Maria Manuela Cruz-Cunha
Philip Powell
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Communications in Computer and Information Science 219

ENTERprise Information Systems

International Conference, CENTERIS 2011
Vilamoura, Portugal, October 2011
Proceedings, Part I

Part 1

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Preface

CENTERIS – Conference on Enterprise Information Systems—is an international conference addressing the largely multidisciplinary field embraced by the enterprise information systems (EIS), from the social, organizational and technological perspectives.

The CENTERIS 2011 edition, focused on *aligning technology, organizations and people*, and was held in Vilamoura, Algarve, Portugal. This was the place where during October 5–7, 2011, under the *leitmotiv* of enterprise information systems, academics, scientists, information technologies/information systems professionals, managers and solution providers from all over the world had the opportunity to share experiences, present new ideas, debate issues, and introduce the latest developments, from the social, organizational and technological perspectives.

More than 180 manuscripts were submitted to CENTERIS, coming from all over the world. There were about 120 papers selected for presentation and inclusion in the conference proceedings. The selected papers represent more than 350 authors from academia, research institutions and industry, representing around 30 countries.

These proceedings are intended for use by academics and practitioners that want to be aware of what is currently in the EIS agenda, from research to everyday business practice. We believe that the high quality and interest of the contributions presented at the CENTERIS 2011 edition makes this an important book in the EIS field.

Please enjoy your reading!

October 2011

Manuela Cunha
João Varajão
Philip Powell
Ricardo Martinho

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From Portuguese to Virtual Globalization: 500 Years of ICT-Driven Civilizational Development and a Triumph of Humanity? The Comparative and Modeling Approach

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Abstract. This study defines the nature, scope, pace, and consequences of the development of globalization waves over the last 500 years. Such waves as led by Pax Portugannica, Pax Britannica, Pax Americana and Pax Sovietica, Pax Consortia, and Pax Virtualiziana are defined. They are graphically modeled and compared within four dimensions: guiding, executable, technological, and societal In conclusion, Portuguese and British Globalizations expanded the world physically and mentally as the Triumph of Humanity, the subsequent globalizations have been testing humanity over the last 100 years and continue to test it, since despite strong technological and economic development, the morality and ethics of humans are in question today. However, there is some hope that revitalized dialectics between Pax Consortia and Pax Virtualiziana may lead us to the Triumph of Humanity again.

Keywords: globalization definition, globalization dimensions, globalization waves, Pax Portugannica Wave, Pax Britannica Wave, Pax Americana Wave, Pax Sovietica Wave, Pax Consortia Wave, Pax Virtualiziana Wave, globalization models, triumph of humanism.

1 Introduction

The purpose of this investigation is to define patterns of globalization over the last 500 years, from the First Wave, led by Pax Portugannica, to the Fifth Wave, led by Pax Virtualiziana. The paper first defines a generic model for assessing major criteria of globalization. Following this model, specific models for each kind of five globalizations are established and characterized. In conclusion the judgment is presented on which globalization was/is a triumph of humanity? Eventually some hope is associated with the current level of virtual globalization?

By globalization one can understand the following conceptually related dimensions:

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1. *Guiding Dimension*: The development of intensified dynamics of social, economic, and political activities for the sake of the global-minded elite in a given time.
2. *Executable Dimension*: The development of market and political networks in different continents controlled by the will of world hegemony in a given time.
3. *Technological Dimension*: The development of information-communication technologies (ICT) and global-wide transportation infrastructures which secure effective relations between globally dispersed markets and political hegemony and its clients.
4. *Social Dimension*: The development of a growing consciousness in society about the interdependencies between "local" and "global" and their impact upon people [19].

These dimensions will be modeled graphically under the form of each wave's architecture. Some assumptions on what lies ahead for the world will be offered.

2 The First 5500 Years of Civilization Were Land-Locked

In ancient times (4000 BC-750 BC) civilizations were developing close to rivers and sea shores; they used some sorts of boats but were limited mostly to inland travels. The Greek (750 BC-146 BC), Roman (44 BC-476 AD), Mongol (1206–1368 AD), and Ottoman (1299-1923 AD) Empires developed on the interconnected lands of Europe and Asia and in some parts of Northern Africa. They used boats but did not have ships to travel across oceans [1,5,6,11].

3 Chinese Exploration versus European Navigation and Land Expeditions: Isolation versus Openness, Amber Path, and Silk Road

Before we investigate European-driven globalization movements, one must mention that China had a better-developed navy in 14-15 centuries than the Europeans. The naval history of China dates back thousands of years, with archives existing since the late Spring and Autumn Period (722 BC – 481 BC) about the ancient navy of China and the various ship types used in war. China became a leading maritime power around the year 1000, when Chinese shipbuilders began to build massive ocean-going junks [23]. However, it closed its doors to the outside world in 1434, and with this isolation from trade in commerce and ideas, began a centuries-long period of stagnation. Before, China was clearly the world's technological superpower, and had been so for at least a millennium. Europe conquered Asia after 1500 with the compass, gunpowder, and the printing press, all Chinese innovations. There was nothing fated about such a turnaround. China's dominance, it appears, was squandered, and 1434 is increasingly understood to be a pivotal year.

In Europe, until the 15th century mariners were essentially coastal navigators, mostly around the Mediterranean Sea. Sailing on the open sea was limited to regions of predictable winds and currents, or where there was a wide continental shelf to follow.

Further ventures were enabled by the development of scientifically and mathematically based methods and tools. Among the early navigational methods and tools known in Europe one can mention the following:

- Determining **latitude** could be accomplished relatively easily using celestial navigation. In the Northern Hemisphere, mariners could determine the latitude by measuring the **altitude** of the North Star above the horizon. The angle in degrees was the latitude of the ship.
- The **mariner's compass** was an early form of the magnetic compass. Early mariners thought the mariner's compass was often inaccurate and inconsistent because they did not understand the concept of magnetic variation, which is the angle between true north (geographic) and magnetic north. It was primarily used when the sun was not visible to help identify the direction from which the wind was blowing.
- During the mid-13th century, mariners began realizing that maps could be helpful and began keeping detailed records of their voyages. Thus, the first **nautical charts** were created. These first charts were not very accurate, but were considered valuable and often kept secret from other mariners. There was no latitude or **longitude** labeled on the charts, but between major ports there was a **compass rose** indicating the direction to travel. (The term "compass rose" comes from the figure's compass points, which resemble rose petals.)
- The **astrolabe, sextant**, and **chip log** were the earliest instruments used to assist sailors in determining latitude. The astrolabe dates back to ancient Greece, when it was used by astronomers to help tell time, and was first used by mariners in the late 15th century. It was used to measure the altitude of the sun and stars to determine latitude.

The Mediterranean was literally a fluid border between Christendom and Islam in the 9th century, during the era of Muslim expansion. Along the eastern and western coasts, Muslim pirates raided ships, villages, and monasteries. Europeans finally abandoned their ports along the western Mediterranean, heading to safer ground inland. One way led through the Amber Path to the Baltic Sea in the North, another one was the Silk Road which led to Asia.

4 First Wave of Globalization – Led by Pax Portugannica and Navigation Information Technology (15th and 16th Centuries)

At the end of the Middle Ages, Portugal, a small portion of Europe in the farthest southwest, undertook a course of action that brought her to astonishing heights. Portugal’s victory over Castile filled John I with expansionist notions. In 1415, he invaded Africa and took Ceuta, just across the Strait of Gibraltar. Fighting at Ceuta was his third son, Prince Henry (1394-1460), and Africa became that son’s passion forever.

Europe had developed a great demand for products from the Far East, fed by the Crusaders’ experience and Marco Polo’s tales of eastern magnificence. Europeans wanted sugar, pepper, and other spices, as well as silk and other luxuries. Now that the Mongol Empire (1206–1368 AD) had disintegrated, trade with the Far East was not easy, especially since the Ottoman Empire (1299-1923 AD) stood squarely across the route. At every step of the way there were tariff charges, and the price of Eastern luxuries went sky-high. And Portugal was at the end of the line, very close to the almost-unknown Atlantic Ocean.

It occurred to Henry that if ships could find their way around Africa to the Far East, they would bypass the Ottoman Empire, and those luxuries would become far cheaper and more available. In 1420, therefore, Henry founded the School of Navigation at Sagres, at the extreme southwestern tip of Portugal. This became the knowledge center for novice and experienced navigators. It was a place where ships (caravels) were built according to new designs that would make them fit for the open ocean; where new aids to navigation (information technology) were devised and tested; where crews were hired and trained; and where expeditions down the African coast were carefully planned.

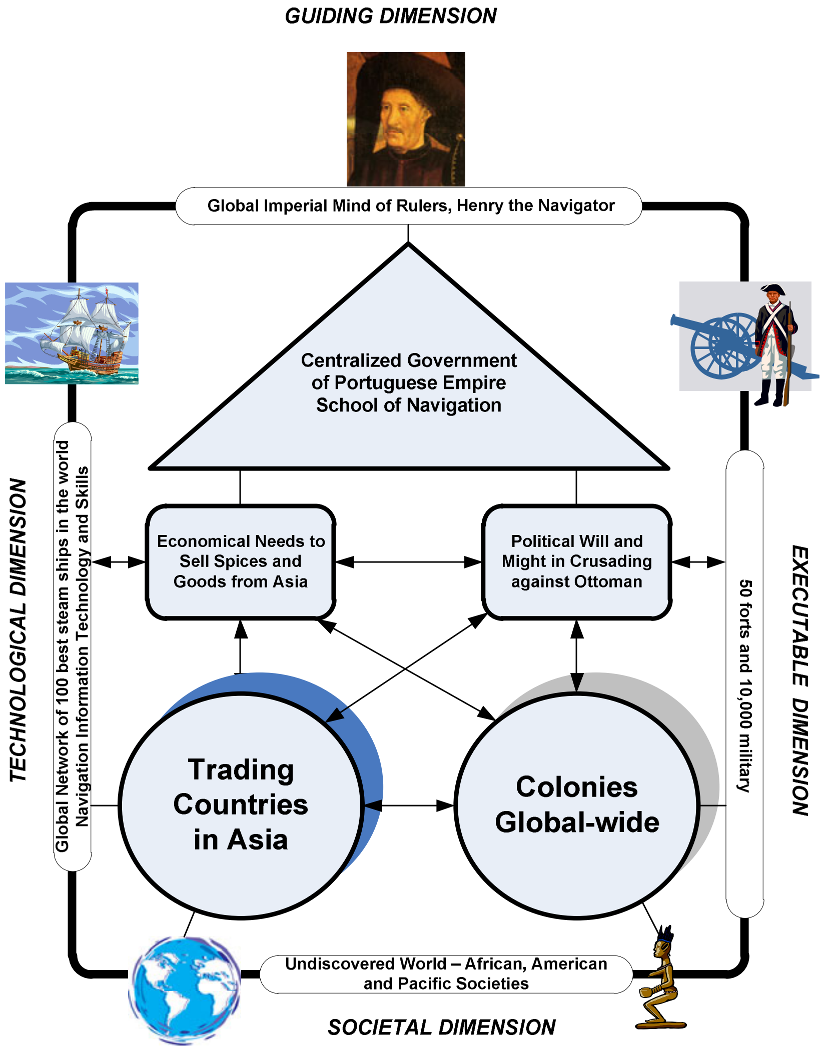

Fig. 1. A Model of *Pax Portugannica*-led Globalization in the 15th and 16th Centuries

Despite the Ottoman (Turkish) Empire's strength and victories, the real cutting edge of European expansion lay in Portugal. They kept going eastward, and in 1472 the navigator Fernando Po discovered the island that bears his name. The island was about 2000 kilometers east of Portugal, well on the way to the Indies. On May 22, 1498, Vasco de Gama (1460-1524) reached Calcutta. He returned to Portugal a year later with a huge load of spices. After trying for 80 years, Portugal had bypassed the Turks and spread their influence worldwide.

In the 15th and 16th centuries, as the result of maritime exploration, Portugal established a global empire that included possessions in Africa (Angola, Mozambique), Asia (Goa in the Indian peninsula), and South America (Brazil) and became the world's major economic, political, and military power. Portugal's Empire was the first and most long-lived (474 years) Global Empire in the world, since it ruled until 1974, when the Carnation Revolution ended the imperial system, based on Christian fascism. Thus, by 1500 Portugal had reached India, and Spain had reached the American continents. Europe, without knowing it, had embarked on its conquest of the world. For this reason Columbus's voyage in 1492 should be considered the beginning of modern times, rather than the fall of Constantinople (Istanbul) in 1453.

The First Wave of Globalization was triggered by Portugal. Despite its small size and population, it became the first true world power and trader—the first nation anywhere, anytime to have a true overseas empire. The factors determining *Pax Portugannica* are presented in a model in Figure 1.

5 Second Wave of Globalization (1837-1914) – Led by *Pax Britannica* and Steamship and Communication Technology

The British-led Second Wave of Globalization took place from 1837 to 1914 due to:

- The British (and later German and American) Industrial Revolutions, which produced goods needed for larger, global (colonial) markets.
- The political will of the colonial British, German, French, Portuguese, Spanish, Russian, Dutch, Belgian, and Ottoman Empires [17] and the economically rising new nation, the United States, to support intercontinental trade by their military might.
- Advances in transportation engineering of steamships and railways, which kept the exchange of goods and people through expanding global lines and increased the size of markets as well as the amount of economic activity.
    - In 1838 four British steamers crossed the Atlantic. Their use rose after the opening of the Suez Canal in 1869 and the Panama Canal in 1914. Sailing ships were in wide use until the 1890s; later, steamships took over global-distance travels.
    - In 1840, there were 8,854 kilometers of railways throughout the world, and in 1900 the figure was 750,000, including the American transcontinental railways (1864) and the Trans-Siberian Railway (1891) [9].
- Advances in global-oriented communication technology—the transatlantic telegraph (1866), international telephone service between London and the

Mediterranean (1870), and the nationalization and concentration of postal service (1840)—which made the exchange of information much faster than in previous times.

- Reduced trade barriers (after 1860).

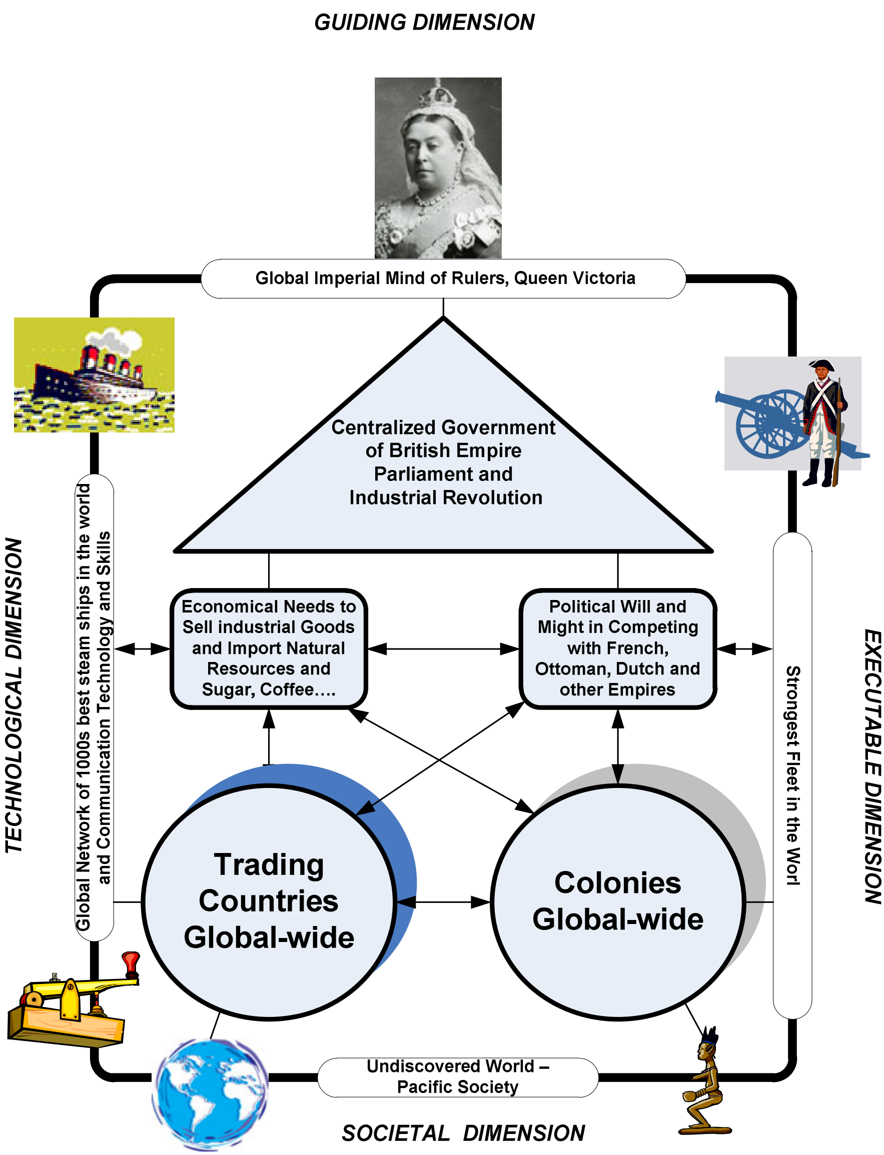

Fig. 2. A Model of *Pax Britannica*-led Globalization in the 19th and 20th Centuries

- Migration of ten percent of the global population (954 million in 1800) to less densely populated countries: from Europe to North America after the end of the Civil War in 1865; from India to Sri Lanka and Africa; from China to Burma, Thailand, the Philippines, Vietnam, and Singapore; and so forth.

The relationships between these factors are shown in a model in Figure 2.

6 Third, Double, Wave of Globalization (1947-1989) – Led by *Pax Americana* and *Pax Sovietica*

By the early 20^{th} century, countries around the globe were closely linked by recent advances such as the telegraph, telephone, radio, post services, and diesel-powered ships. With the introduction of aircraft and armored vehicles, the world became an even smaller place where hostile nations could swiftly project power far beyond their borders and wreak havoc. The two world wars (1914-18 and 1939-45) ended *Pax Britannica*-oriented wave of globalization.

The key **global processes** of the Third, Double, Wave of Globalization are as follows (Figure 3):

1. The political will to confront and contain communism and capitalism by the Western and Eastern (Soviet) Blocs elaborated processes of containment and détente, which were supported by the balance of military power, since nuclear war would destroy the planet. The wise politicians in both Blocs never transferred the Cold War into a Hot War.

2. Economic policy to support the political policies led to the economic integration of each Bloc, which had markets on every continent.

   a. The Western Bloc was developing production and consumption to improve the well-being of its people (also as a showcase for the Soviet Bloc), as well as the industrial-militaristic complex.

   b. The Eastern Bloc was industrializing mostly to support the military infrastructure in pursuing the development of communistic ideas in Africa, Asia, Latin America, and Europe.

3. The Scientific-Technical Revolution was triggered by the Cold War and led to the following accomplishments:

   a. The Western Bloc: the transistor was invented (Bell Lab 1947), leading to the development of telecommunication satellites (Telstar 1962) and powerful mainframe computers (Univac I, 1951), which were very useful in enhancing all industrial (military) products and processes and in enabling processes of globalization.

   b. The Eastern Bloc: Sputnik was launched in 1957 but its technology was limited to military products and processes. This Bloc was one to two generations behind the Western Bloc and it was even further delayed by the embargo on most advanced western products [20].

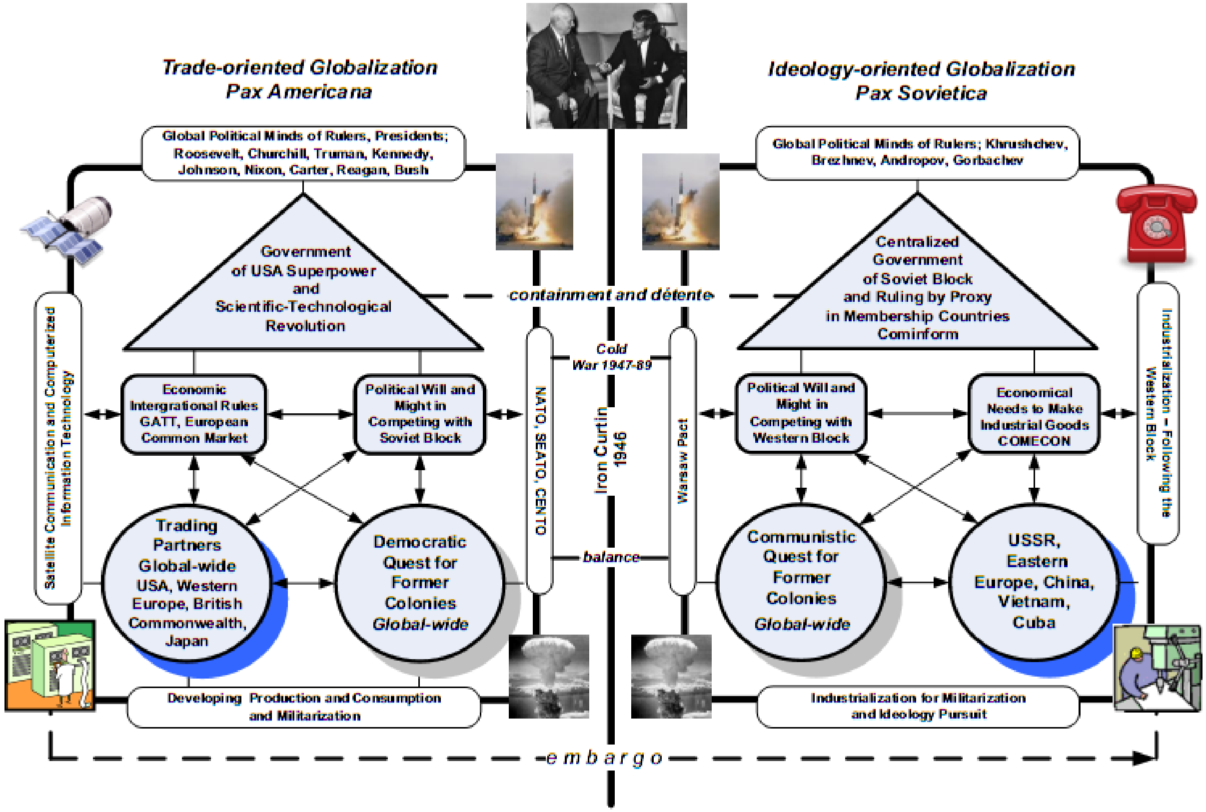

Fig. 3. A Model of the Third Wave of *Pax Americana* & *Pax Sovietica*-led Double Globalization in the 20th century (The Targowski Model)

7 Fourth Wave of Globalization (21st Century) – Led by *Pax Consortia*

The current Fourth Wave of Globalization takes place on the threshold of the third millennium and is the most extensive. The world is shrinking fast and coming

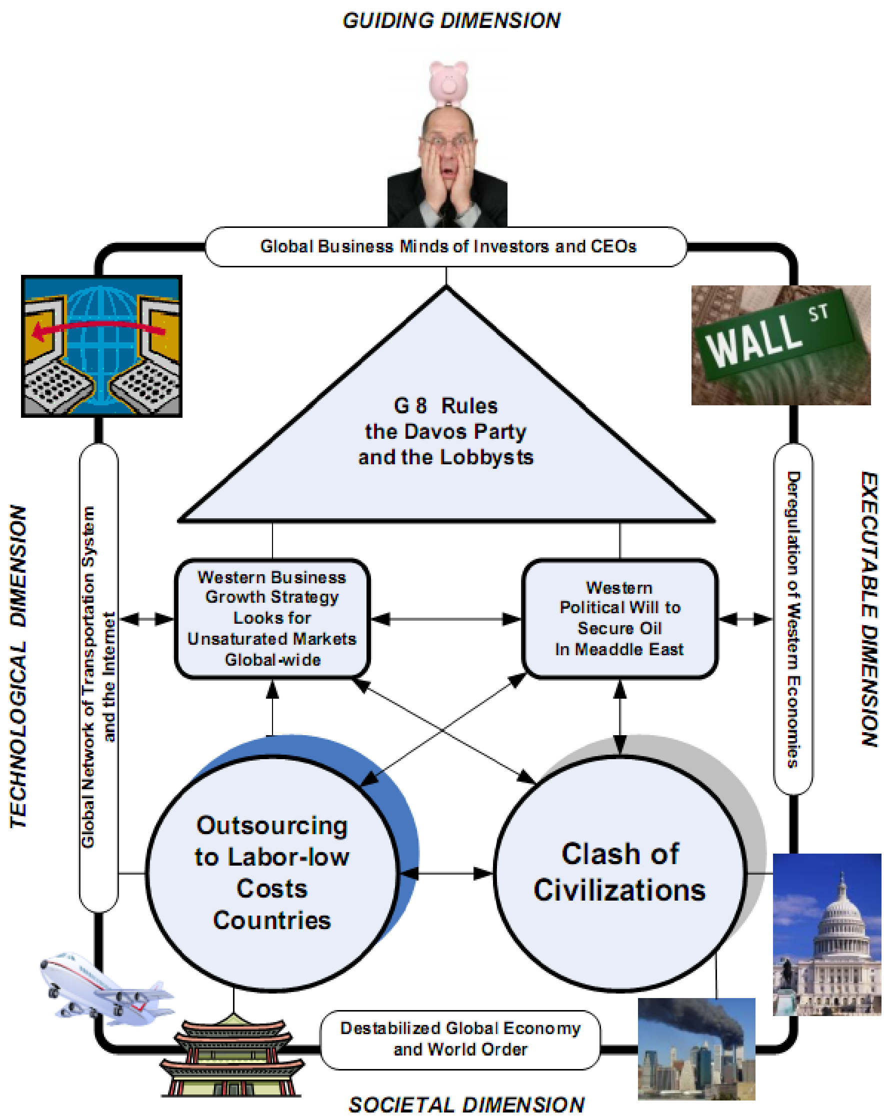

Fig. 4. A Model of the Fourth Wave of *Pax Consortia*-led Globalization in the 21st century

together as a Global Civilization, which shapes our lives and changes politics, work, and families. A model of this wave is depicted in Figure 4. It is characterized by the following:

1. The Internet provides an excellent infrastructure for the development and operation of e-commerce and outsourcing of production and services world-wide, which in effect increases the flow of goods and people through the global transportation infrastructures [7,13-16].
2. Economic policy is dominating world dynamics in the 2000s. The success of global business matters more than military force and nations' well-being. The world is economy-centered and behaves according to the recommendations of the G8 and the Party of Davos.
3. The western political will is centered on securing the supplies of oil (mostly in Middle East) as the prime source of energy for the growing global economy. This leads to clashes between Western and Islamic Civilizations.
    a. To secure the development of a stateless consortia-led global economy, western governments deregulated national economies, which led to the world-wide financial crisis in 2008-10 and no job growth in the national markets of the respective developed countries.
    b. On the other hand, in developing nations, growth of jobs is about seven to ten percent per year, which led to the statement that the "world is flattening" [7].

8 Fifth Wave of Globalization (21st Century) – Led by *Pax Virtualiziana*

Figure 5 defines the Fifth Waves of Globalization.

The development of a Global Economy in the 2010s is well established. An integrated information infrastructure [8] has led to a boom in the development of social networks. It has become a huge area to follow, and nowadays there is one estimate that about 500 larger social networking sites offer services for about 1.242 billion users.

Table 1 illustrates the richness of this kind of info-communication-driven socialization, which can be called the Global Virtual Society (GVS) [3,10].

The coming operational practice of the GVN certainly will elaborate procedures of political processes and systems [18]. It will be fascinating since it will also be the birth of a new civilization, which can be called Virtual Civilization. It will be the next layer upon the existing civilizations. For example, in the 2010s, Western Civilization is being transformed into Global Civilization and also into Virtual Civilization. An American or Portuguese citizen functions in these three civilizations concurrently! It is a big challenge to be successful in such environment.

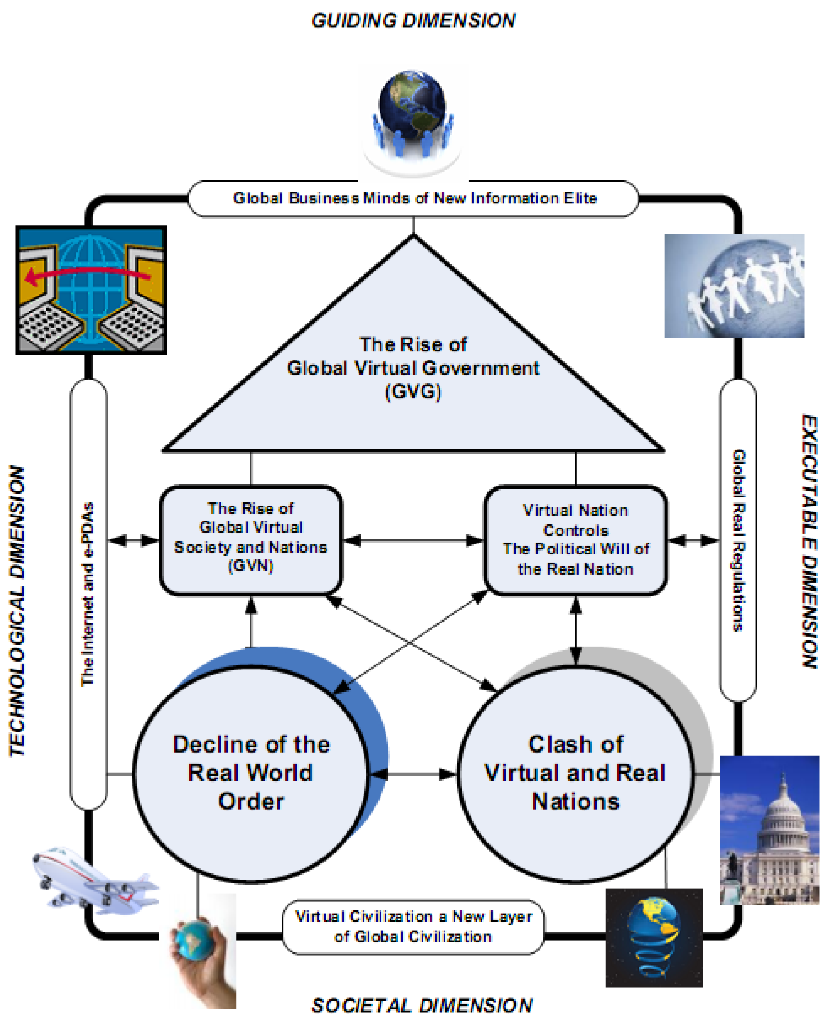

Fig. 5. A Model of the FifthWave of *Pax Vistualiziana*-led Globalization in the 21st century

Table 1. The Ranking of the Largest Nations by Their Citizenships/Memberships in 2010

RANKING	NATION	POPULATION	GLOBAL VIRTUAL SOCIETY
1	China	1.350 B	
2	India	1.210 B	
3	**Facebook**	**500 M**	**500 M**
4	United States	310 M	
5	**MySpace**	**300 M**	**300 M**
6	Indonesia	231 M	
7	Brazil	195 M	
8	Pakistan	158 M	
9	Russia	144 M	
10	Bangladesh	142 M	
11	Nigeria	132 M	
12	Japan	128 M	
13	**Twitter**	124 M	**124 M**
14	Mexico	107 M	
15	Vietnam	84 M	
15	**Other Social Networks**	**Estimation**	**300 M**
	TOTAL		**1.242 B**

9 Conclusion

In conclusion one can state that:

1. Portuguese and British Globalizations expanded the world physically and intellectually as the Triumph of Humanity. The following globalizations have been testing humanity in the last 100 years and continue to test it, since despite strong technological and economic development, the morality and ethics of humanity is in question today. However, there is some hope that revitalized dialectics between *Pax Consortia* and *Pax Virtualiziana* may lead us to the Triumph of Humanity again [21, 22].
2. In order to secure the positive impact of the Virtual Globalization upon humanity, the society should bring about certain sets of social policies, which will secure that this wave of globalization will serve humans properly in times to come.

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On the Studies of the Disaster Recovery and the Business Continuity Planning for Private Sector Caused by Great East Japan Earthquake

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Abstract. Japan has been heavily damaged by Great East Japan Earthquake on this March. In this paper, we will report the damage on this earthquake. Particularly, this disaster is characterized by the enormous damage caused by a tsunami, and the extensive damage suffered by the fisheries and related industries due to their location close to the sea. This paper addresses the subject of how the fishing industry should be restored and rebuilt. We will discuss how to do the Business Continuity in Japan attacted by this disaster.

Keywords: Great East Japan Earthquake, Private Sector, Disaster Recovery, Business Continuity, Tsunami, Fisheries Cooperative Associations, Fishery Rights, Special Zone for Reconstruction.

1 Introduction

Japan has been heavily damaged by Great East Japan Earthquake on March, 2011.

We have never experienced such a big one and Northeast Japan was hit by a tsunami that's following an earthquake, thought have measured 8.9 on the Richter scale. Houses, buildings, cars and even ships were swept away. Communication links were paralyzed making it difficult to confirm levels of damages or injuries. The Japanese government and Tokyo Electric Power Company (TEPCO) together are making every effort to cool down the nuclear reactors and eliminate radioactive contamination to regain complete control. It will take some time, but we Japanese believe they will succeed in solving the problem with the help of the specialists and special equipment dispatched from the United States and France.

As a Japanese, we regret that the broken nuclear power plant have bothered and worried people all over the world. We hope that we will be able to overcome the difficulties as soon as possible and that people across the world will be kept informed of what is happening here and what we have learned from this tragedy.

In this paper we will report the disaster outlines, the damages, the movements toward restoration, reconstruction and how to do the Business Continuity.

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2 Context

2.1 Disaster Outlines

According to the Government report, around 14:46 on March 11, a massive earthquake with a magnitude of 9.0 struck Sanriku Coast, Japan. The ensuing tsunami swept across many cities and villages along the Pacific coast of the Tohoku district, causing tremendous human and structural damage. In Miyako City, Iwate Prefecture, tsunami waves of over 8.5 meters high (maximum) were observed. Tokyo also observed tremors with a seismic intensity of 5-strong, but damage there was relatively modest. Aftershocks still persist, particularly in the Tohoku district. On April 7, an earthquake of magnitude 7.1 (preliminary estimate) occurred, with its epicenter off the coast of Miyagi Prefecture. On April 11, a 7.0-magnitude earthquake (preliminary estimate) struck, with its epicenter in the Hamadori area, Fukushima Prefecture.

Immediately after the earthquake, the Government of Japan set up its emergency headquarters with Prime Minister Kan at the helm, making all-out efforts for search and rescue, assisting evacuees, and reconstructing various lifelines, in liaison with all government bodies and local governments. Efforts have also been being made by the whole government to support the early recovery of people's lives and economic activity. On March 17, for example, the Cabinet Office set up the Headquarters for Special Measures to Assist the Lives of Disaster Victims. On April 11, the Cabinet decided to assemble the Reconstruction Design Council in Response to the Great East Japan Earthquake.

Sympathies have been expressed and assistance offered from around the world. So far, rescue teams and medical assistance teams from 21 countries and regions as well as the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA), an International Atomic Energy Agency (IAEA) team of experts, and the United Nations World Food Programme (WFP) have arrived Japan and have been in operation. Also, the U.S. Forces in Japan are extending assistance.

The earthquake and tsunami resulted in emergency situations including failure of the reactor-cooling systems in TEPCO(Tokyo Electric Power Company)'s nuclear power stations in Fukushima Prefecture. Responses have been taken with regards to these situations.

On April 1, the Government of Japan decided, in the form of a Cabinet approval, to use the name "Great East Japan Earthquake" to refer collectively to the disasters due to the Tohoku - Pacific Ocean Earthquake on March 11, 2011 and the resultant nuclear plant accidents.

2.2 Damages of the Economy and Industry

The earthquake and tsunami devastated the Tohoku and other regions. Damages were inflicted in Kanto region, too. The number of deaths was 14,704, the number of injured is 5,278, and the number of missing is 10,969 (as of May 1 according to the National Police Agency). The number of those evacuated is 168,901 (as of April 28 at 11:00 according to the Fire and Disaster Management Agency).

In the Tohoku and other regions, electricity, gas and water were disconnected in many areas. Roads, railways, airports, and other infrastructure were also severely damaged. Currently, the whole nation is working for the post-disaster rehabilitation, and lifelines and infrastructures are gradually recovering, including a partial resumption of operation, from April 13, of Sendai Airport, which had been closed due to the earthquake and tsunami damages.

Most Japanese companies close their books at the end of March. Individual companies described the effects of the disaster in their year-end financial reports. Regardless of the line of trade, the affected companies have all posted reduced profits.

Regarding the automotive industry, since many of the parts makers located in the Tohoku region were hit by the disaster, automakers were forced to suspend production in March and even though they resumed operation in mid-April, the number of vehicles produced remains at 50 to 70 percent of normal levels. They were also forced to cut back production overseas and Toyota expects to resume operation in September at the earliest, while Nissan expects to do so in October at the earliest.

Also, many electrical appliance makers have stopped operation at many plants in the Tohoku and Kanto regions and the big five appliance makers expect that their combined sales will drop by some /350 billion.

The Fukushima Daiichi NPS is having wide-ranging effect and planned blackouts were implemented at companies and households that use electricity supplied by the affected power company. In addition, the government is calling on companies and households to cut electricity consumption by 15-20% as summer is about to set in when demand for electricity usually jumps with the use of air conditioners. Companies and homes alike have started to take various measures to save power to the extent possible.

Japan's economy has been on the way back to recovery since the middle of 2009, following a plunge caused by "the Lehman Fall" of 2008. However, the disaster has caused direct damage totaling some /20 trillion and torn parts supply chains to pieces forcing many companies to suspend operations, which has resulted in a huge drop in the overall demand level. In addition, factors led by the breakdown of the NPS created a power shortage and lowered capability utilization rates of a number of plants. While preliminary GDP reports show a decline of 0.9% for the Jan-Mar period of 2011 from the previous quarter with effects of price fluctuations excluded, the annual GDP for April 2010 to March 2011 is expected to grow 0.9% in nominal terms (3.0% in real terms) and post a positive growth – albeit somewhat lower than initially forecasted (Norinchukin Research Institute Co., Ltd.).

2.3 Movements toward Restoration and Reconstruction

Even through many residents in the affected areas are still forced to live in schools and other evacuation centers, construction of temporary housing by the government has accelerated. This housing totaling 72,000 units is scheduled to be complete by August. The quantity of rubble from structures, houses, and other due caused by collapsing from the earthquake or swept away by the tsunami is said to be as large as what is generated in three years under normal circumstances, and its removal is a top priority.

It is a role of local financial institutions to support reconstruction initiatives from the monetary standpoint. The Financial Services Agency announced a special measure on the day of the disaster and sent an 11-point request to financial institutions, securities institutions, and life as well as casualty insurance companies to help disaster victims. The Agency called on them to allow disaster victims to withdraw money without their passbooks, to withdraw deposits prior to maturity dates, to provide consultation services concerning lost government bonds, etc., and to provide off-hours services, among other things. Under the circumstances, regional banks and credit unions, even though they have also suffered heavy damage, are trying to service their respective communities by setting up temporary offices or making other emergency arrangements. With restoration of head and branch offices advanced one month after the disaster, these institutions will start to respond to financial needs for restoration/reconstruction of their customers. The Bank of Japan announced April 6 "monetary operation to assist financial institutions of the disaster area" and established a credit line of /1 trillion in total in an effort to establish a support system.

In light of the enormous damage caused by the Great East Japan Earthquake, the government plans to make supplemental budgets early to implement measures for restoration /reconstruction. The first supplemental budget was approved and passed May 2 in the Diet. The total amount is /4 trillion (as opposed to /1 trillion allotted in the first supplemental budget for the Great Hanshin Earthquake) and included in this budget are expenditures for building temporary houses, supporting people's lives, repairing and developing rivers, roads, ports, and airports as well as removing rubble.

Regarding public support for restoration/reconstruction after the disaster, the state contribution for the immediate future is likely to be on the order of /10 trillion and additional supplemental budgets will be allocated as discussions at the Reconstruction Design Council advances. This view is based on the following elements; the government estimates the direct damage of the recent disaster at /16 to 25 trillion, and in the case of the Great Hanshin Earthquake, 30% of the reconstruction funds were born by the public sector, with the balance of 70% provided by the private sector.

The government's Reconstruction Design Council is currently holding wide-ranging discussions and its intermediate proposals are scheduled to be released in late June. The following items are reportedly under discussion.

- Discussion on a temporary tax hike
- Discussion on issuance of reconstruction bonds – financial resources for redemption to be specified at the same time
- Future energy strategy
- Measures to deal with tsunami – to build houses on higher ground
- Community building through utilization of natural energies
- Discussion on establishing a special reconstruction zone, etc.

The premier, with a view to discussing reconstruction designs through making reference to the reconstruction plans for the 1995 Great Hanshin-Awaji Earthquake appointed a member of the Reconstruction Design Council for the earlier quake as head of the recent disaster. The basic ideal of the reconstruction of the Great Hanshin-Awaji Earthquake was "to build a society where people and nature, people and people, and people and society live in harmony". These ideals are incorporated in the reconstruction plan for the recent Great East Japan Earthquake.

3 Extent of Damage to the Fishing Industry and Reconstruction Measures

3.1 Extent of Damage

Most of these villages have been hit by tsunami many times in the past, and there were cases where some villages were entirely wiped out. Therefore, preparatory measures were taken with coastal levees built and houses constructed on high ground, among other things. However, since the recent tsunami was of such an unprecedented scale, villages along the coast were devastated and most of the fish markets and related facilities including ice-making plants, processing plants, and distribution centers were swept away .Furthermore, most of the offshore stationary nets and oyster-farming facilities set in the bays were also lost or damaged and so were most of the coastal fishing vessels.

Losses directly related to the fishing industry are shown below. Losses of such related industries as distribution and shipbuilding are not available but estimated to be substantial.

Table 1. Losses of the fishing industry (as of 5/19) Fisheries Agency

Main facilities damaged	Number of facilities damaged	Damage amount (/ million)	Main damaged areas
Fishing vessels	18,909	1,221	Devastating damage in Iwate, Miyagi,and Fukushima Prefectures. Damage reported in other prefectures from Hokkaido in the north to Kagoshima in the South
Port facilities	319	4,119	
Farming facilities		464	
Farmed products		544	
Common facilities like Markets, Processing facilities		184	
Total		6,531	

Notes: The number of amount of damage-as reported by each prefecture

3.2 Measures to Restore/ Reconstruct the Fishing Industry

a. First Step toward Restoration

As June – the catch/harvest season of marine products such as bonito and wakame – is nearing and now that the country's supplemental budget has been developed, initial activities including the removal of huge quantities of rubble and dismantling fishing vessel pushed ashore or moving them back to the sea are now being carried out. In addition, ground-elevating work is being swiftly done at some fishing markets since the quake caused ground subsidence and the markets are flooded at high tide. Also, using survey vessels to find rubble in the sea, fishermen have started to remove the rubble with stationary fishing nets. Under the circumstances, restoration and reconstruction will be concurrently undertaken in each fishing community.

b. Challenges Associated with the Reconstruction Measures

Most of the fishermen are engaged in coastal fishing, they are independent operators of small scale. Most are getting old and all of them do not have successors. Therefore, from the viewpoint of medium-and long term reconstruction of their business, a question arises as to whether the conventional form of individual fishermen's operation should remain the center core of reconstruction.

Related to this problem, the government has presented a design to consolidate fishing markets and related facilities to create larger fishing centers and at the same time to establish special zones in order to reconstruct fishing industries and release fishing rights exclusively given to the fishermen's associations at the moment to processors and distributors of marine products as well to enlarge the scale of individual fishing businesses.

Fishermen's associations are strongly opposed to the idea of setting up special zones for reconstructing the fishing industry. Their reasons are: If this idea materializes, fishermen will become employees of companies and fishing rights made an item for trade, stable fishing cannot be conducted.

On the other hand, some fishermen's associations feel that each community should work as a unit toward restoration/reconstruction. Their idea includes such initiative as transferring the ownership of the remaining vessels in working condition (some 10% of the pre-quake total) to each association for joint operation by the members and equally sharing income from the catch among them; and acquiring new vessels in the name of the association to replace the ones lost in the tsunami. These associations are increasing in number and are likely to be a key in future reconstruction of the fishing industry.

Overall reconstruction designs and those for each prefecture will be advanced. However, since the importance and conditions of the fishing industry differs from prefecture to prefecture, such measures as blanket release of fishing rights are likely to materialize. Meantime, there may be some progress in the area of enlarging the scale of business.

c. Support for Reconstruction of Fisheries Cooperative Associations

The damage of the disaster extended not only to fishermen but also to many of the fisheries cooperative associations in Iwate, Miyagi, and Fukushima with their offices/stores swept away. In addition to the damage to these associations, many cases have occurred where associations found it difficult to collect money loaned to their members, which is likely to negatively impact their management. For restoration/reconstruction of the fishing industry, government support will be necessary and the Ministry of Agriculture, Forestry and Fisheries intends to provide additional funds to fisheries cooperative associations and is about to revise acts accordingly. In line with such moves The Norinchukin Bank assumes that it will need /1 trillion for the next four years to provide support both to the agriculture associations and the fisheries associations so that they may advance loans to their members for restoration and reconstruction and another /30 billion to increase such associations' capital and reduce interests on loans made to their members. The Bank intends to be fully ready to cover these expected outlays. Furthermore, the computer system linking all the fisheries cooperate associations for information and transaction data processing (JF Marine System) was heavily damaged by the disaster with the loss of relevant offices as well as terminals and ATMs. Support for its early restoration is also an agenda for the Bank.

4 Conclusion

Long-Term Reconstruction Design and State Support
In the case of the reconstruction design for the Great Hanshin-Awaji Earthquake, the basic format was that Hyogo Prefecture would play a key role in developing the reconstruction design with the assumption to create a society for the 21st century and the government will provide financial support. For the reconstruction design of the Great East Japan Earthquake, the same format will basically apply. As to financial resources to cover reconstruction programs, ideas to have the burden shared by the public are being considered, which includes raising the consumption tax (currently 5%) and issuance of extra government bonds.

Review of Energy Policy
The 21st century calls for a society building with due consideration given to peace and the environment including natural energies. Drawing a lesson from the accident at the Fukushima NPS, the parties concerned have decided to suspend operations at the Hamaoka NPS of Chubu Electric Co., Ltd., until adequate safety measures are in place. The government has also promised to review the nuclear-based grand design of power supply held to date and place more emphasis on natural energies.

Selection of Reconstruction Design Respecting Different Attributes of Each Region
In the Tohoku Region, a trait of the residents is patience, probably influenced by heavy snowfalls and seasonal winds in winter. People have developed the tradition and culture to live helping and comforting each other. In terms of restoration/reconstruction measures of the fishing industry there, maintaining the practice of granting the fishing rights mainly to the fishermen's associations should be given priority in the discussion of establishing a special zone for reconstructing the fishing industry since its advantage is demonstrated in joint operations already undertaken by some associations.

Moving Residential Areas to High Ground
In Sanriku and other districts that have been hit by tsunami many times in the past, moving residential areas to higher ground is now under discussion. Securing and developing parcels of land suited for building houses in these districts with harsh topographies requires a considerable amount of money and support from the government and is essential. In addition, with the rapid aging of society, the concept of cooperative town-building based on community maintenance should be the guiding principle for construction of houses as was the case with the Great Hanshin-Awaji Earthquake.

Japan deeply appreciates the assistance offered from 146 countries and regions and 39 international organizations. Rescue teams were sent from 24 countries, regions, and international organizations.

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On the Studies of the Disaster Recovery for the Restoration of Local Communities and Local Governments from the Great East Japan Earthquake

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Abstract. On the afternoon of March 11th, 2011, a magnitude 9.0 earthquake followed by catastrophic tsunami hit northeast Japan, causing massive casualties. This Great East Japan Earthquake has caused serious effects not only in Japan but also in other countries. We should reconsider our energy policies including a question whether to depend on nuclear electric power generation or not in future. In this paper, we will report about this unprecedented disaster, about the impact on the local area, and will share and discuss the present information in cooperation with the local communities from the view point of disaster recovery and try to show the way to restoration by ICT.

Keywords: the Great East Japan Earthquake, Tsunami, Nuclear Power Station, Local Communities, Local Governments, Disaster Recovery, ICT, Virtual Communities.

1 Introduction

The massive earthquake on March 11th, followed by the giant tsunami, and Nuclear Plant accidents caused over 15,000 death, about 9,000 missing, and more than 100,000 evacuees, is officially named as “the Great East Japan Earthquake (GEJE)”.

The causes of such a great damage were not only the earthquakes but the following tsunami and the damaged nuclear power plants. Especially the accidents in the plants inside and outside have been releasing the radiation of high density and have made it difficult for the examiners to approach the plants to access and evaluate the actual damages and causes. As the cooling down of the plants has advanced, and the situation appears to be settled down gradually, but the released information about the inside of the plants still changes day by day.

Under such a circumstance, this paper try to describe the research on the present damage situation in the communities involved, focusing on the damage caused by the

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plants' accidents which have caused the breakdown of the involved communities, the possibility to maintain essential functions of Local communities and Local governments by ICT and lastly a proposal on the restoration of the Local communities and Local governments.

2 Research on GEJE

2.1 Japan Faces an Unprecedented Challenge (Earthquake, Tsunamis and Nuclear Accident)

Occurrence of the Enormous Earthquake. On March 11 th at 14:46 (JST), there was a magnitude (M) 9.0 (preliminary) earthquake at a depth of approximately 25km, off-shore of Sanriku, northeast coast of Japan (fig.1). The magnitude of the main shock, M9.0, is the largest one experienced in Japanese history. This massive earthquake had a maximum seismic intensity 7 observed in Miyagi prefecture, and caused giant tsunami on the pacific coast in northeastern region of Japan.

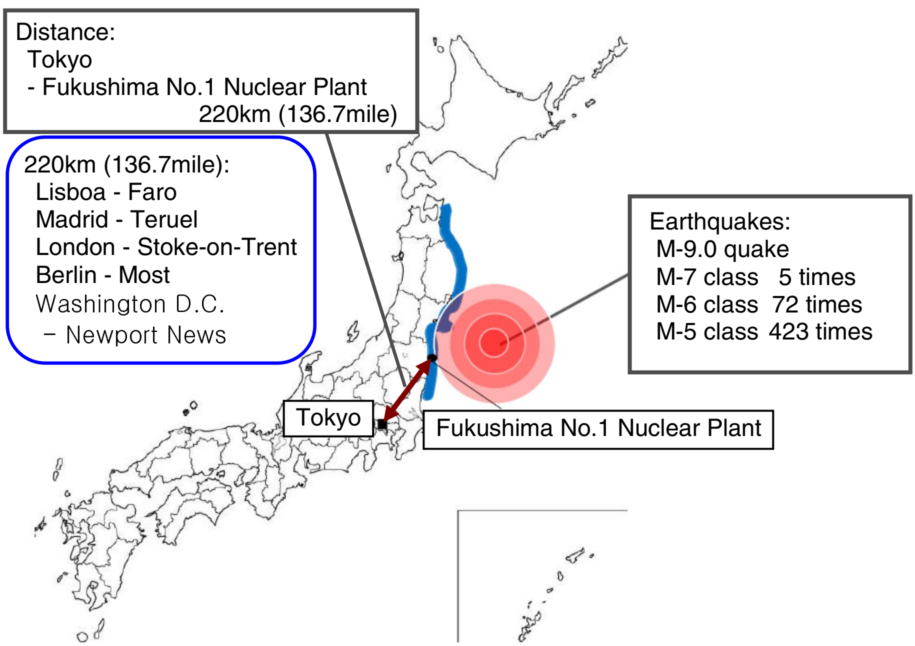

Fig. 1. General view of the epicenter of the earthquakes and the coast part tsunami overcame (Ministry of Economy, Trade and Industry [1]; translated into English by the reporters by adding the distance from Tokyo to the power plants and to other cities and countries)

Earthquake Research Institute, University of Tokyo announced the result of the stricken area investigation, that the largest tsunami height was over 37.9m in Miyako city, Iwate prefecture [2].

This earthquake occurred on the boundary between the Pacific plate and the North American plate (fig.2).

The maximum aftershock was a M7.7 (preliminary) one that at 15:15 on March 11. Shown as follows, Earthquakes M7.0 or over, hit off-shore of the Pacific coast from Iwate through Ibaraki Prefectures. It is thought that the hypocenter area extends widely from the region off-shore of Iwate to Ibaraki prefectures.

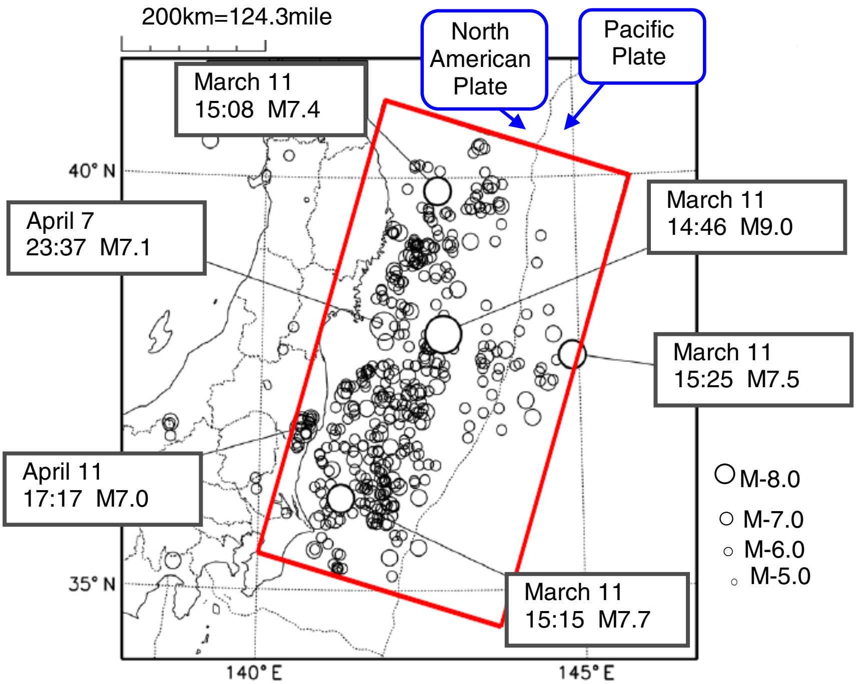

Fig. 2. The epicenters of the main shock and aftershocks (Japan Meteorological Agency[3]; translated into English by the reporters by adding the map and plates)

The Earthquake Research Committee evaluated earthquake motion and tsunami for the individual region off-shore of Miyagi prefecture, to the east off-shore south of Sanriku, and to the south off-shore of Ibaraki prefecture, however, occurrence of the enormous earthquake like GEJE which was linked to all of these regions was out of assumption [4]. With such a giant tsunami, the embankment was no longer useful, and the coastal villages in northeast Japan, including Fukushima Nuclear Plant, received catastrophic damage by the tsunami.

Damages. Because of the repetitious earthquakes on March 11 th, in Kesennuma city there was a very big fire because of the ignition on the fuel oil leaked from ships and factories collapsed by the tsunami. On that day, the life-line including electricity in the north-eastern region of Japan was heavily damaged, and besides electricity, gas and water were also stopped, since the extensive damages involved roads, railways and even airports.

According to the information released by the National Police Agency officials on May 23 rd, 15,188 peoples were killed, 8,742 were missing, 5,337 were injured, and damaged houses, 98,016 totally collapsed and 50,868 half collapsed. Total 2460 safe shelters were set up in 18 prefectures mostly in northeast regions of Japan, and the evacuees are totals to 108,672 persons [5].

2.2 Rescue Efforts and Foreign Assistance

Soon after the tsunami hit, firefighters, policemen and Self-defense force officials searched and rescued victims. Starting with the rescue teams from Singapore and Korea on March 12 th, many foreign rescue staffs arrived including 144 US staffs, 134 French, 75 Australia, 69 UK members with the rescue dogs [6].

So far, 157 countries and regions as well as 42 international organizations have expressed their intentions of assistance with their general intention of assistance, human resource assistance, relief supplies and donations [7]. The Special Headquarters to Support Disaster Victims is consistently processing the acceptance of the offered relief-goods according to the needs of stricken areas. The goods include radiation protect-goods, radiation dosemeters, personal dosemeters and radioactive-proof suits beside the standard relief-goods like water, food and blankets [7].

3 Nuclear Disaster

3.1 Nuclear Power Stations

Model of Nuclear Plant in Japan. In Japan, at Tokai-village in Ibaraki prefecture, the first commercial electricity production by using atomic energy started in 1963[8]. This first Nuclear plant was a magnox reactor made in England, and was rather expensive. Afterwards, most of the models of Nuclear Plants introduced into Japan were classified into two groups, namely, Pressurized Water Reactor (PWR) and Boiling Water Reactor (BWR), and now, five electric power companies including Tokyo Electric Power Company (TEPCO) are using BWR, and other five companies PWR [9].

Situation of Nuclear Plant in hardest hit areas. In Iwate prefecture, highest tsunami was generated, there was no nuclear power plant. In Miyagi prefecture adjacent to Iwate, there was Onagawa Nuclear Plant. Since Miyagi prefecture experienced severe Tsunami attacks in the past, they constructed Onagawa Nuclear Plant in the safer inland area far from the seashore, and the Nuclear Plant automatically and safely stopped on that day, and there was no damage due to Tsunami. On the other hand, Fukushima prefecture adjacent to Miyagi had not experienced any strong Tsunami in the past, they constructed Nuclear Plants in the area near to seashore where they believed to be safe from the statistical points of view.

