and hosted on many different nodes, reputation systems in decentralized P2P networks need to take locally generated reputation information and spread it throughout the network to produce a global reputation rating for the nodes.

The mechanisms for a decentralized reputation system to generate reputation scores depend on whether reputation is measured by peers' objective activities, or subjective ratings from the other peers who have interaction with the target peers. Using peers' objective activities for reputation statistics is similar to access statistics reviewed earlier. Those activities are relatively easy to be summarized and collected (Gupta, Judge, & Ammar, 2003). Using peer subjective ratings to generate reputation scores in a P2P network, however, is more complicated and requires considerable academic work in developing algorithms than e-rating and e-voting in centralized reputation systems. Currently, those works have followed two directions: probabilistic estimation and social network (Despotovic & Aberer, 2006). The probabilistic estimation methods use well known estimation techniques, e.g. maximum likelihood estimation and Bayesian estimation, and a small portion of the globally available feedback to assess the reputation of individual peer. In contrast, the social network approach aggregates the globally

available feedback in the network in order to assess the reputation of a single node. Some P2P network like Kazza (kazza.com) used a hybrid mechanism combining both objective peers' activities and subjective ratings to generate reputation scores. Kazza defines peers' reputation according to their participation level and their rating of file integrity. For Kazza, participant level is the ratio of Mbytes uploaded and downloaded that varies between 0 and 1000 with new user starting at a medium participation level of 100. The integrity of files is rated by each user as excellent, average, poor, or delete file.

3.3 System Output

Most of the existing reputation systems release reputation information by simply displaying a score, a scale, and/or comments along with the objects. While accompanying objects with their reputation scores provide straight shot on the historic quality of the transactions or contents and individual's past behaviors, there are several apparent limitations. First, reputation information is scattered across the website and difficult to aggregate, categorize, and compare with each other. Second, while reputation information could be analyzed and used internally, more often they are output automatically onto the website. Use of reputation information by those sites appear to be reactive rather than proactive so far. There are few reports on the practices of using reputation information for developing strategies and policies, or reaching customers for e-commerce sites or online communities. Finally, other than numeric scores or scales, there are less multimedia data used for reputation releases.

4 Problems with Pre-Web2.0 Online Reputation Systems

Although existing online reputations systems can induce beneficial outcomes to e-commerce systems and online communities, they often fail due to inherent weaknesses that have not been well resolved (Resnick et al., 2000, Malaga, 2004).

First, online reputation often misrepresents the performances of community participants and could be artificially inflated or deflated by the malicious actions of participants. Creating incentives for participants to leave feedback is a big challenge to online communities. Many community participants fail to leave feedback. Of the ones who do leave feedback, it is difficult to ensure that the participants' reports are honest. One participant could blackmail another and threaten to post negative feedback that is unrelated to actual performance. Participants could also collaborate and rate one another positively, and collude against a competitor by providing negative ratings (Resnick et al, 2000).

Second, the anonymity of many online communities makes it very difficult for reputation systems to identify participants and trace their prior histories. It is very easy to create a web identity, or multiple web identities online. People choose pseudonyms at will and can change their identities and erase prior history. Lacking a history make the trust rating impossible because there is nothing to base a prediction of future behavior. Participants that have established a reputation are concerned about their ratings because of the time it takes to build their history.

Third, reputation accumulated in one community cannot be shared on another site, causing portability problems. Participants' reputation could be considered proprietary

and prohibited from sharing outside the community where those reputation are generated. Many participants themselves also have concerns about privacy and reluctant to carry over their reputation scores. In addition, the methods and time-periods used by different communities are not consistent and often difficult to be converted from one to the other. Lack of portability make users have to manually compare the reputation of the same item while traveling to different communities.

The fourth problem is miscalculation of reputations (Malaga, 2004). Many reputation systems use an overall reputation score that is a simple sum of each individual reputation rating. However, such calculations are unable to compare participants who have pure positive ratings and those who have the same overall scores but the scores are from a sum of both positive and negative rating. A general reputation score also doesn't reflect the multifaceted nature of the reputation of a participant. One participant can be very helpful and honest on one subject but not the others. Besides, the method does not count the time and context of a reputation score.

Finally, most of reputation systems today only exploit explicit information like online feedback for reputation calculation. Some of the problems above like misrepresented feedback, pseudonyms, and inaccurate reputation calculation etc to some extent are the results of the use of explicit information. Recently, social network analysis is emerging as a path to the right direction to use implicit information for reputation system. However, there are many problems remain to be solved. For example, the visibility and use of social network data in online communities may affect user confidence in reputation systems because participants of online communities have high privacy expectations.

5 Online Reputation Systems in Web 2.0 Era

While some of Web 2.0's enabling technology components have existed since the early days of the Web, the so called Web 2.0 is more about a set of principles that redefines how individuals and businesses should communicate, interact, and transact through the web. Anderson (2007) highlighted six key principles of Web 2.0:

- Individual production and user generated content
- Harness the power of the crowd
- Data on an epic scale
- Architecture of participation
- Network effects
- Openness

Those principles together encourage users' participation and creativities, capture individual actions to produce collective results, use mass data volume matters and facilitate community and network building among users, and support open data exchange with open standards. The Web 2.0 movement have since influenced many facets of Internet culture and inspired innovative companies to create newer reputation systems to better service customers in the global economy.