In Fukushima, there are two Nuclear Plants, Fukushima No.1 and No.2 Nuclear Power Station, and the severely damaged Fukushima No.1 Nuclear Plant is equipped with several BWR, and they were constructed mostly in 1970s including Unit 1, the oldest one made in 1971.

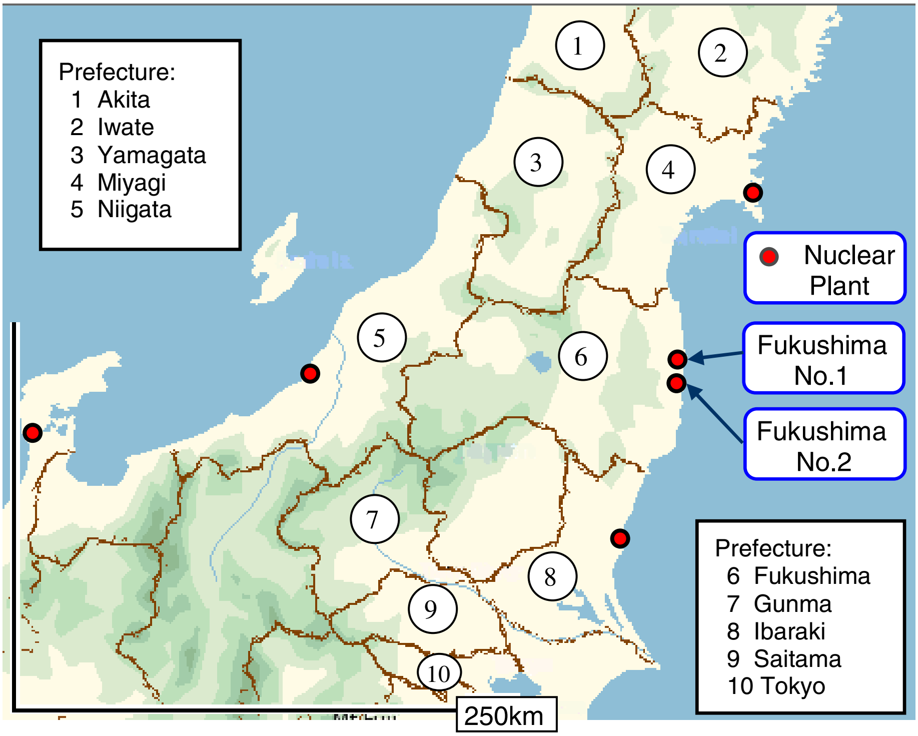

Fig. 3. Prefectures in Northeast regions of Japan, related to this study (made by the reporters)

Damage of Nuclear Plant in Fukushima prefecture. Fukushima No.1 Nuclear Plant has 6 units. Unit5 and unit6 have not operated by the periodical inspection, and totally have cold shut down on that day. Unit 4 is not operated, and is not cold shut down. Unit 1, unit2 and unit3 have operated, and shut down automatically by the earthquake, but cold shut down is not completed [1].

The 14～15m height tsunami reached the nuclear power station which stood 10 meters above sea level. Muddy waters engulfed the main facilities area of the Plant. As the tsunami hits, a power outage and the failure of the emergency generators to provide backup electricity caused the emergency cooling system to stop functioning. The emergency cooling system is the most vital component of the safety system of a nuclear power plant with BWR and must never fail [10].

The government declared an atomic power emergency for the first time, while the government of Fukushima Prefecture advised residents to move out from the nuclear power plant area to evacuate.

When the hydrogen explosion in the building of the nuclear plant occurred, the radioactive substance leaked to the atmosphere. Therefore, the evacuation of the residents in the peripheral area of the power plant was unavoidable.

3.2 Key Challenges

Cool Down the Reactors. After the explosion, sea water was injected to the reactor core. Because dose of radiation is too high to enter the room, the best way appeared to cool down by pouring sea water. TEPCO recovered external power, connecting to the control room. After May, when the fuel pellets were meltdown starting 4hours after the tsunami, as reported, all the melted fuel pellets have accumulated at the bottom of the vessel. The fuel pellets collected at the bottom of the vessel and the radiation leaking was also incontrovertible. It will be necessary to cool the reactor and spent fuel pool to stable.

Contain the Spread of Radioactive Substances. April 1st, highly contaminated water discovered leaking into the sea. April 6th, leak of contaminated water into the sea was stopped by injected polymer. About soil and atmosphere, April 1st, TEPCO sprayed synthetic materials on the surface of the ground and debris to prevent radioactive substances dispersion [1]. Some school removed the surface soil of the school yard/ground to prevent dispersion. In future, disposal method of the contaminated the rubbles and soil and securing of disposal facilities become problems.

Rigorous and Intensive Monitoring. About two months after GEJE, cooling down of the reactors in Fukushima No.1 Nuclear Plant is still continued, and complete cold shut down has not yet been made. To estimate the present state of radiation pollution, the measurement of the radiation in the environments, such as, air, water, soils, plants, animals, foods, and others are needed. Therefore, rigorous and intensive monitoring of the environments, and correct and quick announcement of monitoring results to the residents is necessary. For instances, each local government monitors the radio-activities of the air every hour and water every day, and obtained monitoring results are released instantly on their Website.

According to the data reported by the Ministry of Education, Culture, Sports, Science and Technology, air pollution due to the release of radio active substances from Fukushima No.1 in the air in the northeast area of Japan decreased constantly. On May 10th, so far as the atmospheric dose concerns, only the parts of Fukushima, Miyagi, Ibaraki, Chiba prefectures exceeded the value ordinary of the past. The earth pollution of cesium 137 in Namie town has decreased to 68,716 becquerel/kg from the highest 220,000 becquerel/kg but the more decrease will be doubtful after this as the radiation in the air will be dropped by rain the amount of cesium137. As for the sea pollution, the research from March 23 to May 7th on the cesium 137, the April 15 hit the highest, 186.0 becquerel/L in the offing of Fukushima. The research on the pollution on the earth and sea will be of most importance.

Ensure the Safety of Food and Products. According to the report, the radiation higher than the standard was found in the spinach, milk in Fukushima and the adjacent Ibaraki and kounago small fish from the Fukushima offing and the government stopped the shipment. The radiation rate is checked daily and the earliest stopped shipment was on March 21st. In May, the radiation has been still found among portions of vegetables.

4 Disaster Impact on Local Communities

4.1 Impact on Japanese Economy

Estimated Economic Damage of the Earthquake and Plan for Reconstruction. On March 23rd, the government announced the estimated calculation of 16-25 trillion yen ($195-305 billion) for the damaged roads and facilities, the biggest calamity since the last war. The estimation did not include the cost in the damaged nuclear power plants and radiation in TEPCO. Eventually the total estimation will be further greater. The estimation was based upon the old data of the past Hanshin Great Earthquakes and the cost for the tsunami was doubled. Also the calculation excludes the cost of damage of the TEPCO as it describes the radiation problems in the category of electric, gas, and water. The government postponed the information until after they collect more data [11]. Prime Minister Kan's speech on April 1st and April 12th, in short-term, clearing debris, erecting temporary housing, rehabilitating industrial facilities, in mid-term and long-term creating disaster-resilient local community, eco-friendly social system, and welfare-oriented society.

The government established "Reconstruction Planning Council" to discuss about future concrete revival plan, and to let a guidance reflect them. April 27th, a special law of decreasing the tax for the refugees was setup. On May 2nd, the budget amounted to 4trillion 153 hundred million Yen as the first revised budget to assist the refugees was announced. The budget includes the construction of temporary housing, clearing debris, maintenance of infra-structure which amount at most 300 man yen for a household. After June, another reformed budget is expected to come out for increase of consumption tax and welfare.

Impact on Energy Supply/Demand in Japan. The power plants in Fukushima has been administered by TEPCO and its generation capacity has decreased by 40 % [1].Since the plant accident in Fukushima was serious, on May 6th, the government requested to stop the nuclear power plant in Hamaoka in Shizuoka prefecture which may have a high possibility of another great earthquake. Upon the request, on May 9th, the company decided to stop the operation of Hamaoka Plant. Because of this, people worry the lack of electricity in this summer. For a solution, the government has decided to reduce the consuming amount of electricity by 15 % at home and in companies. Prime minister Kan commented and announced to reevaluate the energy plan made in June of 2010.

4.2 Evacuation Situations

Evacuate in group to a near-by place (Iitate village). The villagers of Iitate village, which was appointed be in the 'Planned evacuation zone,' took refuge in group to a near-by place. It now involves five villages and towns in April 22nd and the government requested to leave the place by the end of May [12]. According to the

Asahi Newspaper, the government had a conference with the village head of Iitate village and the mayor of Kawamata town and proposed Nagano prefecture (250km from Iitate village), and Aomori prefecture 350km from Iitate village) for the group refugees in April 26th. However, to reflect the refugees' wish, they insisted the closer places and have chosen the adjacent Nihonmatsu city (28km from Iitate village) and Fukushima city in the prefecture (24km from Iitate village). As of April 29th, 6,000 refugees (only the half of the village population) are distributed in the local hotels, inns, public facilities and private apartments. They need more evacuation places.

Evacuate in group to a distant place (Futaba town). Futaba town in the 'Non-entry zone' includes nine cities, towns and villages as of May 24th [12]. 27,175 households are now living in gymnasiums and temporary housings. On March 19th, Futaba town sent its refugees to Saitama city, Saitama prefecture. The administration with 1,500 refugees moved to the city outside Fukushima. Excepting 2,200 out of 6,900 villagers of Futaba town are distributed in several evacuation places in Kawamata town (43km from Futaba town). Thinking of the long-term evacuation, they decided to move to distant places. According to the Asahi Newspaper, the mayor gave the reasons to move in group to distant places saying, "The people can stay in one place with the merit of effective administration. In the long-term, it must be easier to find jobs in Tokyo and Saitama than in Fukushima prefecture with the power plant troubles. Since then, 1,400 are living in a high school in Saitama prefecture.

The diffusion of the evacuees. The population in the off-limit areas, which have a radius of 20km is 78,200 as of April 15th [12]. The table 1 indicates the result of the investigation by Fukushima prefecture [13]. The people who evacuated outside Fukushima prefecture as of April 28 are living in the public housings and establishments. The table excludes those living in the relatives and in the private establishments. As the table shows, the evacuation places are for those more than 1,000. Also we see the diffusion of the evacuees throughout Japan and some live 460km away from Akita and Tokyo.

Table 1. Evacuees from Fukushima prefecture(The map and the distant measures were made by the reporter based on the investigation by Fukushima prefecture [13]. Only the prefectures with more than 1,000 refugees are listed.)

Location from Fukushima prefecture	Range (Radius)	Prefecture	People April 28	People May 27
North	220km	Akita	1,080	--
Northwest	56km	Yamagata	1,861	1,861
West	120km	Niigata	7,782	7,876
Southwest	196km	Gunma	2,730	2,628
South	223km	Saitama	4,301	3,080
South	240km	Tokyo	3,644	4,588
		Other	12,514	11,107 (including Akita)
		Total	33,912	35,670

The longer the evacuation period lasts, the wider the evacuees diffusion is possible. The Itate villagers in the 'Planned evacuation zone' , the middle level of danger, may want to choose their evacuation place closer to their former village, hoping their evacuation period would not last longer.

On the contrary, the Futaba Town people, directly located in the nuclear power plants of the 'Non-entry zone, have chosen distant places where they can find employment, assuming the evacuation will last longer.

The government has not shown how long those in the evacuation zone should stay out of their home districts. When the evacuation period becomes longer, the villagers will find their relocation in distant places where they can restore their life with proper employment. The tendency of diffusion will increase as the longer the evacuation period lasts. The seniors and the elderly people tend to evacuate in groups while the young move individually to seek for employment which causes more diffusion among the evacuees.

5 Proposal for the New Model of Local Communities

5.1 The Restoration of the Community After the Diffusion of the Long-Term Evacuation

The above mentioned is the actual situation after the power plants accidents. Even though the government has not clearly shown the duration of the evacuation, the long-term evacuation will be undoubtedly possible. If the off-limit in Fukushima extends to 20 years like the case of Chernobyl nuclear plant, how do they restore the damaged community?

Our proposal presents that using ICT system would smooth the restoration of the evacuees in future. More concretely, setting up the "Virtual Community" (VC) as a policy would enable the evacuees to communicate with their friends, relatives and the people they used to know in their neighborhood communities. After some years when the off-limits are removed, some of the villagers and the citizens in the area might be able to return to the area. If they would be able to maintain the mutual close contact by the VC : the destruction of the community in reality could be somehow restored after certain lapse of time, if they want, so long as they maintain the communication through the VC.

The VC will record the evacuees' sentimental feelings toward their native home by recording not only the maps and the photos of the areas, but also the kizuna (Japanese) bondage among the people involved in the local areas as social capital.

The participants of the VC will register their real names in order to communicate with their partners, their relatives, and friends. Registration with their real name in the VC is important to select partners, and useful to set up the level of disclosed information.

After 20 years, the generations will be changed and the memories of the participants are only possible to restore by the ICT tools. But for those who can not use the modern techniques, the VC members will visit virtually and actually them and record what they hear in this way, the VC helps to keep the oral history of the destructed which should be handed down to the future generations.

The recorded memories of the participants may include what they widely want to hand down to the listeners who can be limited to their relations.

Since the purpose of the VC is restoration of the destructed/disappeared communities, the VC should be carried on by the VC members who should take care of the administration. The VC should manage the rules and regulations on investigations as their restoration policy. VC will not only to promote the communication among the evacuees, but also inform them on the supplies and services of the money for assistance, as well as the restoration progresses.

5.2 Usage of ICT to Transmit the Memories for Restoration

Presently, the governmental usage of ICT is only limited to gain the information on the refugees' evacuation places based upon the information system of the refugees throughout the nation [14]. For future plan, the government decided the summary of a new system, which plans a start of the use from 2015: control the tax and social security system: each Japanese national will receive his/her own identity number which can be used in anyway at the time of the natural calamity [15]. And they do not yet pay attention to the restoration of the communities.

A community member owns the land, and the Local government provides social services with the residents as community members. At this accident, in the lapse of 20 years, the Central government will eventually buy the contaminated land and the people lose the land and no one will live in the forbidden areas which may eventually bring complete disappearance of the communities. By this influence, significance of existence of the Local government will be doubted.

Even though the communities disappear, someday, it will be possible that some former residents may want to return to their old home. When the areas become livable in some days, who would come and live in the area which still will be somewhat dangerous? Besides, Fukushima prefecture is too distant from Tokyo for anyone to commute for his job. So if the government wishes the areas to be restored, the only people may want to return and live there will be those who used to live with some sentimental reasons like their parents, and grandparents used to live there.

The sentiments for the old home can be maintained only through ICT system which makes it possible to gather the information on the dispersed refugees. If the refugees are living with their family members, they can hand down their memories, but not those who have been away from their home and live in distant places. If a person lives alone, he/she has no one to share and hand down the memories of his/her old communities. Therefore, ICT system seems to be the only and the best solution available to gather the dispersing memories and transmit them to the following generations.

Our proposal is a newly developed one and partly based upon so-called 'SECI Model' which had been reported in the literature 'Knowledge Creation Enterprise' [16]. Briefly, 'SECI Model' is consisted of four processes, namely, (1) Socialization, (2) Externalization, (3) Combination, (4) Internalization. The first process (1) is considered to gain and transmit 'Implicit Knowledge' by mutual experiences, the second step (2) is to change 'Implicit Knowledge' to 'Formalized Knowledge', the third step (3) is to create another/new 'Formalized Knowledge' by combining more than one 'Formalized Knowledge', the last step (4) is to experience the knowledge by practicing ‘Formalized Knowledge’, and again go back to the first process. Thus, these four processes go through continuously, and these cyclic processes will be available to knowledge creation.

Memory and knowledge are not completely identical, but “Popular Information” such as memory “is existence that supports Knowledge basement” [17]. Therefore, memory is very closely related with knowledge, and this knowledge creation processes are also very closely related with the memory transmission processes, such as transmission of evacuees’ memories to their descendants.

If well-organized local governments, communities and evacuees participate in the same VC, real civil officers would behave as virtual civil officers, and might contribute to evacuee’s memory transmission processes to others including their descendants. Also, the local governments damaged by GEJE as well as the refugees’ memories on their old towns and villages should be able to continue by VC.

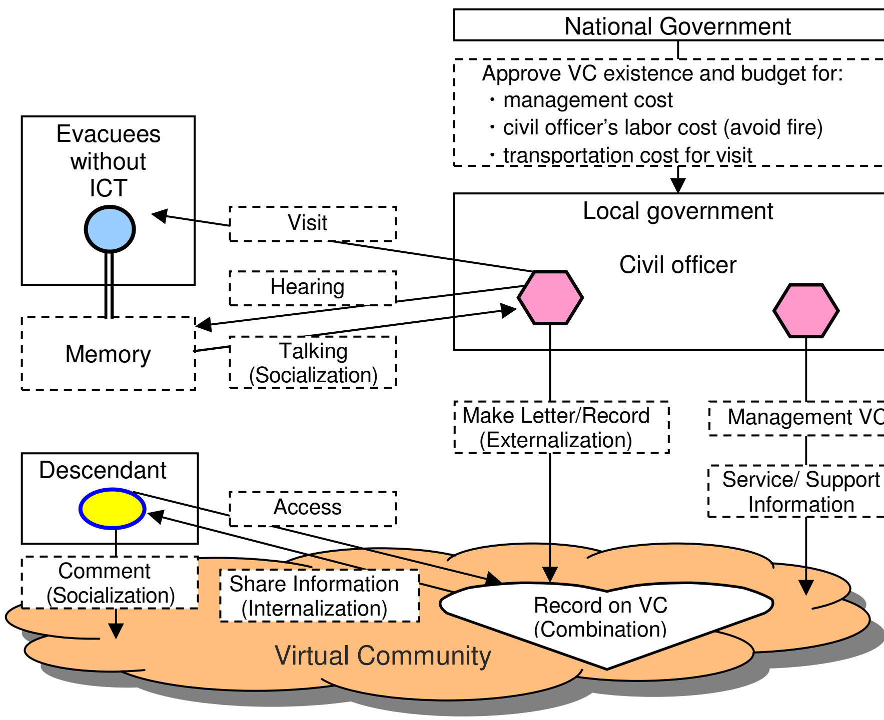

Fig. 4. This schematic figure depicts outlines of virtual community (VC) newly proposed in this paper. Various relationships among governments, evacuees, their descendants are given focusing on continuation of the ‘memories’ of those without ICT among the diffused evacuees

6 Conclusion

In this paper, we researched on GEJE, announced by the Minister of Foreign Affairs, who described the late calamities saying, ‘the hardest national crisis since World War II in Japan’, and showed the current damaged situation for the stricken area. Also, we see the diffusion of the evacuees throughout Japan, who had evacuated their home towns because of the nuclear disaster.

Even though the government has not clearly shown the duration of the evacuation, the long-term evacuation will be undoubtedly possible.

Therefore, we think the necessity of the restoration model for the Local Communities and Local Governments of planned for the long- term evacuation for the evacuees from their home land.

Accordingly, we newly proposed Virtual Communities as the model to restore the Local Systems including both communities and local governments, by using ICT with build-up memories and records of evacuee's home towns.

The method of using such ICT would contribute greatly to maintain Local Systems, and to smooth out restoration of the Local Systems.

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Eco-design Integration: Methodologies and Deployments

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Abstract. The engineer's doings in the new millennium have to cope with the ecological quality objectives, claimed by requirements for sustainable long-term growth; the challenge is extraordinary and involves socio-cultural aspects, too. Here, an overview of the state of the arts is flashed, in particular addressing: - the design of 'product-service' items, deliberately considering the early specifications for the lifecycle and the dismissal phases and: - the integration prerequisites in the supply chain management, explaining the usefulness of networks aids and the connected commercial modifications. The discussion, although offering sketchy suggestions, concerns the proper assessing of the life cycle eco-coherence as utter entrepreneurial challenge: the business design prerequisites incorporate legal issues, so it is not sufficient they are separately dealt with outside the firm.

Keywords: Integrated Design, Lifecycle Eco-compliance, Extended Enterprise, Product-Service, Reverse Logistics.

1 Introduction

The second millennium opens with the intriguing concept of the manufacturer's lifecycle liability of its supply chain. The accountability covers, [1], [2]:

- the corporate social responsibility, with engagements of investors, employees and stakeholders, to guarantee the value-added lawful authenticity;
- the eco-footprint of the product functioning, in accordance with the compulsory recovery and reclamation targets.

For lawful action, the corporation shall contribute to a better society and a cleaner environment. The purposeful contribution and the betterment effort are crucial accountability elements; the aim is ‹keeping one step ahead of regulations›, chiefly in the field of environment protection. The question may arise: why do enterprises engage in an activity at first view economically illogical. The answer considers life-long loyalty and trust, before short-term profit. Here, the current benefit does not stop to the *instant* consumers (*manufacturers* and *purchasers*), but it ought to cover third people, damaged by the *selfish* supply chain. The producers draw earth resources and take return at the point-of-sale, leaving the end-of-life wastes to the community: the transformation value-added is *private* income, the litter and contamination are *public* shortcoming. The new concept balances corporate liability, with compulsory recovery and reclamation targets, each time new products are brought out.

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The deliberate role in long-term issues modifies the enterprise governance, because the lifecycle visibility incorporates new duties, outside the conventional manufacturing phases. The business requires comprehensive plans of action, to be taken globally, nationally and locally by organisations empowered at worldwide level. The protection of humanity survival is *global village* requirement, entailing the yet-to-be generations. The *selfish* utility is not matter of democratic consent, involving the today citizens only: if earth becomes a barren and poisoned land, the temporary wellbeing has meagre utility. From now on, the definition of ‹consumer› includes the whole supply chain, with the further change in term of responsibility: the planning and engineering of the business has corporate explicit role, whereas the end-user is only implicit doer [3], [4].

The eco-awareness is being the challenge of the millennium. The United Nations sponsor the XXI Century Agenda: worldwide sustainability actions, fostering people consensus and authority plans. The idea is joining ‹globalisation› with ‹regionalism›. The eco-threat consciousness is bottom up process that involves one and all: the citizens identify themselves with the yet-to-be generation safety. The welfare of a district includes working conditions, environment protection, political steadiness, etc.; its planning assures regional competitiveness, that is, attractiveness compared to others. The appeal draws more investors, so that the eco-protection turns into crucial feature [5] for the district, and for the companies operating in it.

The political dimension of the XXI Century Agenda is beyond the scope of the paper. From the technical viewpoint, we need to focus on the engineering analysis models, permitting the ‹product lifecycle management›, PLM. The innovation in service-engineering, SE, and reverse-logistics, RL, is essential for an efficient product-service delivery. The SE-PLM and RL-PLM tools are based on the twofold opportunity [6], [7], [8]:

- lifecycle visibility, based on quantitative appraisals, rooted in virtual prototyping;
- information sharing, provided by networks and co-operative knowledge processing.

The appropriate engineering analysis aims at concurrent *product-process* design, and at united *environment-enterprise* running. With product-service delivery, the corporation carries out life-long servicing, including conception, production, overhaul and recovery. The manufacture value-added is just part of the business, compulsorily joined to eco-target accomplishments. The engineering job needs entangled multiple-task efforts, demanding computer models and information management systems [9].

2 Lifecycle Eco-compliance

The eco-design moves from ‹product lifecycle assessment›, PLA. The duty entails pooled tools, with changeful knowledge frames [10]:

- choice between product-service, by streamlined lifecycle assessment, SLA;
- product-service delivery, fitted by computer aided lifecycle inventory, CALI, files;
- life-long monitoring and diagnostics, by PLM (or SE-PLM and RL-PLM) tools;
- interaction with independent certification bodies and control authorities.

The preliminary duty moves from suited SLA, simplified programmes, capable of interfacing the PLA eco-requirements, with the complete PLM database. One major goal is to detail the CALI file, as integral part of the product-service delivery, linking scope definition with impact appraisal. The inventory allows specifying life-long servicing and product-service amalgamation. In fact, the SE is qualifying provision of innovative producers, and RL is required duty in some cases (e.g., ELV, WEEE), chiefly, to expand to all other mass-produced goods (in the EU policy). At this time, the eco-design is far from being efficient, and the three SLA-CALI-PLM steps go on mostly as academic proposals. The independent certification bodies, still now, interact with the users, and the manufacturers only provide product databases, rather than full PLM tools.

The transition to lifecycle liability requires developing innovative CAD tools, chiefly, covering sophisticated multi-scale databases for virtual prototyping [11], i.e.:

- resort to ontology taxonomies, with people-to-document & people-to-people codes;
- definition of product sustainability profiles, with broad ‹technical› failure figures;
- aggregated complexity account, including diagnosis and recuperation purposes;
- purposeful portrayal, to take care of the in-progress enacted EU eco-regulations.

The example CAD aids are chosen to cover fundamental themes in the design engineering (the first two), and applied topics (the other two), directly related with advanced data management and sharing questions. The practical implementations aim at showing pioneering suggestions, for currently emerging engineering duties.

2.1 Database Validation through Ontology

In the area of knowledge management, the ‹ontology› is an explicit specification of a concept group. The ‹concept group›, here, is a simplified view of the world we wish to represent for selected purposes. It consists of the identified concepts (objects, events, relationships, beliefs, etc.), and their (supposed to exist) links. Therefore, an ontology is a precise account of a shared understanding that improves the communication among people, organisations and computers. The knowledge portrayal consistency is relevant to avoid ambiguities and, moreover, to simplify encoders and editors. At this time, the database operation improves, [12], due to:

- the interoperability for PLM applications, without (tailored) translators and editors;
- the automatic construction of group descriptions and population instances;
- the data consultation/manipulation/ transfer, by unified grammars and semantics;
- the knowledge evaluation, based on shared metrics and incorporated standards.

The ontology taxonomies are useful for software interfacing: in the PLM case, the option permits concurrent construction and deployment with reliable issues. The standard construal and reading help in people-to-document and people-to-people activity, with straight association of specification/validation, acquisition/validation, cataloguing/validation, restitution/validation, etc., each time using the chosen ontology to transfer the structured knowledge in a computer code.

2.2 Sustainability Profiles and Failure Maps

The lifecycle eco-compliance is dynamic figure, selected at the design stage, and required life-long during the functioning and at the call-back stages. Early identification and planning of the eco-profile is becoming necessary accomplishment, according to the enacted and envisaged EU rules. It is important, however, to dispose of correlation figures, in view to extrapolate trends and to set up more conservative solutions. The item ‹failure› matches up the *non* eco-conformity. Preserving a viable profile is important feature of integrated design: to such purpose, the analysis aims at specifying the failing/refurbishing processes, [13], having resort to:

- the (law enacted) eco-conformity, defining degradation trend and warning features;
- the (predicted) eco-conformity by bylaws with accuracy and wholeness guesses;
- the pre-planned revival/mending measures, to restore the sustainability profiles;
- the re-design strategies, to improve products/enhanced services.

The technical failure occurs when the gap between the required operation and the actual running exceeds given thresholds. The malfunction is the situation, when the service performed by a device no longer meets requirements. The inability of a product-service to meet or continue to maintain the performance affects the producer/client relationship, and suited bylaws need to regulate fair market conditions. The eco-conformity affects the consumer/environment relation, and compulsory targets ought to be enacted, in view to balance manufacturer/user benefit, against third people damage. The corporate responsibility shall amalgamate the eco-sustainability within the product-service technical failure features, by selecting the value-added transformations and planning the life-long/end-of-life operations.

2.3 Computer Integrated Service Engineering

The traditional separation of the manufacturing from the functioning phases of the products has the effect to ‹forget› the recovery/reclamation duties. The corporate responsibility makes indispensable to manage ‹complexity›, that is, to deal with systems, which parts interact, modifying the behaviour of the all and conditioning the nature of the combined entities. The effect superposition cannot apply, so the reductionism to elemental causes gives misleading depictions. The ‹complexity› is permanent character of service engineering, mixing the design and on-process knowledge. The diagnosis and recuperation purposes, [14], assemble:

- the aggregate description, to produce intra-domain links for domain of reference;
- the connecting knowledge explanation, to rehabilitation schemata, from prognoses;
- the automatic reasoning, to provide synergic models with remedial planning utility;
- the conception of product-service with engineering change management tools.

The aggregate description does not ‹reduce› complexity, but provides replacing instances, at the specified engagement conditions. The combining strategies move from the patterns (path searching, etc.), or from the collective types (attribution, etc.). The causal knowledge is rare in product design practices, because too time consuming. The heuristics frames are common substitutes, linking the data (declarative knowledge) and the operation setting (procedural knowledge) through the on-the-go trustworthiness (contextual knowledge).

2.4 Computer Integrated Reverse Logistics

The eco-regulation, today, devised by the EU Commission (and partners) aims at requiring the corporate liability for the recovery/reclamation tasks of some mass-products (i.e., the end-of-life vehicles, ELV, the waste electrical-electronic equipment WEEE). So, the add-on of the recovery (reuse/recycle) tasks to the manufacturing ones, is dealt with, by the concerned producers, expanding the ‹design-for-x› routines, to include the ‹design-for-recovery (reuse/recycle)› ones. In the setting of the product performance, the ‹design-for-reuse› and ‹design-for-recycle› allow the on-purpose predictable up-grading, to incorporate the reverse logistics cost in the forward processes. The devised options involve [15]:

- the establishment of unified databases, for dismantling/upturn uniform treatment;
- the training of staffs/partners, especially effective in the recovery (reuse/recycle) work-cycles;
- the creation of RL-PLM tools, to be shared with the backward process operators;
- the promotion of applied R&D, aiming at pollution/consumption lowering.

The reverse logistics is, as just recalled, especial target of the EU countries, by now, limited to series of widespread durables. The EU Directives properly address the waste management.

3 Net-Concerns and Extended Enterprises

The carrying out of eco-consistent supply chains moves from the full life-long transparency of the delivery footprint. Now, the information system management needs real-time interconnection of multiple partners, again, with changeful knowledge frames, to economically allocate the tasks, and verify corporate performance. The innovation trends show two choices [16], [17]:

- the product-service, supported by a cluster of partners, providing aimed jobs;
- the reverse logistics duties (of given durables), performed by the producers.

Today, networking is efficient reality, making many partners collaborating on a given business project. The actual achievements entail several steps up [18], [19]:

- the choice between co-operative partners, timely from the ‹facility market›;
- the net-concern set-up, by broking, negotiation, agreement and facility integration;
- the product-service management, fulfilled by the partnership with specific contract;
- the certification by third party, notified to the control authority.

The preliminary step knocks together specialists, relevant for the product-service delivery, so that each one operates in his core business. The second step deals with the negotiation and assembly of the apt extended/virtual enterprise, in order that the enabled partnership acts efficiently, so (third step) warranting the (compulsory or approved) producer’s liability. The subsequent step closes the data exchange, with the certifying bodies and the overseeing authorities.

3.1 Facility/Function Market Operation Ruling

The potential partnership is connected through effectual information systems with transparent competition lay-out. The knowledge sharing in product-service delivery is fundamental prerequisite, with the twofold constraint to keep the transparency of the product data up-grading, and to warranty co-operative problem-solving skill. The facility/function selection and assembly in view of the business project ought to be planned out, tackling technology facets (infrastructures, protocols, standards, etc.), organisation aspects (systems of collaboration, government, reporting, etc.), management issues (relationship rules, performance appraisal, etc.). The current accomplishments avail of robot age equipment and methodologies, and offer widespread potentials [20], [21]:

- to deal with firms, embedding technology/organisation/management aids;
- to exploit learning upbringing, to cancel out borders among enterprises and people;
- to acknowledge the robotic equipment divide, addressing the cognitive revolution;
- to turn to transformations with intangible value added, to minimise eco-footprint.

The entrepreneurial changeover is impressive. From now on, the static ‹factory› does not exist any more. It is replaced by the cluster of facilities and functions, each time, best suited to solve the instant deeds of the current business project. The idea is to create the corporation, which assembles only the manufacture/overhaul functions, needed by the in-progress product-service delivery. In lieu of a ‹productive flow› along the floor-shop, we have an ‹entrepreneurial assembly› along the supply chain. Quite clearly, advanced design methodologies are necessary (e.g., ontology-based lifecycle management -with uncertainty-, etc.), to train people and to amalgamate the technologies. The turn is the only way to address the cognitive revolution, starting by transforming the traditional material processes, enhancing the intangible value-added. The basic technical analyses show that this change is only the beginning: the cognitive revolution, should it develop, requires mingling the robotic aids, combining artificial intelligence and artificial life, towards totally innovative processes.

3.2 Virtual/Extended Corporation Establishment

The cognitive revolution horizons are conjecture for a future (hopefully) to come. Presently, it is better to consider the networking technology and the facility/function market. The first is technical opening; the second is industry outcome, to assure agility to the production corporations. However, the effectiveness presupposes suited work-organisation and business-management. Many solutions are examined, from the *virtual* enterprise top agility, to the *extended* enterprise utmost assembly. In a technology-driven view, agents search for partners to integrate the supply chain: no stable lay-out exists out of the business project and its deviser. For an integration standpoint, the ceaseless change conflicts with the firm theory, with optimal job allocation. Today, the separation of the ‹brand› from the ‹factory› is prospect, fostered with the productive break-up and out-sourcing. The all approaches an *extended* or *virtual* corporation, depending on the inner organisation and on the offer steadiness. In the technical literature, the opinions vary, and, perhaps, the disparity can privilege the knowledge allocation: shared by most of the partners, in *virtual* lay-outs; centralised by the leader, in extended organisations. Noteworthy investigations cover [22], [23]:

- the knowledge entrepreneurship, implemented to look at eco-sustainable results;
- the concurrent corporate opportunities, exploiting technology-driven networking;
- the firm benefit of co-operative altruism, by knowledge sharing mechanisms;
- the facility amalgamation, extending concurrent engineering to corporate functions.

The networking and the virtual/extended corporations opportunities are areas widely discussed in general, and, markedly, with focus on the corporate lifecycle liability. The knowledge sharing in the product-service systems profits by net-technologies, especially, if the suited premises are posed since the design stages (with PLM, RL-PLM and SE-PLM tools).

3.3 Corporate Liability of Product-Service Delivery

The corporate social responsibility is engineering change, with utmost relevance. Up today, the responsibility is, above all, linked to the deliberate infringement of an enacted law: whatever is not forbidden, is allowed. The ownership of goods permits to use, misuse or destroy them, keeping little attention on their lifecycle. Once raw materials bought, a firm has full rights on them, and transfers the same privileges to the product purchaser. Those facts bring to the aberration of the lawfulness of processing boundless earth resources, and, in-progress, transforming them into waste and pollution. The alternative modifies the *ownership*, into *technical tenure*, or right to temporarily enjoy the item, provided *refunding* the third people, for the private appropriation. The *technical* side of the tenure is in the *refunding* process. Here, again, the opinions vary. Basically, we need a metrics, to assess the ‹tangibles yield per unit service›, so that leanness is weighed among equivalent services. Positively, the complexity of such system requires equally sophisticated lead roles. This brings to redefine the ‹consumer›, assembling the manufacturer-and-client. Then, the refunding process is assigned to the manufacturer, that, of course, moves the cost on the supply chain. From engineering viewpoints, the all is extensively investigated [24]:

- the product-service effectiveness depends on reliability engineering attainments;
- the virtual/extended corporation operation is affected by communication aids;
- the networked lay-out needs high-level information government and management;
- the public policy ought to develop social accountability, to grant transparency.

These topics show the weigh of merely technical advances, in the management of the corporate social responsibility. Their technology-driven content confirms that the know-how and knowledge advances are feasible. Their actual deployment is fact entailing civic consent and political decision at the global and local levels. Our survey, just, illustrates example questions.

3.4 Certification of the Consumers' Eco-footprint

The citizens' awareness of the ecology impending threats is not enough, if confined into mostly cultural and ethical sentences. When by themselves, individuals and nation-states aim at their *utility* as contingent achievement. The effects and damages of third parties emerge, when these express the willingness of reactions. Within a country, the welfare policies and solidarity *vs.* less fortunate ones come out in parliamentary democracies. Within the *global village*, the ecology policies and altruism *vs.* yet-to-be generations are much more entangled questions, because these third people act the part of the mankind survival. We have quoted the UN XXI Century Agenda fostering ‹globalisation› by ‹regionalism›. The technical implementation requires worldwide eco-targets and common appraisal metrics. The international consent confers power to a central authority. The local governments take in charge controlling target and tax systems. The eco-footprint certification is done by third bodies (by respect to manufacturers and buyers), having regional accreditation, qualified by notification to the central authority. Limiting the discussion to the engineers' developments, the questions to tackle are diversified, with wide spectra of subjects [25]:

- the efficient administration of cross-links and of external constraint allocations;
- the eco-safeguard monitoring, with reliable ‹technical› failure management;
- the promotion of the eco-quality standards and recovery/reclamation metrics;
- the effectual handling and coding of eco-footprint databases,.

The image of the whole supply chains for the totality of the citizens monitored and weighed *vs.* the *global village* future eco-consistency is rather oppressive and deplorable. At first view, the icon of the personal freedom and civil rights clashes against the full pre-planning of stocks consumption and earth contamination. Perhaps, it is not really so. Today, we accept to fasten the seat belt, when starting the car, and this concerns our protection, more than the wellbeing of other people. With the third-body certification our privacy can be safeguarded: the communication to the controllers and authorities relates to aggregated data, and the information tracking can omit the one-to-one maps. In fact, we accept to not conceal our economic transactions (and to pay the income taxes); we ought to agree to not hide our ecologic transactions (and to pay the related fees).

4 Conclusion

The survey on the engineer's innovation during the second millennium beginning is the excuse to provide a fresco of why technologies evolve. Actually, the human progress is knowledge-driven accomplishment, selecting and performing *artificial* transformations, which modify the *spontaneous* trends, to establish the *civilisation* (compared to wild lands). The progress is regular outcome of the man *intelligence*, the faculty of choosing between facts and manners, and of designing solutions and improvements. The civilisation is man construct, with multifarious facets [26].

The progress through ‹innovation› is ticklish bet. The general policies provide hints, [27], based on acknowledged paradigms. Today, these paradigms are not like yielding growth sustainability; the over-pollution and over-consumption are impending dangers, not mitigated by the earth self-healing potentials. However, the all frames are sometimes questioned: we might devise leopard spot trends, hoping to be able to castle within affluent regions, so that the man eco-consistency is just confined to our safeguard.

The *selfishness* hypothesis is, basically, cherished at nation-state or nation-state cluster level. The guess believes distinguishing ‹developed› and ‹developing› countries, trusting in sufficient advance, so that the bloodhounds never reach the hares. Alternatively, the *altruism* proposition considers the *global village*, and confides in the coming *cognitive* revolution, to make the progress continue. The yet-to-be innovation is only technology-driven optimism; the today diagnoses are truly threatening. The saying ‹forewarned, forearmed› fosters awareness. The engineering habit of impact assessing is the same as ‹well begun is half done›. The capability of understanding the actual seriousness of the earth living beings is available, and it does not leave open *selfishness* hypotheses. The queries can be dealt with along different views, [28]; all devised procedures and quality systems converge to similar conclusions.

The analysis of ecology data requires rather optimistic trust in the man wisdom to turn doing the second half. The innovatory know-how to go ahead is forced to deal with the over-pollution/over-consumption at the *global village* range. It is unsafe to devise sectional successes; the competition is blunted virtue; the stigma inexorably gets to affect the world over. The mentioned *agricultural* and *industrial* revolutions discovered:

- the ‘culture’ achievements: the artificial rising of living supplies; or: the trained and refined state, induced in people;
- the ‘industry’ talents: the business institution by ordered work-organisation; or: the individual diligence, i.e., personal zeal.

The two link up tangible processes and human characters. Yet, only projections on the external world bring to helpful effects; the internal qualities belong to *knowledge* domains. The transition in view of the ‹forewarned, forearmed› warning needs to combine science and empathy, to recognise the ecology constructs [29]. The ‘culture’ and ‘industry’ ambivalence is notable fact.

The *cognitive* revolution follows from akin trends, with the *artificial* exploitation of the genetic codes for *regenerative* processes. The cognitive faculty aims at self-sufficient processes, to enable transparent restoration and reclamation outcomes, based on mostly renewable resources, by ‹bio-mimicry›. The *intelligence* ability is required for process diagnosis and control. The pooled artificial life/intelligence aids merge bio-science/technology and computer engineering, moving the changeover towards knowledge domains: the ‹information› of the genetic codes to use ‹bio-mimicry› self-sufficiency. The current technical advances provide, perchance, hints; the whole innovation is expectation to come [30].

The conclusion is reluctantly vague. The survey insists looking at knowledge-driven innovation, because the ‹revolutions› occur if needed. The corporate social responsibility follows the lifecycle liability; the two bring forth the many topics outlined, from sustainability profile, to net-concerns, from product-service delivery, to aggregated account of complexity. The ‹forewarned, forearmed› warning, thereafter, might suffice, once the ecology threats are understood.

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Exploratory Factor Analysis for the Digital Divide: Evidence for the European Union - 27

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Abstract. Our research aims to analyze the digital divide within the European Union 27 (EU-27). Hence we used a multivariate approach, more specifically Factor Analysis, to study the digital disparities between European Countries. Two latent dimensions on this subject were found. We also found statistical evidence that one of the dimensions on digital development is higher in the original 15 European countries. Therefore, considerable disparities on the Information society were found.

Keywords: Digital Divide, Information Society, European Union.

1 Introduction

The attention given by leaders from all over the world, to the concept of information society and the potential for a digital divide, has, in the last years, risen significantly. At the World Summit on the Information Society, was declared that the global challenge for the new millennium is to build a society "where everyone can create, access, utilize and share information and knowledge, enabling individuals, communities and peoples to achieve their full potential in promoting their sustainable development and improving their quality of life" [1, 2].

Moreover, the European Union (EU) has just released the Europe 2020 Strategy which has the objective of lead to "*a smart, sustainable and inclusive growth for European Economy*" [3] and "*to exit the crisis and prepare the EU economy for the challenges of the next decade*" [4]. This economic growth will be accomplished, among other factors, by developing an economy based on knowledge and innovation [3]. Included in the Europe 2020 Strategy, as one of the seven flagships of the Strategy, the Digital Agenda for Europe was developed and aims to define the central role that the use of information and communication technologies (ICTs) must play if Europe wants to materialize its ambitions for 2020 [4]. Therefore, relevant digital inequalities within 27 European Union countries (EU-27) must be detected and corrected so as not to jeopardize the objectives of Europe 2020.

To the best of our knowledge, until now, there is a lack of studies which address the situation regarding the digital disparities, especially including the whole EU-27. Considering the importance that the EU gives to a homogeneous digital development in all of its members, the first step to be taken towards this objective is to assess the current situation in all of its members. Therefore we hope that this research may fill this gap and shed some light on this issue, so that efficient policies may be deployed.

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2 Digital Divide and Digital Development

The term digital divide was first used in the mid-90s by the former Assistant Secretary for Communications and Information of the United States Department of Commerce, Larry Irving Junior [5]. According to the Organization for Economic Co-operation and Development (OECD), "*the term digital divide refers to the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access ICTs and to their use of the Internet for a wide variety of activities*" [6].

Firstly, the digital divide was understood in binary terms, which means the difference were in "has" or "has not" access to Information Technologies. Nowadays, however, this difference is considered narrow, since that other factors need to be considered. Therefore, digital divide is nowadays understood as a complex a multidimensional phenomenon. [7-9].

There are two types of digital divide. The first is located at an international level, which means, between different countries. The second one is located at an intra-national level, or within a country. In these types of digital divide gaps can occur in access to ICTs between regions, or groups of individuals, when characteristics of different nature are verified like, for example, socioeconomic, gender, ethnicity or even age [10, 11]. Hence, according to this definition, the digital divide can represent a threat for all the *e-strategies* spread all over the world, including the Digital Agenda for Europe [12, 13].

The development and usage of ICTs has had an exponential growth in the last decades. These technologies are playing a decisive role in improving almost every aspect of our societies, including business transactions, communications, politics and economy. Hence new types of interactions, or advanced services, are becoming more and more common like e-commerce, e-government, e-health, e-learning, e-banking or e-finance, among others [14-18]. Moreover, actions and technologies like Internet surfing, YouTube, email, wikis or access to online libraries are taking a part in our daily routines, improving the way people interact with each other's and have access to privileged information against those who has not [19]. Therefore, is consensual that ICTs positively affects economy and welfare in some dimensions [14, 20]. The ICTs creates competitive advantages in enterprises, improves national health systems [21], throw e-health, improves education systems as well [22], throw e-learning which creates a lot of opportunities reducing distances constraints between students and universities or colleges, and creates new employment sectors which decreases unemployment rates [23, 24]. Thus, in order to these benefits be accomplished some obstacles need to be overcome, particularly the inequalities both between and within countries, when it comes to the access to these technologies by population.

3 Measuring Digital Divide

3.1 Framework

In order to measure the level of ICTs in each of the target country for a posterior multiple comparison some obstacles needed to be overcome. Due to its unquestionable importance to improve economy and social care, the problem of how to measure it has been gained a growing attention [12, 13, 20, 25].

Firstly, there is not a single and standardized clear definition of digital development, information society or digital divide, since that, considerations about this subject differs from countries, geographical areas, organizations and information society models [23].

The second constraint is related to a lack of harmonized data available when considering analysis for multiple countries. Hence there is a “trade-off” between depth and width on the analysis. This means that, the more indicators we try to use, less are the countries able to be included in our analysis [13]. Yet this problem was mitigated by the fact that our analysis aims to European countries since that in the last years the EU, via Eurostat, has make an effort on offering harmonized and specific data about this subject on every one of the 27 European Countries. Therefore, all data used in the analysis is gathered from the Information Society Statistics Category in the Eurostat website and are concerned to the year of 2009.

According to the recommendations of the OECD, the variables which should be used to measure the digital divide varies along the objective of the research. For instance, if we want to measure the internal or domestic, digital divide we should “drill down” the ICTs level indicators by groups like gender, age, income, education, geographical place, and so on. To measure the digital divide between countries, the indicators should refer to the aggregated national reality. Since our objective is to analyze it within the European Union, we will follow the second one.

Recent studies concluded that the international digital divide is mainly a consequence of economic inequalities between countries. Besides economic development, countries with lower educational attainment also tend to present lower rates on the usage and adoption of ICTs [26-30].

On the other hand, some authors showed that the domestic digital divide is characterized by a higher risk of digital exclusion of the elderly, women, population with lower income, education attainment, with disabilities, living in rural areas or belonging to ethnic minorities [16, 31-38].

3.2 Data

To measure the different levels of information society across EU-27, we used 13 variables which are compatible with recommendations from OECD, EU and which were already used in prior researches. These indicators were selected by combining a mix of prior studies along with some recommendations from the referred organizations. The variables are the following (See Table 1).

The percentage of households having access to broadband connections (HsBro) and the percentage of e-government services available (egovsup) were used by Cuervo and Menéndez [13], among other indicators, to measure the digital divide within EU-15. Similar variables to the percentage of households having access to the Internet (HsInt) and to broadband connections (HsBro); percentage of population regularly using the Internet (IntPop); percentage of population regularly using the Internet for finding commercial information (IntSrc); percentage of population using the Internet to obtain information, and interact, with public authorities (egovInf and egovInt, respectively); and the percentage of population regularly using e-learning services (elearn), were used by Çilan, Bolat and Coskun [14], to analyze the digital

Table 1. Acronyms and Descriptions of Variables

Code	Variable
HsInt	% of households having access to the Internet at home
HsBro	% of households with broadband access
IntPop	% of population regularly using the Internet
IntSrc	% of population using Internet for finding commercial information
ebank	% of population using e-banking services
elearn	% of population using e-learning services
email	% of population using e-mail
ehealth	% of population using Internet for seeking health information
egovInf	% of population using Internet to obtain Information from public authorities
egovInt	% of population using Internet for interacting with public authorities
ecom	% of enterprises having received orders online over last year
esafe	% of enterprises selling online offering the capability of secure transactions
egovsup	% of government services available online

Table 2. Data Used

Country	HsInt	HsBro	IntPop	IntSrc	ebank	elearn	email	ehealth	egovInf	egovInt	ecom	esafe	egovsup
Austria	70	58	67	54	35	34	63	36	35	39	10	4	100
Belgium	67	63	70	59	46	35	68	33	27	31	16	6	70
Bulgaria	30	26	40	17	2	14	34	10	8	10	3	1	40
Cyprus	53	47	45	39	15	25	38	16	21	22	7	3	50
Czech Republic	54	49	54	50	18	27	55	20	23	24	15	7	60
Denmark	83	76	82	74	66	58	81	46	65	67	19	10	84
Estonia	63	62	67	54	62	31	62	33	43	44	11	3	90
Finland	78	74	79	73	72	69	75	56	45	53	15	7	89
France	63	57	65	60	42	55	60	37	36	39	12	5	80
Germany	79	65	71	69	41	40	70	48	35	37	18	6	74
Greece	38	33	38	33	5	26	31	15	11	12	6	3	45
Hungary	55	51	57	48	16	32	55	36	23	25	6	2	63
Ireland	67	54	60	54	30	40	56	24	23	28	21	9	83
Italy	53	39	42	33	16	35	39	21	15	17	4	2	70
Latvia	58	50	61	50	42	38	54	29	22	23	4	2	65
Lithuania	60	50	55	44	32	28	47	29	18	19	18	7	60
Luxembourg	87	71	83	75	54	66	81	54	44	54	9	3	68
Malta	64	63	55	48	32	39	51	30	23	24	12	6	100
Netherlands	90	77	86	79	73	34	85	50	50	55	22	8	79
Poland	59	51	52	29	21	33	45	22	16	18	5	2	53
Portugal	48	46	42	40	17	40	40	28	18	21	16	3	100
Romania	38	24	31	12	2	18	28	16	6	6	3	1	45
Slovakia	62	42	66	50	26	21	61	30	26	31	6	2	55
Slovenia	64	56	58	49	24	38	53	33	31	32	11	7	95
Spain	54	51	54	47	24	38	52	32	29	30	10	4	80
Sweden	86	79	86	77	71	45	83	36	48	57	21	9	95
United Kingdom	77	69	76	64	45	45	74	34	30	35	16	12	100

divide between member and candidate countries of the EU before the 2004 enlargement. Moreover, the EU, via Digital Agenda for Europe [4], emphasis the role of technologies like e-health, e-learning, e-banking and e-government. E-banking and e-health are considered to be *"some of the most innovative and advanced online services"* [4]; e-government services are also mentioned in the Digital Agenda, since that *"despite a high level of availability of e-government services in Europe, differences still exist amongst Member States"* [4]; Therefore we found measures of these advanced services particularly relevant to our analysis. At our best knowledge, there is a lack of studies on this subject which already included the measurement of these services, reason why we found this inclusion particularly relevant.

We also consider that having retained this data from the Eurostat gives us the assurance that the result of the analysis is not compromised by the quality and adequacy of the data used. The data used can be seen on Table 2.

Table 2 expresses high disparities within EU-27 related to the ICTs. Bulgaria has 30% of households connected to Internet and the usage of e-banking by population is only 2%. On the other edge, we have Netherlands with 90% and 72% respectively. When analyzing the e-government supply availability we have four countries with 100% services available and three with less than 50%. These uneven distributions on the variables will not affect our analysis, since that factor analysis do not make any assumptions about variables´ distributions, but they can be very elucidative about the gap that exists between countries. Moreover, the dimensionality of the data used, with 13 dimensions, makes impossible to address the digital divide with simple univariate statistics, without lead to incomplete results.

4 Methodology

4.1 Factor Analysis

Factor Analysis uses the correlation between variables in order to find latent factors within them. In order to use a successful factor analysis some assumptions need to be confirmed. The usage of this technique depends on the correlation structure within the input data. Hence, we need to confirm that this correlation exists; otherwise factor analysis may bring weak results. Our analysis involved several steps. The first was to analyze the correlation structure of the data, by the correlation matrix. In second, the suitability of the data must be confirmed by the Kaiser-Mayer-Olkin (KMO). Third, we needed to choose the extraction method to be used. Fourth, the number of factors to be extracted was defined and then, finally, we had to interpret the factors based on its loadings.

The correlation matrix (see Table 3) shows that each variable has, at least, one absolute correlation coefficient of 0.67 with another variable. This fact ensures that the variables used concerns to the same phenomena. We noticed that one of the highest correlation level (0.99) exists between the percentage of population using Internet to obtain Information from public authorities (egovInf) and percentage of population regularly using Internet for interacting with public authorities (egovInt), which indicates that the search for government´s information online leads to online interaction with public authorities. On the other hand, the percentage of government services available online (egovsup) presents a correlation coefficient of 0.52 and 0.53

Table 3. Correlation Matrix

	HsInt	HsBro	IntPop	IntSrc	ebank	elearn	email	ehealth	egovInf	egovInt	ecom	esafe	egovsup
HsInt	1	0.94	0.94	0.93	0.88	0.69	0.94	0.86	0.86	0.89	0.67	0.66	0.58
HsBro		1	0.92	0.93	0.91	0.73	0.92	0.84	0.88	0.89	0.72	0.70	0.67
IntPop			1	**0.95**	0.92	0.66	**0.99**	0.85	0.89	0.92	0.62	0.62	0.51
IntSrc				1	0.89	0.73	**0.95**	0.87	0.89	0.91	0.72	0.67	0.58
Ebank					1	0.68	0.90	0.82	0.89	0.91	0.64	0.58	0.56
Elearn						1	0.66	0.79	0.69	0.72	0.42	0.45	0.56
Email							1	0.86	0.89	0.92	0.65	0.63	0.53
ehealth								1	0.83	0.85	0.52	0.43	0.53
egovInf									1	**0.98**	0.60	0.56	0.56
egovInt										1	0.60	0.56	0.56
Ecom											1	0.85	0.58
Esafe												1	0.58
egovsup													1

with the percentage of population regularly using the Internet (IntPop) and the percentage of population using email (email), respectively. These low correlations indicate that, apparently, in some countries the adoption of ICTs by population does not have a linear correlation to the efforts of policy makers to encourage the use of these technologies.

To confirm the suitability of the data for factor analysis, KMO was realized. It returned the value of 0.85, which expresses the good adequacy.

As extraction method we applied the Principal Components Factor Analysis. This is the most widely used in Marketing and Social Sciences [39]. Since that our aim is to reduce the complexity of the problem we had to decide how many factors we would extract from our analysis. There is not a straight rule to do it since that the nature of the problem in study is crucial. There are three main criteria for reaching the number of factors; Pearson´s, Kaiser´s and Scree Plot methods were taken in consideration [39]. All of them were unanimous; the optimal number of factors to be extracted is two. As showed on Table 4 the percent of variance retained in these two factors is 86.6%. This means that, even though, we have just changed the number of indicators to analyze from thirteen to two, only 13.4% of information was lost.

Considering that our objective is to reduce the complexity of the digital divide, we used the rotation of the factors in order to achieve a better split of the original indicators in only one Factor. Although there are several types of rotation, including orthogonal and oblique methods, the orthogonal ones seem to be the most widely used [40]. In particular we applied the Varimax rotation. Nevertheless, Varimax and Quartimax rotations led to similar results.

To measure the scale reliability of each factor, Cronbach´s Alpha Measure was also calculated. It measures the internal consistency of each factor within itself. Nunnally [41] suggests that a value over 0.7 is considered good. The values returned are 0.985 and 0.860 for factor 1 and factor 2, respectably, indicates that the factors are consistent, since that those values are considered high.

Table 4. Results of Factor Analysis and Cronbach´s Alpha

Factor Analysis	Factor 1	Factor 2
Ehealth	**0.909**	0.224
Egovint	**0.902**	0.347
IntPop	**0.884**	0.389
Egovinf	**0.877**	0.353
Email	**0.874**	0.414
ebank	**0.854**	0.397
IntSrc	**0.845**	0.479
HsInt	**0.836**	0.466
HsBro	**0.809**	0.540
elearn	**0.752**	0.248
esafe	0.278	**0.904**
ecom	0.326	**0.880**
egovsup	0.379	**0.655**
Percent of Variance Explained	59%	28%
Cumulative Variance Explained (%)	59%	87%
Cronbach´s Alpha	0.985	0.860

Factor 1 is characterized by high density of usage of ICTs by Individuals along with the availability of its Infra-Structure. Therefore, factor 1 expresses the *ICTs adoption and diffusion by Population.*

In factor 2 we have the capacity of enterprises to provide safe connections on e-commerce, the orders received on-line and the e-government services availability. Hence, factor 2 is related to the *e-commerce, e-safety and e-government.*

We computed the factor scores to each country for a comparison analysis (see Figure 1). The plot shows that Scandinavian Countries – Sweden, Netherlands, Denmark and Finland – are the ones with better position in both dimensions. Luxembourg is the country with better levels in *ICTs adoption and diffusion by Population* but is however, at the same time, one of the countries with lower *e-commerce, e-safety and e-government* levels. United Kingdom is the country with highest level on factor 2, which confirms the theory that is one of the countries in the

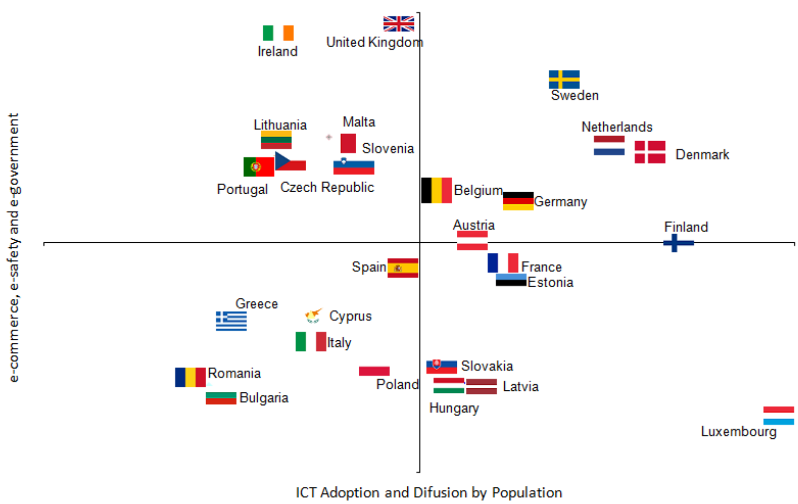

Fig. 1. Countries´ Coordinates on Extracted Factors

world with higher levels when it comes to availability of e-government services [42]. Austria has an average level regard to factor 2 and a slightly higher level than average in factor 1. Eastern Countries like Romania and Bulgaria are the ones in worst position considering the digital development.

Finally, we noticed some countries with very similar coordinates, or digital profiles, like the case of Romania and Bulgaria; Lithuania, Czech Republic and Portugal; Italy and Cyprus or France and Estonia. The fact that these pairs of countries are not necessarily close from the geographical or cultural point of view may bring us to other studies.

4.2 Mann-Whitney Test

After retaining the two dimensions with factor analysis we tested if the original EU-15 countries showed statistically different values on the factors against the countries which entered last. The Mann-Whitney Test showed that the original EU-15 countries tend to present higher levels on both factors for a confidence level of 10% since that p-value is 0.051 and 0.079, respectively for factor 1 and factor 2. However the results are not strong enough to apply a confidence level of 5%, especially for factor 2. Hence we tested the difference in the factors for three groups of countries, in pair with each other, which were formed by the original EU-15 countries, the 10 which entered in 2004 and the ones who entered last (2007). For a confidence interval of 95% both the original EU countries and the ones which entered in the 2004 presents higher levels on factor 1 against those which entered in 2007. Both factors have differences at a significance level of 10%. Moreover, for the same confidence level there are not significant differences between the original EU-15 countries and the ones which entered in 2004, which indicates that these are already mature and fitted to the EU when it comes to the Information Society policies.

5 Summary of Findings and Limitations of the Study

The digital divide appears to have two latent dimensions, which are the *ICT adoption and diffusion by Population* and the usage of *e-commerce, e-safety and e-government.* These two dimensions are independent considering that countries may have a top position in one dimension, and at the same time, a bottom position in the other. The Mann-Whitney Test showed that the statistical difference of the original 15 EU Countries against those which entered last is mainly due to the presence of Bulgaria and Romania in last group. Some policy actions might be proposed from our results: The high performance of some countries in just one dimension of digital divide, and low levels on the other has to be seen as a challenge. Like economic development the digital one needs to be harmonized and affect all dimensions; the worst ranked countries, especially Bulgaria and Romania, need to emphases their policies to the digital development towards the direction of Northern European Countries. This development may only be accomplished with a multifaceted strategy, stimulating both ICTs Infrastructure and adoption by Population with the development of e-commerce and e-government´s boosting policies. We also noticed that, in fact a gap in the digital development within EU exists and that this gap needs to be bridged to achieve the goals expressed by European Commission.

Even though our efforts to offer a complete and multidimensional analysis, some limitations must, however, be considered: First, our analysis refers to the digital divide at specific point of time, which is, the year of 2009. Therefore evolutions are likely to happen in just a few years; second, our empirical application consists of just 13 variables. Hence, some aspects of the information society may not be covered; third, we analyzed the digital divide within EU, with indicators related to aggregate national realities. This ways, internal gaps may not be covered.

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Information Systems for Sustainability: Hofstede´s Cultural Differences in the Perception of a Quality Measure for Sustainability Reports

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Abstract. The objective of this paper is to reflect on the effect of Hofstede's cultural differences on the perception of a quality measure for sustainability reports. The study is conducted with advanced accounting students in two countries (Spain and the United States) as a proxy for users of the main information system tool for sustainability, the sustainability reports. The quality measure is based on previous research. The hypotheses are formulated linking the quality measure variables with the five Hofstede's dimensions of culture, concluding on the consistency of the hypotheses.

Keywords: Information systems for sustainability, Corporate social responsibility, Quality measures, Hofstede.

1 Introduction

Corporate social responsibility (CSR) has become a key issue in management strategy. The most extended tool for CSR communication is the sustainability report (SR). However, as explained in [1], CSR and its reporting represent the company's corporate culture. The mission, vision values, attitudes, and codes of a company, as well as its specific environment, and its concrete geographical area, have influence on how CSR is understood and applied. Thus, culture is assessed as a main variable that affects and influences all kinds of processes at an individual and collective level. Countries' culture has become, since the first publication of the Hofstede model, a constant topic of research, linked to different areas, as shown in several meta-analysis ([2-4]). The research agenda proposal in [5], includes the operationalization of Hofstede's cultural dimension in research.

The objective of this paper is to reflect on the cultural differences identified by Hofstede on the perception of a quality measure for sustainability reports. Due to the increasing importance of reporting practices in Spain during the last years, we decided to compare Spain and the United States, generally perceived as countries with different cultural characteristics. The study is conducted with advanced accounting

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students in these two countries (Spain and the United States) as a proxy for users of the main information system tool for sustainability, the sustainability report. As the connecting point to previous research, the quality measure model developed in [6] (FRR model) is the initial base of the assessment of students' perception. The hypotheses are formulated linking quality variables with the five Hofstede's dimensions of culture. Although the sample size can be assessed as a limitation, the reliability of the results can be considered as worthy. The following section presents a review of literature in the area, followed by the development of research hypotheses, methodology, results and conclusions.

2 Literature Review

2.1 Hofstede Model: Cultural Differences between Countries

Hofstede presents a discussion of cultural differences based on the results of the analysis of the responses of employees of IBM in different countries [7] and [8]. These differences are categorized into the following five dimensions of culture:

1) Power distance (small to large)

A small power distance index indicates that the employees prefer a consultative style of decision-making, and that they are not afraid of expressing their opinion, positive or negative, to their supervisors. On the other hand, a large index indicates that the relationship between subordinates and bosses is paternalistic or autocratic. As discussed by Hofstede, this concept does not imply that the employees look for this type of relationship, but that is how it is. He finds that in small power distance societies power is based on formal position, expertise, and ability to give rewards, while in large power distance societies power is based on family or friends, charisma, and ability to use force. Also, in small power distance societies the government is based on the outcome of majority votes, while in large power distance societies governments are autocratic or oligarchic.

2) Collectivism vs. individualism

The definition of individualism refers to societies in which individuals have to look after themselves and their immediate family. Collectivism, on the other hand, refers to societies in which people are integrated into strong cohesive groups in which members protect themselves. Key differences he found are that in collectivist societies people are born into extended families and identity is based on the group to which they belong. In individualistic societies, on the other hand, everyone is expected to look after him/herself and their immediate family, and identity is based on the individual. Collective interest prevails over individual interest in collective societies, while in individualistic societies individual interests prevail.

3) Femininity vs. masculinity

These categories are based on what is defined in [8] as social roles of males and females. The masculinity index classifies the masculine characteristic as those related with earnings, recognition, advances and challenge, and the feminine characteristics as those related to management, cooperation, living area and employment security. Hofstede discusses that while in feminine societies the dominant values are caring for others and preservation, masculine societies value material success and progress. Hence, feminine societies live in order to work and stress equality, solidarity and quality of work life; while masculine societies live in order to work, and stress equity, competition and performance.

4) Uncertainty avoidance (weak to strong)

This index measures the difficulties to confront unexpected situations. Countries with weak uncertainty avoidance find uncertainty as normal and each day is accepted as it comes, while societies with strong uncertainty avoidance find uncertainty as a threat and fight it.

5) Long Term Orientation

As defined in [8], “Long term orientation stands for the fostering of virtues oriented towards future rewards, in particular, perseverance and thrift. Its opposite pole, Short Term Orientation, stands for the fostering of virtues related to the past and present, in particular, respect for tradition, preservation of ‘face’ and fulfilling social obligations” (p. 210).

The characteristics of the long term orientation discussed in [8] are: “Perseverance and sustained efforts toward slow results; Thrift, being sparing with resources; Respect for circumstances; Concern with personal adaptiveness; Willingness to subordinate oneself for a purpose; Having a sense of shame” (p. 212).

Previous research found that “individualism was correlated negatively with CSR models, while uncertainty avoidance, collectivism, masculinity, femininity and Confucian dynamism were correlated positively with CSR” [9] (p. 493).

2.2 Measures of Quality of Sustainability Reports (SR)

Although different studies have expressed concern about the quality of the SR, there are not many measures of quality developed.

The author in [10] looks at the characteristics of the SR in terms of their content but not in terms of their quality. The study finds that information about employees is the most highly valued by users of SR.

The study in [11] evaluates the extent to which current voluntary corporate environmental reports meet the requirements of two new sets of guidelines: the Global Reporting Initiative GRI 2000 sustainability reporting guidelines and the ISO 14031 environmental performance evaluation standard.

The authors in [12] evaluate the content and quality of SR using data of Germany's 150 largest companies. Their main criteria for this evaluation selects eight material reporting requirements, and another three additional variables related to general quality. The material reporting requirements include economic and management related variables as well as social and ecological variables related to production, products and supply chain. The requirements related to the general quality of the reports include best reporting practices criteria such as materiality, openness, comparability, and communicative quality. They conclude that “there is not always but often a positive correlation between the reporting on performance and actual sustainability performance.” (p. 232).

Finally, the index described in [6] measures the quality of SR by the following variables: Application level by the GRI guidelines namely A, B, C, according to the level of disclosure required; existence of AS; declaration of application level according with GRI guidelines; if SR reports are presented in different languages; number of items disclosed and availability on-line.

3 Hypotheses Development

Table 1 presents the cultural characteristics of Spain and United States according to [7]. Given those differences, we expect that the measures of quality of SR will be evaluated differently in those countries.

Table 1. Dimensions of Cultural Characteristics: Score, (Ranking) and Distance

	United States	**Spain**	**Distance**	**% Distance (USA-Spain)/USA**
Power Distance	40 (57/59)	57 (45/46)	17	-42,50%
Individualism	91 (1)	51 (30)	40	43,96%
Masculinity	62 (19)	42 (51/53)	20	32,26%
Uncertainty avoidance	46 (62)	86 (17/22)	40	-86,96%
Long-term orientation	29 (31)	19 (35/36)	10	34,48%

Power distance

The United States has lower power difference (40) than Spain (57). Therefore, in the USA, members of society have more opportunities to ask for and access the information they need, as well as express their opinion (good or bad) without the fear of being penalized. In Spain, since hierarchies are empowered, users of information receive what they get, what makes the possibility of on-line access to information more valuable to them than to users in the USA. Furthermore, with high power distance there are fewer checks against power abuse ([8]); therefore, in those societies the existence of assurance might be valued higher than in societies with less power difference.

Individualism vs. collectivism

The United States has higher levels of individualism (score 91) than Spain (score 51). Collectivistic societies pray the wellness of the group. This interest for the group as a whole might make them value higher concepts like availability of information in different languages, as compared with individualistic societies that will be satisfied with information available only in their own language.

Femininity vs. masculinity

The United States has a higher masculinity score (62) than Spain (42). Masculinity is linked to values of success and earnings, recognition, advances and challenge, and the feminine characteristics are those related to management, cooperation, living area and employment security. Given that the index is higher for the US, we expect that in the

US economic disclosures will be prioritized, while in Spain, social and environmental disclosures will be given higher rankings.

Uncertainty avoidance risk

The United States has an index of 46, while Spain has an index of 86. A higher index reflects that the society finds uncertainty as a threat and tries to avoid surprises in their future. We expect this factor to affect the value assigned to the information available.

Long-term orientation vs. Short-term orientation

The United States has an index of 29 (low middle range) and Spain has an index of 19 (low range), as well as proximity in the ranking (31 vs. 35). Besides, this dimension is unique to the East Asian countries; therefore, since both countries have a similar short-term orientation, this dimension presents no significant cultural difference.

The hypotheses are stated as follows;

H1: Measures of on-line accessibility are rated higher in Spain than in the USA.

H2: The existence of assurance statement as a measure of reliability of information is rated higher in Spain than in the USA.

H3: Accessibility of information in different languages is rated higher in Spain than in the USA.

H4: The importance of the SR is rated higher in Spain than in the USA.

H5: Measures of quality related to environmental factors are ranked higher in Spain than in the USA.

H6: Measures of quality related to social factors are ranked higher in Spain than in the USA.

H7: Measures of quality related to environmental and social factors are ranked higher than those related to economic factors in Spain

H8: Measures of quality related to economic factors are ranked higher than those related to environmental and social factors in the USA.

4 Methodology

A survey was conducted among Masters' students in Spain and the United States. Besides demographics, the questionnaire asked students to evaluate using a 1 to 7 Likert-scale, where 1 meant "not important at all", and 7 "highest importance", different measures of quality of SR developed in previous studies.

The measures of quality were classified into accessibility, reliability and informativeness disclosures, and in the last category they were classified into economic, social and environmental categories.

The following are the items asked in each category. The evaluation of the results uses the average of the measures for each category.

Accessibility:
- Access on-line
- Information disclosed in different languages
- SR easily readable
- Information clearly organized

Reliability:
- Provides evidence of what is declared
- Includes AS

Informativeness:
- Economic disclosures:
  - Information about sales/income
  - Information about # of employees by geographic location
  - Segment Information
  - Product Information
  - Type of customer information
- Environmental disclosures:
  - Waste management
  - Energy consumption
  - Environment Protection
  - Protection of the environment where the company is established
  - Compatibility about environment and production
- Average Social
  - Programs and objectives
  - Social Structure
  - Shareholders relations
  - Salary and wages policy
  - Non-discrimination of women and minorities
  - Training and education of employees
  - Job satisfaction
  - Social Programs in the community
  - Political involvement
  - Collaboration with non for profits
  - Consumer protection

5 Results

5.1 Descriptive Statistics

25 students participated in a university in the Northwest of Spain and 25 in a university in the northeast of the USA after being taught a class in CSR. 54% of the students are under 26, 22% are between 26 and 35, 12% are between 36 and 45, and 2% are over 45. 10% did not answer the question. 56% are women. 28% have no work experience, 54% have work experience in accounting and 17% in other areas. The mean ranking assigned to the importance of SR was 3.69 in a scale from 1 to 7, where 1 meant “not important at all” and 7 meant “highest importance.”

5.2 Test of Hypotheses

Table 2 presents the results of the test of hypotheses. Hypotheses 1 and 3 to 5 are supported. The availability of on-line reports is rated higher by participants in Spain than by those in the USA (H1). The disclosure of information in different languages is rated higher in Spain than in the USA (H3). The importance of the SR is rated higher in Spain (H4). Environmental factors are rated higher in Spain than in the USA (H5). With regards to the last hypotheses, social factors are rated higher in Spain than in the USA, but the result is marginally significant. Finally although the existence of AS supporting the SR is rated higher in Spain than in the USA (H2), the result is not significant and the hypotheses rejected.

Table 2. t-test of mean values for Spain and USA

		Spain Mean (std)	USA Mean (std)	Sig.
n		25	25	
H1	On-line accessibility higher in Spain	6.52 (.714)	5.00 (1.56)	**<.006**
H2	AS higher in Spain	6.24 (.970)	5.90 (1.25)	<.3
H3	Languages higher in Spain	6.04 (1.02)	3.48 (1.93)	**<.000**
H4	Importance SR higher in Spain	4.56 (2.24)	2.60 (2.48)	**<.008**
H5	Environmental factors higher in Spain	6.472 (.49)	5.66 (1.25)	**<.005**
H6	Social factors higher in Spain	5.724 (.56)	5.309 (.97)	<.08

Table 3 presents the results of testing the last 2 hypotheses. This comparison relates to economic vs. other disclosures in Spain and the USA. H7 is supported, environmental and social disclosures are ranked higher than economic disclosures in Spain. Although the direction is as expected, H8 is rejected since there is no significant difference in the rankings assigned for environmental and social versus economic disclosures.

Table 3. t-test of mean values for Economic vs. Environmental and Social disclosures in USA and Spain

		Economic	Environ mental + Social	sig.
H7	Environmental and social higher than economic in Spain	5.24 (.90)	6.26 (.62)	**<.000**
H8	Economic higher than environmental and social in USA	5.66 (1.25)	5.57 (.24)	<.8

6 Discussion of Findings and Conclusions

This study looks at cultural differences in assessment of measures of quality of SR between Spain and the United States, following the criteria of Hofstede's model [8].

Spain is categorized as a country with high power distance, with collective and feminine characteristics, and with strong uncertainty avoidance. On the other hand, the USA has low power distance and has individualistic and masculine characteristics. The level of uncertainty avoidance in the USA is lower than that of Spain. There is no difference between both countries in terms of long and short-term orientation.

We find that users of SR in Spain are more interested in disclosures related to the environment and social items as opposed to economic information, which is linked to their feminine and collective characteristics. We expected to find that the US privilege economic information over social and environmental disclosures, due to their individualistic and masculine characteristics, but although the results were in the correct direction, we did not find significance.

Consistent with the characteristics of collectivism, we also found in Spain that the disclosure of SR in different languages is highly valued as well as the availability of on-line reports, opposed to the value assigned in the US. Having higher power distance over the US, we find that users of SR in Spain rate higher the existence of AS accompanying the SR, although the result is not significant. Finally, Spanish respondents value higher the importance of SR, what is consistent with a society more likely to cover up scandals, and with higher uncertainty avoidance.

The results show that there is not a "one model fits all" quality measure for SR, since the value of the variables selected will be more or less relevant depending on the cultural factors of each country. Most of the differences found in the participants' opinions whether they are from Spain or the USA, are, in all material aspects, justified with the theoretical framework of Hofstede's Model. Hence, in order to build a generalized model to measure quality of SR, further research is needed to include some type of correction for cultural factors in each country.

This paper has limitations due to its small sample size, but surveys a population that was found in previous research to be representative of individual investors as found in [13]. Future research should replicate the theoretical framework and the methodology used in this study with a bigger sample, and extending the comparison to other countries, especially in Asia, given that cultural differences extend to other dimensions like long-term orientation.

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Is Advanced Automation Consistent with Sustainable Economic Growth in Developed World?

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Abstract. This paper investigates the impact of automation and new globalization phenomenon, outsourcing on sustainable economic growth. Its main scope is to analyze the impacts of automation technology and offshore outsourcing in manufacturing on a structural unemployment. Simultaneously, in the paper is given a special emphasis to the automation driven shrinking of the middle class in countries that are passing to the phase of deindustrialization. Finally, Three Laws of Automation in Manufacturing are formulated and few ideas and recommendations for the future are outlined.

Keywords: automation, overpopulation, outsourcing, robotic laws, service systems laws, automation laws.

1 Introduction

The purpose of this investigation is to assess the question: is automation the right strategy for the developed nations which practice relentless economic grow, regardless of social consequences? In order to answer this question some review of current automation trends is provided, their advantages and disadvantages are assessed, the automation and outsourcing's impact on industrial decline is addressed, which can lead to the judgment that automation is at the cross-roads. In order to apply wise automation, three laws of automation are formulated and conclusions are drawn, among one of them is the proposal for the development of Technosophy, which should be observed by all stakeholders of the wise automation technology and strategy.

Automation in manufacturing is rapidly unfolding, automated factories become a growing reality whether one likes it or not. This trend is logically associated with the substance of the global economic system that is set up in a manner to gain profit and in which automatic factories are inevitable. But the global economic system is also affected by complex social, political and strategic factors that are to a lesser extent predictable than technological changes.

For example, cost of computer and telecommunication technologies are decreasing dramatically while their speed is increasing exponentially and it is reasonably expected that these tendencies will continue in the future. Similarly, it is possible to

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presage inter-sectoral shifts of the labor force in response to technological changes. The employment shift from agriculture sector to manufacturing that was initiated with the industrial revolution culminated in the 1950s and consequently began declining while the percentage of the labor force employed in services grew rapidly [17].

Analogically, when automated factories will be in developed countries widespread, then manufacturing employment will be dramatically reduced to the indispensable minimum and presently dominating sector of services will expand further. However, the inertial need for higher productivity in the service sector will further decrease traditional employment and would require new sources of generating work for those becoming unemployed through the widespread use of super-automation [16]. Moreover, employment in developed countries is endangered by subsequent phenomena that are connected with new forms of organizations such as telework, subcontracting, outsourcing, off shoring and others.

The problem is diversified in nature that requires not only specialized researches but also use of multidisciplinary approaches. In this paper we intend to explore selected aspect of automation in manufacturing as well mentioned phenomena in the organization of firms related to structural unemployment issues.

2 The Pros and Cons of Using Advanced Automation

The effects of a new technology and its importance to leverage economic growth have been a matter of dispute since the Industrial Revolution. In spite of that, at the beginning of the twenty-first century, it is not possible unambiguously to contain the effects of a new technology and automation, because impacts of technological changes are very complex including such factors as pollution, unemployment, and threats to privacy. Moreover, it has to be considered that technological changes often had different effects on various groups in the society and something is more important for some than for others.

Obviously, automation brings many advantages for manufacturers, especially in increasing production efficiencies and maximizing profits. Moreover, firms can achieve through automation many further effects such as error reduction, higher quality performance, reduction the need for work in harsh physical environments and others. In this connection, our intention in this section is to share some thoughts on this issue.

There is quite known fact presented for instance by Travers and Decker [23] that “jobless growth has been one consequence of new technologies the introduction of which has been accompanied by the globalization of capital, the internationalization of work, and the downsizing of government” However, this view is not fully shared among advocates of automation. For example, Brennan et al. [5] claim that “the high degree of automation in modern manufacturing systems, factory automation and control systems have become central to companies’ responsiveness, and arguably the key to competitiveness”. According to Groover [12] and Dorf & Kusiak [7] “some workers who qualify for jobs in today's conventional factories will not qualify for indirect labor positions in highly automated factories and will not be employable”. But they add that “if companies do not automate their factories for the future, there is likely to be no future for these companies”.

We think, that the right question which should be contested is “What is probability that for companies that will prefer the conventional factory model will have no future?”. To find a satisfactory answer to this question in a direct way is rather impracticable. But we could indirectly investigate relevant potential differences between the conventional factory model and the automated factory. The automated factory can be viewed for this purpose as an integration of new advanced manufacturing technologies (AMT), not all of which are computerized, through computer hardware, software, and databases with computer-controlled machine tools, automated material handling and robotics to form a highly automated and flexible manufacturing system [4]. We can certainly assume, that automated factory at least from competition point of view ranks to a position of World Class Manufacturing (WCM) or World Class Factory. Generally, a status of WCM can be achieved by two concepts: Advanced Manufacturing Technology and Manufacturing Excellence (ME), as it is depicted in Fig. 1. This persuasion is shared, for example, by Hammond [13] who pointed out, apart from other incentives, that “By not ruling out any means to attain competitive advantage, U.S. industry will again attain its position as a World Class Manufacturer.

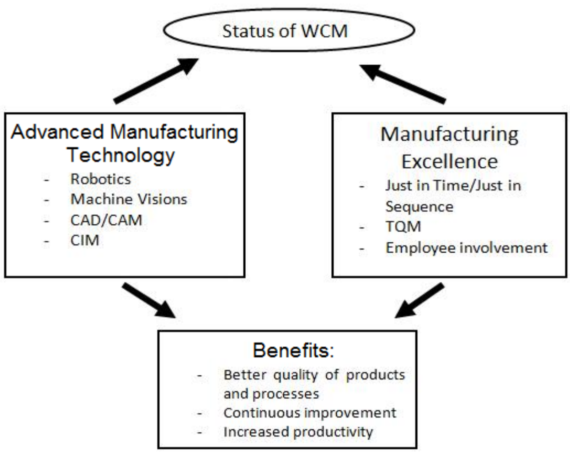

Fig. 1. Two routes to achieving WCM status (adapted from [13])

In generally, separate ways to WCM are characterized as follows. First of them is based on implementation of AMT that includes such tools as robotics, machine vision, computer integrated manufacturing and other automated technology and presents the technical route to achieve the WCM status. For the second way that is also called soft technology, it is necessary to adopt such tools as Just in Time/Just in Sequence, TQM and Employee Involvement methodology. These concepts provide soft enhancements of hard technological solutions.

One of the things that differentiate these two concepts is the necessary level of investment. Naturally, an adoption of AMT involves a high level of investment in contrast with an introduction of Manufacturing Excellence, for which only a considerable managerial effort has to be provided. The major effectiveness indicators of the AMT project are costs and benefits. The problem is that while the costs are ordinarily easily quantifiable, the benefits are often very difficult to quantify. Chen and Small [6] in this sense emphasize importance of strategic benefits such as; early entry to market, perceived market leadership, or improved flexibility, but simultaneously they note that they are not readily convertible into cash values.

Ingersoll engineers in 1985 [19] came up with a set of surprising results from a survey of British manufacturing regarding the risk of introducing new technology in manufacturing firms. They recognized only an 18% rate of success in firms that went for the high technology option; 34% rate of success in firms that invested to the medium level of technology; 60% rate of success in cases when companies underwent only partial equipment change with reorganization; and with an 84% success rate in firms that staked mainly on organization changes, introducing only a minimal changes in equipment. The results obtained may be graphically presented as it is shown in Fig. 2.

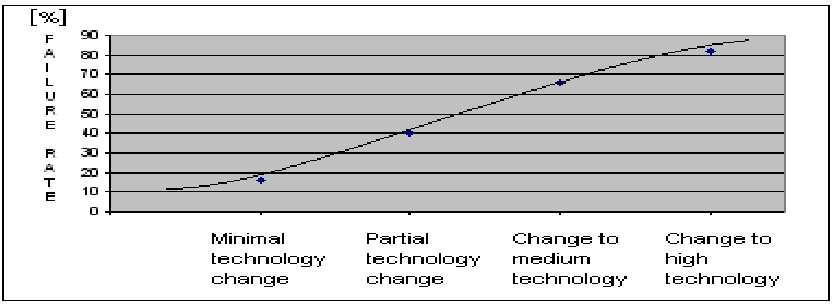

Fig. 2. Assessing the failure rate of introducing new technology in manufacturing industry (adapted from [17])

To prevent a potential risk related to low rate of return of AMT-oriented investment for firms, Schonberger [20] recommends investing in the simplest equipment possible and improving present equipment before considering new equipment and automation. Summarily, a highly anticipated comparison of these two concepts based on decisive criteria is shown in Table 1.

Table 1. Comparison between the AMT route and ME route

CRITERIA	AMT-oriented approach	ME-oriented approach
Managerial effort	Lower	higher
Level of investment	Higher	Lower
Negative environmental impact	Higher	Lower
Rate of unemployment	Higher	Lower
Benefits	comparable	

Thus, a dependence of the competition ability on the extent of investment to the AMT and extend of managerial effort to ME, respectively, can be modeled as depicted in Fig 3.

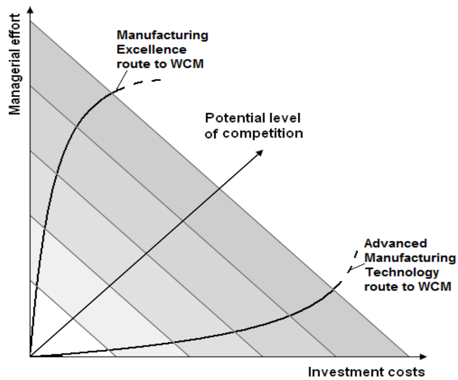

Fig. 3. Model of a dependency of the potential level of competition on the optional routes

Assuming results of comparison of values from Table 1, it is quite evident that debatable quoted above opinion: "if companies do not automate their factories for the future, there is likely to be no future for these companies" has a low probability of being true. But, even though, investing into advanced manufacturing technologies (ATM) and in general in automation is potentially risky, the technically-oriented approach remains only a promising one. Needless to say that these two approaches are frequently mixed what can be optimal solution to attain expected positive results.

3 Automation and Outsourcing's Impact on Industrial Decline

In the last 50 years one can recognized the following approaches towards automation: (a) developing separate components of automated systems, which can fit in most of integrated configurations; (b) developing flexible integrated systems which can optimize overall performance; (c) developing data mining systems, which generate knowledge rules about their functionality and can control adaptively according to new emerging situations. However, in the 2000s, along with the advanced applications of the Internet in manufacturing (d) a new trend of outsourcing takes place, particularly in countries such the U.S., United Kingdom, and to certain degree in Germany, where the expensive labor is being replaced by less costly labor in developing countries such as China and India.

In effect, a concept of automation in so far advanced countries (mentioned above) is marginalized, since these countries are passing to the phase of deindustrialization. Consequently, a reform of the manufacturing industry is now a core strategy for government and private sector. In this context a new term "the automation of custom manufacturer" is introduced and new CIM concepts and technology-intensive industrial structures are anticipated. What factors will motivate decisions for automation in the near future? Three decenniums ago, there were a number of economic and social factors that provided motivation for automation in manufacturing such as, increased productivity, lowering high cost of labor, avoiding labor shortages, improving the use of expensive raw material by better engineering and automation, reducing manufacturing lead time, reducing of in-process inventory [11].

Will they be the same as before? In our opinion, following reviews of automation in the last 100 years will look not at the technical advantage of automation but at its social implication. Mostly it will be looked into following factors:

How automation results in the subjugation of the human beings by machines in times of population growth?

How reduced labor force by automation impacts unemployment rates?

How automation reduces purchasing power of eliminated labor force employed in manufacturing?

Thomas Friedman [10] in his best-selling book "The World is Flat" noticed that the transfer of services and manufacturing from the developed to developing nations also transfers wealth. As a result of it, the world becomes economically "flat." It is interesting to notice that the main tool of this flattening process is the Internet, which was not developed because it was financed by wise capital, as it is true in many other technologies. In fact, the Internet was developed by the military and scientific community.

With off-shore outsourcing strategy and free trade policy of the Global Economy, more and more western businesses are closing up shops in the United States (about 40,000) in Germany and the United Kingdom as well, and moving elsewhere (mostly to Asia), taking millions of jobs with them. The result is a sharp drop in American middle class' standard of living. This was a proud fruit of successful 200+ years of the American Way of handling economic development. Suddenly, these two hundred years of steady climbing to the highest standard of living (by a large country) in the world are put in a reverse gear and leading to the Big Crash 2008-2011 of the American middle class. It leads to a national divide between the global elites (a New Ruling Class) and those have been left behind.

Needless to say that exporting jobs to Asia and Mexico, the corporate elite is destroying the American dream and profiting from the exploitation of sweatshops. Abandoned by their government, American workers (and English ones too) are being forced to compete with cheap Third World labor and are inevitably losing out (Buchanan, 1998).

Global and stateless corporations are profitable, but the competitiveness of the people, business, and communities rooted in the U.S. economy is relentlessly deteriorating. American (and to certain degree English and German as well) workers, from the unskilled to highly educated engineers and research scientists, have been set adrift in a sea of dog eat-dog competition that guarantees a substantial drop in their living standards [9].

Outsourcing and off-shoring can be compared with traditional market competition expanded in a global economy, and enabled by an increasingly robust information infrastructure. Market economies are relentless in their drive for efficiency and productivity. Historic barriers of transportation logistics, off-site management, and knowledge transfer have been greatly reduced by information and transportation technologies. There are obvious short-term financial benefits available to companies by moving well defined systems and processes to lower cost areas of the world. Short-term effects on developed societies are less attractive than they are to companies, with less available jobs and fewer opportunities. Long-term consequences for everyone are open to debate, and potentially foreboding.

Forrester Research estimated in 2004 that American companies will move 3.4 million jobs offshore by 2015. About a third of those jobs pay $46,000 per year or higher [3]. Labor union AFLCIO [1] estimates that the United States lost about 2.7 million manufacturing jobs between January 2001 and August 2004 (AFLCIO, 2007). The U. S. Government Accounting Office indicates that services associated with off-shoring grew from $21.2 billion in 1997 to about $37.5 billion in 2002, an increase of more than 76 percent. But exports from the U. S. of those same types of services also increased by over 48 percent [14].

Fig. 4 describes the long-term effects of continued job losses from off-shoring. Short term profits for U.S. companies improve from lower costs but long term effects of a less complex economy resulting from the loss of the country's manufacturing base, the proliferation of low paying service jobs, a shrinking middle class, and large trade deficits produces a new world economic order in which the United States will play a much less prominent role. In this scenario, the country experiences lower national security becomes a follower rather than a leader in technology and education, experiences a decline in standard of living for its citizenry, and has to contend with a much more radicalized political structure.

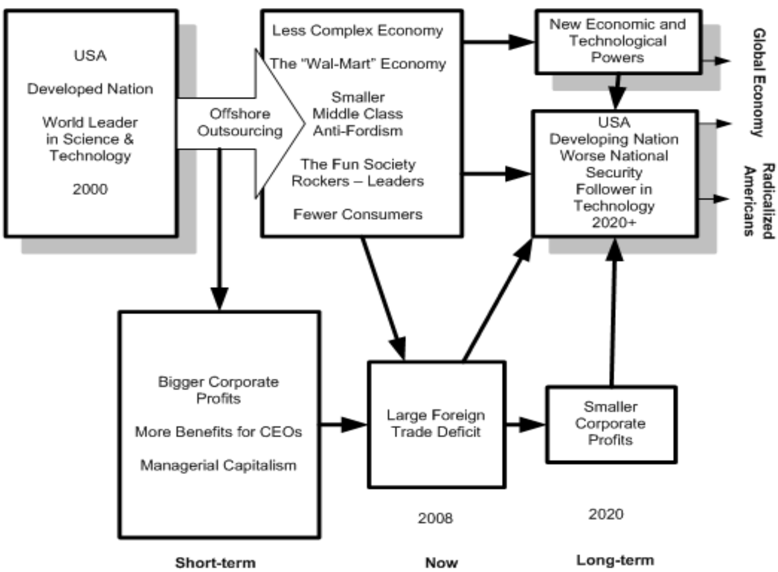

Fig. 4. A model of the consequences of off-shore outsourcing for the U.S. [21]

The following conclusions on off-shore outsourcing can be offered:

- Outsourcing needs sophisticated management that balances short-term profit with long-term investment in competitive position.
- Manufacturing and information technology off-shore outsourcing is a potential strategic threat for the American economy and society.

4 Automation at the Crossroads

A number of important questions one can asked and reply about the effect of automation on society in developed countries:

a) Will automation raise standard of living? Perhaps *moderate* automation could. But today in developed economies we deal with the declining automation due to the trend of outsourcing manufacturing and service to less developed nations where labor cheaper than automation. As the result of it, the middle class is declining in these nations and its standard of living.
b) Does automation create unemployment? Yes, it creates unemployment in developed nations. But because automation's processes are outsourced they can be instantly online controlled by the Internet from the developed countries.
c) Will more skill be demanded or less? In developing nations, the deindustrialization reduces complexity of economy which as service-oriented does not need high science and engineering-oriented skills. In developing nations automation-oriented priority is not the issue, since cheap labor competes with westernized automation.
d) Will workers get more satisfaction from their jobs? No, since they move to service positions, which do not require intellectualization of their work.

However, certain automation of global information systems provides manufacturing and service jobs in developing countries. Because distance is "dead" and electronic management of global, dispersed enterprises is possible. This is considered by the developing nations as the historic justice accomplished and the problem of the North-South colonial issues is being resolved.

The real danger is not that automation and robots will make us mad with power, or that human-like humanoids will themselves become super intelligent and take over the world. The consequences of their introduction will be subtler. Inexorably, we will interact more with machines and less with each other. Already, the average American worker spends astonishingly large percentages of his/her life interfacing with machines. Many return home only to log in a new.

Human relationships are a lot of trouble, forged from dirty diapers, lost tempers and late nights. Machines, on the other hand, can be turned on and off. Already, many of us prefer to forge and maintain relationships via e-mail, chat rooms and instant messenger rather than in person. Despite promises that the Internet will take us anywhere, we find ourselves - hour after hour - glued to our chairs. We are supposedly living in a world with no borders. Yet, at the very time we should be coming closer together, it seems we are growing further apart. Humanoids may accelerate this trend (Ethical Considerations, [8]).

In 1942 – Isaac Asimov [2] wrote "Runaround," a story about humanoid robots which contained the "Three Laws of Robotics":

1. A robot may not injure a human, or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders it by human beings except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

In 2009-Andrew Targowski [22] defined Laws of Service:

1. Do not develop service systems without human presence.
2. Do not develop service systems which harm society.
3. Do not develop service systems which endanger human race.

Law I protects people against passivity. Law II protects society against structured unemployment. Law III protects the human race against the bifurcation into two kinds of species.

This paper authors (Targowski & Modrák) offer the following Laws of Automation in Manufacturing:

Law I. Do not implement high automation technology before you are not sure that same goal can be achieved by another means.
Law II. Do not implement automation technology with aim to totally eliminate human presence in manufacturing process.
Law III. Do not develop automation which harms society or endanger human race.

It would be necessary to organize a forum for suggestions which could improving the laws and promote their applications. Thereafter it would be useful to open even wider forum for discussion, making preconditions and recommendations how future manufacturing systems should be developed and managed in a responsible manner for the good sake of Society.

5 Conclusion

According to known facts, factory automation caused during the last decade worldwide decline in manufacturing jobs, not only in developed countries but in developing countries as well in a uniform manner. Hence, the laws of Robots, Service and Automation Systems should be implemented into society undertaking as follows:

1. The automation systems are one of the most complex systems in civilization which triggered tremendous developmental trends in science and technology in the 20th century. They looked very promising at their early stages, but later provide many doubts about their positive role in Society.
2. The automation systems designed for better effectiveness and reliability & quality are as long positive as long they do not harm and endanger human beings and society.
3. The presented Laws of Robotics, Service Systems, and Automation should be included in codes of ethics of appropriate professional associations.
4. The governments should established national policies for applying these Laws of Robotics, Service and Automation.
5. The professional education should include in its research and teaching these Laws of Robotics, Services, and Automation as securing ones of societal well being and civilization sustainability.

In order to integrate all these laws into one coherent discipline, a new one should be pursued. Perhaps it should be covered by Technosophy, which should investigate *wise engineering* for *wise civilization*. Technosophy is relatively a new term which is needed to identify a purely techno-scientific approach to technology. According to Levy & Junkar [15], Technosophy suggests the need to develop wisdom to accompany the science of technical artifacts. This kind of engineering should be only developed today and aimed at the sustainability of our civilization in times of shrinking strategic resources of the planet. It is widely known that population becomes too big to sustain our western styles of life, even in short-term future. Therefore, many leading corporations comprehended these challenges and adopted sustainability planning over the past few years as a tool to achieve strategic dominance [18]. Hence, the future is now and Technosophy is, in our opinion, needed today as never before.

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The Wisdom Innovation Model - Adjusting New Insights and Hosting New Perspectives to Human Augmented Reality

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Abstract. In this paper, the process of constant innovation is analyzed comparing with the various economic eras that humanity has come through and even with the level of countries' development. While technology enables the possible application of knowledge, the level of expertise may be evaluated by the effective outcomes. In this perspective, analyzing the concept of multimedia interactive books and its impact on learning, suggests the importance or need for emotional and knowledge management in a productive way instead of a reproductive type of learning. The aim of this paper is to present the findings of a Delphi research on the challenges of bringing new possible business models, economically efficient and socially effective when exploring new media tools for enhanced learning based on the technology of augmented reality and to adjust new insights and host new perspectives to the forthcoming human augmented reality.

Keywords: multimedia, interactive, augmented reality, technology enhanced learning, business model, innovation, economics, knowledge, web 3.0, future internet, cloud computing, intercommunication, wisdom, societal development.

1 Introduction

The way firms and other non private organizations combine available resources and technology to deliver value by providing more benefits in relation to costs, as perceived by clients and partners, will determine the marketplace for each product and service proposition. But, when it concerns to launch innovations in the market the successful formation of a marketplace, where supply meets demand, shall have a certain dependency on the specific systemic conditions and characteristics of each geographical region no matter how intensive is the popular phenomena of "globalization".

Because of the various themes arising from technology and learning issues' debate, perhaps is too ambitious to draw upon the results of research concrete new business models. Anyhow, the digital imaging accelerated expansion in the various contexts of graphic and audiovisual creation and has led to many major changes, as well as has promoted the development of a growing digital culture, pushing the boundaries of human value and enabling them to perform increasingly complex tasks. If the eighties

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can be considered as the decade of the introduction and expansion of computer technology, the nineties constitute the early visual experimentation and finding new 'languages' for inter-communication. Thus, based on present and future work one can at least envision the major developers for new tools and services which can trigger an intense interesting debate about its effects on a variety of contexts, from teaching and learning issues to intellectual property rights and governance.

The contextualization of this article requires for a global approach to the emerging issue of Augmented Reality (AR) technology which is a multidisciplinary field of computer science, involving areas like 3D Computer Graphics, Computer Vision and Human-Computer Interaction, dealing with the combination of real-world and computer-generated virtual reality, where computer graphics objects are blended into real video footage in real time. According to Azuma et al. (2001), AR requires the following three characteristics/processes: (a) combine real and virtual environments; (b) interaction in real-time; and (c) registering 3D objects in real environments [1]. Furthermore, and in a more strictly contextualization, it is also relevant the presentation of the Multimedia Interactive Book (miBook[1]) which is a new tool providing a responsive and interactive learning environment which handles with different types of content. miBook may represent a notable instrument for enhanced learning (for individual use or in the classroom) as well as it can represent a great step forward, regarding the enhancement of current digital libraries. Additionally, miBook combines a printed book (or its digital format) with the respective audiobook and its story-related 3D models (as well as 2D graphics), using AR and other multimedia technologies, as frameworks to present and interact with its audio-visual content. Technologically, miBook environment consists of a handheld camera, a personal computer (to generate user's individual AR views), and a physical book. miBooks uses "normal books" with text and pictures on each page and have an additional audio content – the correspondent audiobook.

The results of a Delphi consultation process on miBook's benefits and possible business models has produced the following five major findings, (1) New enhanced learning tools are actually needed and, a set of strategies and recommendations are listed for the development of the miBook's tool, being the most relevant development factors concerned with Structural and Human Capital; (2) the e-book, the audiobook and the miBook tend to be more important and growing in terms of number of users in the near future; (3) Creativity, Realism and Accessibility are the most important benefits for miBook's users during the learning process; (4) Intercommunication and Wisdom are to be of growing importance in near future; and last (5) recommended business strategy for miBook is possibly sustainable when supply is focused on different marketplaces, corresponding to different users' needs: Professional and Business, which are potentially the ideal major developers of the business models for the new media tools.

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This article is organized as follows. After the introduction (section 1) concerning the specific results from a Delphi research and the challenges of bringing new possible business models for innovative media, followed by a brief presentation of the miBook, section 2 focuses on a brief literature review on knowledge society and the phenomena of digital divide. Section 3 focuses on governance and innovation networks and on the process of constant innovation compared with the various economic eras that humanity has come through and with the level of countries' development. While expectations on the Web 3.0 are foreseen in a new economic era, here called Wisdom era (section 4), section 5 adjusts some new insights on modeling innovation systems within the structural scenario of collaboration and sharing. Finally (section 6) presents the basis of new possible business models, economically efficient and socially effective when exploring new media tools for enhanced learning based on the technology of augmented reality and lists some conclusions and limitations (section 7) to adjust new insights and host new perspectives to the forthcoming human augmented reality environment in the near future.

2 Digital Divide in the Knowledge Society

The Web environment represents the facility of having a graphical user interface for hypertext navigation with a browser. Under this perspective, the Web may be seen as the "tool"[2] or the part of Internet that allows for easy navigation in the millions of interconnected computers across the all planet. Users send and receive the data files, create, and view or listen to the content based on internet infrastructure. The power of individuals over digital contents keeps on growing as the proliferation of innovative gadgets produced by the Information and Communication Technologies (ICT) industries, the increasing accessibility to the internet and the ability to upload content that affects original contents. Internet technology is underneath this possibility of co-creation where wireless access network and consumers' control increased demanding for new market structures able to provide them more and more value in a extremely competitive and fast scenario. Nevertheless, as recently stated in a critical review: "*Notwithstanding the opportunities created by the spread of digital technologies, the increasingly global reach of the Internet and mobile telecommunication networks and open collaborative models for innovation and learning, there is concern that these developments also are giving rise to new sources of inequality*" [2]. One of the features of the information and knowledge societies is the Digital Divide explained by some local economic structures, ICT policies and insufficient literacy as well as insufficient physical access to computers and connections.

Multimedia digital content, on-line and off-line, is visibly larger and keeps on growing. Looking, for instance, to the success of the collaborative web-based encyclopedia "Wikipedia[3]", it is intuitive that people of all educational levels and cultural backgrounds are keen to use digital media and also in helping to improve a

[2] The Web has been the major developer for the new tools and services along with other multimedia technologies.

[3] A wiki is a website that allows the creation and editing of any number of interlinked web pages via a web browser using a simplified markup language or a WYSIWYG text editor. *Wikipedia: http://en.wikipedia.org retrieved 25/02/2010.*

web-based system. But yet, all of these types of social applications as blogs, audio and video communication through internet technology and based on the e-commerce business models are no longer interesting since the latest features of technologies announced several applications based on the on-line virtual computing systems.

As an evolving concept, convergence encompasses a combination of opportunities and challenges, not only for the ICT industry, but also for regulators, policy makers and society at large. The "digital divide" (the division between those who have access to ICT and are using it effectively, and those who do not) has a real impact on everyday lives that can potentially create further imbalances, especially in the developing world. "Since information and communications technology is increasingly a foundation of our societies and economies, the digital divide means that the information "have-nots" are denied the option to participate in new ICT-based jobs, e-government, ICT-improved healthcare, and ICT-enhanced education (Bridges[4], 2010)". According to Bridges' studies the Real Access (access providing possibility for people to use ICT in such an effective way allowing the improvement of their lives) to ICT is conditioned by three determining factors:

- Insufficient physical access to computers and connections (affordable capacity);
- Insufficient ICT literacy (educational structure and policies);
- Local economic structures and ICT policies.

3 Governance and Innovation Networks

Computer technology has now been around for several decades (since the 1960s) and since the 1970s that the world economy was ready to spawn new leading sectors. For the first time the world experiments a revolution that was not based on the emergence of a natural resource, a new form of energy or a transport cost reduction. The basis of this revolution was an impressive decrease on communication costs and the globalization in the services' sector. The information technology sector mattered not just because they produce valuable equipment, such as computers but also because their impact throughout the economy by developing innovative wider range of associated services sector. Great transformations occur in economic organization and social structures of developed societies. Services' sector increases the proportion in the total output due to the greater importance of labor resource (in quality and in quantity) widening inequalities in income distribution. Businesses had to reorganize and the role of state has to change by intervening through redistributive policies.

In 2000, the Lisbon Agenda was launched calling for the European Union to become the most competitive and dynamic knowledge-based economy in the world, with more and better jobs and greater social cohesion by 2010, which presupposed strong investment in research (source of new knowledge), in education and in training in order to allow all Europeans access to learning and knowledge. That would only be

[4] Bridges.org is an international organization with a mission to promote the effective use of information and communications technology (ICT) in the developing world for meaningful purposes, such as better healthcare, education and self-sustaining economic development. [http://www.bridges.org/publications/85 retrieved 25/02/10].

possible if the active population is formed in information technology, keeping learning throughout life and allowing them to participate actively in society [3], [4].

Innovation is a clouded issue since in 1934, Schumpeter published his pioneering work on the innovation theory – The theory of economic development - where he points out that an innovation is distinct from an invention, arguing that entrepreneurs innovate not only by explaining how to use the inventions but also by introducing new means of production, new products, and new forms of organization. According to the European Commission (EC) "innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relation. The minimum requirement for an innovation is that the product, process, marketing method or organizational method must be new (or significantly improved) to the firm"[5], therefore regarding the production, assimilation and well-succeeded exploitation of novelty in economic and social domains [4], [5].

In general, according to studies in the field of economic growth, only technological progress is capable of causing continued/sustained economic growth. Technological progress is the firms' capacity of innovation and occurs through the changes and/or through the introduction of new goods and new services in society. To this end, new ideas alone are not enough, it is necessary that entrepreneurs are willing to take risks to put them into practice so that they become profitable, it is necessary the creation of appropriate conditions conducive to the emergence of innovation, namely the investment in research and development (R&D). Spending on R&D is distinct from any other investment in other resources because innovations may, potentially, be used by many companies at once therefore increasing continued growth in the level of society.

The evolution of the world economy focuses, after the Agricultural, Industrial and Information eras, on the actual era of Knowledge which is based on three main pillars: knowledge, Innovation and Technology. The first pillar determines economies' performance according to its knowledge level whether if it is in the form of intellectual capital and / or in the process of constant learning; the second pillar, in this order, expresses knowledge through creativity and, in a systemic way, the potential capacity to innovate of societies and; the third pillar, technology as the underlying possibility for increasing productivity.

The role of State shall change whenever transformations (increasing competition and modifications in firms' dimensions and structures) occur in societies because these transformations naturally affect people's behavior and needs. New governance models are needed to address different market conditions brought by innovative processes, products and services.

In a critical paper reviewing information society, Mansell (2008) [2], referring the post-War World II period, states that "*Innovations in ICTs provided technologists with new toys. If bigger and better versions could be built, they could be sold to the military-industrial-complex, the richest client for their wares. Economists were looking for a productivity strategy to stimulate growth of new information-related industries.*" In those years, the actual denominated "Traditional Model of Innovation",

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[5] `http://ec.europa.eu/enterprise/policies/innovation/glossary/` (retrieved 21/10/09).

talents should work within the companies which, kept innovative discoveries internally and at the same time develop and commercialize them in order to get profits from R&D. Pioneering companies launching innovation were guaranteed successful hence it should always go to market. Adding to this, naturally, patents should be controlled in order to avoid competitors to copy them. The paradigm of "Open Innovation"[6] [6] outlines a new environment for R&D and replaces the traditional logic of the innovation process (closed off from outside ideas and technologies) with a new logic framework process, assuming that firms can and should use external ideas as well as internal ideas, as well as internal and external paths to market, as the firms look to advance their business models.

"*Intellectual capital is recognized as the new economic era's pivotal factor underlying value creation*" [7]. Underneath the logic of competitiveness and profitability in which companies constantly need to operate there is a product (or market) and the need for this product is actually the reason for technology to exist. Companies approach innovation in order to satisfy their customers (companies are driven by market instead of technology-led) and therefore the resources and capabilities needed to do so depend on a complex system wider than just technology or innovation. Adding to this, the increasing mobility of people, goods, and information has driven society into a trend towards cultural uniformity. An educated population is more efficient and this has an influence on the well-being of individuals as they tend to minimize waste, as well as it has a positive impact in the economic health as a whole. However, the effects that education has on the economy are not fully accountable at the time that this type of intangible investment is made. "*Business dynamics of the coming century will by necessity be an integrated and technologically networked global economy, recasting comparative advantages and discriminating pricing for goods and services*" [7]. While this vision calls for a different, renewed understanding of business principles and decision-making processes whilst there will be an increasing demand for intellectual capital resources, a review through some of the principal capabilities is needed to lead firms to success.

Recent understanding of the Web consists in the distinction among the first generation of internet technology - the Web 1.0 - which connected people to networks, the second generation - the Web 2.0 - which connects people with machines and with each other, including blogs and several social networking applications such as photo, video, and bookmark sharing, and finally, the third generation, the so called Web 3.0 *"emerging with better technology and web applications and envisioning the intensification of user's engagement, sharing and co-creation"* [8].

4 Expectations on the Web 3.0

While the Web 1.0, also seen as the *"Information Web"* or as an extension of the off-line media [9], allowed for the global accessibility to static data and information produced by others, centralizing contents' production, the Web 2.0 came with the advent of large volume and cheap storage devices and increasingly adopted

[6] "Open Innovation" is a term promoted by Henry Chesbrough, author of "Open Innovation: The new imperative for creating and profiting from technology", Harvard Business School Publishing: Boston, 2003.

broadband connections, pushing the contents' marketplace into devices that support more open deployment standards. According to Bernal (2010; p. 25) [10] a sub-categorization might be considered, the "Web 2.5 or the Symbiotic Web", defined by a "*current e-commerce model, which relies heavily on the supply of 'free' content, has made individuals and commercial enterprises mutually dependent: enterprises have built business models reliant on a currency of personal data, while individuals expect free access to services supplied by search engines, email systems and social networking sites, and media services such as YouTube and Hulu* [10].

The Web 3.0 shifts towards the possibility of sharing information and knowledge by interacting with others. Contents are no longer centralized and the accessibility is now local, that is to say, if in the Web 2.5 communities are partially out of industries' control, in the Web 3.0 the power shifts from sellers to buyers, definitely increasing market competition. Sellers hoped to replicate the revenues generated by greater efficiency verified during industrialization, as societies became more dependent on services, and they did it again in the Web 1.0 and also in the Web. 2.0, during the Information and Knowledge eras somehow, supporting their strength in the market through the use of Digital Rights Management (DRM). With the growing ICT innovations during the Information and knowledge eras "*policy makers were trying to maintain full employment and growth, and information workers (such as librarians and software engineers) were attempting to increase access to knowledge by crafting better tools for accessing information*" [2].

5 The Wisdom Innovation Model

In the Web 1.0, DRM tools helped establishing business models by providing the market opportunity to the contents' providers but in the Web 2.0, although business models previously established by DRM software still support a certain class of business concept coming from the 'Industrial-Information' economic eras both based on traditional and / or Open Innovation models, this transition to the third generation of the Web has started to evidence that possibly, the established business models based on DRM are no longer efficient.

The application of the principles of Open Innovation simply replaced the control of patents for direct or indirect brokering of data and information resources, generating revenues through targeted groups of customers caught in the markets' construction of previous innovative technologies.

"*Patents are increasingly stretched out to cover "ideas" that twenty years ago all scholars would have agreed were unpatentable*" [11]. The reasons pointed out for the enclosure movements defend that the control over exploitation, in general, ensures that resources are efficiently used and that the common use of tangible or intangible capital would lead to unproductive results.

According to Boyle (2003) [11] we are in the middle of a second enclosure movement - "*the enclosure of the intangible commons of the mind,*" and … *there is a danger of overstatement. The very fact that the changes have been so one-sided makes it hard to resist exaggerating their impact.* The vision that "*ideas and facts must always remain in the public domain [12] - is still supposed to be our starting point, it is, however, under attack. The European Database Directive does (and the various* *proposed bills in the United States would) create proprietary rights over compilations of facts, often without even the carefully framed exceptions of the copyright scheme, such as the usefully protean category of fair use* [13]".

The environmental adequacy of an innovation system facing the Wisdom Era within the paradigm of the Web 3.0 shall require deep analysis of the presented societal characteristics and surely suggests few additional characteristics bringing a possible important redefinition of the innovation model which we baptized as Wisdom Innovation Model (see Fig.1 below).

International Innovation Network			
Other wisdom innovation models	**Intercommunication**		
	Wisdom Innovation System		
Macroeconomic conditions and Public policies	**Human Augmented Reality**		
Scientific system	Management	Digital and Internet access	Communication and future vision
Banking system and Venture capital	Knowledge generation and learning	Innovation and entrepreneurship	Firms capabilities and networks

Fig. 1. Wisdom Innovation Model

A more detailed description of this Wisdom Innovation Model (WIN Model) envisions the validity of critical future scenarios based on open services platforms and on the level of societal development and economic growth supported by functional architectures of the next generation of the Internet or, the 'Future Internet' or even the 'Internet of Things', offering higher broadband, interactivity, mobility and personalization features. Citing Kevin Ashton, author of the expression 'Internet of Things', "*Nearly all of the roughly 50 petabytes (a petabyte is 1,024 terabytes) of data available on the Internet were first captured and created by human beings - by typing, pressing a record button, taking a digital picture or scanning a bar code. Conventional diagrams of the Internet include servers and routers and so on, but they leave out the most numerous and important routers of all: people. The problem is, people have limited time, attention and accuracy—all of which means they are not very good at capturing data about things in the real world.*"[14].

In this envisioned world of services, where there is greater intangibility (it is more and more difficult to find a single product which is not provided along with an intangible service), often, suppliers and customers will ask to be fully integrated in terms of what is really needed and where should be needed. The concept and basis of the 'Flexisecurity[7]' [15] concerning the labour market and the social security in Europe should represent very well that the same need is urging for any market, e.g. companies will be more flexible, being closer to their target markets in order to maintain their inter-temporal value chain to provide efficiently more value added to their customers. This introduces the need for permanent intercommunication between customers and suppliers which may reduce the tension between mass production (cost effectiveness) and customization (matching customer's needs). The possibilities of co-creation of newly and value-added services are not based in single knowledge anymore: technological environment already provides the sharing of wisdom in an open structure provided by the Web 3.0.

The natural intercommunication attitude creates the space and accelerates the chances for wisdom to flourish and contribute to societal development in the sense that knowledge stands for a self internal construction while wisdom can only be achieved by sharing knowledge and collaborating with other's knowledge. The importance of both external and internal knowledge resources along with the general idea that the creation of efficient business models may sometimes be more important than to generate innovations, but rather important than business / marketing is value creation through promoting Creativity, Realism and Accessibility to knowledge thus allowing the construction of a wisdom based society.