In order to illustrate the deep impacts of Web 2.0 on the online reputation systems, we conduct a case study on the reputation systems of Amazon.com. This site is selected

because: First, Amazon is a very successful eCommerce company. In 2008, when the entire retailer sector suffered seriously from decreased consumer spending in the economy recession, Amazon still reported “the best Christmas season ever”—a full year profit \$645m for 2008, or a 36% increase from 2007’s profit (Amazon Press Release, 2009 Feb). Second, Amazon is a well established Web 2.0 company. In fact, the notion of “long tail” (Anderson, 2006) – a key justification of Web 2.0 economic model -was inspired by the analysis of the sales trends at Amazon. Third, both authors have been long term customers and contributors of Amazon’s online reputation systems. The authors have witnessed the migration of Amazon’s online reputation system into a Web 2.0 version. Our interests here are to understand whether Amazon’s Web 2.0 online reputation system is able to address the weaknesses of pre-Web 2.0 reputation systems. Our case findings are first presented in Table 1 and then described:

Table 1. A Comparison of Amazon Pre Web 2.0 Reputation Systems and Web 2.0 Reputation Systems

Pre Web 2.0 Reputation System	Web 2.0 Reputation System
Score/scale/text	Multimedia input
Explicit action required	Implicit reputation derived
Product centered reputation	Reviewer centered reputation
Individual contribution	Community contribution
Single dimension	Comprehensive
Static	Dynamic
Reactive	Interactive

Multimedia feedbacks. Amazon encourages users to create and share reviews in the multiple formats including texts, images and videos. The earlier online reputation systems at Amazon only incorporate scores/ratings and simple text reviews. Now, Amazon encourages multimedia feedbacks including more interactive text inputs (including comments and discussions), as well as customer images and videos. Now, Amazon accepts multimedia feedbacks including text reviews, customer images and videos, which complement the average score rating with richer information and help to reduce the misinterpretation of reputation scores. Often, a picture is worth a thousand words, and a single still image may confer very complex ideas. For example, one product’s images can provide a good sense of product dimension by comparing it with other familiar objects. These types of review are very useful especially when potential customers cannot see, feel, and touch the physical product in the online context. Sometimes, the customer images may even serve as the evidence of product uses, for example, images taken using the digital camera under review, they not only testify the product quality in a way, but also enable viewers to make their own judgment about product reputation.

Folksonomy (tag reputation). Tagging, one of the signature applications of Web 2.0 (Vander Wal, 2005), has also been incorporated in the reputation system of Amazon. Along with each product, Amazon designates an area to allow members to tag the item according to their own definition/classification. Just like a typical tagging system, Amazon not only lists all the tags that have been associated with this particular product by other customers, but also displays the Amazon “tag cloud”, with the most popular and most current tags being highlighted.

As illustrated in a tag list, the number of members who have been using the same label to tag a particular product is displayed to indicate the product-specific tag reputation, which could be viewed as the relevance of the tag to a particular product. Under this context, the tag reputation may indirectly infer product reputation. For example, more customers tag a particular product indicates that more people could be interested in it.

The tag cloud, however, visually displays the tag popularity - a different type of reputation measured by how many times a particular tag has been used to label products in Amazon. Since tags play rather important roles in forming customer communities, the tag cloud visualizes and compares the popularity of different communities.

Reviewer centered system. The past Amazon reputation systems were primarily product centered as it targets products being sold. Reputation scores in the pre-Web 2.0 Amazon reputation system were primarily about how good a product was to customers. As Web 2.0 movement emerges, Amazon has seriously expanded its reputation system to embrace reviewers’ reputation. The reviewer’s profile now is displayed along each review he or she made. Reviewers are ranked based on three factors: the quality of the review, the currentness of the review, and total number of reviews the reviewer has contributed. In Amazon’s current reputation system, the quality of the review plays the biggest role in determining the reviewer ranking. The quality of the review is primarily measured by how many members have voted the review as “being helpful,” which is displayed at the end of each review, readers of the review may easily click on “yes” or “no” button to voice their votes. In other words, Amazon partially relies on a simple voting based reputation system to evaluate reviewer reputation, beyond that, the newer and the more reviews a review contribute, the more likely he/she will be ranked higher in Amazon’s “top reviewer list”.

Other than using a number indicating the reviewer’s ranking, Amazon also rewards reviewers with various “badges” to signify different contributions they made to the community. Apparently, “Top 10 Reviewer” badge highlights the reviewer reputation as being top ranked; the “Real Name” badge indicates that the reviewer’s name matches his/her real world identity – the same name as the one on his/her credit card; and the “Community Forum 04” badge recognizes the reviewer as one of the participants in the 2004 Community Forum at Amazon.com corporate headquarters in Seattle, WA. Even though the last two badges may not be review related per se, they are important aspects that potentially help reviewers to establish their credibility. These practices provide different means for customers to earn their reputation and be recognized at Amazon, which in turn serves as incentives in motivating increased participation in Amazon community.

Community contribution. Since product tags can serve as effective intermediary to connect products and people who are interested in them, Amazon uses tags to form communities. In other words, each community is named after a popular tag. For

example, the URL to a community named “photography”, is displayed as <http://amazon.com/tag/photography>.

At Amazon, a community consists of all the products that have been tagged with its name, the people who contributed those tags, the discussions initiated within the community, the product “Lists and Guides” recommendation created by community members, and images uploaded by community members. A typical community profile not only lists the number of customers, the number of products and the number of discussions in the community, it also indicates when the last time any activity happened in this community. All those numbers in combination inform viewers about the reputation of this community. In this case, a multifaceted measure, rather than a single measure is used to indicate the community reputation. In addition, we observe that Amazon tends to include easy-to-collect, implicit measures such as the number of customers to indicate the community reputation.

Besides, product tagging also helps Amazon to connect like-minded customers into community of practices, where members share product knowledge and help each other solve problems through reviews, discussion forums, and comments. These communication channels also allow customers to interact with each other beyond the initial purchasing of the product. For example, forum discussions may address questions like how to use the product effectively, or which accessories are necessary etc, extending Amazon services to include the post purchase education and support, resulting increased customer satisfaction. Notice this online community building effort may help connect Amazon customers offline as well. To promote its famed Kindle 2 ebook reader, Amazon created the “See a Kindle in Your City” campaign, the discussion forum helped a potential customer who was interested in buying a Kindle device to locate a Kindle owner at their local community, so that the potential buyer could get a chance to see the device in person before making the purchase decision.

Comprehensive reputation. Amazon’s Web 2.0 reputation system measures reputation for every contribution from any member today. Reputation serves as an important incentive for user participation in Web 2.0. What we see is that reputation system permeates every aspect of Amazon.com. As discussed earlier, Amazon provides various opportunities for customers to participate, from less intimidating ones, such as tagging a product, to more daunting ones, such as writing a guide about how to do bird photography. Amazon not only records every contribution that any member ever made, but also measures and publishes reputations associated with all contributions/activities. In other words, Amazon takes full advantage of reputation system, specifically, every tag, every review, every discussion, every images, every lists and guides that is contributed by customers is with reputation attached. In most cases, not only reputations of different contributions are measured differently, but also multi-dimensional measures are developed to evaluate specific reputations. We also see the increased use of implicit measures such as how many users have read the product guide, etc. Ultimately, the reputation of a contributor is sum of the reputations of all the contributions he/she made.

Dynamic and interactive system. Amazon’s reputation system allows members to revise their feedback if they change their mind. This feature is particularly helpful when the member’s experiences with using the product change over time, and the member would like to reflect those changes in his/her review. Amazon’s reputation

system also includes a discussion forum where reviewers can comment on the other reviewers' post. Readers thus can easily voice their agreement / disagreement with a reviewer, adding additional product information, or ask the reviewer additional questions concerning the product. They can even invite other customers who share similar interests about the product to join the conversation. The discussion among members tune up the reputation initially generated by a reviewer and form a collective view of the product.

6 Conclusion

Web 2.0 has transformed how reputation systems are designed and used by the Web. Using the latest Amazon's reputation system as a case, this paper attempts to illustrate the impacts of Web 2.0 principals on reputation systems. From Amazon's reputation system, the paper notes several distinguished features. These new developments all reflect Web 2.0 design principals and promise a path that move towards a relatively trustworthy and reliable online reputation system in the future. While our observations are limited to a single case only, the practices of Amazon reputation system certainly set insights for further investigation of online reputation systems in Web 2.0 era. Further researches in this area are clearly needed and likely very productive.

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Evolution of Decision Rules Used for IT Portfolio Management: An Inductive Approach

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Abstract. IT portfolio management and the related planning decisions for IT-dependent initiatives are critical to organizational performance. Building on the logic of appropriateness theoretical framework, we define an important characteristic of decision rules used during IT portfolio planning; rule appropriateness with regards to the risk-taking criterion. We propose that rule appropriateness will be an important factor explaining the evolution of rules over time. Using an inductive learning methodology, we analyze a unique dataset of actual IT portfolio planning decisions spanning two consecutive years within one organization. We present systematic comparative analysis of the evolution of rules used in planning over two years to validate our research proposition. We find that rules that were inappropriate in the first year are being redefined to design appropriate rules for use in the second year. Our work provides empirical evidence demonstrating organizational learning and improvements in IT portfolio planning capabilities.

Keywords: IT portfolio management, decision rules, inductive learning, logic of appropriateness.

1 Introduction

IT portfolio management and decision-making for IT-dependent initiatives¹ is critical to organizational performance (Jeffery and Leliveld 2004, Piccoli and Ives 2005). Organizations are today trying to leverage the plethora of technologies emerging in the Web 2.0 domain. These Web 2.0 applications have the potential to offer a variety of benefits (McAfee 2007). Such applications can help organizations better connect with their customers. Given the high impact of these applications, the proportion of these Web 2.0 investments are growing in size (McAfee 2007). Given that the terrain of these Web 2.0 applications is constantly evolving, executives are expected to adapt their corresponding decision making for such portfolios of Web 2.0 applications. Portfolios of IT-dependent initiatives, including Web 2.0 initiatives, have the potential to deliver high business value (Maizlish and Handler 2005) but are often plagued with

¹ IT-dependent initiatives are broad organizational efforts. Such initiatives often lead to the creation of several smaller IT development or integration projects.

several factors leading to low success rates. Among other factors, low success rates have been often attributed to inadequate attention being allocated to risk management early during planning (Boynton and Zmud 1987). Managing risks during planning is relevant from an IT governance standpoint. IT itself is constantly evolving; especially the technological terrain in Web 2.0; investments in IT can lead to significant organizational changes. IT initiatives require significant redesign to an organization's business processes including processes that interact with customers and suppliers. Given these changes that ensue due to IT initiatives, refinements to IT portfolio management capabilities are essential.

We find that emphasis on risk mitigation early during planning continues to be a relatively understudied research area. Decision making during planning often results from planners answering for themselves the question: "What does a person like me do in a situation like this?" Building on the theoretical framework of the logic of appropriateness (March 1994) which contrasts the expected utility models for decision making, we define an important characteristic of rules; rule appropriateness with regards to the risk-taking criterion (March and Shapira 1987). We propose that appropriateness of rules will be an important factor explaining the evolution of rules over time. Our work contributes to the research literature in the following ways. We analyze a unique longitudinal data set of actual portfolio decisions (proposed initiatives are rejected or partially approved or fully funded) within one organization spanning two consecutive years. We adopt an inductive learning methodology which is best suited for uncovering tacit decision making rules. We present comparative findings which demonstrate refinements to decision rules. In two of the three comparative scenarios presented, we find that rules that were inappropriate in the first year are being refined to develop appropriate rules in the second year's planning session. These findings provide evidence of organizational learning with regards to the use of appropriate rules over time. Thus, our research provides empirical evidence highlighting the role of rule appropriateness in explaining the evolution or refinement of decision rules over time.

2 Background

2.1 IT Portfolio Management and Rules

IT portfolio management practices are used to improve the return on planned and existing IT initiatives (Jeffery and Leliveld 2004). IT planners manage IT assets as a portfolio; similar to investments in a financial portfolio (Maizlish and Handler 2005). IT planners aim to improve performance of their portfolios by aligning IT initiatives (Sabherwal and Chan 2001) with business objectives and by managing risks (McFarlan 1981). Two predicaments faced by planners are presented in Figure 1. First, *Gresham's law of planning* states that "daily routine drives out planning" (March and Simon 1958, p.185). Planners should ensure that they devote their limited attention to key planning concerns and not be distracted by tactical plan-implementation issues. Second, *the planning paradox* suggests that planners are expected to complete planning rapidly; expediting planning can lead to the development of inappropriate plans; effectively reducing the likelihood of success during implementation (Lederer and Sethi 1996).