A 'better' business model is better because among other direct effective (and positive) characteristics, it does not imply inefficiencies and, in particular when speaking about knowledge, a 'better' business model should not lock the door of knowledge to anyone in society. The value creation capable of higher productivity relies on different market rules based on a collaborative concept of governance possibly based on the nature and implications of the Fifth Estate'[8] [16], enabled by networked individuals and the consequent reconfiguration of access to information, knowledge and wisdom interactivity.

6 HAR - Human Augmented Reality

Behind this Web 3.0 it is hidden the possible success of making more efficient use of own ideas along with the possibility of collaborating with external parties and sharing knowledge in a growing level of interaction and collaboration. Along with this advent, virtualization is rapidly transforming the information technology state-of-art and changing the way people compute.

Computer hardware designed to run on a single operating system have come to an end, more than ever, the Web and other open standards are demanded by users who

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[7] Flexisecurity is defined by Viebrock/Clasen (2009: 306) as a "*...carefully balanced combination of flexibility, where it matters for job creation, and protection, where it is needed for social security...*". [15].

[8] "*The rise of the press, radio, television and other mass media has enabled the development of an independent institution: the 'Fourth State'. … The growing use of the Internet and related digital technologies is creating a space for networking individuals in ways that enable a new source of accountability in government, politics and other sectors: the emerging 'Fifth State'* [16]".

already have their own portable data. The Web 3.0 started many recent positive developments in the field of virtual and augmented reality platforms.

AR has gained a great deal of attention since 2005 but the success of AR as a technology for the "Augmented Learning" still depends on factors that are largely out of the hands of its creators. For the entertainment industry and marketing / advertising companies AR has already proved to be successful and quite profitable, as for instance in the entertainment and marketing industries.

The biggest challenge for AR is now on mobile devices like smartphones or tablets with hardware robust enough to handle AR applications. Mobile AR will possibly represent the major technology that will shape content markets in 2020. This understanding opens the door for many new product opportunities that provide value to demanding customers of the future. Web 3.0 comes with a new distribution model proposal where this time; intermediaries play an important role as collaborative partners. The Web 3.0 shall provide an adequate answer to this demanding environment characterized by a different type of technological relation with mankind: "Human Augmented Reality" or HAR, potentially driving the world to a new economic era of "Wisdom".

Thus, it shall be critical to answer the question: how innovation should be delivered to consumers? Using the economy to bring about a modern society requires the fast adoption of an overall education and training program for all ages at all levels. For this kind of society to become real it shall be necessary to change "structures" in what it concerns to innovative business models capable of greater efficiency and more valuable outcomes comprising real societal development.

A product is measured by the benefit(s) that satisfy the need of a consumer. On the other side, this benefit(s) is represented by the quantity of money or other items of value that the consumer is willing to pay.

Some innovative products or services come exclusively with the Internet but other products, like books, music, movies or any other type of multimedia contents for example, simply use new distribution channels, often adding unique technology-enabled services. The web-based business model is a method by which the organization sustains itself profitably, in the long term, using ICT in order to deliver its value proposition to stakeholders and clients.

An open attitude of sharing knowledge and teaching - knowledge from inside to exterior or wisdom attitude - enhances the chances of discovery and co-creation. Also commercial innovations have this potential capability. miBook's proposal, concerning digital / virtual content, suggests this HAR relation creating more value through promoting Creativity, Realism and Accessibility. Although business innovators face incentives to limit the access of competitors to their innovations and therefore preventing others from gaining access to their discoveries, AR technology opens the door for this authoring tool – miBook - in order to facilitate co-creation and promote knowledge sharing. The most relevant theoretical arguments for cooperation among companies comprise the sum of principal practical benefits: reducing costs of technological development or market entry; to achieve economies of scale in production, and; to reduce development time and facilitate faster marketing new products [17].

Once there appears to be consensual that new enhanced learning tools are needed and, that digital contents (in particular, e-books, audiobooks and miBooks) tend to be more important and have greater number of users, further and faster development of miBook should have strategic interest for both producers and users.

In order to be able to create more value to users, a Wisdom (Knowledge and Emotional management) environment and Intercommunication among interested parties will be critical for this enhanced tool to be validated and wider disseminated.
Naturally, learners always look for the most efficient tools to access contents achieve their learning objectives which has been identified by miBook users' experience; also the Delphi survey identifies potential structural and human factors in miBook's proposal in order to achieve greater learning efficiency. The suggested business strategy by the Delphi panel includes two major developers of business models for miBook: Professional and Business.

The educational scenario in 2014 envisions the inclusion of new enhanced learning tools constructed under structural and human needs, in order to answer demanding learners of the Wisdom era.

The science of enhancing a live experience with virtual components and information breaks with the paradigm between tangible and intangible by presenting no borderline between physical and non-physical. After all, AR suggests no separation at all between state and process, questions the pre-conception of a clear divorce between real and virtual or between mind and body.

7 Discussion, Conclusions and Future Work

For the success of AR technological applications in the educational scenario an attempt has to be made, reviewing the challenges faced by the contents' industry since the web companies started to produce open source platforms of information and knowledge and offering the possibility of social intercommunication and collaboration. But the most valuable contents are still not easy to access in the most efficient way. Although miBook has proved to be successful as a prototype for edutainment[9] by providing several types of multimedia contents and at the same time providing the possibility of co-creation and of interaction in real time, reshaping reality with virtual creativity, its high workload production and therefore very expensive one still represents a major limitation.

When considering the business model trends on ICT services, Cloud Computing[10] and specifically the cloud models Software as a Service (SaaS), Platform as a Service

[9] Edutainment tool stands for educational and entertainment purposes' tool.

[10] "*Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.*" `http://csrc.nist.gov/publications/drafts/800-146/Draft-NIST-SP800-146.pdf` retrieved in 28/05/2011.

(PaaS) and Infrastructure as a Service (IaaS)[11] [18], could save much of the major investment, for instance on the Intellectual Property Rights (IPR) and on the production of 3D animation and special effects which requires a large amount of computer processing. This should be easily accomplished within the construction of structural conditions (e.g. contents' industry cluster), not to mention the already known advantages in the field of the music and other type of similar audio contents.

Summarizing, future work perhaps should consist in strengthening effective technological development coupled with appropriate industry cluster as well as policy development, critical to the evolutionary stages of miBook. The use of cloud computing shall allow the miBook's production in a dramatically reduced time in a processing open platform compatible with the work.

Finally, it is important to consider the main critical factors of innovation success in the context of networked citizens, involving customers as co-creators on equal grounds with the main suppliers. Furthermore, faster development of HAR is emerging everyday applied in a variety of practical life circumstances, and miBook as well as other similar tools, based not only on AR technology but also synergetic linked with other source technologies, should be critical for the strategic interest for both producers and users.

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[11] In the cloud Software as a Service (SaaS) model "*the capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through a thin client interface such as a Web browser (e.g., Web-based email).*", in the cloud Platform as a Service (PaaS) "*the capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or -acquired applications created using programming languages and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.",* and in the cloud Infrastructure as a Service (IaaS) *"the capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. … In any of this cloud computing models the consumer does not manage or control the underlying cloud infrastructure but has control over the deployed applications…".* [18] `http://csrc.nist.gov/publications/drafts/800-146/Draft-NIST-SP800-146.pdf` retrieved in 28/05/2011.

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A Strategy Map for the Portuguese Air Force

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Abstract. The history of Mankind is a history of evolution, a history of increasing adaptation by man in relation to his environment. Mankind's history is also 'Organization's history'. As "Mankind's instruments" [1], organizations also need to evolve and adapt, finding new solutions to the emerging challenges and new objectives. Organization's first response to its challenges is strategy. Strategy is a "plan that configures certain company's aspects, which involves processes, places, people and time in order to achieve organizational goals" [2]. It is organization's 'flight plan' to 'navigate' towards the future it seeks, its Vision. Under the body of knowledge and principles of Organizational Engineering – and other theoretical-practical knowledge – this paper proposes a Strategy Map for the Portuguese Air Force, a tool that clarifies strategy and provides the organization with a mean of communication capable of generating motivation and creating focus and alignment, key features to 'move' the organization towards its Vision.

Keywords: Balanced Scorecard, Business Motivation Model, Non-Profit Organizations, Organizational Engineering, Strategic Management, Strategy, Strategy Maps.

1 Introduction

Today's organizations face unprecedented challenges: driven by globalization, fierce competition, increasing organizational complexity, technology's value and increasing development of optimization, the importance of information, the constant change and the speed at which it occurs. To survive and fulfill its mission, in an unstable and mutable battlefield as this, an organization very much depends on its ability to adapt, act and think strategically.

Alvin Toffler refers to the role of strategy in an organization: *"An organization without strategy is like an airplane weaving through stormy skies, hurled up and down, slammed by the wind, lost in the thunderheads. If lightning or crushing winds do not destroy it, it will simply run out of gas"* [3]. This reveals the importance of strategy, as the mean that one has to head towards one's future Vision, the destination,

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being the primary instrument which first has to deal with all external and internal factors that affect the organization and must be taken into account, and considered the best way, to determine a course of action or several courses of action, which will allow the organization to 'navigate' in the intended course.

Over the years it was found that even though many organizations had strategy, they were having difficulties in obtaining the expected results. Robert Kaplan and David Norton suggested that this situation was originated by two major reasons: problems in strategy formulation, unfocused on vital elements of the business and incorrectly aligned with it; and problems in execution and implementation, much due to communication issues [4]. It is now time to introduce Strategy Maps, the strategic tool that comes to help organizations providing the missing link between both strategy formulation and execution [4].

Despite the particular characteristics of the Portuguese Air Force (PoAF), it is, nonetheless, an organization. As such, it is liable to be subject to concepts applicable to any other for-profit organization, since the scope of that application is properly adapted and developed over a consistent logic of reasoning. Thus, this article organization is as follows: section 2 goes through the necessary literature to develop a strategy map; section 3 focuses on the PoAF Strategy Map; section 4 presents the conclusion.

2 Concepts and Application

This paragraph deals with the theoretical framing that supports section 3, bridging Organizational Engineering to other knowledge theories, principles and models directly relevant and necessary to approach the subject theme, namely Strategy Maps.

2.1 Organizational Engineering and Enterprise Architecture

Organizational Engineering (OE) is a platform that approaches an organization in a holistic perspective, considering it as a complex system of processes that can be engineered in order to achieve specific organizational objectives [5]. Enterprise Architecture reflects how that complex system of processes is viewed through the prism of OE, allowing the capture of essential business elements used to develop 'maps' which assist the business design and management.

2.2 Business Motivation Model

A domain in which the organization must be clearly organized is in its business plan: *"the elements of business governance, how these elements are inter-related and what purposes they serve, id est, their business motivation"* [2]. The Business Motivation Model (BMM) provides a framework which does precisely this. For the purpose of this paper, BMM two major areas will be briefly focused since they embody the core concepts of the model: 'Ends' and 'Means' [2].

The 'Ends' refer to something that the business seeks to accomplish. It comprises the Vision and the Desired Results that the organization seeks to achieve and maintain. The Desired Results can be divided in Goals (more qualitative and general) and Objectives (more quantitative and specific) [2].

The ‘Means’ refer to the methods and instruments that one disposes to achieve the ‘Ends’. It comprises the Mission, the Courses of Action and Directives. The Mission describes what the business does on a day-to-day basis and makes the Vision operative since it focuses on achieving it. The Mission is planned by the Courses of Action, composed by Strategy and Tactics, and corresponds to an action plan to achieve the Desired Results, respectively Goals and Objectives [2].

2.3 Non-Profit Organizations

Non-Profit Organizations (NPO) are organizations where people voluntarily come together in order to fulfill personal and/or social needs that are not completely fulfilled, or should not, or cannot be fulfilled by other organizations [7]. NPO’s Mission represents the sole purpose of its existence and is the link between the organization and society. That is what it proposes to do and to accomplish [8].

PoAF cannot be regarded as a ‘pure’ NPO’s since is in fact a State Institution with a link to the Government. However, in spite of being more correct to integrate PoAF in the public sector, PoAF is also a NPO given its non-profitable nature, the very meaning of the Mission as its purpose, and since it also faces the same challenges this kind of organizations does in relation to its management, namely to prove trustworthy and the need to maximize the use of their resources.

2.4 Balanced Scorecard

Reviewing OE definition, OE intent is to engineer the organization in order to improve its performance so it will achieve its objectives. It is evolution that sets in motion this ever-constant need for performance improvement. While trying to comply with its demanding environment organizations must dispose of the right tools that allow them to make the right choices by providing the right information never losing sight of the ultimate ‘objective’, their Vision. Within this context, BSC arises as one tool available to OE, offering a performance measurement system focused on Strategy and Vision that is ideal for organization strategic management.

The BSC can be defined as a framework that allows the integration of financial and non-financial indicators in different perspectives, enabling a comprehensive view of the organization’s performance to the manager. BSC is built around the maxim *“What you measure is what you get”*, therefore a single measure of business is not enough to analyze the state of the business, its performance and evolution [6]. The metaphor presented by Kaplan and Norton is quite enlightening: *“Think of the BSC as the dials and indicators in an airplane cockpit. For the complex task of navigating and flying an airplane, pilots need detailed information about many aspects of the flight. They need information on fuel, airspeed, altitude, bearing, destination, and other indicators that summarize the current and predicted environment. Reliance on one instrument can be fatal”* [6]. Likewise, given the complexity that characterizes the management of an organization nowadays, managers, like pilots, have to be able to analyze the performance of various parts of the business simultaneously and process this information.

BSC presents four business perspectives, as follows [6]:

- Financial perspective: it is the central perspective that unfolds all the structure of the BSC; linked to profitability, seeks to establish how the organization is providing value to its shareholders; indicators answer: *"How do we look to shareholders?"*;
- Customer perspective: it aims firstly to identify the organization's customers, to secondly identify their needs, so the organization can look into its performance through their eyes, seeking the answer to: *"How do customers see us?"*;
- Internal Business Process perspective: it identifies at which processes the organization must excel at, so it can monitor its performance on the most critical processes to guarantee customer's satisfaction: *"What must we excel at?"*;
- Learning and Growth perspective: it ensures that the organization continues to develop its intangible assets (human, information and organization capital); therefore indicators answer: *"Can we continue to improve and create value?"*.

The BSC structure presented above relates to for-profit organizations and as such its unfolding follows the logic of value creation in these organizations. For that reason the presented structure is not valid for NPO's as the *"ultimate definition of success for public and NPO's is their performance in achieving the mission"* [4]. The logic of value creation in these organizations is therefore different and, like this, the financial perspective in no longer dominant, although its objectives are of great importance [4].

2.5 Strategy Maps

A Strategy Map can be defined as *"a visual representation of the strategy on a single page, showing how it is articulated to create value and what objectives and cause-effect relationships motivate it"* [4].

Strategy Maps evolved from the BSC as executives intuitively started drawing arrows linking the four perspectives objectives and explaining how they related between each other. This feature led Person to compare a strategy map to a roadmap: *"Just as a roadmap shows the path to a destination, the strategy map shows which chain of objectives will lead to successfully executing your strategy"* [9]. Although Strategy Maps evolved from the BSC, they are indeed the first step in the BSC methodology as they describe the strategy and the logic of value creation.

Two advantages of this strategic tool should be emphasized: firstly, the fact that it puts a clear stroke on the business strategy defining how it intends to create value, and how each individual role supports the overall strategy and fulfill the mission while moving towards the vision; secondly, as a visual representation of the strategy is a simple and organized model that is ideal for communication, that allows the organization to align efforts around the same objectives [9]; the combined focus and alignment will generate motivation proportioned by a better understanding of the business and of the individual role on the overall strategy [4].

Before an organization even thinks of developing a strategy map, Kaplan and Norton stress the importance of defining basic elements like the organization's Mission, Vision, Values and Strategy; only then can an organization dwell on the architectural legacy of the BSC [4].

3 Building of the Strategy Map

In order to build a strategy map, a structure that best suits the business of the subject organization must be found. This concern is shared by Person while referring that the map should be in accordance with the 'culture' of the organization, regardless of the model that is pointed out by Kaplan and Norton as to the architecture of the strategy map [9]. This is because it will be that structure that will highlight the critical elements to be identified, defining the 'views' from which managers will look to the organization, just like on an airplane it is critical to have appropriate instruments to monitor the flight.

Once that structure is achieved, and having the business plan well defined – in accordance with the BMM and as stressed by Kaplan and Norton –, the issue is discussing the most critical set of elements to compose the map. These elements, which must be inter-dependent and derive from the mission and strategy, should configure a coherent model. This model will be all more valid if it portrays a more realistic picture of the organization.

3.1 PoAF Business Plan

After analyzing the matrix documents that constitute PoAF strategy and strategic guidelines, it was possible to identify contact points between PoAF business plan architecture and the framework provided by the BMM. As pointed out by the BMM, PoAF also enunciates its Vision, Goals, Objectives – the 'Ends' –, its Mission, Strategy and Tactits – the 'Means' –, and even according with Kaplan and Norton, the Values. All these elements are correctly enunciated and disposed on a hierarchal way so there is a similar purpose on the efforts they concur to, as suggested by the BMM. Since describing all PoAF business plan elements would be impracticable in this paper, only the Mission will be presented while ensuring that the development of the map will be completed without interfering with reader's understanding.

Mission. PoAF Mission, as stated on PoAF website, is the following: *"Cooperate in an integrated way on the Military Defense of the Republic, by conducting air operations and by defending the national air space. It must also fulfill missions assigned under international commitments, as well as missions of public interest"* [10]. Closely related to its mission, is the PoAF motto *"Ex Mero Motu"* [10], meaning, at the smallest request, reflecting the merit that distinguishes it.

3.2 PoAF Strategy Map Meta-Model

The meta-model is the structure upon which the PoAF strategy map model will be built on. Due to the particular mission and military nature of the PoAF, the meta-model will forcibly be different from a for-profit organization and even an NPO's approach is not enough. It is worth looking at what similar organizations have been doing, namely the United States of America Army (USAA) and New Zealand Defense Force (NZDF).

NZDF strategy map architecture puts aside the Financial perspective and in its place identifies a Resources Management perspective, which pin-points the building bricks that the strategy needs in order to be carried out, according to the question:

"What are the resources we need to obtain and manage?" [11]. The same can be verified in USAA strategy map [4]. Moreover, NZDF also identifies a perspective, placed at the top of the map, that comprises the Vision, and one more, placed at the bottom, which comprises the organization Foundations, as considered the Values, Warfighting Ethos and People. Finally, both NZDF and USAA strategy maps rearrange the order of the perspectives, which directly reflects a different perception as to how the organization creates value [4] [11].

After considering the various inputs, PoAF strategy map meta-model was drawn out of these last two case studies:

Table 1: PoAF Strategy Map Meta-Model [12]

<table>
<tr><td colspan="2">Vision</td></tr>
<tr><td colspan="2">Mission</td></tr>
<tr><td rowspan="4">Perspectives</td><td>Customer</td></tr>
<tr><td>Internal Business Process</td></tr>
<tr><td>Learning and Growth</td></tr>
<tr><td>Resources Management</td></tr>
<tr><td colspan="2">Values</td></tr>
</table>

3.3 Selection of the Strategic Objectives

At this point, interviews that were made on the context of the work gave an important contribution, as they allowed not only to bridge the author's view about the reality of the organization – given the 'field' experience of the entities interviewed – but also to make decisions concerning the construction of the strategy map.

Customer Perspective. Through analysis of interviews made across the organization it was possible to identify three types of customers appointed by the majority of the interviewees: i) Citizens; ii) State; iii) Allied Countries and Organizations. Once identified the PoAF customers, the following question is placed: What are the customer's needs? It is by meeting its customer's needs that PoAF produces value, but their needs are not all equal. By analyzing PoAF Strategy and Mission, as well as analyzing the interviews, three objectives were listed: i) Citizens: Generate Trust and Safety; ii) State: Operational and Organizational Success; iii) Allied Countries and Organizations: Cooperative and Reputed Ally.

The objectives of the customer perspective, along with the upper layers of the strategy map, describe what the strategy seeks to achieve. The perspectives that follow describe how it is implemented, materializing it.

Internal Business Process Perspective. With the previous perspective emerges the internal perspective that aims to answer the following question: At what should we internally excel in order to meet customer needs? The analysis of PoAF Strategy provides the answer. However, given the scope and detail of the documents, it is necessary to filter the critical internal processes. The interviews gave an important contribution at this point, since the interviewed consensually considered valid the translation of the strategy on the following seven critical processes: i) Affirmation of

Airpower: capability of a nation to effectively exploit its airspace, which extends from the means to the platforms and aeronautical facilities; ii) Execution of PoAF Capabilities: translated by the five mission types carried out: Training & Qualification, Common, Counter Air, Anti-Surface Force Air Operations and Support; iii) Operational Readiness and Residual: to ensure the critical mass to perform the operations, and also enough margin to respond to unforeseen operational requests; iv) Agile and Deployable Logistics: the support structure that allows the conduct of PoAF activities; v) Organization Management: critical to the organization operation is the correct management of it, which look to ensure not only organization survival but also a high level of performance in mission execution; vi) Building of an Organizational Culture: is the set of values, principles, standards, policies and assumptions that guide behavior and interactions in the organization, of critic importance once it dictates the organization attitude, way of being and acting; vii) Development of Good Relations with Foreign Entities: directly related to the image and credibility that PoAF projects towards its customers.

Learning and Growth Perspective. This perspective seeks to ensure that the organization can continue to improve and create value in the future, addressing the question: How to develop human resources, infrastructure and technology? The intangible assets must be developed in close alignment with the organization critical processes, in order to enable them. That involves specifying the skills and attributes required by the critical internal processes of the strategy. The following objectives were obtained and define the necessary investments: i) Weapon System Modernization: embodies the air defense means and combines the weapons, components, equipment and personnel necessary to support its operation and maintenance; ii) Technological Infrastructure Modernization: the greater and greater growing use of information technology and communications makes necessary and imperative this investment to support the mission; iii) Recruitment, Formation and Training: the third pillar to ensure value generation in the future must focus on the investment performed on people, the basis of every organization.

Resources Management Perspective. Completing the previous perspective, this perspective aims to identify the building bricks that the strategy needs, questioning: What resources do we need to obtain and manage? The following were identified as the most important: i) People; ii) Infrastructure; iii) Technology; iv) Budget; v) Doctrine; vi) Motivation.

Strategic Themes. No two organizations have the same perception about their strategic themes. These emerge from the most critical internal processes to the implementation of the strategy, thus they are quite specific to the organization and translate ongoing concerns of the strategy. The approach adopted for the PoAF strategy map was inspired in another case study, the United Kingdom Ministry of Defense strategy map, which consider the strategic themes as transversal to the whole map, defining a *"path to strategy fulfillment and mission achievement"* [4]. The PoAF Goals were selected: i) Manage with Efficiency; ii) Operate with Efficacy.

Lastly, the map was added of the *"complex web of interactions and causalities that supports the objectives"* [4]. In NPO's the importance of these connections increases as these organizations strive to manage their limited resources.

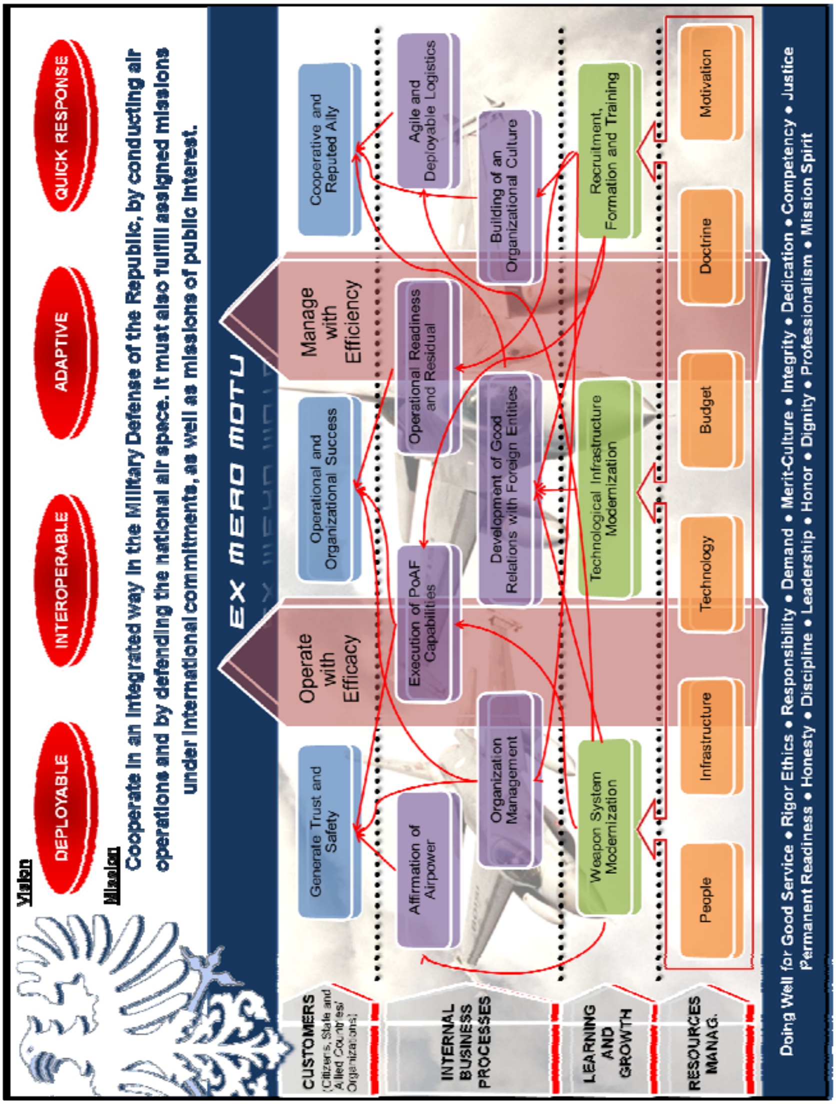

Fig. 1. PoAF Strategy Map [12]

The strategy map is complete, but how real is the value creation that is supposedly offered? Unfortunately, without implementation, there is only room for opinions, which, on behalf of the author and interviewees, give an assent on the matter, as long as the map is well implemented. This happens because no matter how good a solution is, it will not have impact unless it is executed in the proper way.

The strategy map creates value by clarifying the strategy and by being at the same time a communication tool common to the 'organizational cockpit' that explains to everyone *'this is our Mission, our Vision, our Strategy, for which you are important because you do this, and these are our values that guide us'*. It creates value because it motivates people, it focuses on what is important to the organization and it aligns the efforts of everyone in common objectives and goals.

Due to the scope of the map presented – map developed to the strategic level, hence with a more broad-sense – the map can be 'read' by everyone, in accordance with one's functions and responsibility, one will identify stronger connections to a set of objectives. One student pilot interpretation example follows: *"To me it means to study and train to acquire the knowledge, skills and competencies of an officer pilot, not only on air but on ground as well. It also means to strive selflessly for the culture of values that distinguishes military"* [12].

However the ideal would be if each person had their own strategy map. This would permit the generation of much more value to the organization as one would have objectives fitted to their action sphere. By developing a series of maps in a 'cascade' process, each entity, each context, regardless of the level, would have a specific strategy map properly aligned with the 'general' map which would clearly allow to see one's contribution to the organization's strategy and one's fulfillment of the mission. The necessary alignment would ensure that the *"organization flied"* [13] all in the same direction, according to the same strategy, the same 'flight plan' [13].

4 Conclusion

To develop a strategy map it is firstly necessary to observe the specific characteristics of the business, which will directly determine the structure in which it will be built. After pondering some vectors emphasized by characteristics of NPO's and also military organizations, the meta-model adopted to the PoAF strategy map includes the integration of the Values and the core elements of the BMM, namely the "Ends" and "Means", which evidences the importance of having a clear vision and consensus around these elements of the organization business plan.

Once the strategy map is completed, it is important to understand that this tool is not a 'miracle' that comes to 'save' an organization, solving all the strategic issues from strategy formulation to execution. It does however, give a 'big hand' on the matter. The strategy map is a step in the organization's strategy and is recognizable of immense potential. Potential that can be unlocked and converted into value if the organization puts the time and effort required to correctly implement it.

The value of the strategy map is in providing answers to people, giving them food for thought, as they see themselves integrated into a complex web of cause-effect relationships in which they are a link that is expected not to fail, because it is fundamental to the BP a, b or c, critical to the achievement of the objective 1, 2 or 3 of the strategy, which is central to fulfill the mission in a given way. By motivating people, by focusing on what is important to the organization and by aligning the organization efforts, the strategy map endows an organization not only with the 'flight plan', but also with the 'fuel' needed to 'navigate' towards its 'destiny', the Vision.

The map may not yet be inflexible and there must be room for change, to understand as inevitable and necessary, which justifies the search for methods to enhance this tool as a concern in this work, seeking no more than ensure the value creation in the future. In order to unlock even more value to the organization one more step can be taken, which involves exploring this strategic tool according to a new dynamic. By identifying the cause-effect relationship between the objectives of the map and adding these of indicators, linked to a second layer of objectives, it will be possible to create an 'instrument panel', namely a BSC, work that can be futurly equated. While the strategy map describes the logic of the strategy, describes the organization's 'flight plan', it does not guarantee that the organization is 'flying' under the assumed parameters simply because it is not itself a performance measurement system [13]. The BSC adds a new layer of detail which permits the analysis of 'flight instruments' – indicators – in order to establish if the 'aircraft' – organization – is 'on track' or if was affected by the 'wind' – environment – and diverted from the 'course' intended, thus needing to develop corrective actions.

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Change in the Portuguese Air Force

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Abstract. With the increase of organization's development that have been happening in the latest years, the traditional way in which organizations were seen, have been changed. Factors like markets uncertainty and the offer increase forced the actual companies to react quickly to these disturbing factors. The development of management theories connected with the development of Information Technology (IT) has resulted in news methods and tools that assist the decision making leaders by supplying access to the correct information in the right time. With this purpose, appears in the Portuguese Air Force the need to initiate a process of transformation. This study analyzes if that the process of transformation in Portuguese Air Force has brought improvements to the organization. This transformation process was initiated by two Chief-of-Staff Directives. Having in mind that the main goal of these changes is to align the Organization Information Systems with its strategic objectives, it becomes important to realize what involves this full process by identifying the adjacent actions to it. While monitoring this change, it´s important to consider aspects involving a successful transformation, for example, we intend to know the way transformation was approached by the Portuguese Air Force, that is, if the necessary foundations were created to sustain the desired change; identify the gains that the process brought to the organization and identify aspects that may have held back the implementation of this change.

Keywords: Organizational Engineering, Transformation Process, Self-Awareness, Flexibility, Agility, Change, Information Technology, Strategic Level Objectives.

1 Introduction

In order to ease and simplify its management processes, increasing self-awareness of the organization and aligning information systems with the strategy, the Portuguese Air Force has chosen a set of actions and has began a process of change.

Nowadays, Organizational Engineering is a base of knowledge applied internationally to a wide range of organizations. Its main purpose is to increase the

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levels of efficiency, communication and coordination in all areas directly connected to the organization.

This study, concerned with Organizational Engineering, will focus mainly on the process of change that the Portuguese Air Force is currently experiencing, analyzing the action plan proposed by a Tranformation Directive.

Essentially, this change involves the alignment of the information systems with the organization's strategy in the doctrine areas. Therefore we must point out the importance of this work: it is essential to understand the new modifications, as well as, the advantages that the current change will bring to the organization.

2 Self-awareness, Flexibility, Agility and Change

There are numerous methodologies and methods related to the change of the organization which involve the establishment and articulation of the assumptions needed to start manufacturing processes and analyze and report how those really change an organization.

Concepts related to transformation and innovation such as self-awareness, flexibility and agility are treated by various disciplines, including the Organizational Engineering established and studied by the Organizational and Design Engineering Center (CODE) in Lisbon, which decides on the application of the concepts in the organization mentioned above.

This section describes and relates the principles of organizational engineering to concepts of flexibility and agility in the organization, placing them in the midst of change strategies as advocated by modern scientists such as John Kotter (1996).

In the context of change, the strategy and the way to deal with the resources in the process is also important, including how to lead with and avoid errors that may occur.

2.1 Organizational Engineering

Organizational Engineering (OE) is the knowledge that is internationally applied in different organizations. With OE, one intends to increase the efficiency, effectiveness, communication and coordination, being applied to any type of organization and all areas that wish to improve their performance [6].

2.2 Concepts Associated to Transformation and Innovation Processes

In organizations in which there is the need to create deep changes, the concepts Transformation and Innovation are totally related.

The transformation is often promoted by the need of remaining competitive that an organization has. This implies that change should occur at a rhythm that exceeds the usual capacity of an organization to answer the needs of its activities [2].

Innovation means an introduction of something “new and uncommon”, and it is the “heart” of any transformation [2]. It can also be defined as the development of new products, services, technology, work processes, markets and organizational structures [3].

Transformation and innovation increase, when succeeded, certain important aspects of the organization's performance, such as self-awareness, flexibility and agility.

Awareness consists on being conscious of the current moment, and it is important to the knowledge of how the world presents itself and to the adequacy of actions to reality [4].

The agility of an organization consists on its ability to move fast, decisively and effectively in anticipating, initiating and obtaining advantages from the change [1]. Flexibility is the capability of reaching success in different ways. A flexible organization can have the ability to idealize several future possibilities and have, for each of those hypotheses, different ways of achieve them [2].

2.3 Change

Usually, change happens due to the need to adapt the organization to its strategy. Being the human resources the most valuable, they are also the ones that help to aid or hinder the process of change.

Change is not an end in itself, but a need to make a system go from one state to another. Change always happens when a view, a norm, a rule, a repetitive behavior or a process of transformation is modified [9].

Organizations need to be agile to start such process. There are crucial concepts in the organization's adaptation to the effects of internal and external influencers.

This paragraph briefly discusses all the factors described above, pointing out the need of a strategy to implement change, to increase and demonstrate the viability of this complex process.

2.3.1 Adaptability

Adaptation is a dynamic process that comes from the power or dependency that exists between the organization and environment [10].

These two authors have implemented a matrix of determination for a strategic choice. They further add that the strategic choices essentially are independent variables that aim to develop a typology of organizational adaptation.

2.3.2 Change and Human Resources

The success of processes of change in organizations depends on their human resources, who sometimes tend to create resistance to change. It is therefore essential to adopt a strategy for change that ensures, by the human resources, acceptance, membership and involvement in change [8].

In this context, who leads the change may take several options linked to his/her leadership:

- Education and communication;
- Participation and involvement;
- Slackening and support;
- Negotiation and agreement;
- Manipulation and cooptation;
- Explicit and Implicit Coercion.

2.4 Leadership

According to John Kotter, in his book Leading Change (1996), the changes need to be led in a consistent way to be completed with success, so it is necessary to know how to properly target a transformation. Therefore the author defined eight steps to monitor change in order to minimize deviations from the transformation process implementation. These eight steps are:

- **Establishing a sense of urgency.** Establishing a sense of urgency in organizations is essential to obtain the necessary cooperation of the human resources. With a low sense of urgency, it is difficult to have a group with enough power and credibility to guide the effort. There are various ways to establish a sense of urgency.
- **Creating a guiding coalition.** In change, a strong guiding coalition is always necessary, with the proper composition, levels of trust and common goals.
- **Developing Vision and Strategy.** The Vision describes the future state of the organization, but does not define how it will be achieved.
- **Communicating the Vision of Change.** The real power of vision is only triggered when the majority of people involved in the change have a common understanding of objectives and direction. This can help to motivate and coordinate the types of actions that create change.
- **Empowering Broad-Based Action.** This phase consists on training employees to lead in the situations that can occur.
- **Generating short-term victories.** Short-term victories are important because they make the change last. The statement "short-term victories" consolidates the actions and allows for the identification of the "next step". When this step is taken into account, the organization is always focused on change. Good short-term victories have at least three characteristics: they must be visible to allow for a large number of people to see that the results are real and not a mirage; must be unambiguous and clearly associated with the change.
- **Consolidating gains and producing more change.** In a change process, after reaching the objectives above, it is necessary to consolidate these gains. This is a step that can last for years, the more profound is the change, the more the interdependent systems are changed.
- **Anchoring new approaches in the culture.** After the desired change is finally implemented, it is necessary to anchor it in the organizational culture.

When it is necessary to lead a transformation, or any other process that creates a change in an organization, it is required to have leadership in order to obtain the desired changes. Sometimes, in a process of change, some mistakes not previously foreseen can happen.

The same author [5] states several errors may occur in relation to the leadership of a change. Next, the most common mistakes that can occur during a change will be referred.

- To allow for excessive complacency;
- To lack a sufficiently powerful guiding coalition;
- To underestimate the power of vision;
- To inefficiently communicate the vision;

- To allow for new obstacles to the vision;
- To fail to create short-term wins;
- To declare victory prematurely;
- To neglect the incorporation of changes to the solid culture.

3 Changing the Portuguese Air Force

Based on a set of measures approved by the Chief-of-Staff, framed in his vision, and in order to improve the relationship between the Organization's strategy with its information systems, it has been developed an action plan for 13 months that began in March 2009. This plan of action, still ongoing, was intended to be a catalyst for change by identifying several areas of action, as defined below:

- Development of cross-organization doctrine (concepts, procedures), establishing a building of publications for operation and maintenance;
- Modeling of Processes and Activities of the maintenance and operation;
- Establishment of metrics and indicators for decision support in information systems;
- Standardization of repositories of information (operational, maintenance, personnel);
- Integration of the articles' record of operational and maintenance;
- Establishment of control mechanisms.

Before the start of the process, Air Force has developed business rules that allowed the framework of information systems in:

- Mission of the Air Units to reflect the changes expressed in the Strategic Concept of National Defense and the Military Strategic Concept, aligning the elements of the mission with NATO doctrine and defining the mechanisms required to obtain indicators related to air activity.
- The definition of dynamic and flexible mechanisms that would keep the amount of personnel needed for the operation of weapons systems for the purpose of:
  - Automatically calculating, by the given the assumptions, the amount of personnel (operation and maintenance) for the various Air Units.
  - Assessing the existing information on weapons systems and, if necessary, the methodology and verification of information integration, correcting methods and procedures.
  - Quantifying variations caused by specific features of the Air Units.
  - Comparing the existing workforce to the actual with the planned regime of effort.
- Defining and establishing appropriate planning and management planning, integrating information from different systems prevailing in each fleet, the information system of the Air Force
- The legal publications for operation and maintenance, which is to establish the building of Air Force operational publications and define the responsible entities for developing and updating. It underpins all the actions proposed by the plan that the change in the doctrine.

The doctrine, military term similar to business rules, based on experience, best practices and lessons learned, defines how it is expected to employ existing capabilities in a particular operation. The military doctrine is also the basis for future thought integrating new technology and new capabilities [7]. The building of operating and maintenance publications, creating a doctrinal framework, aims to standardize and align it with the strategy across the Organization.

The approach to the processes' organization represents a new paradigm. While the doctrine says how to do, the survey process says exactly what it is done in reality.

The creation of metrics and mechanisms for decision support presupposes the existence and definition of goals and objectives enabling the monitoring and acquisition.

The standardization of repositories and integration of articles of information register forms are elements of dematerialization of essential tools for knowledge of the Organization itself.

The creation of control mechanisms allows the definition of the control points necessary to achieve the objectives.

To make the recommended actions operational it was created an implementation plan, spread over thirteen months, and to create organizational knowledge there were two different repositories for exchanging ideas: a directory on the internal network for staff directly involved and a forum in the Internet that allows global access to information to discuss.

The change also includes other acts such as the spread of organizational engineering at the Academy and at the various Promotion Courses. At the Academy level, 12 Master Thesis were produced, each in close coordination with the staff headquarters and with immediate application on current organization problems on a direct link between the research and operational domains.

One of the key actions to project success was the inclusion of the Business Process Architect (BPA) as the tool to identify the business processes and relevant information (for instances the glossary of terms and definitions). This tool was centralized by a group of persons at the staff level and disseminated across the Organization with very good results, not only within the coherence level but also on the organizational memoir domain.

Project monitoring and control was done by providing monthly reports on a graphical dashboard that indicate the several topics, the percentage of work accomplished and corrective actions when necessary. Each month, the Chief-of-Staff approved the report and the corrective actions required. Upon approval, information update was put out on the internal directory and on the forum. Overall more than 1000 persons were involved in the project several phases and tasks.

3.1 Change and Reality

Table 1 lists the concepts traditionally associated to the change with the six main plan's components to implement change revealing the advantages (green – total, red – not applicable, white – partial) acquired by the Organization in terms of awareness, flexibility and agility.

Table 1. Advantages of actions implemented in the Process of Change [8]

Measure	Awareness	Flexibility	Agility
Doctrine			
Metrics and Indicators			
Processes			
Information Repositories			
Models 1M, 2M/3M			
Control Mechanisms			

3.2 Development of a Model for Monitoring and Verification of Change

Figure 1 illustrates graphically the concepts referenced in this study using the Model of Monitoring and Verification of Change in Organizations. The following paragraphs describe the various elements of the model.

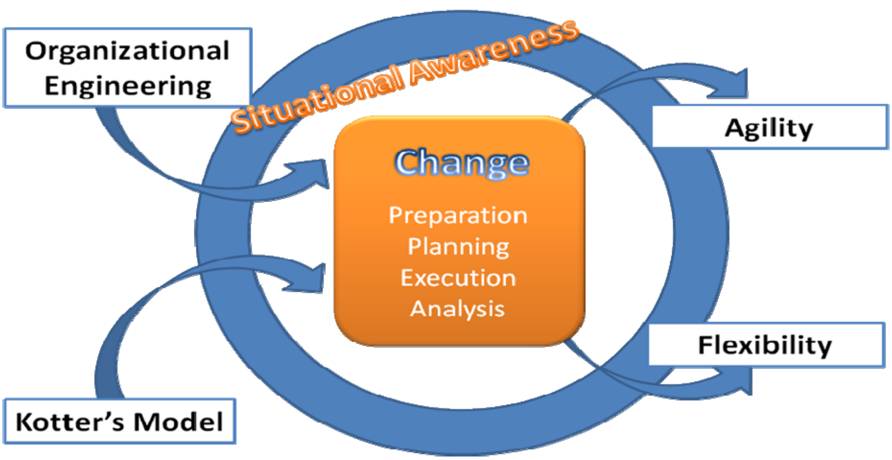

Fig. 1. Model for Monitoring and Verification of Change in Organizations

A model of this nature is important to an organization in change because it is a good way to make known to everyone involved in the process how it unfolds and what are the gains wanted to be acquired.

This model indicates that a particular organization gets more agile and flexible if able to make adequate preparation for such a process. Allied to this preparation is a detailed planning in order to guide the agencies involved. This whole process of preparation and planning must be thought and executed according to the needs of the organization so that their execution can be possible and successful.

Associating all these steps with Organizational Engineering and applying the Kotter's model, this process becomes more affordable to execute and a careful analysis of the work can be prepared, determining the possible errors that may occur and contributing to their correction.

Following this model and applying their constituents in a process of this type is then possible to verify that the organization increased its levels of agility and flexibility.

3.2.1 Preparation

To provide visible gains to an organization, the first step of the transformation process needs to be taken efficiently.

The first step to an organizational change is the preparation, a key step to get aware of the problem. So, we must point out that it's necessary to check the Situational Awareness" in the organization, since there should be an awareness of the present moment with the purpose of knowing the way that the world presents itself, so that we can tailor our actions to reality. In order to achieve change, it must be properly prepared and balanced to be consistent. Thus, it is essential that there is a strategy to implement change, to increase and demonstrate the viability of the complex process that is change. In this context arise "Organizational Awareness" and "Personal Awareness" because it's important to check the levels of awareness in the organization.

3.2.2 Planning

Planning begins with the construction of organizational objectives that will reveal a connection with the Vision of the organization in question.

The development of objectives should be achieved after studying and verifying the previous step ("preparation"), so that goals can be set and achieved with all its requirements.

As a key advisor in this stage, planning the change involves defining the group of people who will be primarily responsible for the entire process, creating a guiding coalition. Then it is necessary to define and specify the tasks and activities corresponding to each organ of the organization, formulating a schedule to monitor tasks in order to define and accomplish deadlines in various stages of the process.

Finally, it is useful to define a communication plan to contact the various agencies involved with the organ responsible for the change to correct potential problems and loopholes in the process as well as define as fundamental the completion of monthly reports that will support the next stage, execution.

Therefore, when applying the model created by [5], a high sense of urgency should be established, there should be a powerful guiding coalition and the Vision and Strategy of the organization should be developed.

3.2.3 Execution

The execution's phase of a process should be implemented in accordance with the previous plan, however, during its execution may happen some unexpected situations or non-fulfillment of planned tasks. Therefore, it is necessary a special attention of the coalition that has a guiding role in monitoring and supporting the successful development of the tasks required.

In this step, it is pointed the importance that monthly reports will have in the development of the process as well as the chiefs' opinions in the reports. The constant setting of appointments is important to obtain conclusions and solutions of possible difficulties that may be occur.

Introducing the Kotter's model at this stage, there are several steps identified by the author in the execution phase. As in the previous phase, it is necessary to develop a great sense of urgency in the organization to avoid the resistance to change, a factor that may hinder its development. Beyond this, it is highly important generating short-term wins because they make the transformation last. With short-term wins organizations can define the next step to make.

In order to obtain all the information needed to carry out this analysis, it must be used all information available, including monthly reports produced, the meetings held and the opinions that the chiefs passed in the course of change.

3.2.4 Analysis

The analysis and change management are a concern with the possibility to intervene and control the changes that occur in such process. However, sometimes there are unanticipated modifications resulting from a possible change in the system.

In this last phase of the change, it is necessary to verify what the gains that the transformation process has added to the organization as well as verify and identify the errors that occurred in the process.

The Kotter's model presents possible errors that may occur during a transformation process and its consequences for the organization, these errors are defined earlier in this study and through which this analysis should be centralized.

4 Conclusion

Due to the vision of the Air Force Chief-of-Staff, and in order to improve the relationship between the organization's strategy with its information systems, it was developed an action plan, which aims to be the catalyst for the instrument change by identifying several areas: i) development of doctrine, ii) modeling of processes and activities of the operation and maintenance; iii) the creation of metrics and indicators to support decision iv) standardization of information repositories (operational, maintenance, staff); v) integration of the operational and maintenance articles record vi) creation of control mechanisms.

To develop the action plan for change the Air Force, in comparison to the model of [5], predicts the existence of eight steps: 1) Establishing a sense of urgency, 2) Creating a guiding coalition, 3) Developing vision and strategy, 4) Communicate the change vision, 5) Empowering broad-based action, 6) Generate short-term wins, 7) Consolidating gains and producing more change, 8) Anchoring new approaches in culture.

According to what has been stated in the previous paragraph, it can be said that the transformation process is valuable because it increases self-awareness, flexibility and agility of the organization (see Table 1), and was well-established but, nevertheless, there are still some limitations that affect its success.

Kotter identifies some of the possible errors that change is subjected to, that in comparison can be classified into "Allow excessive complacency," "The lack of a sufficiently powerful guiding coalition" (the original) and "Allow barriers to change" being guaranteed its correction.

With the analysis of the change process, it was possible to build a model to monitor and verify the change in organizations as described in the preceding paragraph.

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Business Intelligence as a Service - Strategic Tool for Competitiveness

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Abstract. Today, more than ever, organizations face daily environmental changes. The source of change may be a new regulatory law, competitor, business model, hype in technology, new service trend, or the lack of skilled human resources. In order to understand the factors of change and their impacts on business strategies, organizations need to have in place a set of tools, methods and procedures to allow an instantaneous reaction, and foresee proactively the highest number of variables that will have impact in the organization's competitive advantages. One of the central tools that managers have at their disposal to face these challenges come from the use of Information and Communication Technology (ICT), which are entering into a new stage. The maturity of some Internet technologies, business intelligence systems and outsourcing business models allows the availability of new services, based on cloud computing. The rise of new service trends are taking place, and if an organization is able of combining the advantages of those trends, it might gain competitive advantage, throughout Business Intelligence as a Service (BIaaS), and what began as a way to achieve operating savings, will eminently reveal its true disruptive potential throughout the Internet.

Keywords: **C**ompetitiveness, business intelligence, outsourcing, pervasive computing, Internet, Cloud Computing, Software as a Service, Market Intelligence.

1 Introduction – From the Industrial to the Knowledge era: A Changing Environment for ICT

The evolution of global economy has been driven by several factors; faster and cheaper logistic operations; improvement in manufacturing processes which started at late nineteenth century with Frederick Taylor; the advance of Information and Communications Technology (ICT), which refers to a broad field encompassing computers, communications equipment and the services associated with them; information age or information era [1], is an idea that the actual age is characterized by the ability of individuals and organizations to access information that would have been difficult or impossible in the past, and it represent a shift from traditional industry economy to an economy based on the manipulation of information.

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The factors described above, allowed the shorten of the world, generating a highly competitive and in constant change global market, organizations and managers are pressured into a search for the best solutions to develop and sustain their competitive advantage: from Porter's five forces model [2], benchmarking procedures, mergers and acquisitions, new outsourcing business models and to the incremental use of Business Intelligence (BI) tools, everything is being done to keep organizations above the breakeven point.

Managers' actions thought appropriate for one period of time quickly become outdated, and unless organizations show the aptitude to recognise critical change factors and react rapidly, underperformance is generally the outcome.

In order to avoid the decline, a first order requirement is that organizations develop strategic capabilities, translated into the ability for the organization to create value. This means the capacity to be proactive and to be capable of taking actions anticipating its competitors, and better positioning the organization towards markets and the consumers that it serves.

Also, competitive advantage can be earned by reorganizing work flows, removing unnecessary bureaucracy, and using information technology to eliminate redundant work and speed up necessary work. Today with the help of information technology, billions of people are communicating electronically, this boom is the latest and, for business strategists, the most important-wave in the information revolution [3].

Many times, the action or reaction required from managers it's based on the analysis of performance measurements data and since every business is different, each should have its own set of performance measurements [4]. The main purpose of any performance measurement system is to focus the organization and its managers on its strategic goals, and give them coherent and realistic feedback of the organizations performance and environment in order to allow strategies to be developed, realigned or discarded.

The general underlying assumption of any performance measurement system is that ICT plays an essential role since it provides assurance of data accuracy and manages information life cycle. However, due to market stimulus, and the huge amount of technologies, solutions and providers in the business arena, organizations in order to have a quick response, have to trust part of their operations to a specialized outsourcing team which will be controlled and measured by rigorous service metrics

In addition, more than ever, Internet technologies, pervasive computing, service oriented architectures (SOA) and wide access to broad band and ubiquitous communications, allow organizations to develop a sustainable and persistent management approach, to measure the key performance indicators, and transform information into Intelligence, in order to achieve or keep competitive advantage.

2 It's My Business Strategy Limited or Amplified by Technology?

Presently organizations are in the so-called "information age", in the sense that every business is at least an information business, not surprisingly, information represents a large percentage of the corporate cost structure, translated into the cost of capturing, storing, processing, and making information available [5]. Consequently, ICT strategy is incorporated in the business strategy and is recognized that the effective use of ICT requires consistency between the corporate business strategy and the technology strategy [6], thus it is critical to reach an agreement around principles that best address the demands of the competitive environment where the organization operates.

With the help of ICT, millions of organizations and people are communicating electronically; to do business, to chat, to shop, to entertain, this boom is the latest and, for business strategists, the most important wave in the information revolution [3].

According with [7] to stay at the top of their industries, organizations will need to show the ability to identify the technologies and business models that are suitable and appealing to their mainstream customers in a future time. Thus, organizations need to have in consideration a set of steps to keep their competitiveness.

First, a successful organization is one that has found a way to create or enhancing value for the customer [8] which requires the coordination of activities within business processes, and across multiple organizations.

Second, intensified competition, accelerated change, and uncertainty make it difficult to specify detailed activities and strategies in advance, which means that flexibility becomes essential for any organization.

Third, the changes in organizations environment are no longer compatible with huge investments in time and in technological fixed assets that were used in the industrial era, due mainly to rapid obsolescence of equipment and technologies.

Fourth, the rational decision making process, which requires a comprehensive knowledge of every aspect of a problem, doesn't meet the needs of a world with too much information and too little time, according with [9], one of the decision-making models, which fit with today’s organization, is based on “incrementalism”, (which is characterized by the lack of general knowledge and in its place exist a series of small units of change-without any sense of the big picture). The decision model based on “incrementalism”, is called adaptive decision making, which allows organizations to progress with partial information, and it helps organizations to adapt to new information as it becomes available.

Fifth, research and development (R&D) are essential tasks for any organization in order to develop new products or to surpass known limitations of current products, to help on these task technology evolutions and the construction of new services plays an important role.

2.1 Technological Trends

There are several different technologies allowing this shift to take place and contributing towards industrialization of information technology [10]. Among those, we may include Internet protocols as well as open standards like eXtensible Markup Language (XML). This combination results in web services standards that loosely support coupled connections, and allow services to be located, accessed, and used over a variety of middleware platforms (Platforms that execute an orchestrator or mid tier role, doing integration between heterogeneous systems).

The standards assume that providers and users of web services will operate across a broad range of technology platforms therefore, the providers seek to provide maximum flexibility in creating and supporting connections, which define the foundations for SOA [11]. This flexibility is key to allow business integration; however, to realize the full potential of this technology, additional elements are needed, in particular, shared and global services.

By 2002, [12] developed the concept of service grids that were necessary to "assemble a diverse set of specialized enabling services required to support the connections across applications enabled by web services technology", however, the lack of adherence by the market to this evolutionary step, made SOA an internal and vertical market integration issue for organizations, which was, already a major evolution in organizations systems and businesses.

In 2005, a new approach to a large shared, global and scalable services platform offer, which became known as Grid Computing. At the time the focus was on infrastructure capacity such as processing and storage (e.g., Oracle grid computing), having once more the Internet as the underneath network. Once again, the majority of the organizations were not ready to change their business supporting systems, and as consequence the market penetration was low.

Nowadays, organizations have a new model that plays with both concepts (service grids and grid computing), named cloud computing. The main advantage with cloud computing is that it implies that users of ICT related services can be focused on what services they provide (e.g., payment systems, e-learning) rather than how the services are implemented or where they are hosted.

In the context of cloud computing, organizations can find services which can be viewed as non-core competencies of most companies, [10] presents the following examples of technology as a service: Software as a service (SaaS) (i.e., finished applications that are rented and customized); Platform as a Service (PaaS) (i.e., developer platform that abstracts the infrastructure); operating system and middleware to enhance developer productivity; Infrastructure as a Service (IaaS) (i.e., deployment platform that abstracts the infrastructure); or even Storage as a Service (StaaS) (i.e., Similar to infrastructure but focused in storage).

Consequently, organizations purchasing decisions can change from acquiring ICT products (hardware, software and implementation services, with initial investment) towards contracting a service with a specific provider. This type of business model, is something that the ICT industry was chasing from some time.

Gradually, the new version of the Internet Protocol (IP), IPv6, is taking his place in communications infra-structures, as a result of address exhaustion of IPv 4, which it is forecasted that will occur near 2012, accordingly to the OECD ministerial meeting, that occurred in June 2008 (www.oecd.org/futureinternet). Even amazon E3C (Elastic Cloud), limits the IPv4 selling and consequently the associated services due to the already lack of address space. IPv6, will allow the boom of "Internet of things", and pervasive computing [13] which will allow the connection of multiple devices, an issue that will open new business opportunities and force all organizations to adapt to these global change.

2.2 Service Trends

Service delivery is used to characterize a situation where a certain service supplier enables a contractual relationship between itself and a consumer to deliver some capability or work, which is defined not by the physical implementation but in terms of results.

So, when we are thinking about service results, we usually refer to service level agreements (SLAs) which need to be agreed upon both parties the customer or consumer and the service provider [14].

In this sense we argue that cloud computing more than just technology hype or evolution represents a new Outsourcing model, which allows organizations to increase their competitive advantage by accessing professional services faster and cheaper rather than implement directly the services needed. Cloud computing also enables organizations to reduce innovation cycle times, decrease investments, decrease risks, and eliminate inflexibilities, such as fixed overheads and costs [15-17].

So, as argued by [18] some approaches from service providers are now focusing in the bundling of Information Technology Outsourcing (ITO) and Business Process Outsourcing (BPO). From our perspective, the best example of this situation is cloud computing (e.g. eLearning - Infrastructure unaware and part of the business processes content can also be provided by the provider).

So, if an organization wants flexibility and to leverage its skills and resources, it has to concentrate on a set of core competencies, strategically outsourcing the other activities that are not strategic [19]. In the context of cloud computing, we can find some services which can be viewed as non core competencies, of most companies.

Over the past decade, managers have been worried with improving operational effectiveness, and the popularity of outsourcing reflects the growing recognition that it is difficult for an organization by itself to excel in all activities at the same time as well as hiring focused specialists, to do that. Currie [20] observe that organizations transferred their routine computer-based operations to specialized third-party IS/IT vendors (e.g. IBM, Accenture, Logica), in order to be better focused on their core competencies. So, if an organization wants flexibility and to leverage its skills and resources, it has to concentrate on a set of core competencies, and outsource the other activities that are not strategic [19], and the selected vendor should allow organizations to increase their competitive advantage by accessing to professional services faster and cheaper outcomes rather than implement directly the services needed.

Constant innovation, is a factor that links to outside knowledge sources that are able to assemble diverse expertise, also enable organizations to reduce innovation cycle times and decrease investments and risks[15].