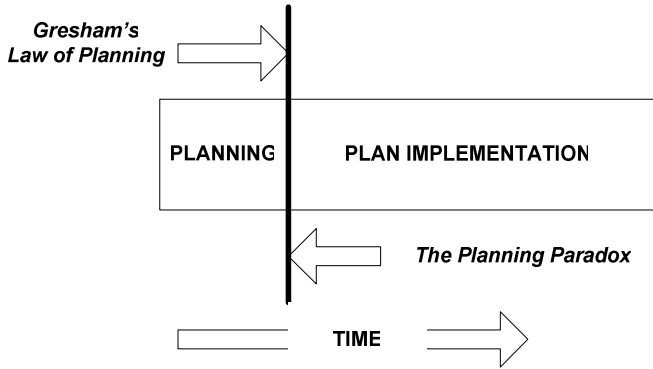


Fig. 1. Issues in Planning

Decision rules address these twin challenges associated with planning (Heugens and Bosch 2004) via three mechanisms. *First*, rules can alleviate problems associated with the bounded rationality (Simon 1955); potentially attenuating the planning paradox. *Second*, rules can facilitate knowledge sharing for improved coordination among diverse groups by routinizing complex organizational behavior (Tsoukas 1996). *Third*, implementation of large initiatives requires delegation of tasks to a set of actors who might not necessarily share the objectives of the planners. Planners can use rules as incentive alignment mechanisms (Eisenhardt 1989) by rewarding rule-following and penalizing rule-defiant behavior. Rules can be central to organizational learning (Levitt and March 1988) where new experiences guide the refinement of rules over time.

2.2 Logic of Appropriateness

March (1994) proposes that decisions are shaped by situational recognition, one’s identity, and the application of rules. Decisions result from people answering for themselves the question, “*What does a person like me (1: Identity) do (2: Rules) in a situation like this (3: Recognition)?*” Logic of appropriateness which contrasts the dominant expected utility models (Luce and Raiffa 1957) serves as the theoretical framework in our research.

Identity: Business strategies adopted by an organization are used to develop distinct identities for organizations. The Miles and Snow (1978) Defender-Prospector-Analyzer classification is one such typology. Defenders are risk-averse; stress efficiency of operations; emphasize a narrow domain by aggressively controlling niches in their industry and engage in little new product development (Miles and Snow 1978). Prospectors are risk-takers; constantly explore emerging opportunities and stress new product development (Miles and Snow 1978). Analyzers who exhibit characteristics of both Defenders and Prospectors (Miles and Snow 1978) are argued to be risk averse.

Recognition: Mitigating risks during planning (the situation here) is arguably appropriate behavior from an IT governance standpoint. Two perspectives on risk-taking (March and Shapira 1987) guide the conceptual development rule appropriateness: (1)

planners perceive risk-taking as a key expectation of their jobs and (2) planners take risks willingly as they believe risk can be controlled. Managers make a sharp distinction between gambling (where the odds are exogenously determined) and risk-taking (where managerial effort can control risks). Before plan implementation commences, executives should exert effort (to gather information or develop skills) enabling them to manage risks (Lambert 1986).

Appropriate Rules: High/medium risk initiatives can place an organization under considerable financial stress. Appropriate behavior during planning requires planners to arrive at decisions on high/medium risk initiatives only after assessing risk mitigation mechanisms devised to control risk (Boynton and Zmud 1987). Planners who approve proposed high/medium risk initiatives without ensuring the presence of risk mitigation mechanisms are gambling and behaving inappropriately. Rejecting high/medium risk initiatives; without exerting effort to manage those risks would also be inappropriate as planners are expected to take some risks during planning. High/medium risk initiatives should be appropriately selected only after ascertaining that some risk mitigation mechanisms are present to manage these sources of risks (March and Shapira 1987).

Definition of Rule Appropriateness: Addressing sources of risk during planning is critical (Boynton and Zmud 1987). Decision rules that show evidence suggesting that risk mitigation mechanisms are present before approving high/medium risk initiatives are defined to be appropriate with regards to risk-taking (March and Shapira 1987).

Inappropriate rules are more likely to be refined over time before being reused in future planning sessions. Appropriate rules will also deserve refinement, especially if they lead to unsatisfactory performance outcomes.

Research Proposition: Rule appropriateness will be a key factor explaining the evolution of decision rules over time.

3 Methodology

We choose a large, public Fortune 10 organization for our study. This organization is head quartered in the United States, operates in 50 locations worldwide, and employs more than 39,000 people. This organization is experiencing tremendous growth and its revenues in 2007 were more than 16 billion U.S. dollars. We adopt an inductive learning methodology to uncover the decision rules used during planning.

3.1 Data

Data were collected based on interaction with five key informants within this organization (Vice President and CIO, and four senior executives in the CIO team). For triangulation, data were collected by the following methods; content analysis of information presented in the annual reports; face-to-face semi-structured interviews with all key informants spanning twenty hours; unobtrusive participation in a planning session lasting two hours; conference calls with all the key informants spanning forty hours; and exchange of confidential documents between the researcher team and our key informants. Based on our qualitative understanding of the business strategies chosen by this organization, we classified it as an Analyzer. Our interpretation was unanimously

validated by the key informants at this organization. Portfolio data were gathered from the field based on our collaboration with the key informants. The unit of analysis used in this study, an IT-dependent initiative, is defined as a large organizational effort (Piccoli and Ives 2005) involving significant investments, design of information systems, most likely the redesign of business processes. We analyze IT portfolio data spanning two consecutive years (presented in Table 1). These portfolios contain 57 IS-dependent initiatives for year one and 106 initiatives in year two. The portfolio for the first year contained 13 initiatives estimated to cost less than one hundred thousand dollars; 9 initiatives estimated to cost over one million dollars and 35 initiatives estimated to cost more than one hundred thousand and less than one million dollars. The portfolio for the second year contained 64 initiatives estimated to cost less than one hundred thousand dollars; 13 initiatives estimated to cost over one million dollars and 29 initiatives estimated to cost more than one hundred thousand and less than one million dollars. Planning decisions were based on a careful consideration of benefit, risk and mitigation capabilities associated with proposed initiatives. For instance, prior literature (for e.g. Broadbent et al 1999) has suggested that managing the business process redesign implications of large IT-dependent initiatives is critical. Thus this is important source of risk which often needs to be managed upfront. Thus considering such capabilities (for e.g. Business Process Redesign (BPR) Work done) before commencing on large IT dependent initiatives, like the ones we consider in this study can be critical. Similarly, we include various organizational mitigation capabilities to comprehensively understanding decision making during strategic IS planning.

3.2 Measure Development

Characterizing Risks

We adopt McFarlan (1981)'s approach for assessing the risk of IS-dependent initiatives.

Initiative Size: This attribute was measured based on the estimated investment. The risk associated with an initiative increases with its size (McFarlan 1981). This variable was assigned three values: Low (investment less than one hundred thousand dollars), Medium (investment greater than one hundred thousand dollars and less than one million dollars) and High (investment was greater than one million dollars).

Initiative Structure: Some initiatives, by their very definition, are well-defined, in terms of their inputs and outputs. The corresponding organizational tasks required to convert inputs to the desirable outputs, are relatively straightforward (Eisenhardt 1985). Initiatives of high structure (McFarlan 1981) are less risky when compared to initiatives with low structure. Initiatives where the expected outputs are vulnerable to change are low structured and inherently risky. This variable was assigned two values: high (well-defined objectives) and low (objectives of the initiative are fluid).

Prior Experience: As the familiarity of an organization with a technology increases, the likelihood of encountering technical problems reduces. Higher the prior experience with technologies used in the execution of an initiative, lower the risk associated with that initiative (McFarlan 1981). This variable was assigned three values: low (new application development with emerging technologies), medium (non-trivial improvements to standard technologies) and high (relatively simple applications of standard technologies).

Table 1. Data Summary

Inputs to the planning process			Outputs of the planning process
	Benefits Associated With Initiatives	Risks/Risk Mitigation Mechanisms	Portfolio Decisions
Year One (n=57)	<u>Initiative Type</u> OSS Initiative (79%) MIS Initiative (53%) IOS Initiative (49%) SDSS Initiative (32%) Process Benefits (82%)	<u>Initiative Structure</u> (Low Structure = 32%, High Structure = 68%) <u>Initiative Size</u> (Low = 23%, Medium = 61%, High = 16%) <u>Prior Experience</u> (Low = 67%, Medium = 23%, High = 10%) <u>BPR Work Done</u> (16%) <u>BPR Resources Committed</u> (23%)	Reject (25%) Partially Approve & Fund (30%) Fully Approve & Fund (45%)
Year Two (n=106)	<u>Initiative Type</u> OSS Initiative (46%) MIS Initiative (19%) IOS Initiative (41%) SDSS Initiative (20%) Process Benefits (89%)	<u>Initiative Structure</u> (Low Structure = 58%, High Structure = 42%) <u>Initiative Size</u> (Low = 60%, Medium = 27%, High = 13%) <u>Prior Experience</u> (Low = 20%, Medium = 33%, High = 47%) <u>BPR Work Done</u> (10%) <u>BPR Resources Committed</u> (43%)	Reject (18%) Partially Approve & Fund (25%) Fully Approve & Fund (57%)

Characterizing Benefits

Initiative Type: Investments in IS can provide benefits to organization in many ways². Based on the various types of benefits that can be extracted from IS initiatives, detailed descriptive information on proposed initiatives was used assign this variable, the following values (Sabherwal and Chan 2001): inter-organizational systems (IOS) initiative and/or marketing information systems (MIS) initiative and/or strategic decision support systems (SDSS) initiative, and/or operational support systems (OSS) initiative.

² A rigorous quantification of benefits associated with initiatives (such as a ROI) would be desirable. But often arriving at quantification like this is extremely difficult and unrealistic especially given the planning paradox.

Process Benefits: IS-dependent initiatives can enable process improvements (Broadbent et al. 1999). This variable was assigned a value of 1 when the initiative enabled business process improvements and a value of 0 otherwise.

Characterizing Risk Mitigating Factors

BPR Work Done: Performing business process redesign before starting initiatives is critical to minimizing process risks (Broadbent et al. 1999) related to the execution of initiatives. This variable was assigned a value of 1 when initiative related business process redesign work was completed and a value of 0 otherwise.

BPR Resources Committed: IS initiatives can either constrain or facilitate BPR initiatives (Broadbent et al. 1999). Committing resources for undertaking BPR before starting technology-dependent initiatives can be a risk mitigation factor. This variable was assigned a value of 1 when resources were assigned to proposed IS-dependent initiatives for conducting BPR and a value of 0 otherwise.

Portfolio Decisions

Decisions for each proposed IS-dependent initiative belonged to one of the following three classes: initiatives were (1) rejected; (2) partially approved and supported with partial funding; (3) fully approved and funded.