Well developed contracts (contract completeness) and governance (high values of coordination and consensus between client and outsourcer) are essential factors for the success of any outsourcing-based business model. Thus, the main issues related with outsourcing implementation include the definition of a contract with a specific (SLA), which represents a contractual means of helping organizations to manage the contract, as well as a specific governance model. These, are essential tools for every outsourcing's contract success [21-23].

Another success factor for outsourcing contracts is the scope of services to be outsourced; since today we can find almost every service in the outsourcing wave and we can call it "something as a service", consequently the pricing model is also key success factor, we can define a price per any unit measure, (e.g ay per use, pay per storage TB, pay per call, pay per report, pay a fixed value per a determinate period, etc). The figure 1 shows the components described before.

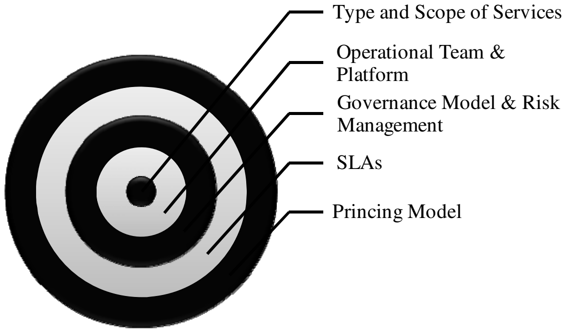

Fig. 1. Outsourcing Components (developed by authors)

As argued by [18] some approaches from service providers are now focusing on the bundling of ITO and BPO, an example of this situation is eLearning services, since it exists Infrastructure unaware processes management and execution, having as a result a distributed training platform, with a price defined by user and a service level agreement between the customer and the provider (www.formare.pt by PT Inovation), other example is for the CRM function, (via www.salesforce.com).

3 Cloud Computing and Business Intelligence

By "business intelligence" we do not mean any specific product or definition, but a broad range of applications, technologies and methodologies associated to the process of using information systems to capture, transmit, store, retrieve, manipulate, and display information used in one or more business processes [24]. These tools and processes should provide the necessary information for the organization decision making process, and they can be outsourced and take advantages from cloud computing, that we define as Business Intelligence as a Service (BIaaS).

We can point out three key factors necessary for making effective decisions. First, there must be a set of goals to work towards. Second, there must be a way to measure whether a chosen course is moving toward or away from those goals. Third, information based on those measures must be provided to the decision maker in a timely manner, since time is a source of competitive advantage [25].

BI systems are an important tool for success. As organizations are blessed (and cursed) with ever increasing amounts of rapidly changing data, decision making cannot be limited to information silos, which. can lead to , decisions made without context and a lack of coordination across the organization and throughout the business ecosystem.

When using BI systems, empowered employees can confidently make timely, decisions based upon facts as opposed to intuition or just corporate policies. These tools also enable more measurement transparency and act as the basis for enterprise risk management. The role of management is no longer that of "ultimate decision maker" but that of "translator" and "coach" who initiates the strategy and define the metrics which bring the efforts of each stakeholder aligned with the strategy as a whole.

In the modern era, BI tools have been enhanced by integrating financial applications into the mix and the suite of applications that are commonly called enterprise performance management solutions. These suites enhance traditional analysis and score carding applications [26] with financial applications such as: budgeting, planning and forecasting capability: profitability modeling, financial consolidation, and management reporting, based on the principles of balanced scorecard [27].

An example of integration between business analysis and cloud computing is IBM service called "IBM Smart Analytics Cloud", a system that is proposed to discover real-time business insights, and access and analyze multi-source data with on-site analytics solution for the enterprise. Also, Oracle introduced "Demand Signal Repository", based on the Oracle database and using Oracle business intelligence enterprise edition to power category management and trading partner. These two examples of IBM and Oracle, corroborate what Etzioni [9]called adaptive decision making, which allows organizations to progress with partial information, and it helps to adapt to new information as it becomes available, also [28], argued that many examples of competitive advantage come mainly from information itself and not from information systems..

The challenge is how to make good use of information in order to use it in the decision and strategic process. Moreover, organizations should show the capacity to define their ICT boundaries between public[1] cloud and private cloud in order to build a hybrid cloud to develop own businesses Intelligence (BI) cloud. In the BI cloud, financial investments and operational results can be optimized, for example – by using data warehouse infrastructures some hours per week just for gathering data from pervasive elements[2] and do some calculations and analytics, which should be sent to the private BI cloud through, web services. By doing this, organizations will have an incentive to invest in these type of solutions [29].

If organizations can abstract themselves from the underlying infrastructure, and focus in defining the set of metrics being measured and captured by all pervasive means available today, organizations will have in place a tool for competitiveness.

However, organizations embarking on or continuing their search for cloud BI services, must not forget, that there are some pre-requisites for success like: the need for a vendor, a team and an appropriated methodology, as well as the right measurements.

Our approach to BIaaS includes four organizational levels that in our view must be considered). The first level to consider is the pervasive level. At this level, all the information related with pervasive information must be gathered. This information may feed/ simultaneously the three following levels of the BIaaS scope, (the

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[1] According Gartner's author Daryl C. Plummer (2008), there are three types of clouds: "Private—data sits behind the corporate firewall, where the organization directly controls the amount of exposure. Public—the data sits in the public cloud exposed to the public; security is dependent on the cloud service provider's security precautions and defenses. Hybrid clouds—some data resides on the private cloud, other data may reside on the public cloud. Security depends on both the organization's internal security controls and those of the cloud provider".

[2] Pervasive elements – all the devices possible to collect data from customers behavior, cell phones, GPS, Internet usage, signage, RFID, mobile and geo banking.

operational, the tactical and the strategic level). The second level (operational), exist a set of processes like, Extract, Transform and Load (ETL), data cleansing, and online analytical processing (OLAP) by exploring datawarehouse techniques [30, 31]. At both (first and second)levels the latency of the information is short, since it is at these levels that all information is gathered and treated as a reliable transaction within the ACID (atomicity, consistency, isolation, durability) concept [32], (e.g. a transfer of funds between two financial institutions). Additionally, at the second level, information is mismatched with other information systems that exist in the organization and a particular care must be taken in order to adequate the information, in order to increase its consistency.

At the third level (tactical) , the use of data collected from the pervasive and operational level is transformed into information and detailed reporting (aggregated data), through the use of data mining processes which allows mid-managers to take some actions related to short term goals. This level already demands a certain amount of integration between business processes and information systems used.

The fourth level, (strategic), is where top management analyzes the business performance with specific Key Performance Indicators (KPI), reporting and predictive analysis which can help managers to design future strategies. At this stage information for management decisions should not be transactional but trusted aggregated and concise. At this level some information may be crossed with market activity, in order to produce useful information to strategic domains.

In a pervasive system, we usually have several services running all together and under different responsibilities. So to be a proactive player in the market, and to keep competitiveness that is needed, an organization must have the four layers well defined and working. Only by doing this, an organization, will be able to provide accurate and useful information to managers within the necessary timeframe to support effective decision making [24, 5].

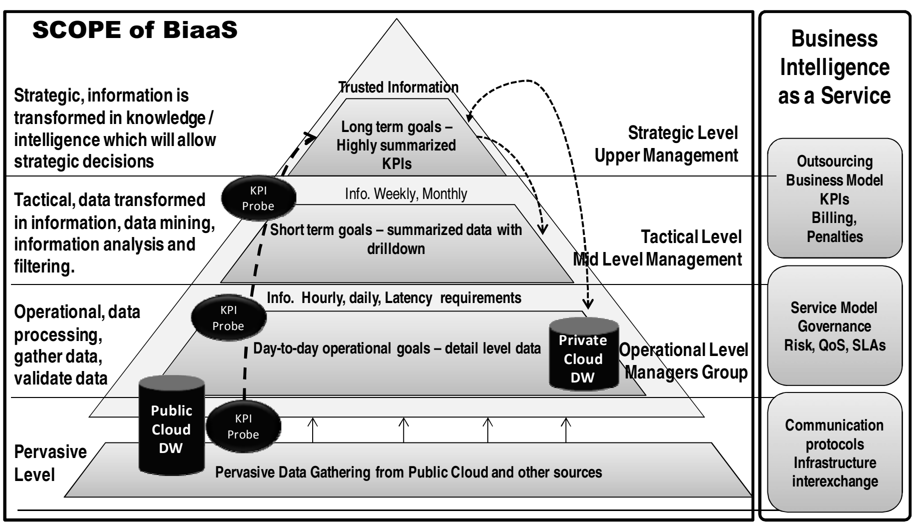

Fig. 2. Levels of Information in Organizations with BIaaS, adapted from [24]

Cloud BI services can be considered as a new business model approach. Thus it may involve some risks that are very similar to those of IT Outsourcing [33], but that remain critical for its success.

First, the lack of management vision for this approach and the difficulty to develop a correct assessment for total cost of ownership (TCO) of a BIaaS solution and simultaneously, to profit from the new decision mechanisms that will be available with the use of these services;

Second, the inexistence of a professional team, either internal to the organization or composed by external consultants, with the ability to foresee and help the managers in choosing the right variables to measure (KPI);

Third, the technology by itself, as previously referred the ICT providers tried several times to get near to the ICT industrialization, but due to technology and market immaturity and prices some service offers were delayed or abandoned. At this time and for the next coming years, pervasive computing and cloud services will be on hype, considering additionally the global adoption of IPv6.

Fourth, the issues related with outsourcing implementation, contract construction with specific SLAs and the definition of adequate governance models, are essential to outsourcing contracts success. Fifth, market dissemination, which depend from the combination of the factors above, and market behavior through customers demand and services use, in order to allow organizations to evaluate heuristically and mathematically the return on investment in BIaaS.

4 Conclusion

Today's world is much more competitive, data 's value may be null if it is not transformed into information that originates accordingly actions. But information is only useful if the business model defines how the organization creates value for itself while providing value to the customer. More than ever, organizations face the challenge of improving business processes to produce the expected results for all stakeholders.

A rise of new technological and service trends are taking place, and if an organization is able of combining the advantages of those trends , it might gain competitive advantage, throughout BIaaS, information value may be null if it is not transformed into knowledge that originates accordingly actions. But knowledge is only useful if it could be used to improve an organization's value, and with that, expand the number of customers through the capacity to develop better and more attractive services or even by opening completely new markets.

More than ever, business environment is characterized by global competition anywhere in the world. The geographic proximity of businesses and customers was more important in the past than it is today, since nowadays both can be virtually anywhere in the world [15].

Our analysis tends to state that exists a set of mature ICT tools (like pervasive computing, web services, Internet protocols, management database systems), and new business models approaches (cloud services), which can be the basis for new models of outsourcing, and that can be used to help the overall business to gain competitive advantage. However, this will only make sense if it is done in the right framework of the proposed organization's strategy. Since today we live in a world where all businesses are information driven, BI systems fulfill the conditions to succeed but, for this to happen, they should have the potential to transform the information into knowledge within the organization. That is to say that ultimately, any success BI system will become a real Business Knowledge Systems (BKS).

The new boundaries of this reality are not clear yet, however, there are known benefits and risks, but augmenting operational effectiveness is essential to superior performance, in any organization, which, after all, is the primary goal of any enterprise [34].

5 Future Work

For this study we executed a bibliography and market analysis, which inherently limits the extent of our findings. Nevertheless, this research method was appropriate for the present research since our goal was the development of some knowledge-base resounding BIaaS, rather than to generalize it into a new business or commercial model. Going forward, a more refined theory for BIaaS and BKS, can be developed through the empirical validation of our findings through the use of qualitative and quantitative methods, case studies and Industry inquiries.

The literature analyzed indicates that the level of trust between the client and provider is a stronger predictor for outsourcing success [33], as well as for cloud services [35]. Thus, another possible area for further work is on the role of trust in the management and evolution of BIaaS relationships between customer and provider as well as billing approaches. A second and related area of research is the management of risk in BIaaS. Like in IT Outsourcing [36], BIaaS will have a considerable level of risk, since we are talking about a new combination of technologies, and consequently new business approaches.

Finally, a deeper look at changes in decision making process due to this new approach for cloud services, BIaaS, would be a good starting point for future research

Independently of any results, management fundamentals, like timeframe, performance and competition are changing and that brings a change on the underlying of management and especially in the domain of strategic management.

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An Extended IDM Business Model to Ensure Time-to-Quality in Semiconductor Manufacturing Industry

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Abstract. Semiconductor manufacturing industry (SMI) has shifted from an IDM (integrated device manufacturer) to a fabless structure where technology is developed in an alliance to share high R&D costs and address time to market and time to volume challenges. In this fabless structure, EDA (electronic design automation) has emerged as a key stake holder to model increasing design and manufacturing interface complexities and its integration within design flow, but collaboration within alliances have resulted information sharing and technology transfer as the key challenges. We argue that IDM model is superior to a fabless structure due to its inherent ability for faster/superior knowledge capitalization. We benchmarked and analyzed a world reputed IDM with use-case and SWOT (strength, weakness, opportunity, threat) analyses to identify the limiting factors that led this transformation and found data and statistics as the core issues. We have proposed an extended IDM business model where engineering information systems (EIS) are tuned for design for manufacturability (DFM) compliance to achieve time to quality (time to volume, time to market) and yield ramp up rate at low cost but effective R&D efforts.

Keywords: SMI business models, design for manufacturing (DFM), time to market, (T2M), time to volume (T2V), yield ramp-up rate.

1 Introduction

SMI is characterized by the fastest change in the smallest period of time and has evolved as a market driven business model along with structural transformation from an IDM to fables model. Till 1980, SMI used to manufacture equipment in addition to the product design, manufacturing, marketing and sales; however first split in late 80s resulted in the OEM (original equipment manufacturers) and IDM models where equipment manufacturing was separated as a specialized task. ITRS (international technology roadmap for semiconductor industries) proposed a fabless model in late 90s by splitting IDM functions in design and manufacturing. In this model IDMs, design companies and foundries collaborate in an alliance for the technology platform

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development with EDA companies as mediators for the CAD (computer aided design) support. In comparison to this fabless model, an IDM includes both design and manufacturing facilities to effectively capture high market share; however success lies in our ability to quickly design, develop and ramp up the products. Shift in SMI business objectives from manufacturability and volume production towards yield ramp up rate resulted EDA with a new role to integrate DFM methodologies across design and manufacturing flows to facilitate information and knowledge sharing within design and manufacturing groups.

DFM is defined as the ability to reliably assess manufacturability and yield issues (model-to-hardware gaps) in early design stages [8] and is categorized as [10] product DFM (producing manufacturable design for the defined processes) and process DFM (develop process with less rework and high manufacturability). It is focused on the economic benefits by trading off cost-quality-time triangle [15]. SMI adopted DFM in 1980 (Fig.2) to mitigate increasing design for manufacturing interface complexities and time to quality business challenges; however biggest challenge is the diversified understanding of the DFM concept among stakeholders and responsibility for its effective integration. EDA has unified the last step in design with GDSII format (final design database) and now they are putting efforts to integrate DFM within CAD tools to support industrial motto "first time correct design". We argue that an IDM has an inherent capability to model its design and manufacturing interface complexities and serve as a platform for faster and superior knowledge capitalization. It is only possible if we investigate the limiting factors in existing IDM model that restrict DFM integration across design and manufacturing flows and led SMI to the fabless model. We found data, statistics and unsuccessful data driven DFM efforts as the limiting factors that led SMI to a fabless structure; hence we have proposed an extended IDM business model supported by EIS and tuned for the DFM compliance by shifting data driven DFM efforts towards information and knowledge driven DFM.

This article is divided in 4 sections. Section-1 provides introduction and establishes the need for an extended IDM business model. Section-2 briefly reviews SMI trends, DFM concept, scope and evolution. Section-3 provides analysis of an IDM model and presents an extended IDM model. Section-4 provides conclusions and key issues to be addressed while tuning existing EIS to support this extended IDM business model.

2 Literature Review

Semiconductor industry *(208 billion USD, 2008)* [9] is characterized by the cyclic demand patterns and higher revenues (Fig.1). It is a fragile, rapidly growing and technologically most advanced industrial domain, governed by the Moore's law [6] which predicts doubling electronic components per unit area every 18-24 months at the reduced cost and power consumption. Moore's law was initially focused on the geometric scaling, but now it has emerged into "more Moore" *(equivalent scaling)* and "more than Moore" *(functional diversification).* This transition led to an increase in the revenues even at decreased demands and moved industry towards high value products *(system on chip, system in package and package on package)* along with increased design/manufacturing interface complexities.

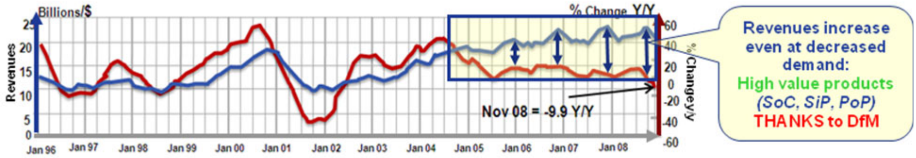


Fig. 1. Cyclic demand pattren and higher revenus

[5] LeBlanc (French) in 1778 and Eli Whitney (American) in 1788 coined an idea equivalent to "DFM" by proposing a system for the production of muskets that received industry wide recognition as "producibility through interchangeable parts". [2] Roger W. Bolz is credited for organized DFM methodology as an alternative term for "producibility", introduced in his book "The producibility handbook"; however "DFM" received industry wide acceptance around 1960 [3]. In 1980 the DFM concept was adapted as a yield enhancement strategy in SMI (Fig.2). The concept of DFM has also emerged in a diversification of terms like DFY (design for yield), DFV (design for volume) and DFT (design for test) etc. but all terms come under the umbrella of DFM along the product life cycle (PLC) as DFX having similar objectives of cost, quality, yield, time-to-market and time-to-volume where X refers to a stage in PLC [1]. DFM has become synonymous with DFX and the concurrent engineering (simultaneous development of a design and process) [8] where DFX tools are focused to provide the designer with predictability information on multiple issues across PLC.

Initially DFM efforts were based on the rough estimates of downstream effects and rest was expected to be controlled by advanced process control (APC) and advanced equipment control (AEC). It went well till 250nm (Fig.2) but after that increasing complexity of circuit layout and shrinking sub wavelength lithography (model to hardware gaps) eventually resulted multiple respins and yield losses. 130nm node is considered the cut-off point where need for DFM was felt to tackle increasing feature

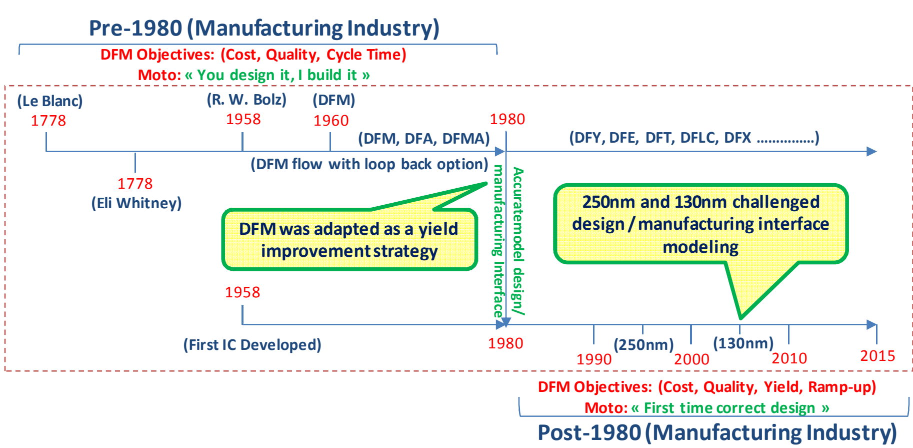


Fig. 2. DFM History and Evolution (pre and post 1980 eras)

limited and design limited yield losses [7]. From a designer's perspective, things are getting more difficult because process windows received from manufacturing are so tight that they are having a hard time getting design methodologies to work" [13].

Technology platform is characterized by a design reference flow, device, interconnect models, processes, equipment and engineering data analysis tools. It is developed in an alliance with partners to share high R&D costs based on partial product life cycle and is then deployed across the complete PLC for the new products (Fig.3). Design phase is critical as design costs are 10% of the total product design and development costs but 70-80% of manufacturing costs are decided in this phase [1, 4].

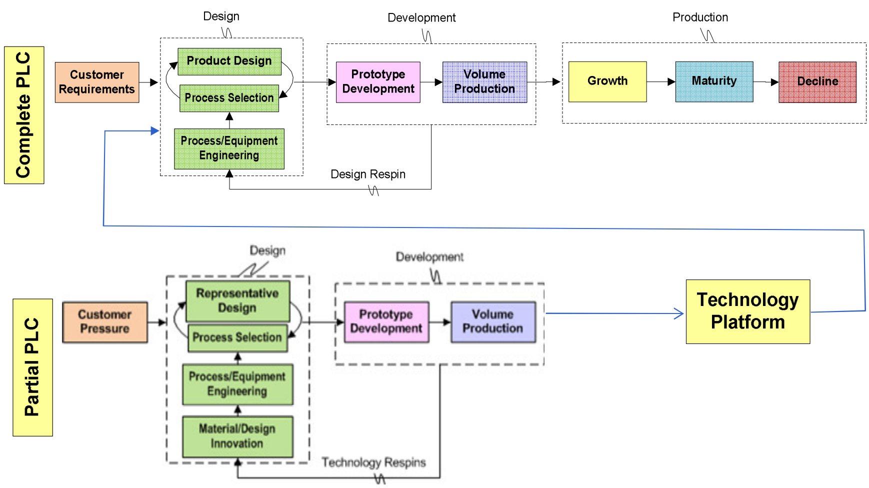


Fig. 3. Complete and Partial Product Life Cycles (PLC)

Operations within an IDM can be categorized as DFM (design for manufacturing) and MFD (manufacturing for design). DFM refers to the operations focused on concurrent design, process selection and prototype development for technical/economical design evaluation [8]; whereas MFD is focused on controlling repetitive operations dedicated to normal production (e.g. advanced process and equipment control APC/AEC). DFM and MFD follow design to manufacturing and manufacturing to design information flows respectively [13], supported by engineering information systems like AMHS (automatic material handling system), MES (manufacturing execution system), SPC (statistical process control), FDC (fault detection and control system) and engineering data analysis. These tools optimize production line capacities and support data driven DFM efforts; however R&D engineers spend most of their time in data extraction, cleaning and alignment before statistical analysis. Primary goals of DFM and MFD are to enlarge the process yield window [15, 16] and to keep manufacturing process in that yield window [11] respectively.

3 IDM Business Model and Qualitative Analysis

IDMs are focused on cost, quality, yield and performance and operate in collaboration with EDA, IDMs, foundries and customers in CAD, technology and product alliances respectively. We have benchmarked a world reputed IDM business model (Fig.4) for new technology development, characterized by device/interconnect models and DRM (design rule manual). Device and interconnect models refer to the FE/BE (frontend/backend) technology and represent processes used to manufacture transistors and interconnects between transistors. Their output is compiled as rules and constraints in libraries, packaged in design and DFM kits used by the designer to simulate new product designs. These simulations assess the product functions against specifications and predict yield with which it can be manufactured for a given technology platform. Technology platform (Fig.4) developed in an alliance is called common technology platform (CTP) and when deployed in the manufacturing facility of an alliance partner, it is referred as internal technology platform (ITP). Products designed using an ITP having backward compatibility, can be manufactured at any alliance partners manufacturing facility (referred as outward manufacturing) and similarly products designed at alliance partners design centers can be manufactured at our manufacturing facilities (referred as inward manufacturing). Product manufacturing decision is taken by the customer based on yield and ramp up rate demonstrated by alliance partners.

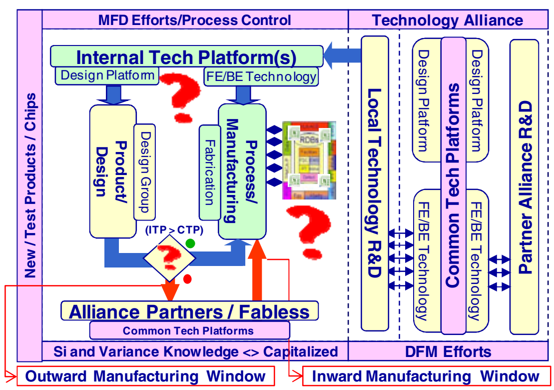


Fig. 4. Existing IDM Business Model in a Technology Alliance

To remain competitive, SMI need to send products quickly to the market with highest production yield and this is not possible without a robust/mature technology platform [12]. [6] Every new technology should have 2x transistor densities, ability to ramp quickly with multiple designs (focused on Design rules and DFM rules) and yield to be as good as or better than previous node (focused on trading off DFM constraints). DFM plays a significant role in technology development and manufacturing process improvements supported by EIS, however principal design of these EISs are coherent to operational efficiencies and support only data driven DFM efforts. Key objectives of an IDM in a technology alliance are to: i) ensure ITPs backward compatibility with alliance partners' CTP (keep intact outward manufacturing window) ii) continuously inject competitiveness by improving ITP (enlarge inward manufacturing window). Alliance partners have access to CTP, similar equipment and material but still one partner get more market share and enjoy high profit margin than others, why? Answer to this question is not trivial, so two questions are formalized and used within brain storming sessions during SWOT and use-case analyses as under:

a) do we have methods to improve device and interconnect models and product development process (Fig.4)?

b) can our manufacturing databases and EIS support continuous improvement in ITP (Fig.4)?

IDEF0 model is presented for the technology platform development process (Fig.5) to answer above questions; however detail description cannot be presented due to time, space and confidentiality constraints. Series of discussions and interviews were held with design, integration, modeling, engineering data analysis and DFM teams in a world reputed SMI. This analysis highlighted device and interconnect modeling as the key functions towards improving a given technology, characterized by improvements in the DRM. Efficiency and effectiveness within sub-functions PT analysis, Inline/PT correlation and inline (geometric)/PT (electrical) data extraction contribute to improve the interconnect modeling function and similar improvement in the device modeling function shall result in an improvement chain reaction ultimately leading to a new FE technology or improved process. It is also observed that the top ranked IDMs always

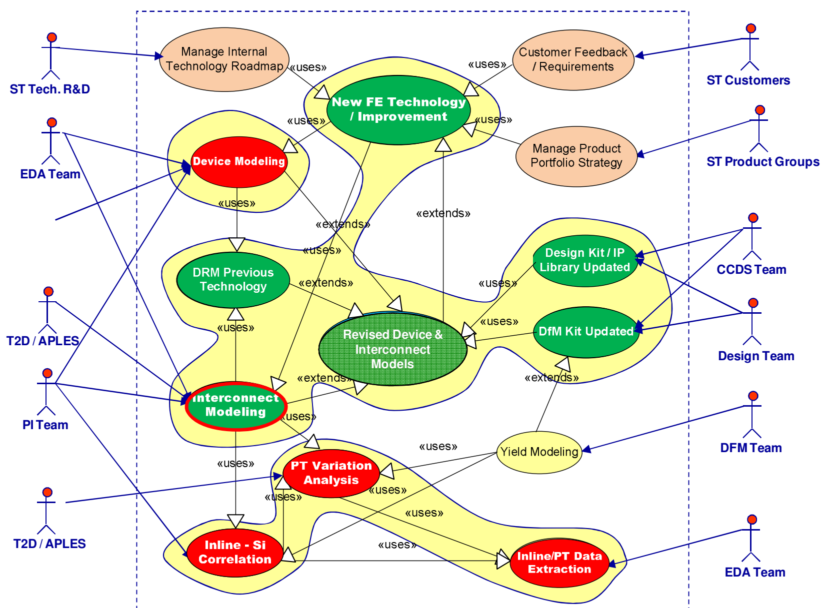


Fig. 5. Use-Case Analysis for Technology Platform Development Process

adhere to best practices and systematic approaches (maturity levels assigned to each step during process or model development); hence answer to the first question is yes, an IDM always use the best practices with the continuous improvement efforts.

A product in SMI is characterized by electrical parameters with target and corner values (SPECS) and models are mathematical equations that determine the behavior (current leakage, timing, delay etc.) of a component (IC) based on geometric shape and process variations. Failures resulting from the process variations force us to either apply MFD efforts (reduce dispersion) or enlarge parametric specs at the cost of area, power consumption and heat generation. During technology transfer models (device and interconnect) are received from the source plant and adapted at the receiving plant as per local environment; hence we perform process and equipment R&D to generate a process window close to the target process received with min geometric variations and dispersion. Success lies in our ability to quickly adapt internal models with those received from the source plant. This process requires simulation followed by validation using prototypes; hence inline-PT data extraction (measurement data), PT variance analysis (model validation based on electrical test results) and PT-inline correlation (root cause analysis against significant variation) enable us to quickly mature our models and deploy them within production lines. During analysis we made following observations:

a) multiple manufacturing data sources (relational databases) dedicated towards operational excellence do not support DFM/MFD efforts; hence engineers spend a lot of time in extraction, cleaning and alignment before analysis and in most cases, it results in zero value addition

b) manufacturing data resources have serious ontology issues (same parameter with different semantics in different databases), as a consequence it becomes difficult to align and correlate data resulting in a missed opportunity

c) unstructured evolution of local databases has resulted missing links which are key to perform a multivariate or predictive modeling across databases

d) Excel is widely used tool in SMI besides advanced statistical tools in an IDM but engineers prefer excel and that could result in misleading conclusions

From above facts we conclude that ontology issues, missing links between databases and transformation of relational databases into temporal multi dimensional structure is a must to support DFM and MFD R&D efforts during technology transfer or existing technology improvement processes. Based on these results we propose an extended IDM business model (Fig.6) where red arrows show local DFM and MFD efforts focused on continuously improving ITP by exploiting manufacturing data. It provides a flow of information and knowledge from manufacturing data towards technology platform and ultimately in the hands of designers through an updated design and DFM kits. This local improvement process interestingly highlights an inward manufacturing window from alliance partners design centers towards local manufacturing facilities. This extended IDM business model focus on keeping intact external manufacturing window while improving ITP to enlarge inward manufacturing window.

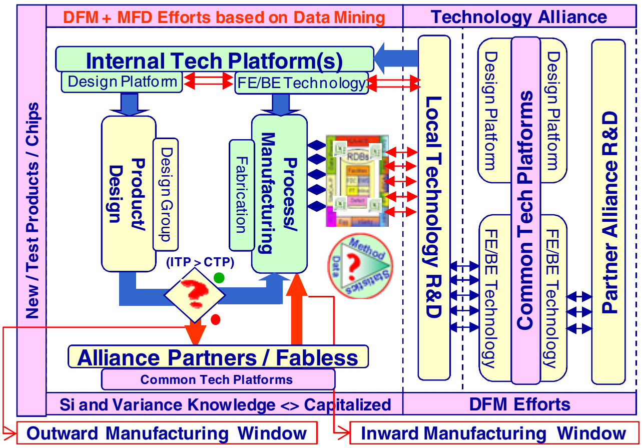


Fig. 6. Proposed Extended IDM Business Model

In order to analyze the conclusions made from use-case analysis and formulate a strategy to be used for smooth transition towards proposed extended business model we performed SWOT analysis (Fig.7). SWOT is focused on the top ranked objective "ramp up rate" because today ramp up rate is directly linked with the profitability and depends on IDMs ability to reduce cost and cycle time of the product. Questionnaire and brainstorming sessions were held with technology R&D, device engineering and process integration teams in this regard.

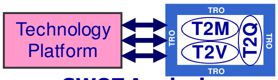
SWOT analysis resulted in the proposition of the 4 strategies as under:

a) **Strength/Opportunity Option:** This option suggest joint ventures with the top ranked IDM to best exploit our strengths e.g. intellectual capital, state of the art equipment, data and methods against potential opportunities (high revenues and market share).

b) **Strength/Threat Option:** This option suggest focus on the design, process, equipment and material innovation to mitigate threats like limiting physics laws, technology platform development and backward compatibility and dynamic customer requirements

c) **Weakness/Opportunity Option:** Ontology issues, missing database links, usage of excel for data analysis, min knowledge capitalization (correlation between geometric and electrical measurements); hence to exploit opportunities, It propose focus on the knowledge capitalization and improved coordination between R&D functions and should be applied in conjunction with option(d).

d) **Weakness/Threat Option:** This option suggest to mitigate threats by eliminating ontology issues, establishing missing links between database and tuning EIS by transforming relational data sources to multidimensional data structures coherent for advanced statistical analysis.



			INTERNAL	
	SWOT Analysis *for* **Top Ranked Objective** "Guaranteed speed & flexibility i.e. T2M & T2V (T2Q)"		**Strength**	**Weaknesses**
			• Intellectual Capital in R&D • State of the art equipment • Quality standards & procedures • Huge manufacturing Data • Product/test chip characterization, FDC, APC, Device and Interconnect modeling methodologies • 11 EDA Tools & 7 Databases	• Ontology Issues • Missing links between Databases • Excel (widely used) + Data Filtering • Interconnect & Device modelling based on previous DRM • Min knowledge capitalization
EXTERNAL	**Opportunities**		**SO Options:**	**WO Options:**
	Environmental Factors • Huge demand increase is expected • Higher revenues with high value products • TCAD Alliances to reduce R&D Costs	**Competitive Factors** • Capitalize methodological knowledge • Stretch CMOS to the limits • Strength of Euro in comparison with Dollar & other currencies	"Establish joint venture with TOP IDM's to reduce R&D costs and capitalize knowledge for higher revenues and profits."	"Capitalize local production knowledge & improve coordination b/w R&D functions to understand information needs"
	Threats		**ST Options:**	**WT Options:**
	Environmental Factors • Dynamic customer requirements • Physics laws are limiting to answer variability • Fabless business model	**Competitive Factors** • Technology Platform development & competitiveness • Backward compatibility with common technology platform • ITRS Pressure	"Innovation in material, design & process along with efficiency and effectiveness at methodologies"	"Remove ontology issues, missing DB links & base device & interconnect modelling on Si Data" << M2D is a solution >>

Fig. 7. SWOT Analysis Results

Strategies a & b are already deployed at the IDM under consideration i.e. establishing joint ventures with top ranked IDMs and incorporating every year a significant number of industrial PhD students as well as collaboration with LABS and industrial partners; however added value come from the weakness mitigation. It shall strengthen the opportunity window by minimizing threats; hence strategies c & d should be focused. Rectification of ontology issues, missing links and increase in silicon (results from the wafer measurement) knowledge capitalization must be enhanced. It cannot be achieved until and unless we tune our engineering information systems by transforming relational data sources to multidimensional data structures truly coherent with advanced R&D objectives.

Based on the above analysis and discussion we easily identify that DFM is dependent on data-method-stat triangle and success lies in our ability to accurately interpret knowledge from this data analysis. We propose the concept at very basic level for this term to be taken as data driven DFM efforts, which is truly inline with the global objectives to assess manufacturability, yield and yield ramp rate. In the current scenario when design and manufacturing interface complexities have risen to heights, we need to shift from data driven DFM towards information and knowledge driven DFM. This concept provides the basis for our proposed extended methodology which is focused on increasing knowledge and this is not possible until and unless we remove ontology issues and missing links between manufacturing databases.

4 Conclusions and Future Perspectives

The DFM concept has a wide range of understanding across manufacturing industries and has emerged in multiple diversifications like DFY, DFT, DFE, DFX etc. We have proposed a unified DFM concept based on data, information and knowledge and is strictly focused to address the extended shift of DFM objective (yield ramp up rate). Profitability within SMI is directly linked with this new phenomenon hence we need to accurately model design/manufacturing interface complexities. Industry has shifted to a fabless business model to address this extended DFM focus and resulted EDA vendors as the key stake holder to help DFM integration in the design flow. This collaboration among competitors from the past resulted in information sharing and technology transfer challenges. We argued that IDMs have an inherent capability to support faster and superior knowledge capitalization and proposed an extended IDM business model based on use-case and SWOT analysis. Analyses results concluded data, statistics and unsuccessful data driven DFM efforts as the limiting factors that led SMI to a fabless model. DFM efforts support manufacturability and yield assessment BUT yield ramp up rate could only be achieved if DFM and MFD efforts are joined together as proposed in our extended IDM business model which is focused on keep intact outward manufacturing window while enlarging inward manufacturing window. It is achieved by fine tuning existing EIS as DFM compliant systems by transforming the existing relational data sources to multidimensional data sources and incorporating agility within EIS for compliance with data model evolutions.

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Strategic Alignment through Organizational Modeling: A Case Study in a Public Institution

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Abstract. The results-oriented management, performance evaluation systems and operations alignment entails the creation of a new organizational environment with novel management practices. This paper addresses organizational strategic alignment issues and offers a modeling technique as a possible solution. A case study of Information Technology alignment in a public organization was developed to test and validate the technique. The study uses a methodology to link the information systems with organizational objectives. The modeling technique proposed by this methodology can be used by managers to formulate, communicate and align the strategy with operations execution. Thus, the methodology applied in this case study can assume a central role in the transformation process of public organizations trying to achieve efficiency and providing quality services to the citizens and society. Finally, this paper presents a new alignment management practice based on organizational engineering.

Keywords: Organizational modeling, strategic alignment, operations management, information technology alignment.

1 Introduction

In the present unstable economical context, public and private organizations are faced with a number of challenges, compelling those to rethink the management practices for better achieving their missions.

Executives use many management tools [1] in the organizational development management processes such as strategic planning, performance management, quality management, business process management, information technology management and others. However, the remaining challenge is to formulate an integrated management process that combines all these processes and tools.

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This paper aims to present a methodology usage, named MLearn [3], for assuring strategy and operations management alignment. Based on a case study involving the modeling of a public institution, this paper illustrates how it helps to achieve strategic alignment of Information Technology – IT.

This paper is structured as follows: next section (2) introduces some references that evidence the awareness for the need of strategic alignment approaches; in the third section (3) the alignment approach is presented; the fourth section (4) covers an example of the methodology implementation in a public organization; in the last section (5) the conclusions are presented.

2 Strategy and Execution Misalignment

Management practices adopted by different organizational units usually are unrelated among themselves because they do not share the same base conceptions. Kaplan and Norton [4] presents a study where more than 60% of the organizations do not link their Budget, Human Resources – HR and Information Technology – IT plans with corporate strategies and usually they are unsynchronized with the enterprise calendar agenda.

Luftman [6] has been conducting surveys annually that show IT alignment is one of IT managers top concern for many years. Another related concern, also a top priority, is the IT strategic planning. Luftman [7] also presented a well-known methodology that accesses a company´s alignment. His instrument evidences the complexity of the alignment effort by presenting a methodology and a Tally Sheet, providing 38 practices organized into six criteria of maturity: communications, competency/value measurement, governance, partnership, technological scope and skills.

In public administration this unrelated management practices is also highlighted. OECD [8] mentions that only 18% of their members link expenditures to all of their output targets and many said it was not common for politicians to use performance results in decision-making.

2.1 Information Technology Alignment

The Strategic Alignment Model (SAM) proposed by Henderson and Venkatraman [9] is the most referenced approaches to the Business and IT alignment problem. Its main objective is the integration of the strategic and functional alignment. It evidences the complexity of this problem, by underlining the need to align the functional dimensions (business and IT) and the need to align both strategies with both infrastructures and processes.

Other more recent models also evidence this complexity. Examples of this are the Benbya and McKelvey [10] and the Gutierrez models [11].

3 Strategic Alignment Using MLearn Methodology

Several management practices can be used for strategic alignment. Kaplan and Norton [5] introduced the closed-loop management system. The Hoshin planning [12] is widely used in Japanese industries. In the public sector, some efforts for strategic alignment can be seen in projects using quality management assessment tools (CAF, ISO 9000, etc.).

One of characteristics that distinguish MLearn [2] from those practices is the use of modeling techniques that allow the design of the organizational architecture where the competencies structure are intrinsically linked with the strategic objectives.

The MLearn methodology was developed by Coelho [2] to integrate the various existing management systems, enhancing their performance through the use of a modeling technique of the organizational competencies.

According Coelho [3], the MLearn is a methodology that guides the organizational development through the design of the organizational strategy based on modeling techniques and interactive workshops. It is a top down, integrated, and systemic approach, strategy-focused and service oriented.

The purposes of MLearn methodology are: (i) to assist the definition, control and communication of business strategy, providing organizational agility; (ii) to integrate the various organizational management practices; (iii) to create a clear picture of organizational and individual accountability: (iv) to contribute for the effective change of behaviors.

The MLearn methodology process can be divided into stages:

- Stage 1: Formulation of the strategic vision of the organization (ought to be):
    1. Clarification of the organizational medium range strategy: mission, vision, objectives and measures,
    2. Discovery and definition of the organizational competencies
    3. Deployment of the organizational architecture in terms of the decomposition of the organizational competencies and respective objectives.
- Stage 2: Operational plan definition (to be):
    4. Review of short term strategy: objectives and measures of competencies,
    5. Design of competence activities, tasks, operations, instructions and rules,
    6. Design of scenarios and processes as workflows
    7. Identification of organizational development initiatives and process improvement projects,
    8. Planning of human resource capacity and individual objectives and measures
    9. Planning information systems applications needs
    10. Planning financial resources needs

The organizational modeling begins with the "ought to be" framework design. Based on this framework it looks at the "as is" trying to define a "to be", according to the capabilities of the organization, closer to the "ought to be".

3.1 Organizational Strategic Vision Formulation (Ought to Be)

This methodology stage is focused on the discussion of the following issues: Definition of the mission and vision of the institution, understanding of the business strategy and of the organizational strategy.

The process of clarifying the organization's strategy defines a unique guideline, conveniently shared with the two highest levels of the organizational hierarchy, and specifically through: (i) indicators and targets, (ii) model of organizational competencies (the organizational architecture); (iii) priorities for improvement, (iv) guidelines for establishing the institution's business plan and budget.

Identifying the organizational competencies means to discuss what the organization needs to know how to do, in order to respond to the clients, according to the business strategy. An organizational competence is a system that provides business capabilities to respond to internal or external stimuli.

The short term strategy is expressed in terms of objectives related to the strategic stakeholders. The conditions to assure the business strategy should be created near the external context (set of strategic stakeholders) and internally by means of the organizational competencies.

In this stage it is important to define the strategic role of information systems.

3.2 Operational Plan Definition (To Be)

According to the organizational strategy defined in the previous stage and having in mind the strategic priorities, it is possible to move forward to the stage of operational plan definition (to be).

In this stage, the operational or short term objectives and measures of the organizational competencies are defined as well as the organizational change initiatives needed to achieve them. Thus, the organizational competencies framework is the driver of human resources allocations and subsequent definition of the individual objectives. This methodology reveals itself to be an important instrument for the human resource management, allowing alignment between individual and organizational objectives and goals.

Modeling the organizational competencies into activities and tasks helps choosing the best process scenarios to have the work executed. This is the contribution of the methodology approach for process improvement initiatives.

The information needs for each organizational competence can also be defined in terms of requirements for information systems that define the alignment technique presented in the next section.

3.3 Information Technology Alignment of MLearn Methodology

The organizational strategy, expressed in terms of the organizational architecture by means of organizational competencies, play the key role of linking the information systems and processes to the business strategy.

The alignment can be achieved going down in the organizational architecture. From first level the organization competencies and strategic objective going down to second level and operational objectives until activities, tasks and processes.

From activities is possible define information needs of people and establishing the process automation opportunities and its impacts on operational and strategic objectives.

4 Organizational Modeling Case Study

The public institution chosen for the case study is the Army Geographic Institute (Instituto Geográfico do Exército – IGeoE) which is internationally recognized for having good management practices such as quality management and process management, among others.

4.1 Organizational Strategic Vision Formulation (Ought to Be)

The strategic formulation starts with mission and vision statements. The Institute mission is conceiving, producing and selling geographic information. The vision is to be the Portuguese leading provider of geographic information and to be considered an international reference by the quality of its products and services.

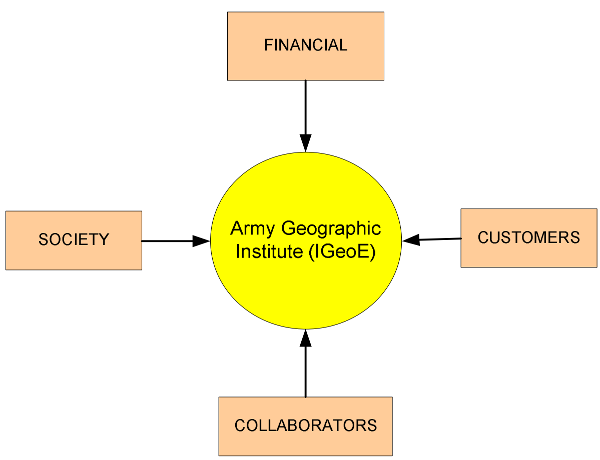

Fig. 1. Motivation model

Once clarified the mission and defined the vision, it is necessary to translate it into medium term strategic objectives and indicators. However, first it is necessary to identify the Institute motivations or the reasons for its improvement and development. Fig. 1 shows the motivation model proposed by MLearn methodology.

Thus, in table 1, with reference to those motivations it is possible to define the strategic objectives and how they will be measured (indicator, periodicity and type of evaluation).

Table 1. Strategic objectives and measures

Strategic objective	Indicator	Periodicity	Type
Customers motivation			
To increase customer satisfaction	percentage of satisfied customers	annual	quality
To increase products sales	sales	monthly	profitability
To increase product quality through innovation	success of new products releases	annual	quality
Financial motivation			
Reduce costs	cost of each product	monthly	profitability

In this stage, the step of clarifying the business strategy seeks to identify the model of the external context, i.e. identify the strategic stakeholders of Institute. Strategic stakeholders mean all external entities that affect the strategy of Institute and simultaneously may be influenced by the institution, in order to facilitate achieving its strategy (Fig. 2).

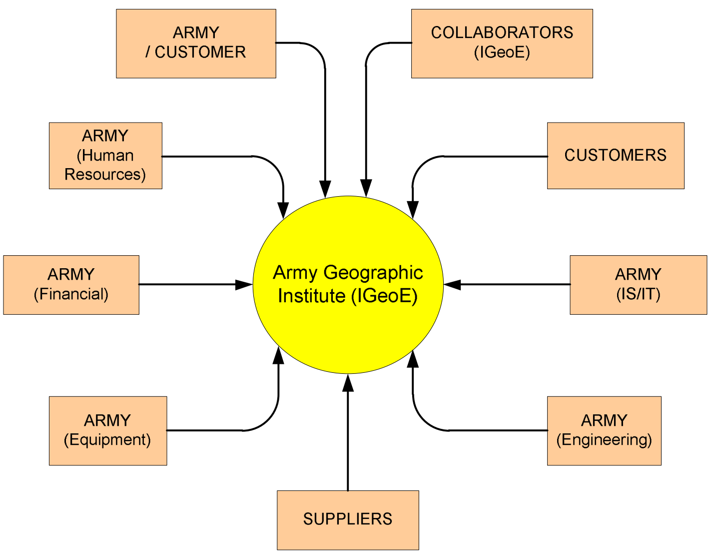

Fig. 2. Strategic stakeholders

The Army (and some of its units), is both the main customer and the main supplier. Customers are identified as some private firms and other public organizations such as municipalities, central government entities, etc. Other suppliers represent companies that provide the necessary materials for the production chain of the Institute.

The Fig. 3 shows the Institute first level model of organizational competencies. These competences can be divided in two types: the core (inner circle) and support competencies (outer circle).

The core competencies are those that are linked closely to the added value chain of Institute products and those that are responsible for the organizational commitments to customers. Like “Manage and Promote Product / Service”, a competence which has expressive visibility by customers.

The support competencies aim to create conditions for a proper organizational functioning through the issue of guidelines and provision of resources and infrastructure, like “Managing IS / IT”.

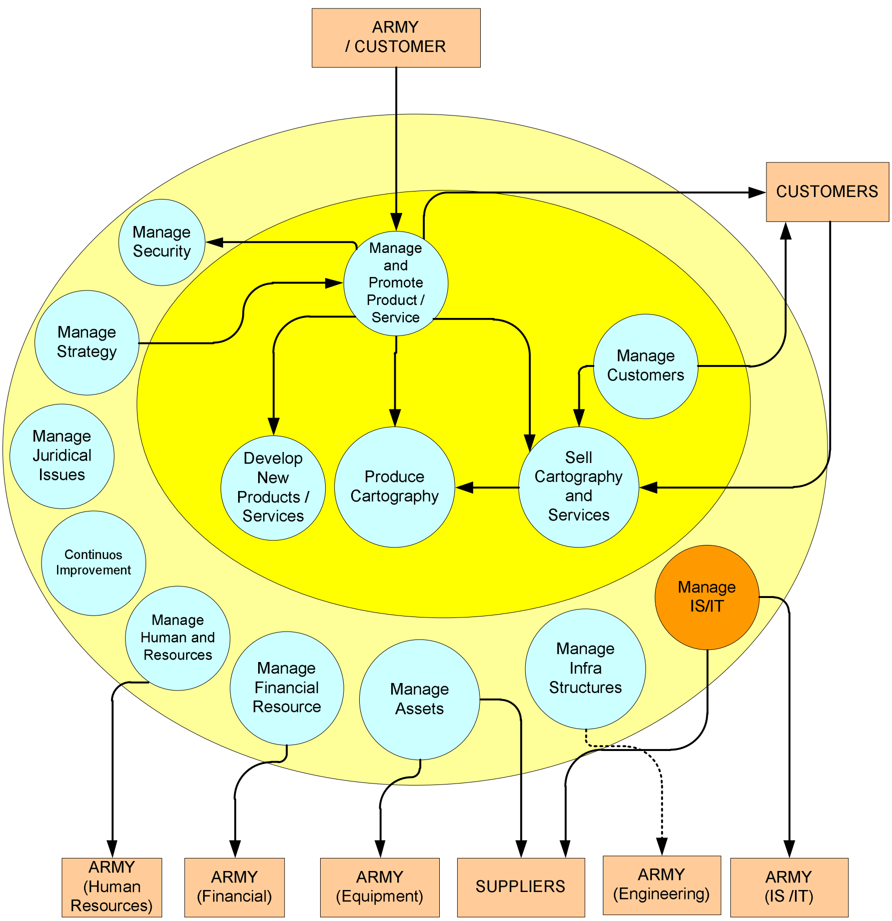

Fig. 3. First level model of organizational competencies

Each organizational competence must be organized in terms of sub-competencies of lower levels, until resulting in the most elementary process.

4.2 Operational Plan Definition (To Be)

At this stage, the operational objectives are defined based on the critical success factors to attain strategic objectives and the relationship of the organization with its strategic stakeholders.

The organizational competencies are detailed into activities and tasks and the best process scenarios are chosen to achieve the operational objectives.

As mentioned previously, the Institute has been using several of the known management best practices. MLearn is a supporting methodology that allows link these operational practices.

The quality management is one of these operational process covers the Institute annual quality targets, the improvement plans for development of new processes and promoting changes in the products. The quality management process has ISO 9001 certification. The continuous improvement is the Institute modeled organizational competence responsible to link of quality initiatives with operational and strategic objectives.

The human resource is another modeled competence responsible for the alignment of organizational goals with individuals' goals. Portuguese Central Government has an initiative for organization performance evaluation at three levels: entity, managers and servant. MLearn methodology has capability to address this initiative in integrated way.

Manage Information System competence is responsible for definition of contribution of information technology to the operational objectives. This alignment technique explained in the next section.

4.3 Institute Information Technology Alignment

The design of different scenarios supports the processes improvement practices and accordingly potential improvement contribution of information systems. The methodology assists in the identification and specification of information needs to the implementation of Institute systems applications.

For instance, considering Institute warehouse where a worker receives a material from a supplier. The tasks that he would perform are (1) validation according to the order, (2) update of the material database and (3) range the material in the warehouse. With the modeling technique we design a workflow with the three tasks. Then to implement an information system, is necessary to identify the information needs and the information requirements. The question is how to assure strategic alignment. In fact, the worker in the warehouse normally knows neither the business strategy nor the whole organization.

Some questions can be formulated: what is the impact of applying IT on that workflow? What is the return of the investment? Who should validate the contribution of the worker? Normally is the manager of the warehouse who is in charge of validating the results of interviewing the worker. But the issues raised to the worker are the same, as the warehouse manager also has a partial view of the organization.

But if you model the organization in terms of organizational competencies you get a great help. The first task belongs to the organizational competence "Buying" and, the second one to the "Materials Management" and, the third one to the "Warehouse

Management". The negotiations with suppliers may depend on the time of clearing the invoices, which depends on the time of validating the material in the warehouse.

So the information requirements coming from the first task should be validated by the buying manager and not by the warehouse manager. The second task should be validated by the materials manager. MLearn uses the business objects to define the information system needs. These are expressed in terms of objects, services, attributes, status diagrams and object contexts.

The information systems requirements are not gathered by interviewing the users. The users don't have the necessary conditions to identify their own information requirements; they have neither the knowledge of the entire macro process nor the expertise on IT potential to support it. It is the continuous improvement coordinator of each macro process that do that job with someone from the information systems area to assure integrated and aligned business and information systems strategies.

The business objects and the organizational competences are used to define the applications systems in an business specifications of the information systems, systematized by organizational competences, will be useful to support the acceptance tests of the software applications and the users training on the procedures and new software. The information needs can be identified based on the Operations, Instructions and Rules or even on the processes or workflows designed with them.

The Institute organizational architecture modeling allows the ease identification of information systems impacts on operational and strategic objectives.

5 Conclusions

The MLearn methodology as organizational alignment practice is the result of a combination of various contributions to support operations and continuous improvement initiatives.

It offers a common language and an integrated approach to several organizational practices beyond information technology management: strategy management, quality management, reengineering, control management, knowledge management, human resource management, operational risk, and innovation and process management [2].

The adoption of MLearn allows: a model for expressing objectives levels and its indicators, to facilitate the understanding of the strategy and the collective commitment, and defining the essential foundations for the strategic alignment across the organization.

In this exploratory case study demonstrates the importance of adopting an organizational model, even in organizations referenced management practices. The methodology is effective in diagnosing and organizational alignment.

This study also demonstrated how information technology can be aligning to the organizational strategy and objectives. This study contributes to the implementation of a continuous improvement approach using of information technology. That provides a quantum leap in the maturity of public services and a significant increase in its efficiency, responsiveness and quality reflected in the organizational performance.

This study, therefore, tested the MLearn methodology application, validated the implementation process and provided guidance to public organizations that want to begin the practice of organizational improvement process through organizational engineering.

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Failures of a Business Process in Enterprise Systems

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Abstract. A business process model typically describes a desired flow of events in an ideal environment. However, the reality tends to be more complicated than what is designed in the model. During the execution of business process instances, a lot of exceptions may occur. These exceptions are deviations from the correct, specified sequence of events. Thus it is important to know the behaviours of process instances in the presence of exceptions. The classical approach of incorporating exception analysis in process models has been trying to anticipate beforehand all possible exceptional conditions that might arise and argue the process model with those additional conditions in order to determine the exception handling actions. This approach, however, might be problematic because the identification of all possible exceptions relies on the experience and intuition of the participants.To have a clear understand of the failure behaviour of a business process is equal important, but first of all, it has to be studied what characteristics of failure often have. In this paper, we present the initial findings of our project that targets to the enterprise issues of healthcare systems.

Keywords: Failure, Failure characteristics, Business process.

1 Introduction

An enterprise system is an information system that promises a seamless integration of all the information flowing through an organisation.It provides a technical platform that enablesorganisations to integrate and coordinate their business processes. The concept and adoption of enterprise systems have attracted increasing interests as organisations have been seeking how they do their business more efficiently. In the approach of adopting an enterprise system, business processes become a dominant factor because that without having a clear understanding of those business processes, the dream of integration proposed by the enterprise system will quickly turn into a nightmare.

In order to understand them, business processes have been analysed for various purposes, for example validation, verification and performance evaluation. During the analysis, the properties of a business process, for instance correctness, effectiveness, and efficiency, can be modelled and checked by formal or informal methods. Usually, some exceptional mechanisms are designed to handle the known errors that may occur in the execution of business processes. However, the reality tends to be more complicated than what is designed in the model. During the enactment of a business process a lot of failures might occur. To assure that a business process is still able to

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fulfil its organisational goals, it is of equal interest to know the behaviours of a business process in the presence of failures.

This paper will present our research onstudying the characteristics of the failure occurred in the business process. The purpose of this research is to provide a comprehensive view of the failure so that the business process analysis in terms of failure behaviour can be easily and systematically done. The paper is structured into 6 sections: Section 1 is the part to briefly introduce the research; Section 2 distinguishes some important terms used in our research, and explains the focus of our research at the same time; Section 3 describes the method of our research; and Section 4 is the main part of this paper, it shows the initial findings of our research; Section 5 discusses some other characteristics of a business process failure; Section 6 concludes the findings and indicates the future research works.

2 Background and Definitions

The concept and issues about failure have been studied in many domains. In this section, we filtered the information for the purpose of studying business processes, and gave the definitions of several terms used in our research.

A business process, by its definition in [OMG/BPDM], is a collection of related, andstructured *activities*. The specification of a process defines the set of activities as well as the procedure and conditions on when such activities will be performed, i.e. in what order an activity is executed and how. A business process might have a hierarchical structure, therefore it can be defined as: a business process is composed of a set of activities linked together in order to interact, where each activity is another process, etc.; The recursion stops when an activity is considered to be atomic: any further internal structure cannot be discerned, or is not of interest and can be ignored.Although there is a difference between the terms of *process* and *activity* in terms of internal structure, we use them analogically.

The *function* of such a business process is what the process is intended to do and is always described by its requirements in terms of functionality and performance. On the other hand, the *service* of a business process is what the process behaves to implement its *function*.

A *correct service* is delivered when the service implements the process function. And a**service failure**, often abbreviated to **failure**, is an event that occurs when the delivered service deviates from correct service. The deviation from correct service may assume different forms that are called service **failure modes** and are usually ranked according to **failure severities**.

In short, **failure** is a term to describe the state or the condition of a processin which the process does not satisfy thedesirable or intended objectives. A **failure** is usually viewed as the opposite of **correctness**.

As in definition, failure is a state deviated from a correct state. In the domain of business management, there is another term *exception* that is also defined as a deviation from desired sequence of events. The concept of a failure and an exception are treated differently in our research. Basically, an exception is a deviation of the sequence of the activities in the process, and a failure refers to a deviation of the state of the activities. An exception is always an issue related to the structural model of a business process, but a failure is a run-time behaviour of a process. For example, in a business process management system of car insurance, the process of an insurance claim may have several exceptional routes to handle the unusual cases. However, in a real instance of insurance claim, the case at any stage in the process may have errors, for example, the incorrect description of the accident or over-estimated damage of the accident. All those errors may cause the outcomes of the activity fail to achieve its designed function, so it is a failure. But the case may be processed following the normal procedure because the fault in the outcomes of the activity is not identified.

A business process management system is cased-based, i.e., every activity is executed for a specific case. The goal of a business process management system is to handle cases as efficiently and effectively as possible. The business process model is designed to handle similar cases. A part of common cases may have additional conditions, and they are modelled as exceptions. From that point of view, failures are not exceptions that are not foreseen during the design of the process model and not captured during the execution of business process instances. Therefore, the study of business process failures that will increase the awareness of failures in process engineers' head is a vital factor to improve the overall quality of business process management system. In next section, we will firstly introduce the method of our research.

3 Research Method

The research was seeking a comprehensive view of business process failures so that the failures can be handled by exceptional routes in the business process model. In terms of identification, the methods to identify exceptions or identify failures are same. So in the research, on one hand, we reviewed the methods of exceptions identification, especially various classifications of business process failures, for example [1,3-15]; on the other hand, we also gathered the published analysis results of the business failures, for example [16-25]. In this paper, we discussed the initial findings from our literature review.

4 Dimensions of Failure

In the research, we found that same as quality of business process, a failure of a business process has also several dimensions. In this section, we discuss these dimensions in details with examples. The discussion is based on one of our case studies, a business process of stroke care in secondary care. Figure 1 shows the diagram of the partial process which can also be viewed at NHS map of medicine (http://eng.mapofmedicine.com/evidence/map/stroke_and_transient_ischaemic_attack_tia_2.html). A set of brief descriptions of each activity are also published on the website. In this paper, we do not explain the process in many details, but basically it is a clinic treatment process, started from a suspect stroke patient receiving normal clinical representation, and ended with the patient admitted to stork unit.

In the process, failures might occur at every activity due to the reasons related to the activity itself, issues related to the resources or human errors. In spite of the sources of a failure, we also find that a failure may fall into one of following categories:

- Incomplete, the activity does not fully perform its function.
- Invalid, the correct service does not last for a right period of time.
- Inconsistent, the activity cannot perform consistently.
- Timely, the activity is not enacted on time.
- Inaccurate, the activity is not enacted for the right purpose.

In following, we will explain them in details.

Incomplete – For example in Figure 1, the activity 13 is to carry out a blood test. In the specification, there will be 5 blood tests: 1) blood glucose level - exclude hypoglycaemia as the cause of sudden-onset neurological symptoms; 2) full blood count (FBC); 3) urea, electrolytes, and creatinine. There are also some tests to consider, including a) coagulation profile, especially if considering thrombolysis or if haemorrhagic stroke is suspected; b) erythrocyte sedimentation rate (ESR) or C-reactive protein (CRP); c) lipid profile; and d) troponin, if ECG is abnormal or history of chest pain. For those tests, the result of test would be important evidences. However, if there are some tests missed, especially the three basic tests, it will be an incomplete failure.

Invalid – Taking the same activity as an example, when the blood tests should be done, it requires the relevant resources are available for a period of time, for example 1 hour. That means in this 1 hour, the resources to perform the blood test, including human resources, equipment, test material, etc., should be ready. If not, it is an **invalid** failure at this activity.

Inconsistent – In a hospital, most of test can be analysed by machine and today's technology can provide a satisfied consistency. However, some examinations or tests are still only by human, for example the brain image (activity 14). The outcomes of this activity need a curtain consistency in order to improve the quality of care. The **inconsistent** failure might occur at this activity because of the experience of brain image examiner.

Timeliness – Timeliness failure usually refers to early or late failure, which means the outcomes of an activity are either too early or too late. For example the activity 16 --- reviewing investigation results, the doctors diagnose the type of stroke which the patient may suffer and then send the patient to relevant unit to have a right treatment. However, the diagnosis may take longer for some reason, so that the patient may miss the best time to have a treatment. That will be **timeliness** failure.

Inaccurate – Inaccurate failure usually means that the activity is enacted for a wrong purpose, or the value of the outcomes is wrong. For example, the blood test, the results of blood tests may be inaccurate because the sample may be contaminated. The inaccurate failure is one of common types of failures.

5 Other Characteristics of Failure

During our research, we also find that in some cases there are some other characteristics of failure need to be modelled in the business process. For example, considering a failure tolerant business process, the degree of failure deviation may be needed. In another case, considering timing sequence, the time parameters of service validation are requested.

In summary, a failure can be modelled as a tuple (*mode*, *degree*, *timing*), in which the *mode* is failure mode which can be in one of dimensions listed above; *degree* is an estimation of the degree of deviation; and the *timing* is the valid time period of the failure. In a business process model, especially when analysing failures, degree and timing characteristics are optional. But for the case of performance evaluation of a business process, the value of timing parameter of a failure is usually available.

In a complex case study, it can be easily too big to model all possible failures in a graphic model. Therefore, we can store all information of failures in a business process in XML files, and manage the files in a native XML database. We define an XML Document Type Definition (DTD) to do that.

```
<?xml version= 1.0?><!ELEMENT Task (ID, Name,
Brief,Activity+, Resource+, Constraint+)>

<!ELEMENT ID (#PCDATA)><!ELEMENT Name (#PCDATA)>
<!ELEMENT Brief (#PCDATA)><!ELEMENT Activity
 (ElementID, ElementName,ElementBrief, FailureMode,
Category )>


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ElementBrief,FailureMode,Category)>


<!ELEMENT Constraint (ElementID, ElementName,
ElementBrief,FailureMode,Category)>


<!ELEMENTElementID (#PCDATA)>

<!ELEMENTElementName (#PCDATA)>
```

6 Discussion

The evaluation of our research is a long process that depends on a large amount of applications. It also depends on the method and tool that how to analyse the failures in a business process. These two parts are highly coupled. From a process point of view, the evaluation of our approach is an iterative process: applying approach to new case studies; getting experience of using the classification we proposed in this paper to identify possible failures; and finally evaluate the approach.

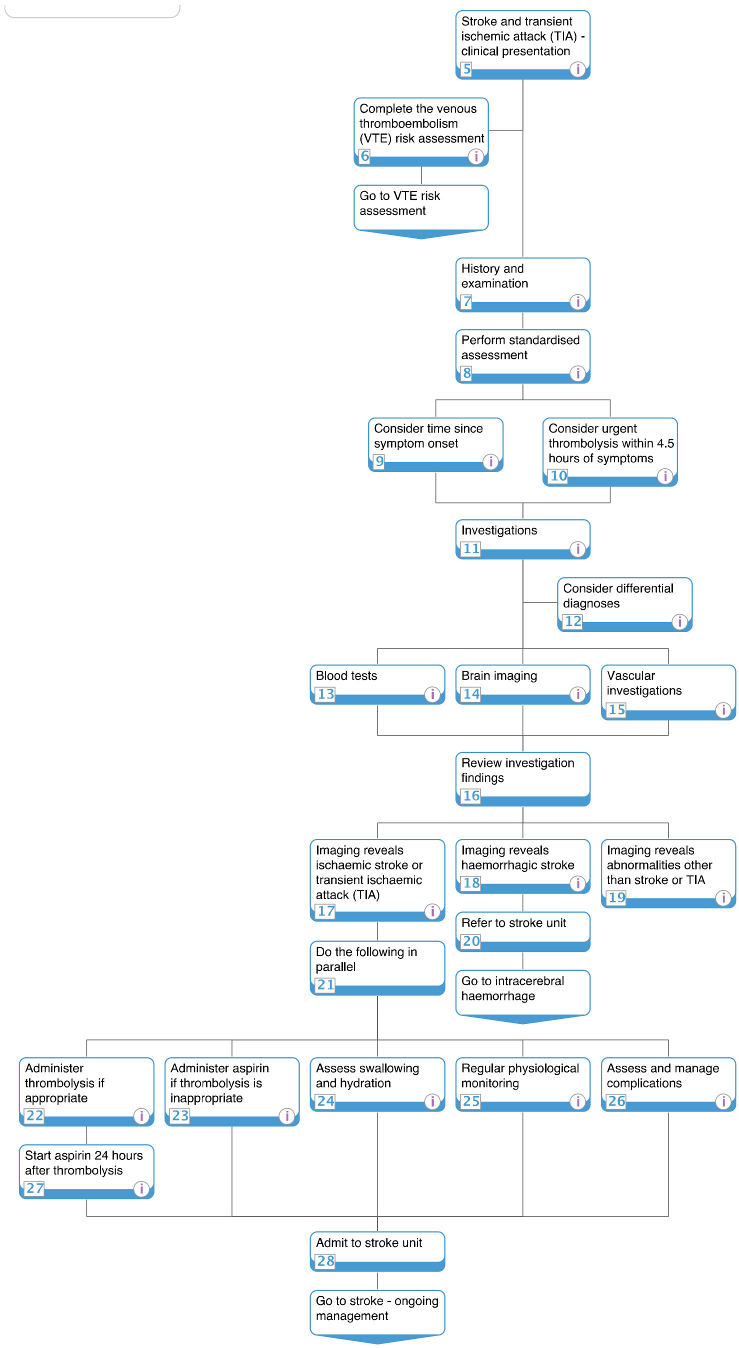

Fig. 1. Pathway of Stroke and Transient ischaemic attack (TIA) Patients in secondary care [2]

In our research, we also identified there are several points to be improved in the near future. One of them is the language of modelling failure. There are many complex scenarios in the real case studies. However we only construct a simple structure of failures and their relationships.

7 Conclusion

We have described our initial findings of studying failures in business processes, particular the processes in healthcare organisations.These findings can be a starting point of set up a failure repository for the next step of our research. Because our project is still at early stage, it is difficult to validate the research with limited case studies. The next step of our research will be more case studies to strengthen the knowledge of business process failures. We aim to have a comprehensive knowledge database to help the reform the business process in healthcare organisations.

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A Tale of Two ERP Vendors – and the Crucial Decision of Choosing the Right Business Model

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Abstract. The paper looks at the history of two ERP vendors (Maconomy and Navision) in Denmark pursuing two different business models. On one hand, Maconomy decided to develop, sell and implement ERP packages directly to customer. They believed they would be best at it, and they would obtain valuable information about customer requirements in the process. On the other hand, Navision adopted a business model which relied on an ecosystem of partners consisting of value added resellers (VAR) and independent software vendors (ISV) to sell, implement and further develop add-ons for their software. The paper presents a Resource Based View (RBV) analysis comparing and contrasting the resources of the two companies, in order to explain why Navision was sold for 16 times as much as Maconomy. We posit that the main reason for this huge difference is the value of Navision's ecosystem enabling them to achieve economies of scale.

Keywords: Resource Based View, ERP, Value, Business model, Ecosystem.

1 Introduction

This is the history of two Danish ERP vendors, Maconomy and Navision, who used different business models for going to the market. The contrast between the approaches taken by these companies is seen in the decisions and strategies each company made to sell and implement their respective ERP solutions.

Maconomy decided that their company had the capability of selling and implementing their own system for two reasons. First, because they felt that they can better assess how to meet customer requirements through software modifications. Second, because they believed that this allowed them to gain valuable information for future revisions and further development of the general software.

Navision decided that in order to achieve economies of scale in selling licenses, it would be advantageous to sell through partners. Navision therefore had to develop a number of development tools for the partners and a procedure for collecting information about customer requirements for future developments.

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In 2002, Navision was acquired for $ 1.2 billion (DKK 10 billion)[1] by Microsoft, and eight years later Maconomy was acquired by Deltek for $ 73 million (DKK 438 million).

Using the postulates from the Resource-Based View (RBV) theory as a technical-rationalist framework, this paper analyses the strategies employed by Maconomy and Navision to establish and develop themselves as ERP vendors within the context of the competitive climate in Denmark and the global industry. The paper also discusses how the two firms took advantage of the resources available to them and how these vendors successfully developed their capabilities to achieve a core competency in developing ERP solutions.

In particular, the paper looks at whether or not an ERP vendor should use a partner channel to develop and distribute their ERP solutions. In order to achieve this, the paper is organized as follows: Firstly, it will contain a literature review of the RBV. Secondly, it will detail the methodology used to conduct the case study. Thirdly, it will describe how the two companies developed their capabilities. Fourthly, it will apply the concepts of RBV to the case. Finally, it will discuss the limitations and further implications of the case study.

2 Literature Review

The RBV theory postulates that a firm which owns rare and valuable resources can use these to achieve temporary competitive advantage [2]. Moreover, a firm has intrinsic and extrinsic resources at its disposal which, taken singly or in combination with others, can be developed into capabilities. These capabilities markedly enhance the value of assets, include managerial and technical skills, as well as systems development or integration processes [3]. If managed, as well as safeguarded from being copied, substituted or transferred, these capabilities can be extended towards long-term sustainability [2-4].

One shortcoming found in applying RBV is that researchers in the field have used terms and evaluation criteria inconsistently [3]. This paper adopts the definition of resources as both an asset and a capability [4, 5]. RBV capitalizes on the ability of a firm to look at the different resources and to identify resources that provide most value to its business. These firm resources, whether pertaining to IS or not, include both tangible and intangible assets that serve both as “inputs” and/or “outputs” to a process that enables the firm to respond to market changes [3].

Critics have noted that the theory fails to take into account the relationships between the firm, its environment or the industry that it operates in [6, 7]. In response, some researchers have extended RBV to show that based on the need to obtain additional resources, alliances are formed in order for firms to compete more effectively [7]. These researchers suggest that the formation of alliances is advantageous for several reasons: First, an alliance allows the allied firms to share costs and risks; second, it legitimizes and/or enhances the status of the firms,

[1] All currency figures are provided primarily in USD ($). If original amount was in Danish kroner (DKK), the equivalent amount is shown in USD and the amount in DKK is shown in parenthesis. The calculations are based on an exchange rate of 12 DKK to 1 USD before 2003, and DKK 6 to 1 USD after 2003 due to the depreciation of the USD particular in the early 00’s.

especially in a crowded market; and finally, it allows the firms the ability to combine "buying powers" and "distribution channels" [7].

The use of RBV to explain competitive advantage is an effective approach because it incorporates concepts from three research areas: 1) strategic management; 2) industrial organization management; and 3) organizational economics [8]. In the field of Information Systems (IS), it has been adopted to explain the role of IS resources, as well as other resources, in the long-term competitiveness of a firm [3]. This study aims to contribute to the literature on RBV by examining the resources of two ERP vendors, which influenced the strategic decisions they made to obtain competitive advantage.

3 Methodology

This paper uses both semi-structured interviews [9] and document analysis of secondary sources to validate and triangulate the findings and minimize risk of bias that can skew the results of the study. The interviewees were selected among current and former executives from the companies, who have been around since the original companies were formed. All the interviews were summarized into a thick description and triangulated from secondary resource, whenever available.

The researchers used an interpretative approach [11] to describe the history of the two companies using the interviews. The write-up of the history allowed "unique patterns of each case to emerge before investigators push to generalize patterns across the case" [10, p. 540]. Subsequent analysis was made by identifying the resources of each ERP vendor based on the interviewers' description of their product and business model. Then, the attributes of these resources were examined in RBV terms – i.e., whether they were valuable, rare, inimitable, and non-substitutable. Finally, by comparing and contrasting the resources, the researchers were able to determine which of these resources provided a competitive advantage for the firms.

As part of the RBV analysis, a financial analysis of the two companies has been carried out. However, this does not attempt to provide an in-depth analysis of the financial performance of the two firms. We have not found that necessary in order to substantiate our conclusions. The differences between the financial performance of the two companies is so huge that even substantial inaccuracies and/or impreciseness in the data are without implications for our conclusions.

4 Maconomy Case Study

Maconomy was founded in 1983, not in the garage but in the bedroom of Per Theis Knudsen, who remained the Chief Executive Officer (CEO) of the company until 2002. Early on, the company received a request from Apple to develop an accounting package for the Apple PC. The CEO of Apple in Denmark was Walter Thygesen, and together with the management of Maconomy, they applied for a substantial grant of approximately $ 1.5 million (DKK 20 million) from public Danish sources (Dansk Udviklingsfinansiering) to develop such a system. However, only a small fraction of this amount was obtained in the end, and most of the development was financed by the company itself through unpaid or low paid labor.

Unfortunately, the development of the accounting package took much longer than initially planned because of the strong focus on making the system graphic in line with Apple's philosophy. This proved to be very complicated, and it took almost five (5) years to develop a system robust enough to sell. It was later estimated that the cost of development of the system was $ 2.5 – 3.3 million (DKK 30 – 40 million). By all accounts, the PPU system, as it was called, was an excellent system with many innovative features.

At that time, the idea was to sell "shrink-wrapped" software through the Apple stores, but it turned out that the market for this type of software was limited. Apple only commanded about 10% of the total PC market, and only 10% of the users would be interested in having an accounting package. Maconomy realized that they would never be able to get a large sales volume on the proprietary Apple platform. Accordingly, when Windows 95 came out for the PC, they decided to develop a version for the Windows platform, and to build a general applicable ERP system to be sold similar to the way that SAP and Oracle are selling even today, where a major part of the sales is done in one's own sales organization.

In order to finance the development, sales and distribution, the company decided to do an initial public offering (IPO). However, due to several delays, the IPO did not take place until December of 2000, shortly after the dot.com collapse. Although the bank advising Maconomy initially estimated a price of $ 10 (DKK 120) per share earlier in 2000 when the dot-com euphoria was at its peak, the board of the company reluctantly decided to price the offering at $ 5 (DKK 60) per share.

The ambitious professional investors on the board pushed for Jim Beckman to be appointed as co-CEO to Per Theis Knudsen with the sole aim of "making the US market". Six centers were then established with 75 employees during 2001-2002. In retrospect this turned out to be an expensive decision to try to penetrate the US market using their own resources. Sales continued to be lackluster, and the company was losing money in most of the years after the IPO. Focus turned on selling and in an attempt to close sales wherever possible, the firm ended up obtaining orders from customers with very different requirements, which meant a lot of extra work for the systems development department. "Essentially, to close sales, field representatives of the company had to promise customers a lot, and it was difficult to meet all the promises" (Bent Larsen).

In 2002, Bent Larsen, who had recently returned from a top job as director of sales for NCR in Europe, took over as CEO. Subsequently, two major changes in the company strategy were attempted. First, convinced that it would be an advantage, Larsen pushed to develop a partner channel for selling their packages and achieve economies of scale. Second, Maconomy decided to concentrate on the project- and service-oriented business niche, which had a sizable number of large organizations with a lot of project work needing a means to control hours spent on activities and other costs.

The development of a partner channel proved unsuccessful for two reasons. First of all, the kernel architecture or the basic software package was not easy to modify for partners and the development tools were too complex for partners to use in the customization process. Thus practically all sales to customers were done by Maconomy employees themselves. Second, the company executives realized that "the cost of selling/marketing an ERP system is 3 to 4 times more than the cost of developing it" (Bent Larsen), which made it difficult to create a profitable business.

In 2007, Larsen stepped down as CEO of Maconomy, and Hogo Dorph took over with the strategy of focusing on direct sales to large project-focused businesses. About three years later in July 2010, Maconomy was acquired for a price of $ 73 million (DKK 428 million) by the US-based company Deltek headquartered in Herndon, Virginia[12]. Deltek focuses on offering "solutions to every major sub-vertical within the broad professional services marketplace ... and drive innovation for project-focused organizations across the world"[12].

5 Navision Case Study

The company Personal Computing and Consulting (PC&C), later renamed Navision A/S, was founded in 1984 by three graduates of the Technical University of Denmark: Jesper Balser, Torben Wind, and Peter Bang. Its first product was an accounting solution targeting the small/home office market, originally developed for the Commodore 64. In 1987, Navision released Navigator 1. This proved to be a commercial success. A key reason was the decision of the company to allow its dealers to be certified resellers of the company's products. With this arrangement, which was considered a novelty at that time, IBM became the major reseller in Denmark, and pushed Navigator to become a bestseller [13]. Another important aspect for Navision was that as early as 1989, the firm had realized that the Danish market was too limited and that the German market represented a huge opportunity. Navision partnered with a German company in Hamburg, which was tasked to oversee and carry out the localization for the German market including the different language, legal and other requirements. By 1990 Navision had also expanded into Iceland, Spain and UK. Navision became profitable from the early 1990s, and it became natural to attempt an IPO, which took place in 1998. The IPO provided the company with funding for further development.

Around the same time in 1983, a third Danish ERP rival was established by Preben and Eric Damgaard, Damgaard Data A/S. The company released and distributed its first accounting software called DANMAX, also through IBM. Later in 1986, Damgaard released Concord Finance, which was one of the first business management solutions that utilized the LAN technology. About twelve years later, the company launched Axapta 1.0, a system which supported several modules for finance, trade, inventory management, logistics and production. This was marketed to the American, Danish and other European markets. In 1999, the company released Axapta 2.0 with Active X support using the Axapta Object Server.

In 1998, Damgaard A/S got listed on the Copenhagen Stock Exchange. Subsequently, Damgaard and Navision merged in 2000 to form an even more competitive company, much to the surprise of many observers who thought that the funds obtained by the two companies in their respective IPOs would enable them to continue on their own. Insiders, however, characterized the "merger" as an acquisition by Navision, the more dominant of the two companies due to the strong demand for Navision's very successful and effective ERP package. In contrast, Damgaard had the newest and most advanced system in Axapta, but it was not fully operational; in fact, it actually took several years to get to a stage where it could be sold to clients.

Critical to the success of the business strategy of Navision as well as Damgaard was to sell through partners. Both companies realized that economies of scale were all important. The marginal cost of producing “one more system” was negligible, and high sales volume meant that development costs could be spread over a larger number of systems, thus reducing the cost per unit sold. However, to achieve economies of scale, it was necessary to sell through partners, and it was important to enable independent software vendors building customized and focused solutions for industry verticals.

As a matter of design philosophy, Navision wanted to develop a flexible architecture that would allow it to 1) sell internationally (i.e. in many countries/markets in Europe, India and the US); and 2) make modifications that would cater to various industry verticals. Accordingly, Navision came up with a three-layered architecture: a kernel architecture layer, a verticalization layer, and a localization layer. The kernel architecture provided all the basic stable functionalities general to ‘all’ companies and industries; the verticalization layer allowed partners to make modifications that would cater to particular industries; while the localization layer allowed the partners to adjust to cater to local requirements (typically involving legal requirements, standard practices, or reporting requirements in the different markets). This setup meant that customizations to a particular customer should not be done in the raw code of the kernel.

To allow partners to make the necessary localizations and develop verticals, the partners were given a development tool called C/Side. C/Side was relatively easy to use, and since all partners were using the same development tool, they could help each other by exchanging software modules. This created an ecosystem around the development, sales, implementation and further development of the Navision ERP system.

In 2002, Microsoft approached Navision and declared an interest in acquiring the Danish company [14] because “Navision's 2,400 partners, the bulk of which [were] based in Europe, [would] be a major asset for Microsoft” Microsoft[15]. Microsoft had earlier on acquired Great Plains Software, which had a successful ERP software for the US market, but was not easy to modify and adjust to different markets because its architecture was not developed to handle modifications like changing the language, handling several currencies, etc. Accordingly, Microsoft was on the lookout for an ERP vendor which had a proven and successful architecture and which, with a minimum level of effort, could be modified to the Spanish, the Indian and even the Chinese market.

Following the acquisition, Microsoft’s strategy on ERP systems was formulated around selling Great Plains and Solomon in North America, and Navision/Axapta in Europe and the rest of the world. That is still the case, although the largest development efforts are now going into developing the Axapta code base for the global market. All code bases are marketed under the same brand name of Microsoft Dynamics with the suffix NAV (Navision), AX (Axapta), GP (Great Plains) and SL (Solomon,).

6 Financial Case Analysis and Discussion

Since their founding in the early 80’s, the two ERP vendors have shown two divergent financial trajectories. While there may be several reasons for the divergence, the use of RBV theory from an IS perspective offers an explanation. Table 1 summarizes various aspects of Maconomy and Navision as independent companies prior to their acquisition.

Table 1. Financial highlights of the two vendors

	Maconomy	***Navision***
Year Founded	1983	1984
Year/month of IPO	December 2000	September 1998
Total capital obtained at IPO	$ 20 mill. (DKK 240 mill.	$ 120 mill. (DKK 813 mill.)
Market capitalization at time of IPO	$ 93 mill. (DKK 1,100 milli.)	$ 268 mill. (DKK 3,889mill.)
Date Acquired	July 2010	May 2002
Acquired by	Deltek	Microsoft
Total sales price	USD 73 mill. (DKK 426 mill.)[17].	USD 1,230 mill. (DKK 10,000 mill.) [14]
Gross Profit the year priorto acquisition	USD 37mill. (DKK 222mill.) as of 2009	USD 102 mill. (DKK 1,226 million) as of 2001
Sale price as a multiple of Gross Profit	2 times gross profit	12 times gross profit

As a function of valuation, profitability (both historical and expected) provides some insight into how the intrinsic assets of the companies add value. In order to control for the differences in the financial circumstances between the two companies (e.g., initial capitalization, date of founding, date of IPO, date of sale, income), the researchers reviewed the key financial figures of the two firms. To aid the analysis, profitability was only used as an indicator of success and as a way to measure the firms' respective sale prices as a function of profit. Profit-related growth rates were also used as a way to compare the performances of the two vendors. We have chosen to show the development in gross profit and net income for the two ERP vendors in the figures 1 and 2.

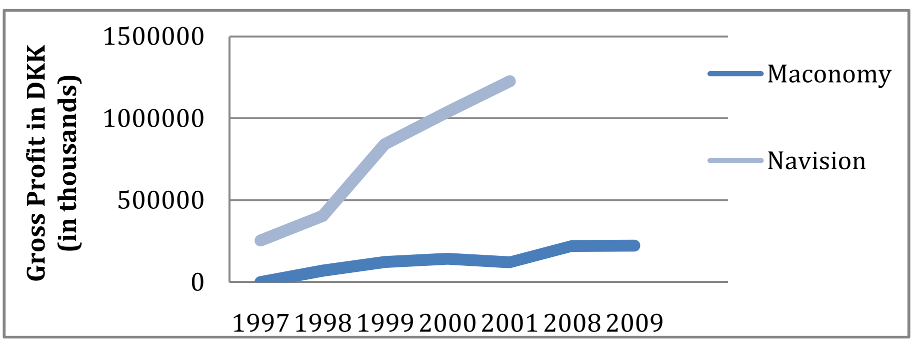

Fig. 1. Gross Profit of Maconomy & Navision (1997 – 2009)

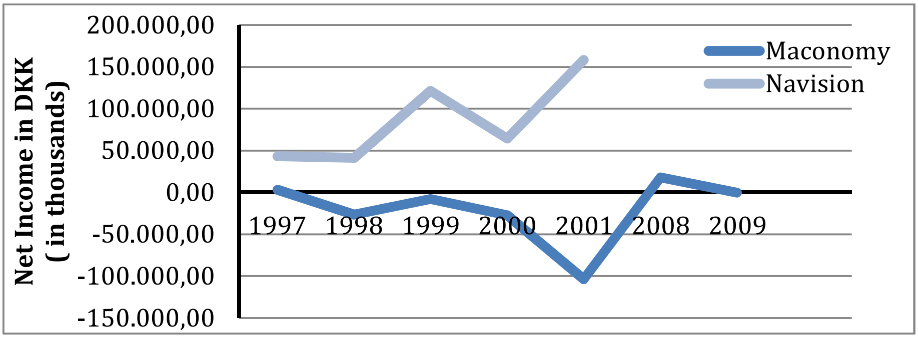

Fig. 2. Net Income of Maconomy & Navision (1997 – 2009)

From the data above it is clear that Navision significantly outperformed Maconomy during the period covered by the analysis. For instance, in 2001, Navision managed to post a positive net income and had increased its gross profits by 23%. Maconomy, on the other hand, , posted a 15% increase in gross profit but almost quadrupled the amount of its net loss from the previous year. The figures also reveal that at the time of their respective acquisitions, Navision sold for a multiple of12 times gross profit while Maconomy sold for a mere 2 times gross profit.

7 RBV Case Analysis and Discussion

Maconomy and Navision were both founded around the same time, in the same country and developed ERP solutions for the same competitive market. So the question we ask ourselves is: How did Navision manage to outperform Maconomy year in and year out?

An RBV analysis shows that both firms invested in building a capability for developing packaged accounting solutions that would be valuable to SMEs. Additionally, both vendors ERP-package did not prove to be rare, inimitable and non-substitutable because of the presence of market substitutes for packaged solution on the PC and other firms competing on this market.

The key feature of Maconomy's business model was a focus on a particular niche industry and carry out the implementation at customer site themselves. The key feature of Navision's business model, on the other hand, was to develop a partner ecosystem, which could assist in further development as well as sales and implementation of the ERP package at customer sites. This strategy meant that Navision had to split the revenue from sales of licenses with one or more partners which results in a substantial reduction in gross revenue for Navision. Clearly, the partner selling the license and implementing it at customer site should have part of the license fee, and so should an ISVs developing modules and/or industry verticals used in the final solution. For instance, a typical sale to a customer would be USD 300,000 and is broken down into 20% for the basic license, 10% for SW add-ons from ISV's, and 70% for customization and implementation. From this sale, Navision would only get around 50-70% of the license, i.e. 10-15% of the total revenue. However, this low return on each sale is more than offset by the huge scaling possibilities considering that Navision had several hundred ISV partners and more than 2,400 VAR partners selling and implementing the system at customer sites world-wide.

As the two firms developed, Navision surpassed Maconomy because it developed four (4) key resources that enabled them to obtain competitive advantage: (1) Packaged software with an architecture allowing for development of add-ons and easy customizations; (2) The development tool called C/SIDE for partners; (3) A partner ecosystem (VARs) that sells; (4) A partner ecosystem (ISVs) that develops add-ons. These resources each contribute value, taken separately or in combination with the others, to create a final ERP solution. Both the development tools and the partner ecosystem would later also evolve and exhibit strong characteristics of rareness, inimitability and non-substitutability allowing Navision to substantially leapfrog Maconomy and obtain a sustainable competitive advantage.

While the ERP kernel by itself does not make it a rare resource, the ability of an ERP vendor to maintain a competitive advantage with its ERP kernel architecture depends on continuous investments in its products to further increase their value and rarity. Navision did this by providing its partners with development tools enabling partners to do two things. ISVs could develop industry verticals and general purpose add-ons, while VARs could develop highly localized and customized solutions catering to their clients' needs. Maconomy, on the other hand, had to make all new developments and all the customizations themselves, thus limiting their ability to cater to multiple verticals.

The ability to develop tools as well as the ability to build a partner ecosystem is Navision's rare and inimitable resources, which contributed to sustainability of their competitive advantage. Navision's early decision to adopt a partner model enabled the company to gain early profitability successes and enabled Navision to differentiate itself in a crowded market of vendors selling ERP solutions. Additionally, Navision's alliance with its partners provided all the network members with more visibility in the market, which further contributed to the legitimacy of the system being sold. Maconomy's eventual decision to adopt a partner strategy shows that it too realized, albeit belatedly, the value of having partners especially for wider- scale distribution, but as we have seen, to no avail.

In the ERP industry, sustainable competitive advantage is dependent on whether an ERP vendor is able to guard its resources from imitability and substitutability. These factors – the imitability and substitutability of the ERP system – are likewise dependent on the vendor's ability to make customizations based on its clients' needs. In the case of Navision, its partner ecosystem allowed it to achieve economies of scale and expand its base, owing to its partners' ability to reach new markets and customize the product using the development tools. This allowed Navision to compete in multiple industries by partnering with smaller software developers and software implementers, which had substantial knowledge, experience and contacts in various industries. Thus, where Navision was able to take advantage of various distribution channels that its partners provided, Maconomy was limited to narrowing its focus to project-focused organizations.

Due to substantial lock-in effects once the customer had bought its first ERP system, the substitutability of the product is not likely to be seriously threatened by customers who need to upgrade existing systems. This means that it is absolutely critical for any ERP Vendor to capture the market for new customers. In this aspect, Navision is in a much better position than Maconomy to sell to new customers with its broader network of partners.

8 Conclusion and Implications for Future Research

This paper applied the RBV theory to identify resources that contribute to the core competency of developing, implementing and selling an ERP solution for two Danish ERP vendors, Maconomy and Navision. These two firms followed two different business models. Maconomy sold directly to customers, while Navision used a partner ecosystem for sales/implementation at customer sites as well as customizations and localizations through the development of add-on's. The RBV analysis shows that Navision was able to effectively combine and leverage its resources – a well-designed ERP kernel architecture and an easy-to-use development tool, with a partner strategy for marketing ERP software, and for integrating add-on's from the partner ecosystem. These all contributed to accelerate the pace of development to deliver customized and localized products to meet the clients' needs.

Our RBV analysis shows how an ERP-vendor can form alliances to obtain competitive advantage in order to manage and leverage their resources more effectively including sharing the costs and risks of implementing ERP systems. While the exact value of the partner ecosystem cannot be measured, the fact that Navision was sold for 16 times the value of Maconomy is compelling evidence of the value of such a channel. The formation of alliances through a partner ecosystem provides competitive advantage through a much larger distribution/sales capability, but it also provides a competitive advantage through the enhancement of the capability to develop localized and verticalized ERP solutions as well as value creating add-ons.

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The Impact of Quality Information Provided by Business Intelligence Systems on the Use of Information in Business Processes

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Abstract. The main purpose of introducing business intelligence systems in a firm is to increase the quality of information available to knowledge workers at various organizational levels. However, quality information is of little value to firms if it has not been used in firm's business processes. Literature suggests the use of information mainly helps organizations in two ways, namely in managing their business processes and in making decisions. The quantitative analysis carried out on data from Slovenian medium and large organizations further shows that information quality differently impacts the two uses of information with impact on business process management being stronger.

Keywords: Business intelligence system, Information quality, Use of information, Decision making, Business process management, Structural equation modeling.

1 Introduction

The complexities of modern-day decisions are forcing firms to use information analysis tools to support their business decisions [1]. In a decision-support context, business intelligence systems emerged as a promising technological solution with a wide range of analytical capabilities to provide stakeholders at various organizational levels with valuable information for their decision-making [2]. Although the most often cited direct benefit of implementing a business intelligence system is improved quality of information for decision-makers [3], the business value of business intelligence systems can only result from changes and innovations in ways of working [4]. If we think of business intelligence systems as providing (quality) business information and business analysis in support of fact-based decisions in the context of business processes, it becomes clear that business intelligence systems are closely linked to business processes when delivering business value [5].

Firms today are repeatedly recognizing that making quality decisions depends upon the quality of information available to support these decisions [6], thus making the provision of quality information the key to gaining a competitive advantage [7; 8; 9].

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Yet, simply acquiring or possessing information is not directly related to firm's performance, but it is rather the utilization of information (as reflected in the decision-making process) that is the key link between information acquisition and the firm's performance [10]. If firms want the available quality information to contribute to their performance it must be used within business processes to improve the decision-making [11], process execution [12] or ultimately to fulfill consumer needs [8].

With this research we aim to address the question of how does quality information provided by business intelligence systems affect different uses of information within firm's business processes. The purpose of the paper is therefore to explore the impact of information quality provided by business intelligence systems on different contexts of information use in business processes.

The outline of the paper is as follows: Section 2 introduces the fields of information quality and the use of information in business processes. Section 3 aims to present the methodological framework for the study, while Section 4 deals with the testing of the proposed research model and hypotheses. Section 5 concludes with a summary, a discussion of the main findings, and future work.

2 Information Quality and the Use of Information in Business Processes

In today's business environment quality information is a matter of primary interest. For more and more firms, information has increasingly become a critical resource and an asset in their business processes [13]. According to [14], for firms' "processes that depend on information, the quality of information is one of the key determinants of the quality of their decisions and actions". The contribution of high-quality information to firms is that it makes it easier to convert available information into knowledge, by helping to interpret and evaluate the information, by assisting the connection with prior knowledge, and by facilitating the application of the information to new contexts [15].

While it is broadly recognized that information plays a critical role in the success of firms [16; 17; 18], any information acquired by decision-makers will deliver little impact on final firm performance if it is not actually used in the making of decisions [19; 20]. In the view of [21], the value of information increases with the use of information. To contribute to firm performance information must be good quality and support decisions in those organizational processes whose results add value to firms. Many authors [11; 22; 23] suggest in quite a limited way that better information quality would improve firm performance, but provide no detailed explanations regarding this relationship. [24], however, maintains that better information and access to information per se do not affect firm performance; the key question is instead what firms do with such information [25].

Our research focus is presented in Figure 1. It has been previously established that business intelligence systems maturity [3] along with appropriate business knowledge for business intelligence initiatives [2] positively affects the quality of available information within firms. Moreover, information use is a critical aspect of information processing since in this phase the acquired and disseminated information is applied to strategic and tactical outcomes to impact firm performance [26]. We thus focus in this paper on the relationship between information quality provided by business intelligence systems and the use of information in business processes.

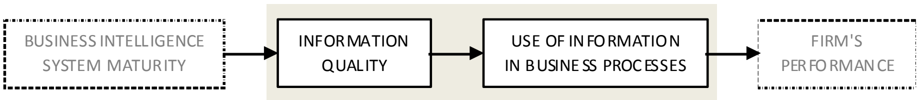

Fig. 1. Research focus

The relevance of information quality in the business process context has been previously acknowledged [27; 28], but its use and impact on processes rarely researched [29]. According to [30], quality information is a key element in business process management by enabling the follow up of results, online process analysis and control, and consecutively the dynamic adjustment of the firm. [31] similarly points out the link with business processes by asserting that information provided by business intelligence systems enable process analysis to help understand real-time and historical performance, enable users define and share best practices for the process, and help look for bottlenecks and drive real-time adjustments. Seen more broadly, the quest for delivering value to firms via business intelligence systems can be regarded as a matter of determining how a firm can use the information provided through business intelligence systems "to improve management processes (such as planning, controlling, measuring, monitoring, and/or changing) so that management can increase revenues, reduce cost, or both and/or to improve operational processes (such as sales, order processing, purchasing) so that the business can increase revenues, reduce costs or both" [5]. Literature on information and knowledge utilization [13; 16; 18; 32; 33; 34; 35; 36] suggests the use of information mainly helps organizations in two ways: 1) in managing their business processes; and 2) in making decisions.

With process orientation gaining importance [30; 37], the need to effectively manage business processes is of great importance resulting in new requirements for decision support. Supplying information related to business processes enables the measurement of process performance and helps firms identify opportunities for process improvement [18; 38]. With a broader view of their business processes, firms ensure that business processes provide maximum benefits to the firm. Many researchers have shown interest in exploring the relationship between the use of information and process management: [39], using Xerox as an example, explains how quality information was applied to improvement actions such as improving products, business processes, and improving the understanding of customer needs, [26] explore the effect of a firm's strategy type and the use of information on new product outcomes, and [40] explore how effective use of quality information affects quality performance and process performance to facilitate management of supplier relationship, product/service design, and process management.

Literature [16; 18; 41] suggests available information in organizational processes pinpoints problems regarding process execution and exposes them to managers and other users within the organization. Further, information actively supports continuous process improvement programs [18], business process change initiatives [38; 41] and, as suggested by field experts, assessments against process standards (such as Six Sigma or the ISO 9001 standard). Several researchers moreover suggest that information motivates new innovations in firms' internal processes [18; 42] as well as external services [43].

The impact and use of information for decision-making has been extensively researched in the literature: [44] inspected how managers in publishing and telecommunication industries use information to make day-to-day decisions and formulate longer term strategies, [45] analyzed the impact of information usage on clinical decision-making, [32] studied the impact of information usage on decision-making in government departments, [36] researched the impact of information utilization on corporate decision-making in the UK banking sector, [46] researched this impact on the insurance sector whereas [47] analyzed this impact on the pharmaceutical industry. In a case study of Singapore's managers, [33] investigated how information is used as a tool for management decision-making.

According to [48], any attempt to value information within an organization has to be looked at in the context of the activity or decision it affects. The value of information depends on the information's relevance to the decision to be made, and on its precision, cost and reliability [49]. In an ideal situation, decision-makers would utilize information from those sources perceived to offer the highest quality information.

Regarding the use of information in decision-making processes literature suggests many potential beneficial effects for organizations, such as: reducing uncertainty [36; 50; 51; 52], enhancing confidence [22; 33], improving operational effectiveness [53; 54], reacting to business events [16; 48], performing proactive business planning, and supporting changes in corporate strategies and plans [55; 56].

Based on the extensive literature review of the fields in question we put forward the following two hypotheses:

H1: *Information quality positively affects information use for business process management.*

H2: *Information quality positively affects information use for business decision making.*

3 Methodology

This study employed a survey to obtain data measuring participants' perceptions of available information quality and perception about the use of information in business processes. The questionnaire was developed by building on the previous theoretical basis in order to ensure content validity. Pre-testing was conducted using a focus group involving academics interested in the field and semi-structured interviews with selected firms who were not interviewed later. This was also used to assure face validity. We used a structured questionnaire with a combination of 7-point Likert scales and 7-point semantic differentials.

In order to assess information quality we adopted previously researched and validated indicators provided by Eppler [57]. We included 11 of the information quality criteria from Eppler's framework in the research instrument (Table 1).

For measuring use of information in business processes we used indicators available in the reviewed literature and those obtained from the pilot study. Since there were no previously validated indicators generally applicable to this study, we made some modifications to existing indicators and added ones derived from the pilot study (see Table 1). The pool of indicators for measuring the use of information corresponds to previously established uses of information in business processes (see Chapter 2).

This study's target population were Slovenian medium and large size firms (at the time of data gathering 1,329 met the criteria according to the Slovenian Agency of Public Records and Related Services). Empirical data for this research were collected by means of paper and Web-based survey. Questionnaires were addressed to CIOs and senior managers estimated as having adequate knowledge about the quality of available information for decision-making and the use of information in business processes. The final response rate was near 14%.

Table 1. Indicators for the constructs.

Construct	Label	Indicator (description)
		(1 = Strongly Disagree … 7 = Strongly Agree)
Information Quality	IQ1	The scope of information is adequate (neither too much nor too little).
	IQ2	The information is not precise enough and not close enough to reality.
	IQ3	The information is easily understandable by the target group.
	IQ4	The information is to the point, without unnecessary elements.
	IQ5	The information is contradictory.
	IQ6	The information is free of distortion, bias or error.
	IQ7	The information is up-to-date and not obsolete.
	IQ8	The information provision corresponds to the user's needs and habits.
	IQ9	The information is processed and delivered rapidly without delay.
	IQ10	The background of the information is not visible (author, date etc.).
	IQ11	Information consumers cannot interactively access the information.
		The available information within our organization's processes …
Use of information for BPM	UI1	… exposes the problematic aspects of current business processes and makes stakeholders aware of them.
	UI2	… provides valuable input for assess business processes against standards, for continuous process improvement programs, and for business process change projects.
	UI3	… stimulates innovation in internal business processes and external service delivery.
Use of information for decision making	UI4	Information reduces uncertainty in the decision-making process, enhances confidence and improves operational effectiveness.
	UI5	Information enables us to rapidly react to business events and to perform proactive business planning.
	UI6	We are using the provided information to make changes in corporate strategies and plans, modify existing KPIs and analyze newer KPIs.

4 Results

We analyzed the gathered data using a form of structural equation modeling ('SEM'). For the estimation of the model we employed SEM-PLS (Structural Equation Models by Partial Least Squares) [58].

We first examined the reliability and validity measures for the constructs in the model. In the initial model not all reliability and convergent validity measures were satisfactory. Once all the items that did not load satisfactorily had been removed, the model was rerun. Figure 2 shows the results of testing the measurement model in the final run. In the final model all Cronbach's Alphas exceed the 0.70 threshold and were above to 0.80. Without exception, latent variable composite reliabilities are higher than 0.80, and in general near 0.90, showing a high internal consistency of indicators measuring each construct and thus confirming construct reliability. The average variance extracted ('AVE') is mostly around or higher than 0.60, indicating that the variance captured by each latent variable is significantly larger than variance due to measurement error, and thus demonstrating a convergent validity of the constructs. Reliability and convergent validity of the measurement model was also confirmed by computing standardized loadings for indicators and bootstrap *t*-statistics for their significance. All standardized loadings exceed (or were very marginal to) the 0.70 threshold and they were found, without exception, significant at 0.1% significance level, thus confirming a high convergent validity of the measurement model.

To assess discriminant validity, the following two procedures were used: 1) a comparison of item cross loadings to construct correlations, and 2) determining whether each latent variable shares more variance with its own measurement variables or with other constructs. The first procedure for testing discriminant validity was to assess the indicator loadings on their corresponding construct. All the item loadings met the requirements of the first procedure in the assessment of discriminant validity. For the second procedure we compared the square root of the AVE for each construct with the correlations with all other constructs in the model. All the constructs show evidence for acceptable validity.

A bootstrapping with 1,000 samples has been conducted to test the hypothesized relationships between the constructs. As shown in Figure 2, the standardized path coefficients range from 0.562 to 0.620 while the R^2 is moderate, i.e. between 0.316 and 0.385, for both endogenous constructs. We can see that about 39% of the variance in use of information for business process management is explained by the influence of information quality, while about 32% of the variance in use of information for decision making is explained by the influence of information quality.

As indicated by the path loadings, information quality has significant direct and different positive influences on information use for process management ($\hat{\beta}$ = 0.620, $p< 0.001$) and use for decision making ($\hat{\beta}$ = 0.562, $p < 0.001$). The *t*-statistic for the difference of the two impacts is 2.4 with $p = 0.003$ hence confirming that the two hypothesized impacts are indeed different. These results thus confirm our theoretical expectation and provide support for *H1* and *H2*.

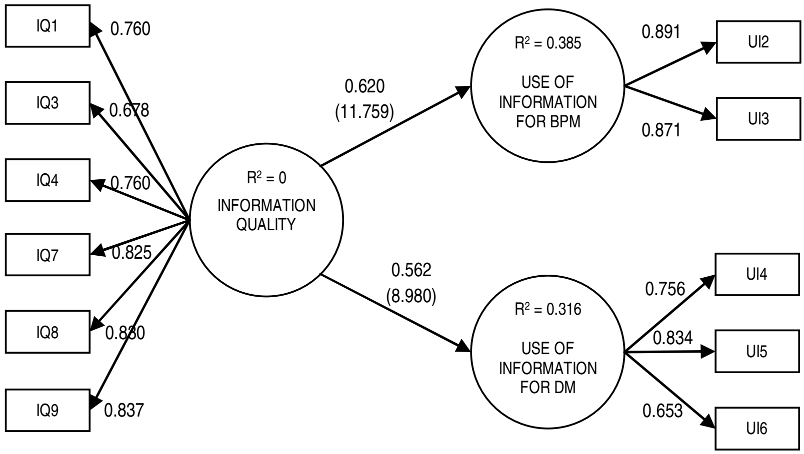

Fig. 2. Final model of information quality impact on different uses of information in business processes

5 Conclusions, Limitations and Future Work

One of the most important characteristics determining the degree to which information is used is its quality. This study analyses the relationship between information quality and the use of information in business processes. The use of information construct, as conceptualized in our model, reflects the role of information for managing business processes and for decision-making in business processes. For managing business processes information provides valuable input for business process assessment against standards, for continuous process improvement programs, and for process change projects. In decision-making, information reduces uncertainty, enables organizations to rapidly react to business events, and supports firms in making changes in corporate strategies, plans and performance indicators.

While it is widely recognized that information plays a critical role in the success of firms, information acquired by decision-makers will bear little impact on ultimate firm performance if it is not actually put to use in the making of decisions. Nevertheless, decision-making use of information appears to be less important than the relevance of information use in the business process management context. It seems as firms primarily seek to improve business process management practice through the generated information that help analysts tune the processes to serve their purposes better. The less intensive use of information for decision-making might be the result of less developed fact-based decision-making culture in firms.

A limitation of this research is the cross-sectional nature of the data gathered. In fact, although the research and measurement model are well supported by theoretical assumptions and previous research findings, the ability to draw conclusions through our causal model would be strengthened with the availability of longitudinal data. For this reason, in future research other designs such as experimental and longitudinal designs should be tested. Moreover, future research could also focus on testing the proposed model on individual industries and comparing results between them. Last but not least, it would also be useful to validate the proposed model in an international setting with comparable firms, since due to cultural differences we can expect different impact in our model.

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ERP Lifecycle: When to Retire Your ERP System?

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Abstract. A lot of research has been undertaken focusing on ERP systems lifecycles, but very little paid attention to retirement. ERP retirement means the replacement of an ERP with another. The aim of this research paper is to investigate why and when should organizations retire their ERP systems. A convenience case study of an SME has been selected from Egypt. The case study under investigation has retired their local ERP system and replaced it with SAP ERP. Results of our analysis indicated that reasons of retirement were: wrong selection, users were not involved in the selection process, and lack of an official implementation methodology. This is considered a new finding since main stream literature was mainly focused on retirement after maturity.

Keywords: ERP, retirement, lifecycle, case study.

1 Introduction

Besides globalization, there are many other forces e.g., competition, rise of the information economy, etc that drive an organization to an ERP adoption decision. Mostly, organizations adopt ERP systems to manage the everyday large volume of operations and information which are created from within the organization. Not only this, more and more organizations are involved in strategic business alliances, and a substantial volume of information needs to be controlled and utilized amongst these partnerships. All of this has led to the punctual need for ERP systems, which is why nowadays small and medium enterprises are adopting ERP systems in order to manage this vast information flow.

Due to the substantial needed efforts, organizational changes, time and resources, an ERP adoption is considered one of the biggest and most critical projects a company could carry out [1]. ERP adoption projects may vary in size, methodology, and structure. The implementation process requires a systematic and careful management monitoring and decision making [2]. There are many variables and factors that can affect an ERP adoption process. Contextual factors (e.g. government policies, culture) [3-5], legacy software reuse, and embracing a specific vendor's ERP implementation methodology are among those factors [6].

ERP adoptions in SMEs differ than those of large enterprises, as organization size serves as an important variable [7, 8]. In general, SMEs have been recognized as vitally different environments compared to large enterprises [9]. The literature calls

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for more attention and focus on SMEs, as a little attention has been given to research on ERP in SMEs, in relation to ERP studies which are often based on findings from large enterprises [10-12].

The ERP adoption process happens in phases, those phases are usually referred to as ERP lifecycles. A number of studies have developed ERP life-cycle models and frameworks like [13-19].

In ERP literature, lifecycle phases vary in name, number, and level of details from model to model, however, those models usually include several phases, like adoption, selection, implementation, use and maintenance, and evolution. J. Esteves & J. Pastor [19] have extended the common ERP models' phases to include a retirement phase. Retirement phase is the stage when a certain ERP system is replaced by another ERP system or any other information system [1, 19]. According to ERP literature reviews, there is no current studies on ERP retirement phase in a general context [1], nor in SMEs context [12].

The rest of the paper is organized as follows: first we present the background of the study, followed by methodology, case study, then analysis and conclusion, and finally future research.

2 Background

As previously mentioned, there are many ERP systems lifecycle models developed. Indeed, the infamous enterprise systems implementation process lifecycle model developed by Markus and Tanis [18] is one of the most adopted models in ERP literature, however, in this section we are going to present the model developed by Esteves & Pastor [19]. The model is comprehensive and consists of six phases that represent different stages through which an ERP system goes through during its lifecycle in organizations. Although it has been adopted by previous studies [12, 20, 21], however, the main reason behind selecting this model is that it includes the retirement phase which this study addresses. The model's phases are: adoption decision, acquisition, implementation, use and maintenance, evolution, and retirement. Next follows a brief sketch of each phase:

1. ***Adoption decision phase.*** In this phase, in order to satisfy their business and technical needs, companies start to question the need for an ERP system. Current ERP literature has tackled several corners related to the ERP adoption in SMEs context and environment e.g. [7, 8, 22-27].
2. ***Acquisition phase.*** This phase refers to the actual buying of the ERP system and vendor selection. This happens after evaluating the organization's business needs, ERP packages, and vendors. As the selection is critical, the acquisition phase has been a focus of many studies e.g. [10, 28-32].
3. ***Implementation phase.*** This phase deals with the actual ERP system installation. This phase includes many activities, like customizing the system to comply with the business needs, business process re-engineering, data migration, end-user training, etc. As the implementation phase is the most critical, costly, and time consuming phase, it is not surprising that it has the highest attention from ERP researchers [1, 12]. Some examples of research papers tackled the implementation phase are [33-39].

4. ***Use and maintenance phase.*** After the ERP system implementation and the *go-live* take place, users start using the system on daily basis. Many topics were subject for research in this phase, like system use and user acceptance [7, 38, 40-44], benefits management and realization [7, 35, 44-52] , ERP impact on organization [53-57], and maintenance processes [58-60].
5. ***Evolution phase.*** This phase involves the extension and integration of the ERP system with other systems such as customer relationship managements, supply chain management, or advanced planning and scheduling systems. The ERP system evolution is a non trivial process, and requires a stable and mature ERP system. This phase has not been a center of attention in ERP literature [1, 12], and requires more focus from researchers in correspondence with its criticality. Examples of studies that covered the evolution phase are [13, 31, 61-63].
6. ***Retirement phase.*** Retirement phase corresponds to the stage when an ERP system is abandoned and substituted by another information system or ERP system. While there are cases in practice, our literature review reached the same conclusion as Haddara & Zach [12], Tariq [15], Uppatumwichian [64], and Moon [1], that ERP literature lacks research that covers this phase. As a matter of fact, this has been the motivation for us to conduct our case study research.

3 Research Methodology and Case

According to our literature survey, we believe that there is a research gap in ERP retirement. This is supported by the fact that we have not come across any case study research investigating why companies retire their ERP systems. Needless to say that this is not only a motivation for research, but also a call for more and more research efforts to unfold the retirement decision and process. Accordingly, lifecycle models should focus more on retirement as a phase.

Single case studies are useful to represent unique cases when exploring a new phenomena and when there is a lack of theory [65]. Although single case studies' generalizability is limited, however, it can provide important insights and direction for future research. We have therefore chosen an exploratory case study methodology. This would allow us to collect rich descriptive data on an ERP retirement phase in a manufacturing SME in its natural setting. The purpose of this study is thus to increase our knowledge of the factors which leads for an ERP retirement decision.

This research was carried out as single in-depth case study [66]. The authors conducted more than forty qualitative face-to-face and semi-structured interviews in Egypt. The interviews were conducted in one Egyptian SME and all interviews were focused on the reasons behind the ERP system's retirement. The interviews ranged from 30 to 90 minutes, and notes were taken during the interviews. The participants included a mixture of stakeholders who have been involved in the ERP system selection and implementation. The interviewees positions included the CEO, GM, IT Manager, IT Staff, business function managers, mid-level, and front-line employees. The interviewees variety engendered different perspectives which enriched the data collected through data triangulation [67], and the findings consequently. Beside interviews, observation and document analysis were also used as data collection means, as we attended board meetings, IT staff meetings, and had access to project related documents.

3.1 Case Study: Food Co - An Egyptian SME

The case study under investigation by this research was chosen based on convenience. The company works in the food manufacturing and distribution in Egypt, to preserve identity we will refer to it as "Food Co", a disguised name. Food Co is considered an SME.

According to reports prepared by the Egyptian government [68-70], the SMEs classification and definition in Egypt is not yet standardized nor clear, especially across industry types and sectors [69], as the current classification through employees number and fixed assets is not adequate [70]. Hence, the interviewees where asked to classify their organization's size according to its annual turnover, number of employees, number of ERP users, and their perceived size in their market in comparison to competitors in same industry. The interviewees classified their company as a medium size enterprise.

3.1.1 Company Brief

Food Co is an Egyptian company that operates in different fields of business. Their name has become synonymous with a range of quality fresh and frozen products in domestic as well as international markets. The company started business in 1932 as a family-owned and run business. The group is active in the production and marketing of a range of products e.g., natural pure ghee, natural butter, processes cheese, cheddar cheese, long life juices and long life milk and flavored milk. The Food Co consists of four legal entities:

1. Investment: This is a food importer and was established in 1985. It has the following products: frozen fish, frozen chicken, frozen liver, and butter;
2. Industries: it was established in 1998 and it has the following products: juice, table butter, milk, and ghee;
3. Products: it has been established in 2004 as a major producer of cheese;
4. In 2011, Food Co. has successfully established a forth company for distribution of its products.