3.3 Inductive Learning

Decision trees have been used to study organizational decision-making (Quinlan 1986, 1990). In its general form, the inductive learning process contains three phases: (1) instance space; (2) algorithm used for learning; (3) output describing the target concept. The instance space is an n-dimensional space where each instance is described by n attributes and a classification concept. For every run of the learning algorithm the instance space is represented by a training sample. In our case the target concept is a description of the induced managerial decision-making process. The purpose of induction is to discover the most precise approximation of the target concept. From an instance space, an approximation of the target concept, called hypothesis is induced. Each such approximation forms an instance in the hypothesis space. Each hypothesis represents a more or less credible approximation of the target concept. The decision tree representation which has been previously applied to discover decision-making processes, describes the target concept using a set of conjunctives (Quinlan 1986, 1990). Trees create an ordering among the attributes characterizing examples that belong to a particular class and the ones that do not. The tree-based inductive learning approach discovers and represents the knowledge contained in a decision process in a comprehensive and structured way (Shaw and Gentry 1988, 1990). Decision trees possess predictive validity comparable to other statistical classifiers. Given this high descriptive validity, decision trees offer unique advantages over statistical classifiers. An interpretation of the paths in the decision tree provides insights concerning the underlying structure of the data, which highlights a collection of attributes used in the classification procedure (Tessmer, Shaw and Gentry 1993, Gentry *et al.* 2002). The number of examples classified on a particular decision path guides us in the discovery of patterns in the decision-making process (Tessmer et al. 1993). The length and the width of the decision trees capture the complexity of the underlying

decision process. A randomly drawn sample of 70% of the portfolio data was used for training and the prediction accuracy of the induced model was tested on a disjoint randomly drawn sample of 30% of the total size. Every random sample was selected such that all the classes of the decision were represented; ensuring purity of induced trees. Trees were randomized ten times at this stage to study structural stability and to compare the prediction accuracy of the induced models. To further improve the validity of the findings, the same analysis was conducted using an 80% training sample and a 20% testing sub sample. All the decision trees were generated by using the C4.5 inductive learning algorithm (Quinlan 1986, 1990). A decision tree with high structural stability and prediction accuracy was selected as the best approximation of the underlying, unknown decision making process. Steps taken to choose the best representative are presented in Appendix 1.

4 Results

4.1 Key Findings (Year One)

Figure 2 presents the best representative model for the first year's planning session. These attributes were selected (in the order in which they appear) by the C4.5 classification algorithm (Quinlan 1990) based on the amount of information they provided regarding the output classes (i.e. the various decisions). The interpretation of this decision model reveals the following findings. In total, sixteen rules were sufficient to compactly represent the underlying decision-making process for the fifty seven choices made by planners during this planning session. The average strength of the rules was 3.56 choices per rule. The average length of the decision rules was 3.875 implying that on average more than 3 decision-making criteria were considered before making choices. The *Analyzer* emphasizes both efficiency improvements and exploring emerging opportunities. Balancing these two conflicting organizational goals is often challenging. The best representative decision model reveals a balanced decision-making paradigm given that of the 14 decisions attributes in the model half pertained to characterizing benefits and the other half pertained to mitigating risks. This Analyzer's decision space was also relatively complex; proposed initiatives were not only rejected or approved; but some promising initiatives are also partially supported with partial funding. As should be evident based on the length and width of the decision tree, we believe this decision model faithfully captures the underlying complexity of the decision-making process. Initiative size was *the most discriminating attribute* and different decision-making criteria were used to decide upon initiatives within the three size categories. The *main path in this decision tree*, the decision rule with the highest strength, was one that partially approved and funded eight medium sized initiatives proposed to deliver strategic benefits. Given that this decision rule did not include any risk mitigation mechanisms to manage risks associated with these substantial medium-sized investments; this decision rule was judged as being inappropriate with regards to risk-taking criterion. Of the total 16 induced decision rules, 7 decision rules (43%) were judged as being appropriate based on the risk-taking criteria. In total, 10 initiatives were decided upon using these appropriate decision rules (22%). Of the 28 proposed initiatives approved in this planning session 8 were approved using appropriate decision rules.