3.1.2 ERP at Food Co

In year 2006, Food Co has decided to implement a local Egyptian ERP called Al MOTAKAMEL by OFIS Soft. OFIS is a well-known ERP in the Egyptian market. Since 1986, OFIS started to help businesses to improve their IT operations and implementing ERP systems. OFIS is providing its information technology services to the Middle East, and to Egypt's most important sectors such as commercial, industrial, retail, and construction. Further, OFIS is also providing large-scale WAN-based solutions, in addition to bespoke applications.

3.2 Data Collection

Semi-Structured interviews were used as the main data collection method, in addition to observation and documents review. The reason for the choice goes back to the nature of the company and the lack of: documentation, decision making channels, and organization structure. During a period of nearly two months, interviews were made with various Food Co officials and stakeholders. The main purpose of the data collection is to find out:

1. How did you select the current ERP i.e., Al MOTAKAMEL?
2. Why did you decide to retire it?
3. How did you choose the new ERP i.e., SAP ERP?

The following section details the data analysis of the previous three questions.

3.3 Data Analysis

In this section, we are going to answer the research questions based on the data collected from Food Co.

3.3.1 ERP Selection 1st Phase

During the data collection interviews, all interviewees confirmed that their opinion has never been considered when Food Co decided to implement Al MOTAKAMEL ERP. When asked about whether the decision was financial or managerial, they all explained that they have never been aware of the decision nor its motives.

Further investigation explained that the decision to acquire and implement Al MOTAKAMEL ERP was mainly the former IT manager decision. Here it is worth mention that, the decision solely was made by technical people, with just approval from CEO.

Food Co started Al MOTAKAMEL ERP implementation in 2006. A further astonishing finding is that the implementation was made by the internal IT team; at that time only two people were involved in the implementation: the IT manager and the DBA. Of course this has resulted in a slow-down implementation and a lot of frustration in all branches and functions.

In 2008, the situation becomes very dangerous as the master mind of the implementation i.e., the IT Manager has resigned leaving the company and the project in the middle of nowhere! Food Co then recruited another IT manager with Al MOTAKAMEL knowledge and experience. Afterwards, Food Co also hired an external ERP Consultant to help in the situation.

3.3.2 ERP Retirement

By 2008, it was clear to all stakeholders that the current ERP, Al MOTAKAMEL, is no longer beneficial to them and it needs to retire, and the seek for a new system must begin. According to the interviews, officials explained that the system needs to retire because: 1. they explained that they did not choose the system to defend its existence; 2. the system does not have an HR module and this is something they needed; 3. they have never been trained on the system; 4. interface did not enable them to augment all business units together; 5. it is not web based; and 6. reporting is so complicated where each year is stored in a separate DB.

According to the interviews, the system did not provide them with any tangible benefits to retain it. And that is why, it must retire.

3.3.3 ERP Selection 2nd Phase

In the second time, Food Co prepared a requirements list and invited 4 vendors; SAP, Oracle, Focus RT (an Indian product), and for the sake of objectivity, Al MOTAKAMEL ERP vendor was again invited. After product demos and offers, SAP All-in-One ERP which is usually used in SMEs was selected. It was a mixed approach of financial as well as managerial criteria.

4 Results

Traditionally, ERP systems retire after a period of maturity and value-adding to the business. However, in our case study the retirement of Al MOTAKAMEL ERP at Food Co preceded even its full go-live date! That is, a decision was made to retire the system before waiting for any maturity or gains. We do believe this is a new finding. When the following happened, expect early retirement:

- Functional managers are not engaged in the decision making process
- No implementation contract i.e., Food Co only bought a license rather than any service
- Functionality of the system does not meet minimum business requirements
- Inability to augment all information of business units
- Complex reporting techniques
- Lack of web-based interfaces, and
- ERP decision was mainly made by IT people.

Unfortunately all of those reasons were found to be true at Food Co and therefore they have retired the system.

5 Conclusion: Esteves and Pastor Model Revisited

Results of our case study analysis have helped to deduce the following:

- Choice of the ERP system should be taken by both business and IT staff
- Criteria of choice should include current as well as future demands e.g., web-interface, business intelligence, HR, user-friendly interface, etc
- It is very important to have key users and functions owners supporting the system as acting as a bridge between implementation consultants and functional users
- Buying an ERP license and putting the implementation in the hands of the internal IT department only has proven failures
- Ignoring the official selection methods is risky and would lead to failures and inability to evaluate the situation.

Esteves & Pastor [19], described the retirement phase, p.5 as "this phase corresponds to the stage when with the appearance of new technologies or the inadequacy of the ERP system or approach to the business needs, managers decide if they will substitute the ERP software with other information system approach more adequate to the organizational needs of the moment". However, based on the analysis of the case study under investigation, the retirement came as a result of wrong choice and other user engagement options, instead of merely new technology. So, we believe that the risk of wrong selection and insufficient user involvement could solely lead to retirement, same as seeking new technology or new unmet business requirements. Of course the risk of retirement before maturity, or even go-live, is magnified since it reflects loss of investment.

6 Future Research

The area of ERP retirement needs further investigation and deeper analysis. Future researhc in needed and encouraged to explore the reason(s) why companies retire their systems, how and when. Cross-industry surveys and longtudnal research efforts are highly recommended.

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Barriers to e-Commerce Implementation in Small Enterprises in Sweden

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Abstract. The research in this paper has looked to find the barriers that small enterprises in Sweden have faced in the implementation of the e-commerce during pre and post adoption phases. Taking four small enterprises as case studies the paper is presenting the post adoption barriers faced by these enterprises that are currently using e-commerce. The outcome is that 'security issues associated with e-commerce' identified in previous studies appeared as an obstacle in both pre and post adoption phase. Moreover lack of time to improve e-commerce activities, synchronization of demand and supply, price war among competitors, need for extensive marketing effort, payment related hazards are explored and identified as post-adoption barriers. Finally, a model has been proposed through which we wish to consolidate both pre and post adoption barriers and have a complete picture of the barriers faced by small enterprises in implementing e-commerce in Sweden.

Keywords: e-commerce, small and medium enterprises, small enterprises, pre and post adoption barriers, Sweden.

1 Introduction

There is no doubt that Information Technology (IT) is becoming an integral part of businesses today as more businesses use the Internet to communicate through emails, publish websites, and even perform entire business processes such as buying and selling. Many businesses today are looking into offering their products or services electronically because of the benefits provided by this channel. Internet technology offers opportunities for companies to establish distinctive strategic positioning [16].

Small and medium enterprises (SMEs) are playing a significant role in any economy. Many opportunities are available for SMEs to exploit the benefits of IT and e-commerce for operating and trading in domestic but also global markets like the large corporations do. But still, different researches show that larger businesses are mostly those who are benefiting from e-commerce adoption while small businesses are much slower in the adoption of e-commerce [18]. Moreover, larger businesses usually have more advanced technologies and better IT infrastructure needed to conduct business electronically. According to the study of European Commission [6], in January 2010 about 96% of all enterprises in Sweden had Internet, 88% had fixed broadband connection, and 89%had a web site. But SMEs in Sweden are considered as the strategic backbone of its economy. The development, growth and employment

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in every sector of the national economy are basically triggered by the SMEs [8, 21].Based on the data of Structural Business Statistics Survey in Sweden [28], “the smallest enterprises were the most profitable in 2008, measured by the share of the operating profit (after depreciation) in turnover” [28].Small enterprises are defined as “enterprises which employ fewer than 50 persons and whose annual turnover or annual balance sheet total does not exceed 10 million euro” [5]. On the other hand micro enterprises are classified as a one that employs fewer than 10 persons, while in small enterprises the number is less than 50 persons and for medium-sized enterprises the number is more than 49 persons but fewer than 250 [28]. While Sweden has a number of well-established and dominating multinational enterprises around the world, there is a significant number of SMEs (employ less than 250 employees as per EU definition) - over 185 000 SMEs [8].According to a European Commission report 2010, Sweden’s enterprises get a better turn over percentage (18%) from their use of e-commerce than the European average (14 %) [6].

Despite its benefits, SMEs are facing many barriers when adopting e-commerce [30] which previous studies have identified and used as a starting point to develop different models. While, most researchers have identified a large number of barriers to e-commerce adoption in small businesses, we did not come across to any previous research effort that has tried to categorize these barriers in pre-adoption and post-adoption phases. Also, no study attempting to develop a single model showing the possible barriers faced by those who do not adopt e-commerce as well as by those who adopt e-commerce but face problems in the implementation phase. Therefore, we are proposing a model contributing in categorizing possible barriers faced by small businesses in Sweden in deploying e-commerce in pre-adoption phase and in the phase after adopting it i.e. during implementation of e-commerce. In our study we have focus only on the small enterprises that employs less than 50 employees [5].

2 Research Background

Even though an organization might be using IT in many areas of its operation but it does not essentially mean that it is participating in e-commerce. While many organizations use IT for its daily operation, only a few of them are actively using Internet to process transactions and payment [29].. e-commerce is identified as a part of e-business and is firmly positioned as less sophisticated than e-business [26]. In e-commerce, business transactions are conducted over the Internet where involved parties hand over ownership and rights to products or services through selling or buying. Whereas “e-business is the complex fusion of business processes, enterprise applications and organizational structure necessary to create a high performance business model”[10]. e-business can therefore, use e-commerce but it also embraces and carries most internal processes over the Internet for instance: product development, inventory management, finance, risk management, human resources and knowledge management [2]. Researchers interested in e-commerce have pointed out several benefits gained by implementing e-commerce in business processes: e-commerce can work as a “source of transaction and cost advantage based on the exploitation of information and communication technologies and a way to reach more customers at relatively low costs” [19]. Businesses can reach new markets and customers [15] without the need to build a new and sometimes complicated distribution channel. By delivering the product or service directly to the end user, e-commerce can also enable a better dialogue among buyers and sellers. Moreover e-commerce can provide businesses with the ability to screen out geographical areas with a large number of potential buyers [19]. The possibility to offer improved customer service at a low cost [4] and the ability to show the customer the products and services in a multimedia and interactive way are other advantages that e-commerce can provide to SMEs. Thus e-commerce helps SMEs improving its competitive position in the market place [1].

Various previous studies identified a wide range of factors as inhibitors or barriers which restrict small businesses from adopting and thereby capturing the benefits of e-commerce. Possible barriers for SMEs that are the most commons are the following: “security and privacy concerns” [9, 12, 14, 23, 29, 32, 34], “integration of legacy systems with new technologies” [12, 29], “lack of employees with the necessary IT skills” [3, 9,12, 14, 17, 23, 29, 13], “lack of awareness and availability of related technology” [12, 23, 32], “lack of government incentives” [9, 12], “high cost and low availability of consultants” [12, 23], “high initial and maintenance costs of telecommunications infrastructure” [31, 9, 12, 29], “high investment requirements”, “complexities and time associated with implementation” [9,14, 17]. Other possible factors reviewed from the literature are: the SMEs perception that their customers either do not use the Internet or are not ready to do business online [9, 12, 23, 32], putting the product portfolio on the Internet might decrease the firm’s competitiveness, lack of critical mass among trading partners such as suppliers, customers and partners using the e-commerce technology [22], launching e-commerce application might increase expenditure [34], the cost of implementing some of the standards specified in some of the B2B framework, lack of confidence and trust in new technologies [3] and lack of managerial support [31, 22, 24, 27]. An interesting finding was made in a study involving SMEs in the manufacturing industry in Australia where Scupola [23] mentioned productivity decrease as being a barrier to e-commerce adoption. As we have noticed in certain industries SMEs rely solely on face to face interactions and word of mouth if they want to hold their reputation and the guarantee for quality and reliability [12, 29]. So, the characteristics of the industry it-self can be a barrier to e-commerce. Furthermore, in a study of two retailers in the UK and the US [32] concerns about not been able to fulfill customer orders and online sales cannibalizing offline sales appear as other possible barriers. The increased workload volume as a result of extra enquires (coming from on-line customers), technological changes and evolution, owners lacking innovativeness, and no visible return on investment were also mentioned as possible barriers throughout the research literature [12, 23, 29, 32]. In a research done by MacGregor and Vrazalic [14] based on empirical survey on 47 small businesses (non adopters and potential adopters) in Sweden and Australia in 2005 the authors developed a model (Fig. 1) showing e-commerce adoption barriers for small businesses in regional areas in both of those two countries. The barriers are grouped into two different factors: e-commerce is either 1) too difficult or 2) unsuitable for the business.

However, due to the dynamic nature of the business environment, new factors might have appeared in the meantime as well as some barriers might have already been tackled by small businesses that have adopted e-commerce. Therefore, a new look at the model in the current conditions could be beneficial. While most previous studies focus on barriers for e-commerce adoption in general and no previous study has developed a model that divides the possible barriers in pre and post adoption phases, our study attempts to fill up this gap in the literature.

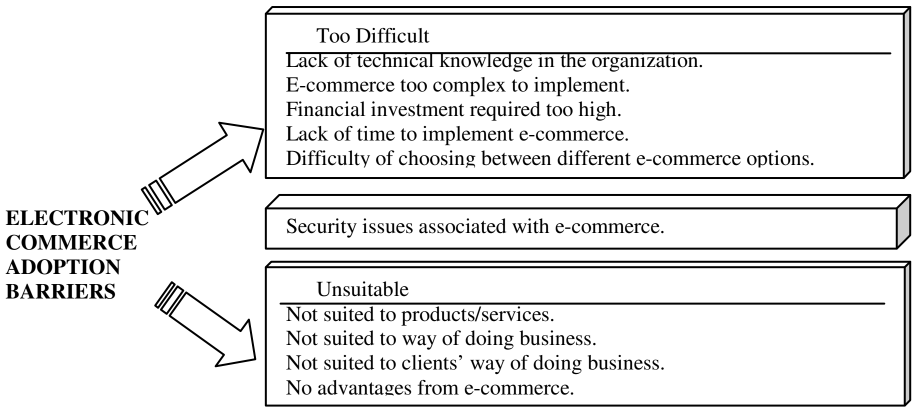

Fig. 1. A basic model for e-commerce adoption barriers in small businesses [14]

3 Research Methodology

This research intends to find out what barriers do small enterprises in Sweden face when implementing e-commerce. Even though e-commerce can bring benefits and advantages to SMEs, many of them have hold back from using e-commerce and many have faced problems in the implementation phase. Therefore in this research we are proposing a model that shows the barriers that the non-adopters and adopters of e-commerce are facing in small enterprises in Sweden. For this purpose the following research question has been addressed: *What are the barriers that small enterprises in Sweden are facing when implementing e-commerce?* A qualitative research approach has been adopted to answer the question. Many researchers [20, 25, 33] claim that qualitative research has the possibility to provide new perspectives on issues that are already generally accepted and proved. A case study method has been applied to propose the model. We have chosen case study method because case study is used to find out whether theories' propositions in research background are correct or whether some alternative or additional set of details are more applicable [33]. It may be used to prove or challenge a theory or to represent a distinctive case [33]. Therefore case studies are used in this research to identify the appropriate causal links for analysis [33] and propose a new model. Following Yin [33], this study uses multiple-case study methodology where four organizations are studied as the unit of analysis. Multiple cases are more preferable than single-case because it increases the chances of a good case study [33]. Among the studied organizations two are adopters and two are non adopters of e-commerce. One adopter and two non-adopters have been chosen from same business field with similar business nature to define some control variable in order to neutralize the effect on the outcome. The adopters are chosen from two different business fields in order to maximize robustness of our analysis [33].]. In

1st phase of our research, the non-adopters have been chosen to identify what factors inhibit them for adopting e-commerce so as to test the model (Fig.1) discussed in literature review. In the *2nd phase* ,the adopters have been chosen to identify what barriers they faced during adoption of e-commerce and what barriers they are currently facing during the implementation. These will ultimately contribute to add new knowledge in our proposed model. Multiple data sources have been used to elicit the details from the experience and perspective of the participants and conclusions have drawn on those facts [30]. First, we have collected and analyzed extensive secondary materials like: documents available in firm's website and research reports to complement the case study. Then, we conducted face-to face interviews with the owners of the firms. Two sets of questionnaire were used: structured questionnaire for the non-adopters to test the model and semi-structured interview and open ended questionnaire for the adopters to compare factors identified in literature review and to explore new factors. In both types of the questionnaires we have used Likert scale to collect data. The interviews and questionnaires have provided primary data on the studied organizations, the owners' personal profile and their perspective on e-commerce practice. Our study is limited to small number of case studies so it is not possible to make a rigorous evaluation of the model and to generalize the conclusions based on that. So the proposed model needs to be tested further. However, its implications represent some thought on what barriers small enterprises in Sweden faced during implementation of e-commerce. The case studies were based on the owners' perspectives, so it lacks employees' views to have a complete picture.

4 Data Analyses and Results

4.1 Data Analysis

Through a number of questions developed from previous literature and models we intended to gather information to either corroborate previous mentioned barriers or to identify new possible ones in order to contribute to the field of study. During the interviews with both adopters and non-adopters we asked the owners about their personal profile like academic and professional background, years of business experience, etc. The results are summarized in the Table 1:

Table 1: Personal profile of the owners and business type

Small Enterprises		**Academic background**	**Business experience (yrs)**	**Products Offerings**
Adopter	A_1	IT education	30	Water & air filters, health products and video telephones.
	A_2	Business	15	Indian groceries like spices, ready foods, rice etc.
		Computer Programmer	>7	
Non-adopter	NA_1	Biology	15	Mainly Indian groceries
	NA_2	General Science	14	Mainly Indian groceries

MacGregor and Vrazalic [14] developed the basic model for e-commerce adoption barriers by conducting research on non-adopters only. Asking the same questions as MacGregor and Vrazalic [14] to our non-adopters, we found the answers provided support for eight out of the ten barriers identified in the model (Fig. 1). Both non-adopters provide strong support for the two barriers: e-commerce is not suited to their products/ services and the way they do their business. While NA_1 strongly supports for three other barriers: e-commerce is not suitable for the ways their clients do business, they don't have technical knowledge and the time to implement e-commerce, NA_2 supports fist one moderately but does not think last two as barriers at all. NA_1 moderately supports the claim that e-commerce might provide some advantages to their business whereas NA_2 does not support it. Security risk is supported strongly by NA_2but moderately by NA_1. Where NA_2 believes the financial investment requirement could be high for e-commerce options, NA_1 thinks it is not a barrier for them at all. Both the organizations don't support two of the barriers: 1) e-commerce is too complex to implement and 2) choosing a suitable one among available standard e-commerce options is too difficult.

Since the factors under the 'too difficult' category are relevant for potential adopters [14] we asked questions about those five factors to the adopters to find whether they regarded them as 'difficult' at the pre-adoption phase of their online business. The result shows that only security issues gets support as a barrier to both pre and post adoption phase of e-commerce. Lack of time to implement e-commerce at pre-adoption phase is not supported by them but lack of time to improve and thereby implementing e-commerce activity to the fullest is considered as strong inhibitor at post-adoption phase. None of them think financial investment requirement is high for e-commerce. The owner of A_1 assumes that technological changes and evolutions and low use of e-commerce by customers and suppliers as barrier both in pre and post adoption phase. The owners of A_2 face a challenge where his firm fails to assess customer demand and they were out of stock for certain products, so they had to deliver customers' order by purchasing from the market without making any profit. The owner of A_1 thinks over supply i.e. products in stock but not requested create extra cost for storage. Moreover, both of them encounter problems with payments. While, in one instance, A_1 did not receive any payments after delivery, A_2 got the delivery back and did not receive any penalty charges for the postal fees. Both of the adopters claim that user unfriendly website, need for massive marketing activities and price war could create problems during the implementation of e-commerce.

4.2 Results

Overall, our findings are consistent with previous studies. First, after testing the model proposed by MacGregor and Vrazalic in 2005 (Fig. 1), we identified that two out of ten factors were strongly supported and six factors got varied degrees of support. However, the following two factors: 1) e-commerce is too complex to implement and 2) choosing a suitable one among available standard e-commerce options, were not mentioned as barriers at all. This could be attributed to the increase e-commerce awareness and knowledge among the small business owners as well as to the availability of easy to handle e-commerce solutions or to the educational background of the owners. Further research needs to be done to prove this. Moreover, all four case studies supported ‘security issues inherent with doing business on-line’ as a barrier to adoption decision and successful implementation of e-commerce. The model in (Fig. 1) categorizes some factors as ‘not suitable’ which distinguishes non-adopters from potential adopters. The authors have argued that there are some businesses for which e-commerce is not suitable. Our research data on non-adopters found support for all four factors under the ‘not suitable’ category but obviously not by the adopters. We chose an adopter involved in a similar business offering similar products as the non-adopters (example: groceries). The owner thought e-commerce is very suitable for the products he is offering since grocery items do not demand customers’ preference or physical inspection before purchase. From our case study, we think the ‘not suitable’ factor is a subjective judgment from the small enterprise owner and it requires further investigation on cognitive factors i.e. the mental maps of individual or organizational decision makers [11 refers to 7] of the SME owners. The relative supports of the factors from our case studies are shown in Table 2,where we compared our findings with the e-commerce adoption barriers found by MacGregor and Vrazalic [14].

Table 2. Comparison between e-commerce adoption barriers framed by MacGregor and Vrazalic [14]and two non-adopters of our case study organizations. (SS=Strongly Support, MS= Moderately Support, DS=Does not Support)

Categories of factors	**E-commerce adoption barriers identified by MacGregor and Vrazalic [14]**	**NA_1**	**NA_2**
Not suited	Not suited to products and services	SS	SS
	Not suited to the way of doing business	SS	SS
	Not suited to clients way of doing business	SS	MS
	No advantages to our business	MS	SS
	Security issues associated with e-commerce	MS	SS
Too difficult	Lack of technical knowledge in the organization	SS	DS
	e-commerce is too complex to implement	**DS**	**DS**
	Financial investment required is too high	DS	MS
	Lack of time to implement e-commerce.	SS	DS
	Difficulty in choosing between different e-commerce options	**DS**	**DS**

Our study has found that the owners’ previous knowledge of business is not related with the e-commerce adoption decision. But we have interestingly observed that both of the adopters have IT knowledge and background, whereas the non-adopters don’t have. So, this is consistent with the previous studies arguing that companies would avoid doing e-commerce due to the ‘lack of IT understanding and skills within organization’ [9, 14, 17,13]. However, the owner of NA_2 is a potential adopter who does not have IT education but does not think that the lack of technical knowledge is a barrier for him to adopt e-commerce. This is similar to Sparling, et al., [27] where they found evidence for ‘organizational support’ as a strong determinant for e-commerce adoption decision for Canadian SMEs but owners characteristics such as education and formal IT training are not highly relevant for the decision. Besides previously mentioned factors we have indentified new factors as possible barriers. Based on our findings we propose a model which is shown in Figure 2.

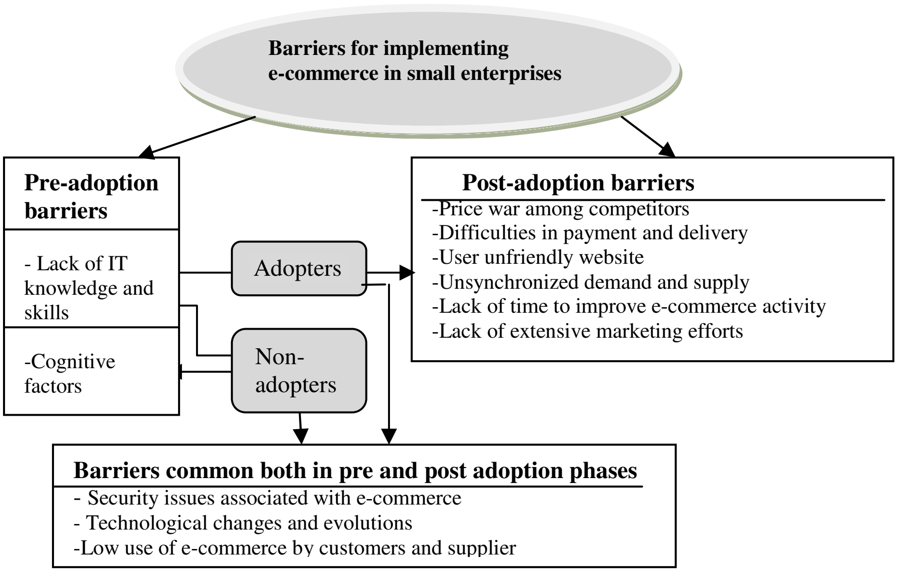

Fig. 2. A model of e-commerce implementation barriers in small enterprises in Sweden

We have noticed that our findings agree with some possible barriers to e-commerce implementation identified in the research literature such as the fear of being unable to fulfill customer's orders [9]. Both organization A_1 and A_2 did not support lack of time as barrier for adoption rather lack of time available to improve their online marketing efforts has mentioned as a possible inhibitor to their success and their ability to implement e-commerce activity to the fullest. So, this factor is associated with post-adoption phase and not with pre-adoption phase.

The second possible barrier in post-adoption phase that was consistent with previous studies was mentioned by owner of A_2. The problem of synchronizing inventory products with demand from customers to an optimal level is a challenge for adopters and failure to do it well can result in going out of the business. In their study the authors arguing that companies would refrain from e-commerce due to a fear to "fail to meet customers' demands" [32]. Moreover, both of the adopters encounter problems with payments (either with advance payment or with payment against invoice) and delivery which supports the study of [11]. While, in one instance, A_1 did not receive any payments after delivery, A_2 got the delivery back and did not receive any penalty charges for the postal fees. The owner of A_1 assumes that technological changes and evolutions and low use of e-commerce by customers and suppliers as a barrier both in pre and post adoption phase of e-commerce which is consistent with the previous study.

A new possible barrier to a successful implementation of e-commerce was mentioned by both adopter of e-commerce: the ability to keep prices low which is considered as a very important factor. The price war among businesses conducting business online was identified as a possible inhibitor to buying and selling products online. Customers look for the lowest price when it's a product or service that does not require much research before buying (such as groceries). It is very easy to compare price of products sold online because of the availability of information of product and price. So, compete on unique offerings of products/service and quality of service could provide competitive advantages. Another factor that is related to the demand-supply concern is 'over supply'. Sometimes some products might be kept in stock but not requested by the customers can cause a cost of inventory. Furthermore, need for huge marketing activities could create problems in implementation of e-commerce. Therefore these factors could be added to the field of study because we did not identify these factors as barriers while we have reviewed the previous studies. As we have noticed many barriers mentioned in the research literature are not applicable for small enterprises in Sweden. For example, many previous studies identified lack of cost effective telecommunications infrastructure as a barrier to e-commerce, but both adopters in our study did not seem to have any problem with this factor. Both of them claim that Sweden is a good place to do online business because customers are very well acquainted with online shopping and there is good infrastructural support for this purpose. Finally, both the adopters believe that a user friendly website, rigorous marketing and promotional efforts, continuous demand assessment and optimizing inventory in the warehouse, building and maintaining communication and relationship with buyers and suppliers are important for a profitable and successful implementation of online transaction.

5 Conclusions and Future Research

The paper examines previous researches on e-commerce adoption barriers in order to find out what barriers small enterprises in Sweden face in implementing e-commerce during pre and post adoption phases. Four case studies were undertaken and found that many barriers were corroborated in our study while some new possible barriers have appeared. In order to investigate barriers related to pre-adoption phase, we first used an existing model that focuses only on pre-adoption phase and found that some factors are not prevalent in our studied organizations. Complexity coupled with implementation of e-commerce, difficulty in choosing among e-commerce options and financial investment requirements are not come out as inhibitors. Then our research has explored some post adoption barriers faced by small firms currently using e-commerce. Both of the adopters mentioned that over supply or excess demand, lack of time to improve e-commerce activities, a user unfriendly website, advance payments on returned products, missing payments after delivery, price war among competitors, need for extensive marketing effort might inhibit successful implementation of e-commerce. Some barriers previously identified by other researchers were neither supported by the non-adopters nor by the adopters. Possible reasons for this could be: increase of awareness and knowledge about e-commerce among the small business owners as well as availability of easy to handle e-commerce solutions emerging during the last couple of years, educational background of the owners, the supportive infrastructural facilities and on-line shopping habits of customers in Sweden, etc. Our study has explored a number of new barriers related particularly to post-adoption phase of e-commerce. What might be the appropriate strategy to deal with those barriers are beyond the scope of our study. However, based on the respondents' experiences we found that continuous demand assessment and optimizing inventory in the warehouse is important for a profitable and successful online transaction. One factor that might inhibit them from performing better is the ability to compete on price and quality when there are lots of players in this field. Building and maintaining relationship with buyers and suppliers will be the key to handle this barrier. Although our research was conducted on a small number of cases, some barriers discovered in this study contributes to the development of a model which researchers and small enterprises can use to their advantage and could be used as a basis for further research.

Our study has explored some new factors in addition to the previous research. Therefore, a further in-depth research needs to be conducted to find out whether those factors are specific only to the case study organizations or are applicable to other small businesses practicing e-commerce in Sweden. Also, two factors like: 'e-commerce is too complex to implement' and 'the difficulty of choosing between e-commerce options' stated by MacGregor and Vrazalic [14] which are not supported by the non-adopters necessitate a further investigation to make a judgment that those barriers have changed over time. We found that two small enterprises having the same type of business revealed an opposite opinion; one claims e-commerce to not be relevant to the organization while the other claims to be highly relevant to his organization. Therefore, further research is highly encoraged to test this 'not suitable' factor. Moreover, further research could be conducted among small enterprises that use e-commerce as a complement to their traditional way of doing business.

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Development of a Conceptual Model to Support ERP System Selection in Developing Countries

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Abstract. Enterprise Resource Planning (ERP) systems have been heavily adopted in developed countries in the past decade and most studies on ERP adoption and selection focuses on these countries. With the emerging trend of ERP adoption in developing countries, the crucial question is: How to select an adequate ERP system. Of course this is not a new issue and already discussed in the developed countries, but many of the available studies are highly focused on this setting. Developing countries can actually adopt the available selection models but the suitability of the models has to be approved in the context of these countries. This proposal, therefore, intends to indicate the methodology to be followed in analyzing the suitability of the existing selection models in order to come up with a prototype of a suitable ERP system selection model for Ethiopia's context.

Keywords: ERP, ERP selection, ERP selection framework, ERP selection Model.

1 Introduction

Enterprise Resource Planning (ERP) system is an integrated set of programs that provides support for core business processes, such as production, input and output logistics, finance and accounting, sales and marketing, and human resources. An ERP system helps different parts of an organization to share data, information to reduce costs, and to improve management of business processes [2]. According to Wier B. and his colleagues [37], ERP systems aim to integrate business processes and ICT into a synchronized suite of procedures, applications and metrics which goes over firms' boundaries. In order to be more efficient, many companies rely on extensive use of IT, often by installing ERP systems [23]. There are reports of ERP systems providing benefits such as cost reductions, improved productivity, better managerial decision-making, and facilitation of process or structural change [29, 5, 17, 12].

ERP take-up has been much lower in developing countries (DCs), with estimates that they make up some 10-15% of global ERP sales [15, 25]. However, developing countries look set to become the locus for a major expansion of ERP implementations [22] and accordingly the adoption rate is also increasing [1]. In line with the inclining

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adoption rate of ERP in developing countries, a comprehensively systematic selection policy for ERP systems is very important for the success of ERP projects [30].

ERP software selection is tedious and time consuming due to the complexity of the business environment, the limitations in available resources, the complexity of ERP software and the diversity of ERP alternatives [36]. Therefore, ERP system selection is crucial in the early phase of an ERP project. In addressing this concern, several models have been developed to support the selection of ERP systems. The earliest proposed software quality model is the McCall model [21]. There were a conceptual model for ERP package enhancement and a six-stage model to evaluate ERP software [28, 34]. The fuzzy analytic hierarchy process (FAHP) model, which is developed by Shing-Ko & Chi-Tai 30], is one of the models for ERP selection. This model works by considering software quality characteristics; besides it can also solve the multi-criteria decision making (MCDM) problems and facilitate group fuzzy MCDM process [30]. The ERP selection model by Wei, & Wang [35] classifies the selection attributes in the categories of project factors, software system factors and vendor factors.[35]. Lin [19] and Luo & Strong [20] studied the ERP evaluation models for universities. The ISO 9126 software quality model is also incorporated in the ERP selection model developed by Shing-Ko & Chi-Tai [30].

The models, mentioned above, are developed by considering certain situations and evaluated in areas where the models are developed. The FAHP model by Shing-Ko & Chi-Tai [30] considers management aspects in Taiwan. Two empirical cases in Taiwan, company A and college T respectively, belong to different industries were also conducted to prove the practicality of the proposed FAHP model. This implies that in order to use such models in different situations, context based suitability analysis should be carried out. National culture also has a crucial impact on the selection and adoption of ERP systems [16]. This research, therefore, intends to access the suitability of the available ERP system selection models in the context of developing countries, like Ethiopia, and will customize or develop a new suitable model for Ethiopian context.

The main topics will be discussed in the following five sections. Based on the problem definition in the next section, the objectives of the study will be defined in section 3. The 4th section will show the methodology followed by the expected results of the study. Finally beneficiary groups will be introduced.

2 Statement of the Problem

Several studies prove that SMEs in a number of developing countries are largely benefited out of appropriate ICT adoption [4]. It is also obvious that information system investments can bring substantial benefits to companies. On the other hand, there are also many risks involved and possible failures can cause serious problems. To ensure appropriate decisions, the strategic effects of IS investments should be taken appropriately into account [24]. Companies expect to get several kinds of benefits from information system (IS) investments. However, there are also serious risks involved. Failed IS investments can even threaten the functioning and existence of the whole company and it is even true in the case of large, company-wide systems, such as ERP software. Therefore, appropriateness of such system should be ensured by comprehensively systematic selection policy [30].

In recent years ERP software vendors have increased their focus on small and medium sized enterprises (SMEs). Oracle small business suite (OSBS) and SAP Business One, Business by Design or Business All-in-One initiatives by SAP are examples of this trend. Furthermore, there are a large number of international vendors specialise in ERP software for SMEs together with a large number of domestic ERP vendors. There are a number of issues that have encouraged the interest of ERP vendors towards SMEs. These include the saturation of the market as most large enterprises have implemented ERP software, electronic commerce benefits from close integration between large and small enterprise systems (e.g. through supply chain integration or B2B eCommerce syste. The high number of SMEs compared to the number of large enterprises, and the technological development together with the availability of relatively cheap hardware confirms this trend [13].

The spreading of ERP applications is also reaching into developing countries. Some businesses in developing countries have already implemented or are in the process of implementing ERP systems. Researches undertaken by different institutes [10, 26, 31, and 32] approve this fact. In paving the way to ERP adoption, several studies should be conducted indicate measures that should be taken in the ERP adoption and selection process in developing countries. Existing ERP commercial packages cannot provide a once-for-all business model for every process of all industry. Thus, no single ERP packaged software can meet all company functionalities or all special business requirements [27; 33; 14]. Therefore, companies must choose a flexible ERP system and a co-operative vendor that is responsive to customer needs.

There is no systematic and suitable evaluation framework in place when most companies in developing countries evaluate ERP systems. In addition, ‘‘ERP vendor hype’’ further complicates the selection process. Decision makers frequently adopt the common ERP evaluation criteria as the measures without developing tailor-made objectives and clear requirements that echo the company characteristics, its position in its competitive environment, and its corporate strategy. The result is an inevitable delay of ERP implementation and under-performance of the system. Hence, an ERP system selection framework is extremely critical in assisting executives to evaluate from the perspective of company strategies [9].

As the adoption rate of ERP systems increase in developing countries through time, suitable selection frameworks will be crucially demanded by corresponding companies. As in any other developing countries, companies in Ethiopia are also using trends of others in the ERP system selection process which might lead them to failure. So at this early stage, developing an ERP system selection framework is a timely response for the emerging ERP adoption trends and will also address the problems most companies are facing in the ERP system selection process. One way of coming up with ERP system selection framework can be through evaluating the existing frameworks against specific contexts and making the necessary adjustments or changes to bring the framework fit to the specific context. That can also be considered as suitability analysis followed by customization or changes to develop a context based ERP system selection framework. As such studies are not conducted in Ethiopia context; this research will gear towards filling the knowledge gap and addressing the problem companies are facing.

3 Objectives of the Study

The major objective of this study is developing a framework which will be used in supporting the tedious and time consuming ERP system selection by considering Ethiopia's context. Companies will save time, effort and money which they might expend through the time consuming ERP system selection process and in operation time. In doing so the following specific objectives will also be addressed:

- Creating depth understanding on the existing frameworks
  - As the study basis on existing frameworks, suitability of the frameworks for Ethiopia's context will be analysed and the analysis will help for depth understanding of the frameworks.
- Developing a quick reference
  - In conducting the analysis detail comparison will be carried out between the models and this will be used as a quick reference to understand the similarities and differences of the models.
- Filling the knowledge gap
  - There is no study on ERP system adoption in Ethiopia. Therefore this study will take the lead and will address the adoption coverage and will also determine specific characteristics to be considered in developing ERP systems for companies in Ethiopia. This will contribute to the knowledge domain by stipulating the specific characteristics to be considered in developing ERP systems for countries like Ethiopia.
- Easing vendors effort
  - Local or international ERP system vendors can use the result of this study as a reference and the criteria list will help them to fit their product to Ethiopia's market.
- Opening the door for further studies
  - The adoption of ERP systems is far behind from developed countries. Not only such big and complex systems but also the basic ICT adoption in Ethiopia is also lagging behind. But determining the reasons and initiating the potential companies for appropriate ICT adoption is an issue which requires further study. This study, in addition to the crucial problem it is aiming to address, will open the door for further studies.

4 Methodology

The whole research process to be followed in this study is represented by a flow diagram as given below (Fig 1.)

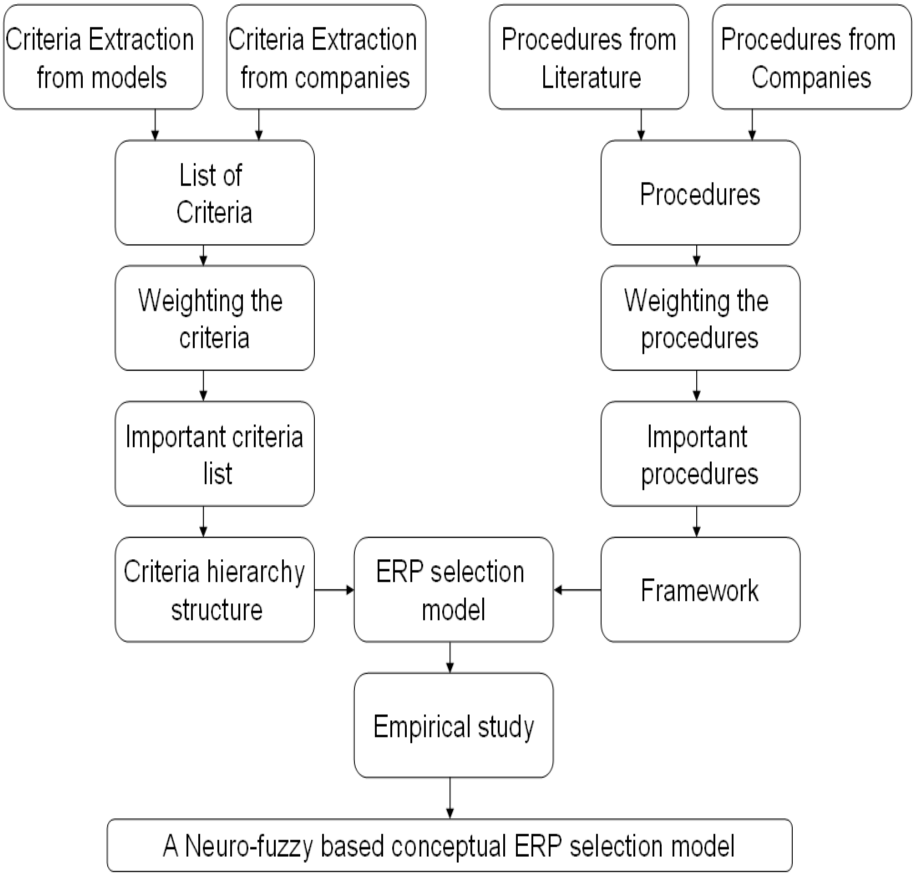

Fig. 1. ERP selection methodology

The study will begin by identifying the available ERP system selection models. The models should be those which have got acceptance by the scientific community. Depth study will be carried out on each model and extracting the detail list of selection criteria out of the models will follow.

The criteria used by companies in Ethiopia which have implemented or are on the verge of implementing ERP system will be gathered in parallel. The companies will be any of manufacturing, service or business companies and include both SMEs and Large Enterprises (LEs). Based on the available literature review and deep interview with companies, additional important criteria will be identified. According to different studies, when implementing an ERP project, price and time are both the most important factors, besides; the vender's support is also a crucial issue [18]. Except the investment cost of ERP project, the annual maintenance cost and human resource cost are also the potential expense for organizations [8, 7]. Wei & Wang [35] sift three categories of attributes to select an ERP system including project factors, software system factors and vender factors. Everdingen et. al.[11] explored that software system and supplier are the major criteria which contents 10 sub criteria for selecting an ERP system. Bernroider & Koch [6] even found that the priorities of criteria are different between small-medium sized company and large sized company. Therefore, during extracting additional criteria, such recommendations of literatures and the reflections of companies will be considered. These additional criteria and the criteria used by companies will formulate the important criteria list to be considered when selecting ERP systems for companies in Ethiopia. The same procedure will be followed in determining the important steps to be considered in the selection of ERP systems.

Having the criteria and procedures, a neuro-fuzzy based conceptual model will be developed. Most of previously developed models works based on analytical hierarchy process (AHP). In this study a neuro-fuzzy based approach is adopted to test the applicability of neuro-fuzzy systems in the multi criteria decision making environment. Finally the practicality of the model will be tested by conducting an empirical study.

5 Expected Result of the Study

Design science research should addresses important unsolved problems in a unique or innovative way, or solved problems in a more effective or efficient ways [3]. As a design science research, this study will address the specific problem in an effective and efficient way through the model to be developed. Therefore, the most expected result of this study is a model to support an ERP system selection process in Ethiopia's context. Hevner et. al [3] also stated that the key differentiator between routine design and design research is the clear identification of a contribution to the active knowledge base of foundations and methodologies. The researcher believes that the unique criteria to be identified and the enhanced model to be developed will formulate the contributions to the knowledge domain out of this study.

Apart from the above mentioned main outputs, the comparison between the available models will also be additional contribution that can be used as a reference to get a quick understanding of the available models.

The criteria used by SMEs and LEs will be compared so that vendors will take specific criteria into consideration when developing ERP systems for SMEs.

6 Beneficiaries

The primary beneficiaries out of the result of this study are companies which want to implement an ERP system. ERP software selection is tedious and time consuming due to the complexity of the business environment, the limitations in available resources, the complexity of ERP software and the diversity of ERP alternatives, [35]. Therefore the model will support companies to make decisions in selecting an appropriate ERP system.

The study conducted by Alemayehu & Arjun [24] revels that vendors include many criteria that were not considered so important by the case companies. Therefore, the evaluation criteria perceived important by the client companies will be disposed for local or international vendors and they can use it in developing ERP systems for the specific market.

There is no study on ERP system adoption in Ethiopia. Therefore this study will take the lead and address the adoption coverage and will also determine specific characteristics to be considered in developing ERP systems for companies in Ethiopia. The scientific community will be benefited out of the specific characteristics determined, and the enhanced model, together with these specific characteristics, can be considered as contributions to the knowledge domain.

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Combining ERP Systems with Enterprise 2.0

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Abstract. The paper discusses both the complementary factors and contradictions of adoption ERP based systems with enterprise 2.0. ERP is well known as its' efficient business process management. Also the high failure rate the system implementation is famous as well. According to [1], ERP systems could achieve efficient business performance by enabling a standardized business process design, but at a cost of flexibility in operations. However, enterprise 2.0 supports flexible business process management, informal and less structured interactions [3],[4],[21]. Traditional researcher claimed efficiency and flexibility may seem incompatible in that they are different business objectives and may exist in different organizational environments. However, the paper will break traditional norms that combine ERP and enterprise 2.0 in a single enterprise to improve both efficient and flexible operations simultaneously. Based on the multiple cases studies, four cases presented different attitudes on usage ERP systems and enterprise social systems. Based on socio-technical theory, the paper presents in-depth analysis benefits of combination ERP with enterprise 2.0 for these firms.

Keywords: Enterprise resource planning, enterprise 2.0, informal communication system, efficiency, flexibility, agile BPM, sociotechnology.

1 Introduction

Enterprise resource planning system (ERP) is well known of integration functions on business process management to improve operation efficiency on reducing process cycle time, producing documentation quickly, and eliminating errors and duplicated process design [23], [20], [31]. However, there is an increase awareness of shortcomings of traditional ERP systems, because of the high failure rates. It has occurred particularly in SMEs and firms of developing countries [24], [12], [28]. Many ERP vendors invest innovative software and applications embracing with ERP systems to use in order to reduce the costs for these firms to implement ERP, such as EAI, Saas, SOA, and cloud computing [19], [32]. However, the most important barrier for these corporations to adopt ERP is less structured business process and informal documentation, rather than software costs [16]. Huang et al., 2001) Mullins [25] called these firms as informal organizations that highlight flexible operations and the working procedures based on social and psychological needs without formal defined and structure. ERP facilitates a formal, structured, planned, transaction-based process management, while the informal organization focus on different business

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norms that are informal, less structured, more spontaneous, knowledge-based operations [21]. Thus ERP and informality seems to have some natural contradictions.

So how do the informal enterprises use ERP to achieve the efficient benefits? Traditional researchers support the successful ERP implementation should eliminate informal communications and systems [36], [2]. ERP systems supports for planned and routinised process management. (1, Monk and Wagner, 2008) So it seems to be incompatible with less structured and spontaneous based informal systems. McAfee [21] introduced of enterprise 2.0 to incorporate the social interactions in the firms. Knowledge workers could share and discuss their knowledge through online communication platform, which enables practices of knowledge and output more visible. Based on the case studies, two firms already implemented enterprise 2.0 related social software aligning with ERP adoption. This paper will deeply discuss the contradictions and complementarities of combination ERP and enterprise 2.0.

2 Key Features of Enterprise 2.0

As discussion above, existing arguments between enterprise systems and informality motivate researchers to explore enterprise social management supports tools---enterprise 2.0. McAfee [21] termed Enterprise 2.0 as part of Web 2.0 to bring and build Internet-based software platforms to facilitate informal, less structured, more spontaneous knowledge-based works in a company. Technically, enterprise 2.0 developed from web 2.0 to enhance the communication by transforming static HTML web page to be dynamic and two way interactions [21]. Beyond a technology tools, enterprise 2.0 benefit organization to establish freedom, network-oriented, less hierarchical structure, and collaborative, trustful and transparent culture. The organizations adopted with enterprise 2.0 tend to be flatter that transfer from bottom-up to top-down structure [4], [13]. In summary of recent researches, the software is build according to four features. The following will explain the key features of enterprise 2.0 software in related to organizational informality.

- ***Week structure:*** The strong tied relationships work in hierarchy or team structure with formal and well-defined business processes. [6] However, the week ties aim to motivate spontaneously interactions between social actors and to create new perspectives on solving problems. Thus, enterprise 2.0 enables open and unstructured online communication that motivates spontaneous interactions between social participants. (MaAfee, 2008) Enterprise 2.0 supports for more effective informal communications through online platform. Cook [4] said the informal and unstructured process management is supported by communication and cooperation social software. Communication software allows individual level interactions that people could question or opinion and gets response from others, such as discussion forums and blogs. Cooperation social software could share information along with process to construct something in the process of sharing knowledge. All these social software could work in relative unstructured manners to improve informal and spontaneous communication among individuals.

- ***Social engagement:*** Enterprise 2.0 social software also breaks existing enterprise system norms that usually are centralized and planned. McAfee [21] indicated the enterprise social software encourage people will engage into the network to filter and refine the information with more effectively and precisely. The typical social productions are Wikipedia and Lindux operating systems that will achieve cooperative through collective influences of participations [3]. As discussion above, the informal process might be inappropriate due to manual errors. Thus the frequently and more people enragement in social interactions through enterprise 2.0 system will improve informal communications more precisely.
- ***Participant empowerment:*** What is more, enterprise social software does not only bundle with web 2.0 technology, but also benefits for improving internal organization to abolish hierarchical structured [4]. The social software highlights the contributions of all participants and they could have equal rights to participate construct a best business solution [33]. The key feature of enterprise 2.0 supports informal enterprise to empower all staffs adapt agile knowledge-intensive management, rather follow rigid business norms.
- ***Cooperative and open nature:*** As MacAfee (2009) mentioned, emerging social software contributes to form a low-cost cooperation knowledge management to improve social collaborative among not merely customers or prospective customers, but also employees, suppliers and all business stakeholders. Rather than intranets-based software, the enterprise social software composes of extranets and public websites. Thus, it encourages people to share the context and relationship, indirectly and indirect in both central and distributed methods. The cooperative nature of enterprise 2.0 software just could improve social relationship among informal groups and develop a culture of trust through connected all stakeholders on a shared platform. adopting enterprise 2.0,

3 Contradictions between ERP and Enterprise 2.0 Supported Informal Communications

However, the two systems have rather different natures: ERP is formal, structured, and focus on efficient management, while enterprise 2.0 is relative informal and unstructured interactions and flexible operations [21]. The difference might challenge for combining them.

Firstly, the two systems have different natures. ERP is formal and structured based system that the system is based on formal and documented business process redesign (Al-Mashri, 2003, [20]), while enterprise 2.0 is relative informal and unstructured software that establish two way online communication portal and spur the business stakeholders to share knowledge on the platform without any form or norm [21], [3], [4]. More specially, the business process management, communication, collaboration, decision-support manners, and organization structure have distinctive difference.

Also, the business interactions in an ERP system are based on design to integrate across organizational functional groups [10]. By contrast, Enterprise 2.0 supported informal interactions depends on unplanned and individual interactions in the social networks [29], [30]. ERP achieves effective communication with information and knowledge sharing within a centralized system [34]. Knowledge here is explicated such that it could be codified into the system [27]. However, enterprise 2.0 supported informal communications is based on decentralized method that is called the "grapevine" [14]. It can rapidly transmit information in the social network and skip the entire organizational chart. The knowledge and information in the informal network is tactical, and is hard to retrieve, because it is embedded in the human's mind and diffuse in the social communities [15]. Also, the organizational decision-making methods are different. ERP provides a formal method to support top managements through systemic analysis, which could integrate with business intelligence tools [10]. The decision-making of informal organization is related to experience and intuitions, and the engagement of front-line employees [8].

Moreover, in the traditional perspective, ERP and enterprise 2.0 are suitable for different organization environment. ERP usually was successful implemented in formal enterprise that is in a tighter, deliberate, and impersonal mode of bureaucratic organization [22]. Also traditional ERP has been used in the capital-intensive industry, such as manufacturing, construction, aerospace, and defense [1]. These industries have volume and mass process management focus on efficiency strategy [7]. However, enterprise 2.0 supported informal system suits for informal organization chat call as "sociogram", which entails with a loosely structured, spontaneous and social interaction in the organic organization [8]. The informal communication networks are widely used to improve knowledge-intensive works that information could be exchanged and influenced by enterprise staffs [5], such as: SMEs, innovative companies, and firms in the developing country [12], [26], [35].

4 The Complementary Benefits of Combining ERP and Enterprise 2.0

However, according to the case studies, we found ERP and enterprise 2.0 systems are not incompatible. The following will discuss the complementary benefits of ERP and enterprise 2.0 based on Heinen and Bosttom's [11] social-technical theory including: technology, organizational and people paradigms.

4.1 Technical Benefits: Efficiency and Flexibility Simultaneous

In the technical dimension, combination ERP and enterprise 2.0 will achieve efficiency and flexibility simultaneously. ERP is not only an efficient technical system, but also it is a flexible system. Moreover, enterprise 2.0 also support for efficient management by simplifying the business interactions.

Traditional researchers hold the perspectives on ERP systems as efficient technical system, and the vendors were focus on development efficient functionalities of ERP system [1], [18],[17], [14]. But the paper found ERP also benefits on flexible adjust productions and services based on the market demand. In the C1, ERP based systems could accurate analyze the tenants' sales and C1's income. As most of tenants' sales are increased, there will more demands for the renting in the shopping centers. Then the new contracts' rental and services fees will be increased. Moreover, as the demand is increased, C1 will invest on expanding market in new locations. ERP based system also could analyze the business resources (including assess and tenants resources) assist to report when to flexible adjust the rental fees and services, and how to speed-up to expand market are appropriate. Therefore, it shows that ERP system could provide analytical flexibility to support executive decision making.

Enterprise 2.0 does not only could support flexible performance [3], [17], but also we found that it supported efficiency, because it is able to simplify the complicated and formal system procedures. In the C3, one of important reason to adopt online forums is to simplify the report system procedures. The software development company contents mass of troubleshoot and testing process. The rigid and complex reporting system lead the company could not solve the climes' software requirements efficiently. All the changes and troubleshooting processes need to have formal reports and examined by hierarchical managers. The low efficient working method leads engineer to work in extra hours in order to meet climes' requirements and finish software development in time. The enterprise 2.0 supported informal communication system enables the staffs and managers who relevant with the project development could cooperate together and communicate efficiently. Therefore enterprise 2.0 also can be viewed as efficient system by simplifying system process and solving the problem directly.

4.2 Organizational Process Management Benefits: Generate New Model of Business Integration

In the operation process management, ERP also effective works for informal process integration, while enterprise 2.0 supports for agile formal business process management.

ERP is well known as its' integration function to support business process management [9]. Beretta 2002) In the case 2, the company keen to use the integration function of ERP systems to solve the wastes due to unstructured and unplanned informal process management in different inter-sites, and assist the company to achieve chain store operation. However, C2 provide negative perspective on informal process that top managers do not remain any informal procedures, even if branch store claim that different informal operation process will benefit for them to provide customized services. As Thmistocleous and Corbitt, (2001) said, ERP is not a best solution for integration, because it could not co-exist with other applications. Pure ERP system in the C2 could not accept for different business process management methods in different stores.

By contrast, C1 is better to use the integration advantage of ERP system. As similar as C2, C1 also wants to achieve chain-store operation strategy, so C1 adopted ERP to assist the company to develop a standardized business model to assist new branches could have successful operation model to imitate. However, C1 still treasures value of informal processes in different divisions. Each division still could have their informal activities to operate in different market environment. The relevant informal process data will be transferred from OA system (online communication system) to ERP system to store information in the database and do further informal performance analysis. But the different stores are horizontally linked by the integrated ERP systems. Thus, all the divisions work in their autonomies, but they have shared business vision and services based on integrated enterprise system. Different stores work in broader integrated environment, and they could continue to improve the enterprise system to align with their working procedures.

The following figure describes the usage of ERP system in C1 and C2. Informal interactions in the different sites are mass and less structured. ERP could support for business process integration in C2, because different inter-sites cooperate on a single system that all the interactions are relative formal structured, but different stores needs to implement same process management method to deal with complicated market environment in the different stores. However, if the ERP system could be combined with enterprise 2.0 support systems, the better integration will be achieved in C1 that different inter-sites could have decentralized business process management, but all performances are supported shared business objectives and interacted on centralized enterprise system. Therefore, the combination of ERP and enterprise 2.0 generates new business integrate that indicates the informal practices can be better performed in a structured way.

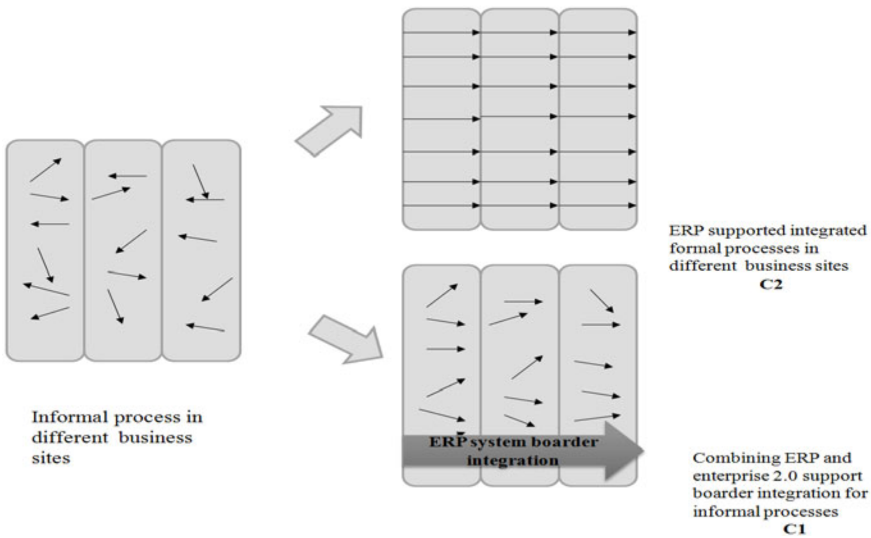

Fig. 1. The usage of EPR system integration in different companies: C1 and C2

4.3 Social Participants' Benefits: Not Only Coordination, but Also Collaboration

The combination of ERP and informality might contribute to achieve collaboration, not merely coordination. ERP is well known as its' enterprise-wide integration functions to coordinate people in different parts of an enterprise [23]. Informality will enhance the social collaboration. It improves the communication more efficiently and effectively with common understanding of specific factors. Also informal relationship relies on interpersonal trust based on social arrangement and emotional loyalties [37]. People are not only physical connection on an enterprise system platform, but also they collaborates them with feeling of intimacy.