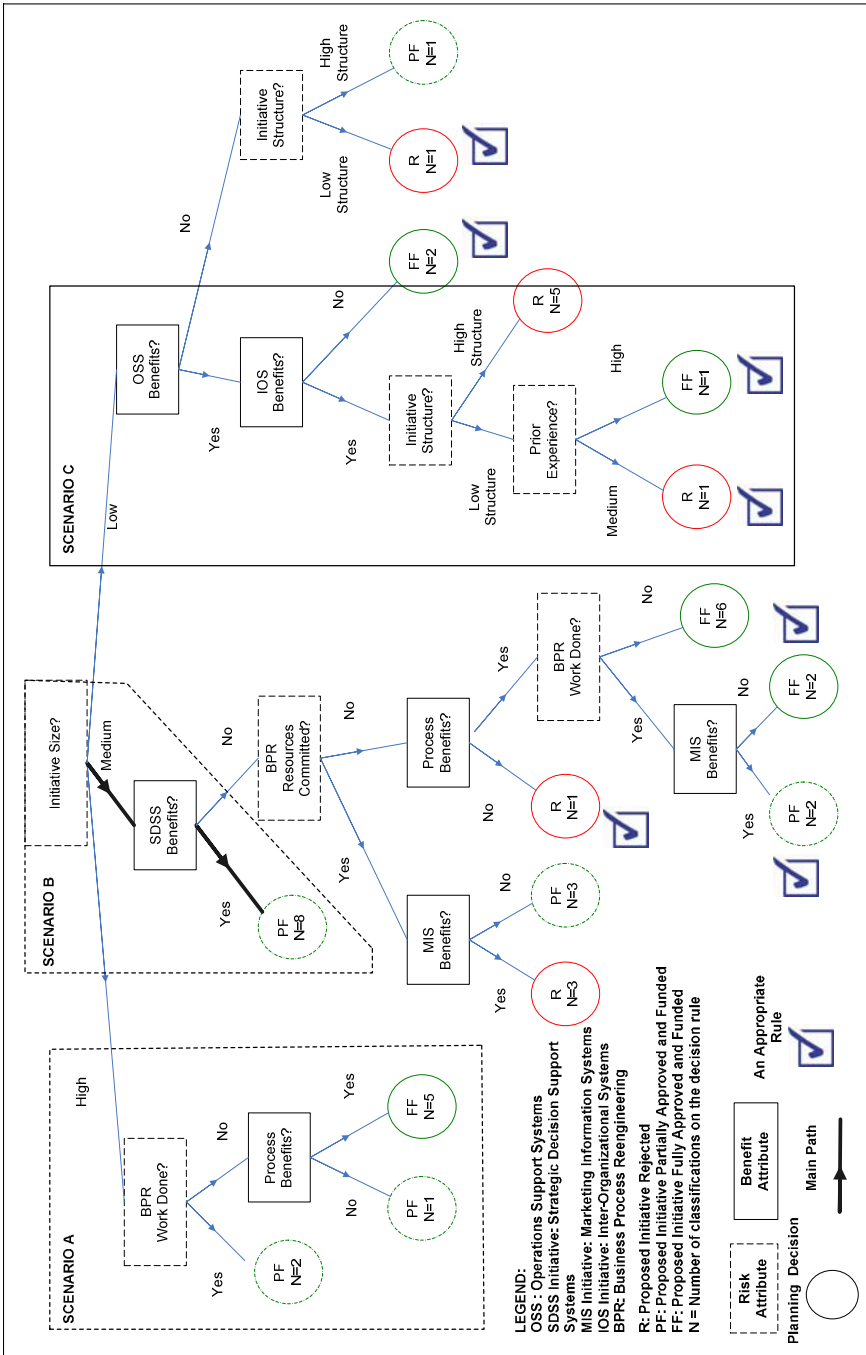


Fig. 2. Decision Model (Year One)

4.2 Key Findings (Year Two)

The second year’s best representative model was chosen using a similar methodological approach as presented in the appendix. The most discriminating classification attribute for the selected decision model presented in Figure 3 is “SDSS Initiative” where as now “Initiative Size” emerged as a level two decision-making criteria. Again, these attributes were selected (in the order in which they appear) by the C4.5 classification algorithm (Quinlan 1990) based of the amount of information they provided regarding the output classes (i.e. the various decisions). Though the size of the decision problem has increased, a more compact decision model emerged as a satisfying representative of the underlying unknown decision-making process. As seen by the size of the decision model, this model is compact when compared to the previous year’s decision model. The average strength of the decision rules is 8.83. The average length of the decision rules in year two is 3.75. The comparison of these two models along the dimension of appropriateness with regards to risk-taking reveals some interesting insights. The second year’s decision model has fewer appropriate decision rules: only 3 of the 12 decision rules (25%) are appropriate based on the risk-taking criterion. Given that the average strength of the rule has increased, a larger proportion of choices are made using these fewer decision rules. In the first year, 10 of the total 44 initiatives (22%) were decided upon using appropriate rules where in the second year 9 of the total 31 initiatives (29%) were decided upon using appropriate rules.

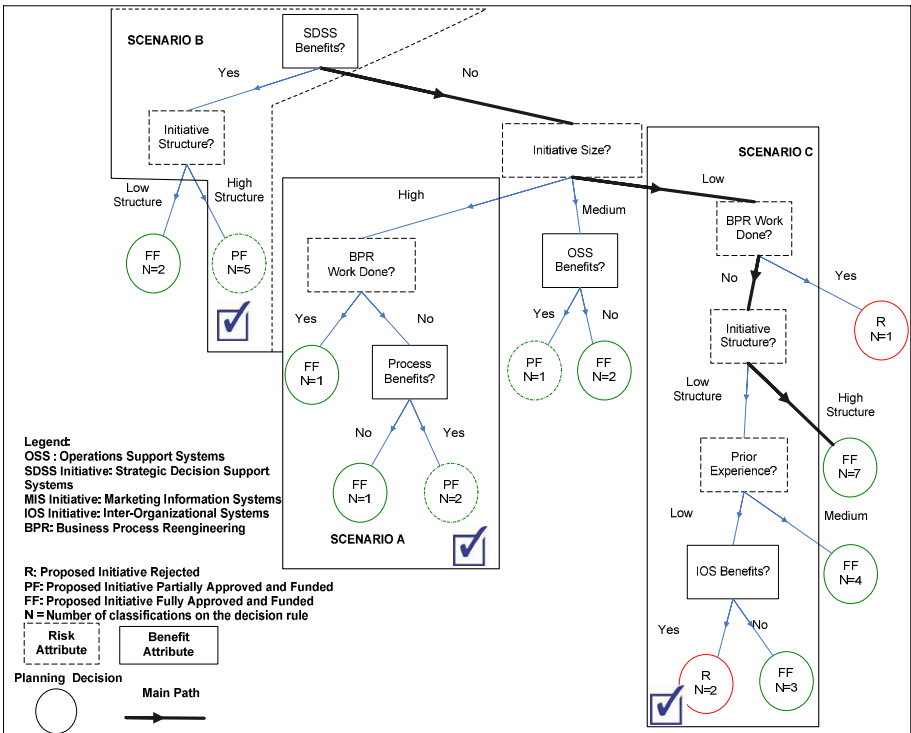


Fig. 3. Decision Model (Year Two)

4.3 Comparative Findings

A comparative analysis of the two consecutive decision models presented above reveals the following interesting insights. Organizational learning and systematic improvements in the maturity of the planning process are shown by scenarios where decision rules that were inappropriate in the past were refined to design appropriate rules. We elaborate on three instances demonstrating organizational learning. In two instances (Scenario A and B: Table 2), rules which were inappropriate in the past are redefined to design appropriate rules. Scenario C summarizes a refinement to an appropriate rule which was retained in the appropriate form for the future.

Scenario A: In the first year, 5 high risk initiatives (investments greater than one million dollars) were fully funded even when the decision rule did not show evidence of the presence of any risk mitigation mechanism. The rule suggests that such initiatives were designed to provide process improvements, but the business process rework for such proposed initiatives was not completed during planning. In the second year we find rules with similar structural properties with one key change. 2 similar high risk initiatives were only partially approved and funded. By awarding only partial approval to these initiatives, these initiatives commenced with a narrower scope and additional funding was provided only after the recommended business process rework was completed. 5 initiatives were decided upon using an inappropriate rule in the past; in the second year, evidence of organizational learning suggests that 2 initiatives are being appropriately decided upon. This rule dealt with multi-million dollar initiatives; thus the substantive significance of this improvement is arguably very high.

Table 2. Refining Inappropriate Rules

	Inappropriate Rule (Year One)	Refined Appropriate Rule (Year Two)
Scenario A	(High Initiative Size) & (BPR Work Not Done) & (Process Benefits) →Fully Approve and Fund Strength of the Pattern: 5	(High Initiative Size) & (BPR Work Not Done) & (Process Benefits) →Partially Approve and Fund Strength of the Pattern: 2
Scenario B	(Medium Initiative Size) & (SDSS Benefits) →Partially Approve & Fund Strength of the Pattern: 8	(SDSS Benefits) & (High Structure) →Partially Approve & Fund Strength of the Pattern: 5

Scenario B: In the first year, 8 medium sized investments (investments greater than one hundred thousand dollars but less than one million dollars) proposed to deliver strategic benefits were partially approved and funded. There was no evidence to suggest that this rule included any risk mitigation mechanisms. In the second year, similar initiatives were partially approved only after ascertaining that such initiatives were developed with a high structure (higher structure of the proposed initiatives reduces the risks associated with

scope creep (McFarlan 1981)). 8 initiatives were decided upon in year one using an inappropriate rule and now 5 similar initiatives were decided upon using an appropriate decision rule. This rule dealt with relative relatively large strategic initiatives; thus the substantive significance of this improvement is arguably very high.

Scenario C: This scenario summarizes a pattern where an appropriate decision rule was retained in the future decision rule set with some refinements. The length of the decision rule is being modified and some of the questions associated with the decision-making (in this context an appropriate rejection rule) are being refined. Consistency in the decision-making is desirable especially for appropriate decision rules.

5 Concluding Comments

We define the appropriateness of decision rules (with regards to the risk-taking criterion); an important characteristic of rules used during IT portfolio planning. We propose that rule appropriateness will be a key explanatory factor guiding the evolution of rules over time. We use an inductive learning methodology to uncover tacit decision rules used during actual IT portfolio planning over two years within one organization. We present comparative findings which demonstrate systematic improvements in planning rules used over time. In 2 of these 3 scenarios presented, we find that rules that were inappropriate in the first year are being refined to develop appropriate rules for the second year's planning session. We provide empirical evidence to demonstrate organizational learning and highlight the role of rule appropriateness in explaining the evolution of rules used in planning over time. Such continual improvements to the planning capabilities are crucial when planning for IT portfolios. Given that the data used in this study were obtained from one organization, we realize that our findings could suffer from limited generalizeability. In this one instance, we demonstrate the role of rule appropriateness in guiding the evolution of decision rules over time. Though the exact operationalization of rule appropriateness in different organizations is likely to differ, we expect rule appropriateness to be a critical guiding force which can guide executives to improve their planning decision over time. Alignment of IT investments has been studied in organizations in the manufacturing industry, and given that we choose an organization in this industry, that can help us improve the generalizeability of our work. Also this organization we examine was classified as an Analyzer; our findings can generalize to other organizations that can be classified as Analyzers. Moving forward comprehensive models explaining the evolution of decision rules over time will be developed based on a comprehensive set of rule characteristics (namely rule length, strength, performance and the causal ambiguity in the application of the rules).

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Appendix 1: Selecting the Best Representative Decision Model

As can be seen in Table 3, though decision models that had “BPR Work Done” as the top classification attributes were induced most number of times, the error rates for these decision models were consistently high. Decision trees with “Initiative Size” as the top classification attribute, on the other hand, were relatively stable and their error rates were also consistently low. Tree 11 (marked in bold in Table 3) was chosen as the best representative model given its high stability, lowest error rates. A similar methodological approach was used to select the best representative model for year two.

Table 3. Improving Reliability of Decision Models with Sensitivity Analysis

#	L	W	Level Two Attributes	Top Classification Attribute:	Error Rate in Prediction
PANEL 1: (Training set = 70% of original portfolio Testing set = 30% of original portfolio)					
1	5	15	MIS Initiative, BPR Resources Committed	IOS Initiative	87.5
2	7	16	Initiative size, OSS Initiative	BPR Work Done	50
3	8	21	Initiative size, OSS Initiative	BPR Work Done	43.75
4	9	23	BPR Work Done	OSS Initiative	50
5	7	18	Initiative size, SDSS Initiative	BPR Work Done	43.75
6	6	18	MIS Initiative, BPR Resources Committed	SDSS Initiative	31.25
7	7	18	BPR Resources Committed	BPR Work Done	37.5
8	6	17	BPR Work Done, SDSS Initiative, BPR Resources Committed	Initiative Size	30
9	7	20	BPR Work Done, SDSS Initiative, BPR Resources Committed	Initiative Size	27.5
10	6	17	Initiative Size, BPR Resources Committed	BPR Work Done	50
PANEL 2: (Training set = 80% of original portfolio Testing set = 20% of original portfolio)					
11	6	16	BPR Work Done, SDSS Initiative, OSS Initiative	Initiative size	18.18
12	6	17	Initiative size, BPR Resources Committed	BPR Work Done	45.45
13	6	17	MIS Initiative, BPR Resources Committed	SDSS Initiative	54.55
14	8	21	Initiative size	BPR Work Done	63.64
15	8	21	Initiative size, BPR Resources Committed	BPR Work Done	54.55
16	8	20	MIS Initiative, OSS Initiative	BPR Work Done	63.64
17	8	20	MIS Initiative, BPR Resources Committed	BPR Work Done	54.55
18	8	16	BPR Resources Committed	BPR Work Done	45.45
19	7	18	Initiative Size	BPR Work Done	45.45
20	8	21	SDSS Initiative, BPR Resources Committed	MIS Initiative	63.64

L = Length of the induced tree, W = Width of the induced tree

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