The following figures demonstrate the knowledge management transformation in C1. After implementation ERP and enterprise 2.0, the company achieves to transfer knowledge linear management in dependent divisions to social knowledge network management. All the divisions are connected within a central knowledge "gatekeeper" headquarters, and they collaborate within a social network called OA (office assistant) online enterprise 2.0 communication platform. Compare to traditional linear knowledge management in informal communities, social network knowledge management model benefits the firm to be open, to communicate all divisions with common language, to integrate all divisions with shared resources, and to spur all divisions to participate business activities with a common business targets. The knowledge assets in the each division will not be only stored in individual divisions or independent informal groups, but the network model enables to develop corporation knowledge that is managed by central gatekeeper, which is headquarter in the C1. Consequently, all division could collaborate together, and share their experience and resource in order to solve unbalance development between north and south divisions. Although all division communicate on a common platform, each division still could flexibly use enterprise 2.0 technology to achieve routine changes in improving ERP to fit their working environment. Thus the combination of enterprise 2.0 and ERP enables a new generation for business collaboration and knowledge innovation. Consequently, the firm could efficient work in a shared network, but each part also could maintain their unique performance flexibly.

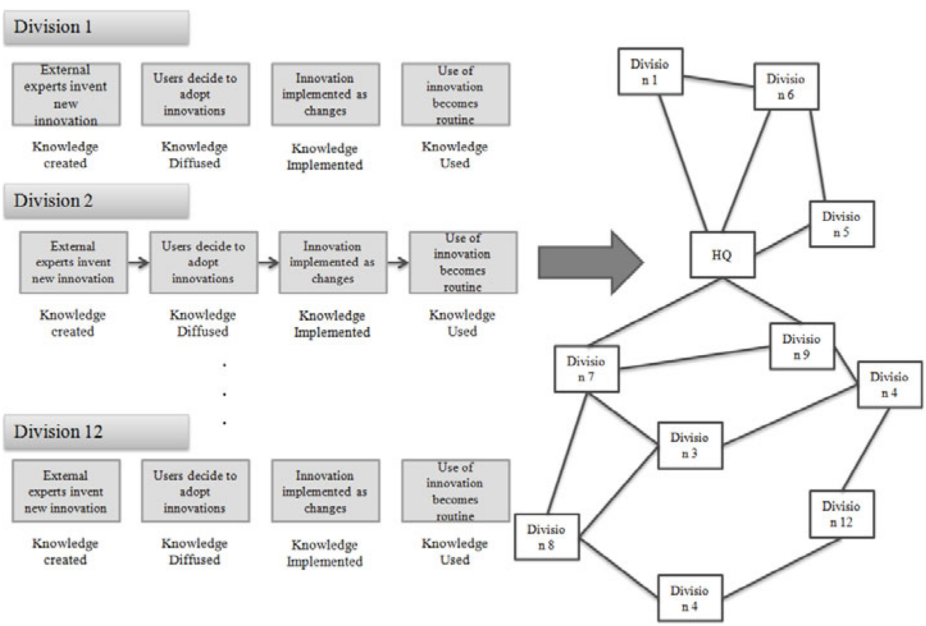

Fig. 2. New generation of knowledge management in C1

5 Conclusions

To conclude, the paper presents break traditional agreements on ERP and enterprise 2.0 are contradictory. In a summary of existing researches, ERP is relevant to efficient, formal and standardized process management, centralized system based interactions, and in tighter and bureaucratic organization, while enterprise 2.0 consists of flexible, informal and loose structured procedures, decentralized interactions, and open and organic environment. However, the paper shows the combination ERP and enterprise 2.0 can be complementary benefits in technology, process, structure and people dimensions. Firstly, in the technical aspect, the combination of ERP and enterprise 2.0 could complementary the insufficient supports from single efficient system (EPR) or single flexibly system (enterprise 2.0). In the operation process management, the combination achieves effective business process integration as well as agility process management. Finally, the adoption ERP and enterprise 2.0 simultaneous improves corporation collaboration and maintain the harmonious social environment. Eventually, it will benefit business to develop of a new generation of business management that connect business sites in a coordinated network, also maintain the independent sites' knowledge sharing and innovation.

Table 1. Summarization of ERP and enterprise 2.0 systems

	Contradictions	Complementarities
ERP	● Efficiency as formal and standardized business procedures	● Also support for flexibility as systemic analysis
	● Centralized system interactions	● Corporation process management
	● Tighter and bureaucratic organization	● Enhance business coordination
Enterprise 2..0	● Flexibility as informal and loose structured activities	● Also support for efficiency to simply business procedures
	● Decentralized interaction: grapevine	● Empowered business activities
	● Open and organic organization	● Enhance knowledge sharing and innovation

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Designing an R&D&i Project Management Software for Business Environment: GIDIX

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Abstract. Current generic Research, Development and Innovation (R&D&i) management systems implemented in businesses lack of project requirements specification and they hardly integrate IT control issues. This paper focuses on the definition of a model for managing R&D&i projects in companies. This model, based on ISO/UNE 166002:2006 [1] standard, addresses the shortcomings that the generic models have by means of integrating good practices in IT management from framework COBIT [2]. Moreover, our proposed model includes requirements for research and development projects as specified in ISO/UNE 166001:2006 [3] standard. Once this reference model is set, we introduce the GIDIX software for giving support while developing such projects. This software can be used as the main tool for managing R&D&i projects in a company making use of our R&D&i management system model and it incorporates the features needed to fulfill the requirements specified by our model.

Keywords: R&D&i, Research, Development, Innovation, Project Management Software, ISO, UNE, COBIT.

1 Introduction

Times are changing, and businesses have to change with them. In an environment of growing competition, companies are certainly assuming the need to investigate new techniques, products and processes in order to improve the efficiency of each productive task. Nowadays, this objective is accomplished by means of investment in research, development and innovation. This business strategy is supported by several investigations which link R&D&i investment directly to the productivity growth and quality improvement. We should emphasize the relevance of these tasks at two levels:

Business level: The increase in investment for research and development is positively correlated with the growth in its sales, productivity and market value [4].

Aggregated level: Studies in the U.S. [5] and the European Union [6] suggest that an increase of 1% in stocks of knowledge increases productivity by 0.05% to 0.25% in the long term.

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A recent study [7] suggests that near 50% of work productivity growth in USA in 1950-1993 period was mainly due to the increase in research intensity from G5 countries. Moreover, research and development policies contribute to create more quality employment.

The European Union has recently launched the Lisbon Strategy for growth and employment [8], emphasizing R&D&i activities as a cornerstone. The European Commission estimates that reaching the Lisbon objectives would suppose an additional income rise of 3% in real terms as well as an additional employment growth of 1.4% in 2010. Given this scenario, it is of great relevance for businesses to adopt an R&D&i management system.

This issue is the focus of this paper, since these particular projects have specific requirements that differ from the rest of the company projects that are addressed. In addition, these projects have a strong technological component that entails taking into account Information Technology (IT) management issues. Both current R&D&i management systems and project management applications do not meet the requirements set out from the above features. Our model and the related support software GIDIX fix these shortcomings, providing the perfect framework for any company which has these special projects in its portfolio.

The paper is organized as follows: in Section 2, after a brief introduction to the R&D&i management, we outline the evolution of management models, the associated regulations and point out the shortcomings of current models regarding the R&D&i; Section 3 focuses on our proposed management model and its advantages over the current models; in Section 4, we present the GIDIX Enterprise Information System (EIS), which supports the proposed model and we present a comparison between GIDIX and current tools of project management; finally, Section 5 concludes the paper.

2 Related Work: Current R&D&i Management System Models

Obviously, research, development and innovation are processes which require a high degree of creativity and intuition. However, we should not forget the importance of a good organization and management. In fact, all of these items are improved if we have at our disposal a management system which supplies and integrates the resources needed for their implementation.

In this way, it is needed to have an R&D&i management model in order to understand and manage the research and development tasks to get a strengthened innovation process [9]. At this point, we must take into consideration the different alternatives that we have. The following subsection shows the evolution of these alternative models.

2.1 Model Evolution

A first group of current R&D&i management systems follows the simple scheme or *linear model* [10]. This model represents a first attempt of managing research, development and innovation processes. It considers the process of innovation in a business as a several stage sequence. The main core is the knowledge acquired through research. Subsequently, the market is the item which is paid more attention.

The linear model shows several deficiencies, such as considering innovation as a single stage, or stating that a strong scientific basis implies a greater change in technology and innovation, which is not often true. Because of these limitations, more complex (mixed) models have been defined. These new models try to account for the lack of simplicity of the innovation process.

Most current management systems implement a *mixed model*. Taking as a reference the well-known Kline's Chain-Linked Model [11], the mixed model tries to better show the complexity of innovation process, suggesting five paths [12].

In R&D&i management systems based on the mixed model, there are multiple paths from which innovations may arise and many forms of feedback. Besides, research is not usually considered to be the initial step, and the primary sources of innovation are now the stored knowledge and the technological paradigms.

2.2 Current Models Shortcomings

The main shortcomings of current management systems for research and innovation have to do with two features that make the R&D&i projects particular. These characteristics are, firstly, compliance with current regulations (national and abroad) and secondly, a very strong IT component.

Regarding regulations, current models suffer from being too generic [13] and do not include features that allow projects to incorporate regulations. Such incorporation of existing legislation in research projects is very important since compliance is mandatory for research projects wishing to apply for government grants. These grants are vital to the development of research and innovation projects as these projects often have a low return on investment in the short term. This legislation can be local or international, as well as within the scope of the process or product on which the project is being developed. Examples of this shortcoming are found in the Cross-ministerial R & D Management System (e-Rad) [14] from the Japanese Government and the ISO 9001:2000 standard [15].

As for IT, research projects often have a strong IT component, which makes it interesting the technical integration of IT management during the development of these projects. However, once again current management systems do not specify neither controls nor good practices on IT during development process, since they do not detail these aspects of IT management (human resources, acquisition of software / hardware, methodologies development, technical documentation) during the life cycle of projects. Integrating aspects of IT management in the management system would be of great value and utility. Therefore, our model assumes a standard management system as a starting point and incorporates the necessary improvements to strengthen the aspects of regulations and IT. Thereby, our proposed management system model is more complete and optimal.

3 R&D&i Management System Model Proposed

In order to improve the management of innovation in current systems and address the shortcomings aforementioned, a general reference framework for our model is needed. Thus, normalization standards have been taken as a starting point since nowadays, normalization techniques commonly used for other activities such as quality or environmental management are also applicable to R&D&i. In this context, the Spanish standards agency AENOR published in 2006 a national standard designed to provide guidelines for establishing and maintaining management of these processes. In particular, the standard UNE 166002:2006, entitled "R&D&i Management: R&D&i Management System Requirements" has been selected as our reference framework. This standard belongs to the UNE 166000 family. This standard provides to our model the following advantages: (i) promote research, development and innovation activities, (ii) provide guidelines for the organization and effectively manage innovation processes, including selection and management of the R&D&i projects portfolio, (iii) ensure no loss of activity that could generate its own technologies and patents, through which additional benefits from technology transfer or tax rebates can be obtained, (iv) enhance the R&D&i as a distinctive factor for competitiveness, and (v) help plan, organize and control units of R&D&i, achieving resource savings and improved motivation of employees.

Among these advantages, the additional profits earned via tax reliefs can be highlighted. This will be a key reason for enterprises to support the investment in research and innovation projects.

The Kline's Chain-Linked Model, discussed in the previous section was the model that AENOR used as a basis for designing this standard has been. Once the reference model is set, it is needed to focus on the particular characteristics of the R&D&i projects. These characteristics are, as noted earlier, compliance with current regulations (national and abroad), and a very strong IT component. An analysis of national (Spain) and international (European Union) regulations applicable to research, development and innovation IT projects was performed in order to address the task of defining a management model which had into account the regulations/standards compliance.

As shows the analysis presented in Figure 1, the number of standards applicable to product and processes in R&D&i projects is overwhelming, in both Information Technology and Software Engineering fields. Examples of these regulations are: (i) the Law for Business Tax [16] which set the tax rebates for businesses developing innovation projects, as well as the requirements that companies must meet to get such rebates, (ii) the Law for Protection of Personal Data [17], which set the controls that any Enterprise Information System should include in order to preserve the privacy of personal data in such systems, and (iii) the ISO 9001:2008 [18], which set the requirements for any Quality Management Systems in business. Moreover, additional indirect impact regulations on the project (as those derived from secure electronic transactions between different countries) must be added to the initial set of regulations. We can conclude that R&D&i requires special treatment in their management due to these conditions. At this point, it is necessary to first establish a generic model and from it to incorporate an addendum.

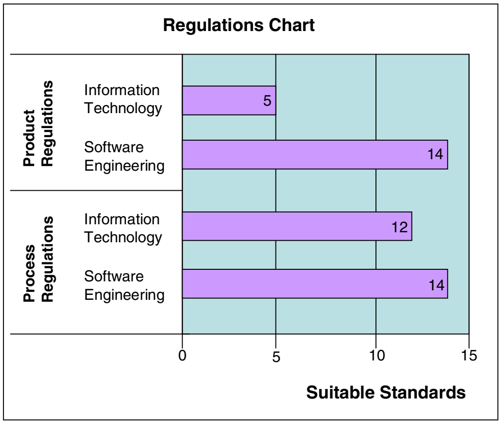

Fig. 1. Regulation analysis for R&D&I projects in Spain and the European Union

This addition to the initial model will allow the inclusion of the product-specific regulations applicable to the R&D&i project.

Given these factors, we decided to take as a reference model one of the standards from the UNE 166000 family, aimed to R&D&i projects. This standard is the 166002:2006, which is entitled "R&D&i Management: R&D&i Management System Requirements". In this way, we use this standard to establish the main characteristics that a project management system must meet in the specific field of R&D&i. These features will be included in the following categories:

- Project organizational structure
- Project planning
- Processes carried out to ensure quality
- Resources
- Documentation

Additionally, we have used the UNE 166001:2006 standard as a reference for establishing the requirements that R&D&I projects must meet. This set of requirements includes the specific tasks to include the regulations applicable in the projects developed.

As aforementioned, the vast majority of R&D&i projects usually have a strong technology component, so it is very important the management of IT on them. Thus, we considered to supplement the standard UNE 166002 with the control objectives from the methodology for the IT management COBIT. COBIT is one of the most extended and accepted framework for IT governance and it is strongly supported by the IT Governance Institute and the ISACA (Information Systems Audit and Control Association). This model addition improves the management of the technological components of the project with a number of good practices on the management of technology issues in any project. Table 1 shows a snapshot of the relationships we have established between COBIT control objectives and tasks set out in our model based on UNE 166002 (one relationship per category).

Table 1. UNE 166002 – COBIT integration

UNE 166002 Requirement	COBIT Control Objective	Our Model
Management review	Defining the Processes, IT Organization and Relationships	There should be policies and procedures for all functions involved in the development of R&D&i
Planning	Definition of an IT Strategic Plan	Draw up a strategic IT plan so as to manage and direct all IT resources in line with R&D&I management system
Processes to ensure quality	Quality Management	Establish and maintain a QMS (Quality Management System)
Provision of resources	IT Resource Acquisition	For all the R&D&i projects, procedures for acquisition of IT resources and supplier selection
Documentation	Manage IT Human Resources	Documentation, seminars and staff support

The combination of UNE 166002:2006 / UNE 166001:2006 standards, and COBIT control objectives results in a powerful model which improves the IT management and clarifies the specifications of R&D&i projects. Figure 2 shows our proposed model based on such integration.

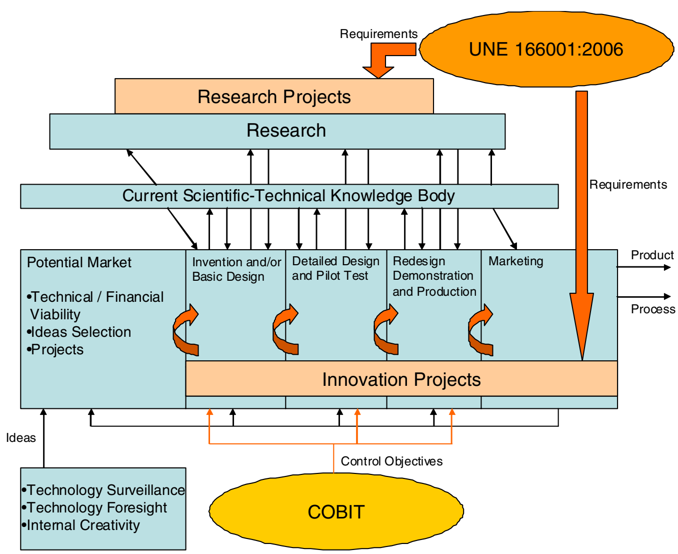

Fig. 2. New Model diagram based on UNE 166001/166002:2006 R&D&i Process and COBIT

4 GIDIX: EIS for R&D&i Project Management

The main objective of our model is to facilitate the systematization of R&D&i projects and improve their management. Hence, it is very important to use project management software that facilitates the development of the project dependent tasks, as well as to meet compliance with the requirements arising both from the UNE and the specific legislation in the field which the project belongs to (technology, industry, environment, data protection).

One of the main advantages from our model is the specification of a set of requirements for R&D&i projects. These requirements incorporate those needed for the inclusion of regulations/standards applicable to projects, as well as the requirements related to the control objectives from COBIT. As a result, we have the opportunity to create our own tool, suitable for businesses carrying out R&D&i projects. This tool will also allow the incorporation of specific regulations applicable to: (i) the product developed in the project, and (ii) the business area which the product belongs to.

4.1 Approach and Features

GIDIX for R&D&i project management has been developed in collaboration with a commercial company. Figure 3 shows the different design stages of the new management system model for R&D&i projects, as well as the implementation of the specific management software for such projects.

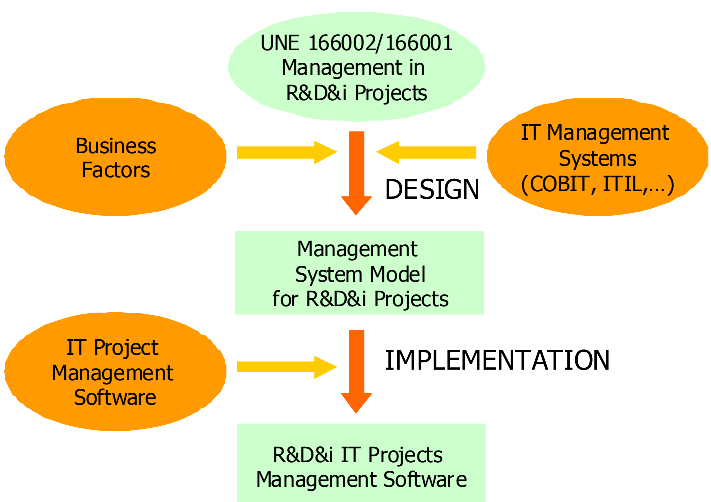

Fig. 3. Design stages of new model and support software

This software has the functional characteristics necessary to strictly comply with all requirements specified by the model of quality management for R&D&i projects based on UNE 166002 + UNE 166001 + COBIT that we have defined. Specifically, this software includes the following features that are specific to such projects:

Identifying the key objectives and the secondary objectives included in each project.

Protection of project results, indicating the ways and means that the company plans to spend for it.

Laws and regulations which are applicable to the project. It is made possible through the upload of documents and their linkage to the project.

Inclusion of control flags which allow assessing the status of the project during its development and its success after completion.

Risk analysis and definition of contingency plans, with links to specific project objectives.

Project Time planning, including the definition of phases, tasks and milestones, and the corresponding Gantt chart and Critical path.

Financial management of the project with the possibility of assigning economic items and get a summary of the economic situation of the project at any time.

Project Documentation management, allowing the maintenance of all documents uploaded to the system and assigned to it.

Project status reports, from multiple viewpoints (economic, planning, etc).

Both the development environment and the implemented system are based entirely on free software. Our application is designed as a system of three-tier architecture through an object-oriented paradigm. Figure 4 shows the different menu sections available, which give access to several of the main features included for project management.

4.2 Current Project Management Tools and GIDIX Comparison

In order to check the improvements that GIDIX provides regarding R&D&i project management, we have reviewed current available project management tools and we have tested their compliance to the project requirements that our model specifies. In addition, in order to minimize the cost that businesses are going to have for getting adequacy to our model of quality management for the R&D&I projects, and given that this type of project does not have an immediate income, we have restricted the analysis to those applications which are open source. In total, we have initially considered 20 tools, but we have focused on seven of them, since they have a demonstrator that allows in-depth analysis. The tools that we have analyzed are: AceProject, Collabtive, Egroupware, GanttProject, Launchpad, OpenGoo and TodoYu. For each of these tools, we have tested if it integrates the functional characteristics set by our model to meet the requirements under our management system, as GIDIX does.

After the analysis, we could not find a free software tool that allows compliance with the key regulatory requirements involved in our model. Specifically, there are notable shortcomings of these tools in the following key points for the R&D&i projects in our model: (i) lack of Indication of project objectives and approaches for achieving them, (ii) fields to indicate the factors of innovation and novelty of the project, (iii) applicable legislation and regulations are omitted, and (iv) absence of data about application of results, including identification of new products or processes, potential market, income protection mechanisms, etc.

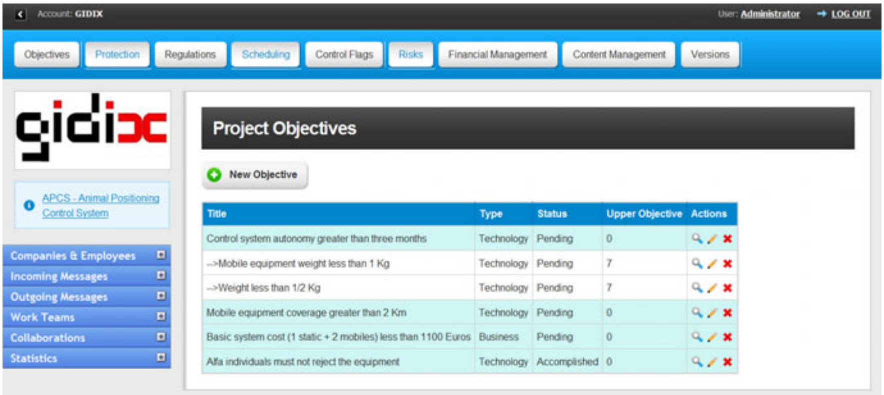

Fig. 4. Screenshot of GIDIX, our R&D&I Project Management software

5 Conclusions

In an environment of increasingly open competition in the scenario of a global crisis, there is a clear need of increasing the competitiveness of enterprises. Thus, R&D&i projects are of vital importance to allow businesses to be placed on the market in an advantageous position over competitors. Moreover, the economic crisis has forced some countries to rethink their economic model, thus making these projects a strategic value for governments. However, these projects have intrinsic qualities that differentiate it from other company projects. These projects have strong links with current legislation and are subject to specific development standards set by the government in case businesses want to apply for a state grant, which is the main source of funding for a large percentage of R&D&i projects. Finally, these projects, by definition are linked to processes of quality management in enterprises. All these reasons indicate that this type of project requires a specific treatment that goes beyond the standard project management.

This relationship with quality has made us to develop a management model for R&D&i projects. This model can be used as a framework by which to establish the mandatory requirements of such projects in a company. The standards UNE 166001 and UNE 166002 serve to our purposes perfectly. Furthermore, we have added to this framework components derived from the best practices of COBIT framework for the IT governance, in order to enrich the process of project management.

Having established the requirements for R&D&i projects and after finding shortages in current open source projects management tools, it has been highlighted the need for a project management software specifically for these projects, which incorporates the functionality to satisfy the requirements of our business model. The final result of this work provides companies, on the one hand, a management model for R&D&i projects based on quality criteria and established standards, and on the other side, a support software that will simplify management tasks and enable businesses to have all the information of such projects in a centralized and computerized way.

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Identification of Requirements towards a Business Information Tool

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Abstract. Many companies act in fast developing markets, characterized by a strong global competition and rapidly changing production structures. Continuous development of advanced technologies leads to frequent product changes and to short production runs. Collaboration across the supply chain is one possibility to face these challenges and to stay competitive. Effective collaboration requires an intensive information exchange between supply chain partners. Currently, there are several concepts and tools, automating information exchanges on the operational level. However, collaboration and thus the corresponding information exchange support on the tactical and strategic levels have been neglected so far. The CONVERGE project aims to fill this gap. It develops a framework and tools for exchanging tactical and strategic information between equally powered supply chain partners. This contribution describes the results of a problem analysis, conducted to determine requirements on a suitable business information tool. Several requirements, towards the information exchange itself were identified. Furthermore, the article describes characteristics and deduced profiles, which aim to support the identification of a collaboration's particular requirements. These characteristics cover a company's need for information exchange, security and confidentiality as well as its supply chain stability.

Keywords: collaboration, information exchange support, tactical and strategic level, business information system, supply chain networks.

1 Introduction

Companies have to collaborate closely to remain competitive. In particular, collaboration in non-hierarchical supply networks and thus the corresponding intensive information exchange is crucial to maintain its performance. Literature distinguishes between three levels of planning: operational, tactical, and strategic [1]. The strategic level is concerned with the company's alignment and thus with long-term planning. The tactical level covers mid-term plans and decisions, which aim to implement strategic decisions in the foreseeable future. The operational level focuses on the effective execution of processes. In particular, in supply chains, this level includes the exchange of information regarding production and delivery. On the operational level, the information exchange process is well-structured [2]. In contrast,

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the process is nearly unsupported and unstructured on the tactical and strategic level. In order to develop methods and tools to support and structure the exchange of tactical and strategic information, it is necessary to clearly identify a company's requirements. Therefore, four industrial use cases, originating from the European electronic industry, were chosen for a problem analysis.

This article presents general requirements towards a business information tool, as well as characteristics that help to identify a company's particular needs. Based on these characteristics, the sectors of the electronic industry were grouped in three categories with comparable properties. The next section shortly characterizes the European electronic industry and describes particular challenges that companies have to face. Afterwards, it sketches existing work from the literature regarding supply chain management techniques and collaboration concepts, which aims to tackle these challenges. Section three provides the procedures of the problem analysis. The fourth section presents those requirements identified, as well as profiles for each category.

2 The European Electronic Industry and Literature Review

The electronics industry is a highly heterogeneous and dynamic industrial branch. In 2008, mass-market products, such as mobile devices, TVs, PCs etc. accounted 53% of the electronics industry [3]. This industry acts as supplier for many other industrial branches and covers professional electronic equipment, such as embedded electronics in transport, defense equipment, IT infrastructure as well as electronics in manufacturing. Due to this diversity, the electronic industry splits up into seven sectors: telecommunication, home applications, audio and video, data processing, industrial and medical, aerospace and defense as well as the automotive sector [3].

Across all sectors, modern electronic products evolve away from simple electronic circuits towards more complex ones, each with its own program logic. Additionally, the development and production processes are changing. Companies have to react flexibly to constantly changing customer requirements, in particular during the development phase [4]. Furthermore, suppliers of electronic components are increasingly involved in product development. Summarizing these aspects, the electronic industry faces the following developments [5]: A shift from local to global operations, a development from isolated factories to networks, a change in production targets from high volumes to a more flexible production, and an organizational development from hierarchies to teams of equally powered partners.

A very close collaboration within the supply chains or networks is one possibility to tackle these challenges. A critical requirement for successful collaborations is a stable and well-structured information exchange between the supply chain's partners [6] on a tactical and strategic level. Sharing of tactical and strategic information requires mutual trust and reliability as well as different management methods to support interactions between companies.

In this context, supply chain management (SCM) has become a subject of increasing interest to both academic and industrial communities [7], [8], [9], [10]. A supply chain consists of several nodes, each receiving inputs from their suppliers, and generating outputs to their customers. A supply chain actor is usually involved in several supply chains at the same time [11]. The scope of SCM is the systematic coordination of operational functions and procedures inside a company and between its supply chain members [12]. Belonging to a supply chain partnership (and not just a customer/supplier relationship) means to act globally in a win-win manner [13], as the pursuit of isolated objectives results in a decrease of the overall supply chain performance [14]. There are several supply chain management concepts, which support the exchange of information, aiming to improve the collaboration between partners. Each of these concepts, e.g. Collaborative Planning, Forecasting and Replenishment (CPFR), Efficient Consumer Response (ECR) and Quick Response (QR), as well as IT-based supply chain management systems and tools focus on particular functions like procurement, forecasting, inventory and transportation [15]. Furthermore, there exists a framework for collaborative planning [16]. Camarinha-Matos et.al. [17] describe different processes in collaborative networks and provide reference models for particular functions.

In the context of SCM, the term collaboration has been defined many times in the literature [15]. Across all definitions, there are some common aspects mentioned: A true cooperation needs intensive information exchange/communication in a trustful and mature relationship and in a balanced situation of power [15]. Negotiation concepts for planning activities are one aspect of collaboration. Usually, these are applied on the operational level [18]. All of these concepts require technical support. The other way around, technical solutions strongly impact the quality and level of collaboration between supply chain partners [19].

With reference to the tactical and strategic levels, additional challenges arise, as trust and reliability become major factors. A more generic information exchange tool would enable companies to achieve a higher level of collaboration on these management levels. Therefore, concepts for data and information sharing have to be developed, which embrace today's existing solutions. Existing data sharing solutions, like EDI as well as information and communication technologies, e.g. e-portals and extranet systems [15] have to be adapted to a more generic approach, in order to meet these level depending requirements. Traditional business information and decision support systems have to be extended to include cross company information. In order to identify these additional requirements, a problem analysis was conducted [20], which is shortly described in the next section.

3 Problem Analysis

Due to the electronic industry's high diversity of products, production techniques and collaboration types, a business information tool has to be designed to enable an adaptation to a company's particular requirements. Therefore, a problem analysis based on a literature review as well as on four industrial case studies from companies of the European electronic industry has been conducted. These companies mainly act as suppliers for the automotive sector, defense and aerospace sector as well as for the industrial and medical sector. Nevertheless, each company supplies other sectors and industrial branches as well.

The first step of the analysis was the identification of suitable supply chains and processes. Therefore, the main criteria were the processes collaborative character, e.g.in collaborative product development, as well as a non-hierarchical power balance. Furthermore, the companies' contexts were considered in detail. The context includes the distribution of customers and suppliers over the different sectors, the types of products they manufacture, as well as a description of their manufacturing processes.

In a second step, the companies' organizational structure, their IT infrastructure, and the selected supply chains were recorded. Up to this point, all information was derived from internal documents and interviews with the companies' management. Using this information, the selected processes were modeled using the Business Process Modeling Notation (BPMN) and further methods [20]. The BPMN models particularly focused on the interfaces between the company and their suppliers and customers. Each process step was interlinked with the corresponding IT systems and organizational units, in order to enable a more detailed analysis in the final steps.

In the last step, the models were used to determine the companies' particular requirements. Therefore, interviews were conducted with the companies' operational staff and with people from the companies' management level.

4 Results of the Problem Analysis

During the analysis, different processes, e.g. the product development, were analyzed. Each of these processes requires a close collaboration between the company and its suppliers or customers. As a result, two sets of requirements were identified. General requirements concern the quality of the information exchange. Collaboration specific requirements strongly depend on the company's situation. While the general requirements have to be satisfied in each case, the collaboration specific requirements emerge from different characteristics of each two partners' mutual relation and their single contexts. Based on these results, the European electronic industry's sectors were grouped in three categories with comparable characteristics and requirements.

4.1 General Requirements on the Information Exchange

As a result of the interviews, it became apparent that a lot of information is exchanged apart from the prescribed processes. In particular, during collaborative product developments, a lot of additional information is exchanged by phone, fax, or email. Usually, this "informal" information is rarely stored or made available within the company for further processing. Another issue that became apparent concerns the formalized information exchanges. In several cases, these exchanges were delayed due to information gateways and distribution breaches, causing additional costs and risks. For example, several companies deploy departments responsible for the communication with their partners. Information is only provided to and from those departments and is redirected within the company to those departments capable to handle the requests. If several departments are involved, the internal coordination effort increases strongly, sometimes causing critical delays or a loss of information.

From those issues sketched, several general requirements on a business information system have been defined [20]:

Connectivity to different platforms: Within a supply network, there exists a great variety of information sources, which must be connected and exploited to deliver required information automatically.

Information filtering: Once thesesources are connected, the information must be filtered according to the partner's interests. Within a supply network, there exists a lot of information, which is only relevant to some partners.

Control of information flow: Provided information must be directed to the responsible persons or departments automatically and in time. Additionally, all relevant information has to be consolidated before a request or response is provided. Sent and received information should be traced to ensure transparency and quality.

Availability of collaborative information: With respect to subjects of the collaborations, it is necessary to access and to provide information, concerning the supply chain's overall situation. Information, relevant to supply chain partners, must be made available immediately to the rest of the supply chain.

4.2 Collaboration Specific Requirements

The second set of requirements can be very different and varies strongly from company to company. These requirements depend on several factors like the company's necessities on security and confidentiality, quality regulations, the stability of each company's supply chains, their core competencies and products, as well as on their own suppliers and customers. As a result of the analysis, four major characteristics have been identified that provide insight into the respective requirements. It is necessary to investigate these characteristics with reference to each partner of a company. Those characteristics identified are the company's supply chain stability, their need for tactical and strategic information exchange, their level of collaboration, and the required level of security and confidentiality.

Exchange needs: Depending on the type of collaboration, a companies' need for tactical and strategic information exchange differs. In the context of configuring a collaboration within a business information tool, this criterion has a strong impact on the amount and kind of shared information. For example, in case of simple procurement, there is only little need to exchange information. During a co-development project, more information has to be shared. In addition, high quality standards could increase the need to exchange tactical and strategic information in longer termed relationships. If only a low level of exchange needs exist, default configurations may be applied to accelerate a tools configuration. With an increasing level of exchange needs, more customized configurations become necessary.

Security and Confidentiality: A business information tool has to ensure that information is only accessible to authorized people. In particular, when sharing tactical and strategic information with supply chain partners, these aspects become more severe. Companies apply different regulations on the content of shared information, authorization, anonymization, encryption and information transport (e.g. internet/email, phone, fax, hard copy etc.).A company may hold different policies on security and confidentiality, depending on the level of collaboration with a particular partner, their mutual trust, or the type of project or product they collaborate on. These aspects can be realized within a software tool by implementing access rights, role concepts, and appropriate data encryption standards. Security and confidentiality procedures can also be requested by partners. This criterion influences a company's internal flow of information, as well as the treatment of information. Depending on the requirements associated with this criterion, different processes can be necessary for the same task. In addition, it prescribes technical requirements towards data storage and transmission technologies.

Supply chain stability: The reconfiguration of existing collaborations, as well the addition or removal of supply chain partners could lead to a lot of effort in setting-up and maintaining a business information tool. The supply chain stability depends on the company's requirements on quality, security and confidentiality, its degree of specialization concerning their own products and of those they procure for manufacturing. For example, in case of a company only using default products for manufacturing, they are very likely to switch between suppliers easily. In contrast, if they require highly specialized components, or apply high quality standards, they are less likely to switch to different suppliers. Table 1 summarizes some indicators on the level of supply chain stability for a given company.

Table 1. Indicators for the level of supply chain stability

SC stability	Indicators	Characteristics
Low level	- Mass market products - Standardized components - Broad range of customers	- Frequent removal or addition of supply chain partners - Mostly the same terms and contracts with customers and suppliers
Mid Level	- High quality requirements - Mid-term contracts - Certification procedure - Project based collaboration	- Frequent removal or addition of supply chain partners for standardized components - Customized information exchanges for Frequently reoccurring or default partners for high quality or specialized components
High Level	- Specialized components, Small product palette - High security requirements, Legal aspects - Certification procedure - Long term contracts, Long project runtimes - Recurring collaboration due to highly specific characteristics of commodities	- Mainly default customers or suppliers - High degree of partner specific information exchange - High degree of trust

Level of collaboration: Depending on the partner's relationships, there exist different levels of collaboration within one supply network. These levels range from no collaboration (only mandatory contact, mostly based on orders) to a very high level of collaboration, which involves a high level of trust and mutual information exchange. A high level of collaboration can only be established, if both partners understand and respect each other's particular requirements. This criterion differs from the pure need of exchange, as it characterizes two partners actual level of collaboration. For new relationships, both criteria can be on an equal level. Nevertheless, the collaboration may extend beyond the need of information exchange, for example, by growing trust or by additional requirements on quality or security. Table 2 provides several indicators on the level of a collaboration.

Table 2. Indicators for the collaboration level

Type of Relationship	Indicators & Characteristics (example)	Level of tactical and strategic collaboration
Short Term	- Dominant partner (e.g. OEM) - Standardized components - Communication based on orders	- Low level
Mid Term	- Quality requirements e.g. hygienic aspects, industrial standards - Certification procedure - Mid-term contracts - Conjoint development of functional and technical components / parts / products	- Medium level of tactical and strategic collaboration with trustful customers and suppliers - High level of collaboration during project based, collaborative development and manufacturing
Long Term	- Highly specialized components - High security requirements, legal aspects - Certification procedure - Long term contracts, Many years of project runtime - Recurring collaboration due to highly specific characteristics of commodities	- High level

4.3 Usual Characteristics for the Electronic Industry's Sectors

Typical profiles were deduced using information from the use cases as well as from the literature review. They provide an abstract view on characteristics of collaborations within each sector. Nevertheless, a distinct profile can be identified for each company. The presented profiles could provide a point of origin for the profiling of a particular company and might deliver additional hints on a partner's context.

With regard to the their requirements on information exchange, their typical level of collaboration, their supply chain stability and their requirements on security and confidentiality three categories of similarly profiled sectors emerged. Fig.1 provides an overview over the sector's World Electronic Equipment production per application segment in 2008 and depicts those sectors belonging to each category.

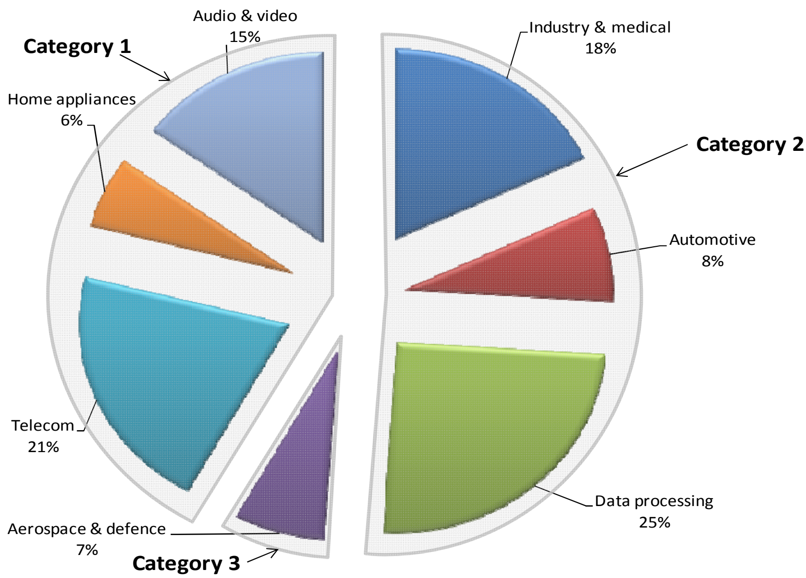

Fig. 1. Categorization of the electronic industry's sectors

Fig. 2 depicts profiles for the three categories. Within the first category, there are the sectors audio and video, home applications and telecommunication. These are characterized by comparably short times to market and product life cycles. Therefore, most products relay on default components. Long-term relationships can rarely be found in these sectors. As a result, the companies' exchange needs, supply chain stability and security requirements are comparably low. Higher levels of collaboration may exist, due to long lasting relationships, e.g. with valued suppliers or customers.

Category two includes the sectors industry & medical as well as automotive and data processing. Products of these sectors have to satisfy high quality standards, and are subject to longer life cycles. As an example, most automotive manufacturers deploy strict qualifying procedures for their suppliers. On the one hand, suppliers have to follow strict requirements to ensure quality; on the other hand, customers are more likely to stick to their suppliers, if possible, as qualifying takes time and causes additional costs. Consequently, this category's supply chain stability, exchange needs and security usually are on a medium level. Due to the high number of co-development projects, the level of collaboration can easily extend to high levels.

The third category only contains the aerospace and military sector. This sector in characterized by the highest requirements on quality, security and confidentiality. High quality standards can only be achieved in long-term collaborations with trusted partners. This sector's characteristics are on the highest level. Low-level collaborations can rarely be found.

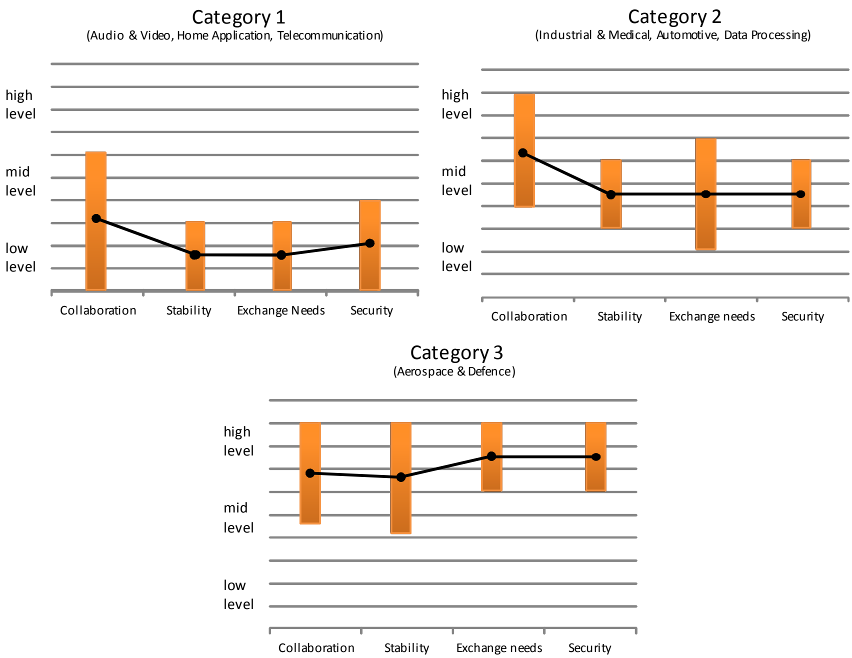

Fig. 2. Sector specific profiles

5 Conclusion and Outlook

This article presents the results of the investigation at four companies from the European electronic industry and from the literature review regarding requirements towards a business information tool, which enables the exchange of tactical and strategic information. Two different sets of requirements were identified. The first set is concerned with characteristics of the information exchanges themselves. The second set differs strongly from company to company, but relies on four major criteria: a collaboration's need to exchange information, their requirements on security and confidentiality, the involved company's stability of their supply chains, and their actual level of collaboration. These characteristics subsume different requirements, which have to be taken into account when setting up a business information tool.

A prototypical business information tool is currently being developed in the project. It will be capable to satisfy the identified requirements. The tool uses a web access interface, to enable employees of the companies to interlink each other by a personalized IT-desktop and with respect to confidentiality. It will provide the capability to access existing IT infrastructure, to acquire information automatically, if configured to do so. As a result, each employee in the supply chain, who has access to the tool, will be provided with relevant information. The tool will be evaluated at the four focal companies' sites.

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Building an Ontological Model for Software Requirements Engineering

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Abstract. This article is a work about the development of a model for the engineering requirement based on ontology. The development patterns are not used efficiently, especially for non-observance of the principles of requirements engineering. The overall objective of the article is to propose the use of a ontology based on the artifacts of software requirements engineering and can be used on any project developed in any organization. The method uses experimental procedures, which will be held in experiments with real situations in a project in progress at a reputable company in the development of hardware, but that currently covers its business in the software services industry. As a result, there was an improved understanding of software requirements, as well as its trace within the scope of the project, that is, one can easily traverse the model and identify all the artifacts impacted by the change.

Keywords: ontology, requirements engineering.

1 Introduction

Several problems occur during the software development, causing damages to the developers and customer dissatisfaction. Note that the lack of standardization is a cultural factor that covers scenarios, composed of short deadlines and high costs that contribute to this situation. As a result, this process, more specifically the Software Requirements Engineering, has undergone for several changes, mostly to improve the quality of the final product. In this context, it means that standardization and management of information extracted from software requirements through ontology is the main motivation of this article. It is known that ontology provides a better understanding of the requirements of key stakeholders (customers, users and developers) in development of software to facilitate the traceability of software requirements throughout the process. The general objective of the article is to propose the use of a basic ontology based on the artifacts of software requirements engineering that can be used on any project developed in any organization. This article is structured into this introduction, approach to Requirements Engineering and Ontologies, Ontology Development for Requirements Engineering and Conclusion.

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2 Requirements Engineering

In [1] requirements engineering is a process that involves all the activities required to create and maintain the system requirements document (set of artifacts related to the requirements), which is the official statement required of the team developing the system. User requirements and system requirements are defined in [1]: User Requirements, "statements in natural language as well as diagrams on the functions that the system must have and the constraints under which must operate." System Requirements: “provide accurate and detailed the functions and system constraints, through more detailed descriptions of user requirements.” They may serve as a contract between the buyer and the developer of the system, it means, a contract for the implementation of the system and therefore must be a complete and consistent specification of the entire system. Software requirements can be classified as functional or nonfunctional areas According to [2] IEEE Std 1233 IEEE Guide for Developing System Requirements Specifications, defines requirements as: "a documented representation of a condition or capability; “a condition or capability necessary for a user to solve a problem or achieve a goal”; "a condition or capability that needs to be answered or be present in a system or component to satisfy a contract, standard, specification or other formally imposed document"

In [3], the stage of development of requirements consists of four phases, which are described: elicitation or requirements elicitation aims to discover the effects that the system should have about the problem domain. Analysis is divided into two other sub-phases: problem analysis, which includes the elimination of ambiguities or contradictions of the requirements raised in the previous phase, and analysis of alternatives solution, the focus has to contemplate the possible solutions to the problem. Requirements specification into two types: Client and System. The former, where is the problem to be solved and serves to validate all the other artifacts of the system. The latter defines the chosen solution to the problem during the analysis of alternative solutions, serving as an initial step for the refinement of the system. It can be represented by different means, including natural language (RUP, use cases), graphical or mathematical modeling, prototypes, or even the combination of these means. Validation: The activities of requirements validation mechanisms are designed to ensure that the requirements specification of the system has a solution that satisfies the requirements presented in the specification of client requirements. In [4], Requirements management means to control its changes by assessing the impacts of appearance, change and disposal system requirements, as well as measuring the volatility these requirements. Versioning of software and its documentation also becomes essential to avoid contradictions arise due to lack of communication, just as the status of each requirement must be registered and taken into account in order to ensure the implementation and tracking of all, it will help the management of its dependencies prevent changes from being made without proper study of its impacts.

3 Ontology

For [5] "ontology is a formal and explicit specification of a shared conceptualization." In [6, 7] define ontology as a specification of a conceptualization: a description of concepts and relationships that exist in an area of interest. In [8] comments that the theme ontology is the study of categories of things that exist or may exist in some domain. However, in [9] reports that the area of research in ontologies is considered multidisciplinary. The ontology provides a common vocabulary of an area and defines, with different levels of formality, the meaning of terms and relationships between them [10].

Ontologies can be classified as to its generality, as proposed by [10]. The IEEE has proposed creating ontology of top standard, Standard Upper Ontology, or UDS. That's because there are some proposals for this type of ontology, and among them there are fundamental differences in the way they organize their information.

Domain ontologies can be reused their concepts within a specific domain. Task ontologies describe the vocabulary related to a task or specific activity; Task-domain ontologies, the same as described above, may be reused in any area. This does not apply to similar areas; Ontologies methods, these ontologies provide definitions for the concepts and relationships relevant to a process to achieve a goal; Application Ontologies - Ontologies are dependent on a particular application.

As reviewed in the literature, there was not a perceived pattern of development. Ontologies are being built in any area of knowledge that makes use of methodologies, tools, languages and libraries. However, it is necessary to identify all the factors surrounding it, as well as its structure and fitness for a domain area [11, 13-15]. It is considered that the knowledge in ontologies uses five types of components:
Classes – are usually organized into taxonomies. Sometimes, the notion of ontology is diluted what means that taxonomies are considered complete ontologies. *Relations* – represent a kind of interaction between domain concepts. They represent a kind of interaction between the concepts in the field. (n: n). *Functions* - represent a special case of relations. The functions are defined to calculate the price (example) of a second car. *Axioms* - are used to model sentences, setting the values of attributes and arguments of relations. *Instances* - are used to represent specific elements. Describe the instances of one concept. They are used to represent the elements of the domain.

4 Ontology Development for Requirements Engineering

In developing this article was chosen Protégé [16] tool for building ontology based on basic artifacts of requirements engineering. This is a free software suitable for definition of ontologies used in different areas of knowledge. The following shows the layout of classes and subclasses of the ontology:

Client: representing all stakeholders who are not part of the development team.
Necessity: indicates the need for the problem that justified the purchase or use of software.

Requirement: are descriptions of a condition or capability to which a system must be in agreement, whether directly derived from user necessities or stated in a contract, a standard, specification or other document related RUP [17]. The class requirement has the following subclasses: Functional Requirement: are statements of functions the system must provide; and non-functional requirement: are restrictions on the services or functions offered by the system.

Efficiency: represent the requirements that ensure the system's ability to perform its tasks without any waste of resources, under conditions previously established.

Supportability: they represent the requirements that improve the supportability and maintainability of the system. Include coding standards, maintenance access and system utilities.

Usability: represent the requirements that make the system easy and attractive to the user.

Restriction of the project: represent determinations of the project that have been imposed and must be obeyed.

Trustworthiness: correspond to requirements that ensure the software remains on a certain level of performance in specific situations.

Metrics: represent the quantification of a requirement by using a particular metric, such as Function Point or hours.

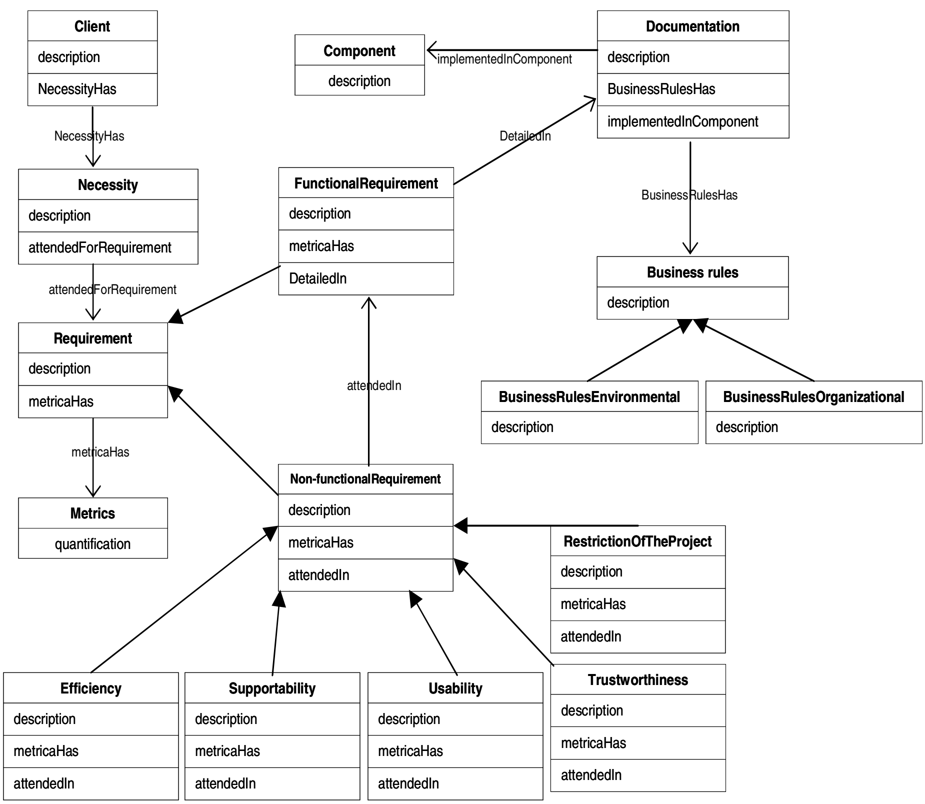

Fig. 1. Model of the ontology for Requirements Engineering

Documentation: corresponds to the form of documentation of software requirements. Business rules: refer to policies or conditions that must be met within the business.

Business rules environmental: representing business rules related to political, economic and patterns that may affect the organization [17].

Rules of business organization: constitute the rules of the organization. The rules for procurement and use of computer systems originate from this information [17].

Component: represent parts of the software product that will be delivered to the customer. Customer class has been defined, which relates to the class of property. In the Necessity class features all of the customer's needs through the Description property. In this class still have the property met the requirement, which indicates as customer necessity is being met by the requirements raised.

Creation of classes and subclasses, its relationships and attributes, in the Protégè tool are called slots. Slots represent attributes of classes and subclasses. Slot of a class, observed from a super class or a subclass, is named subslot or superslot respectively.

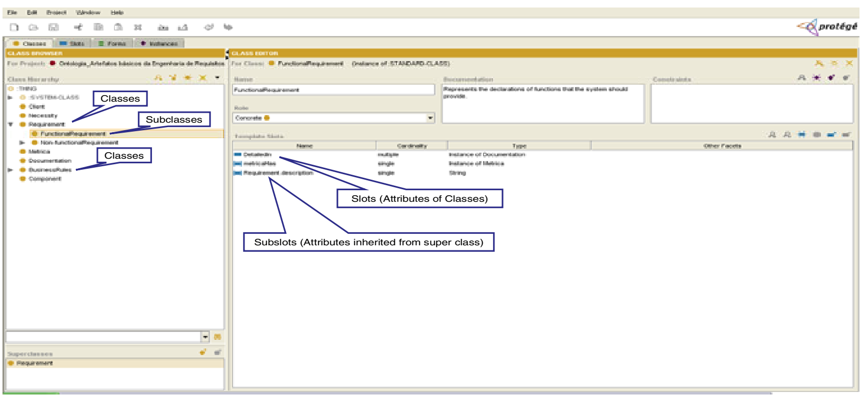

Fig. 2. Relations between classes and attributes (slots)

The requirement class derives two subclasses, and Functional requirement and non-functional requirement. In requirement class there is property metric, which is used to relate a requirement for a metric, for example: set the number of hours required for the development of a particular requirement. Subclass non-functional requirement some characteristics were modeled as non-functional subclasses, such as efficiency, supportability, usability, and reliability restriction of the design and trustworthiness. The subclass non-Functional requirement has served in the attribute that identifies in which functional requirements are being met non-functional requirements.

Subclass Functional requirement also has the detailed property, which represents the way the requirement is detailed, for example, use case.

The documentation class has rule business which represents instances of the class that is divided into two subclasses: Environmental Business Rules and Business Rules, Organizational.

The component class, which represents the implementation of a requirement, is related to the class documentation through the implemented in Component property facilitating the assessment of impacts is required when modifying a requirement.

4.1 Validation of the Proposal Use of Ontologies in Requirement Engineering

To perform the experiment was used the proposed ontology in progress on a project in a reputable company in the development of hardware, but that currently covers its business in the software services industry. The projects developed by this subsidiary company, which is located in Belo Horizonte, meet demands systems in mainframe platform responsible for the entire billing system, customer service, billing and revenue of a telecommunications company operating in a large part of the country.

This project aims to provide to the telecommunications company greater flexibility in the actions of adjustments of the documents printed through Print Centers, offering flexibility in the layout changes of telephone bill sent to customers. Thus, the relationship with the Print Center will be accomplished through the interface files in TXT format, where information is structured to allow the formatting of documents is made by those responsible for printing the same.

Besides this transformation in the process of interfacing with the Print Center, the demand causes changes to the layout of the wireline phone bill and implements a control quality process of the earnings. The changes to the layout of the phone bill are:

- Separate phone billing of invoices;
- Associate and display specific messages (based on the profile of the phone bill) to each phone bill on time Billing;
- View on the invoice values representing the agglutination of subscription services, habilitation, consumer franchise and other extra services;
- The quality process control of the billing is based on the following reports:
- Sampling of billing accounts;
- Demonstration of selected messages for accounts billed in the billing cycle;
- Volumetry of printed pages.

That telecommunications company intends, with this project, to solve the problem of lack of flexibility to meet changes in documents generated through the Print Centers due to the stiffness of the interface through the spool, pre-formatted documents sent to the Print Centers for printing only. For the experiment of ontology, was selected only the most important requirements of the project in question due to the complexity of it.

Aiming to facilitate understanding, the instances of ontology classes were represented in tables and were identified by the column "Item", facilitating the traceability of requirements of this system.

The Customer class (Table 1) represents the customers of the project. In the case of the company studied, customers are represented by various sectors of the same, for example: billing, Attendance, etc... The property has necessity to show necessities related to each client, and it is described in Table 2.

Table 1. Class Client

Item	Client	Necessity Has
C01	Billing	N01, N02
C02	Service	N01, N04
C03	Collection	N03

In Table 2 is described instances of the class Necessity, which has the properties described and met the requirement. The latter indicates which requirements a particular necessity is being met. On the other hand, these requirements may be functional (Table 3) or non-functional (Table 4).

Table 2. Class Necessity

Item	**Description**	**Attended For Requirement**
N01	Create documents in TXT format for Print Centers	RF01, RF02,
N02	Restructuring procedures Messaging of phone bills	RF03, RF04,
N03	Restructuring procedures Generation of phone bills	RF05, RF06,
N04	Changing the layout of the documents issued online	RF07, RF08,

The table 3 represents the instances of the subclass Functional requirement. The attribute has metric, inherited from the requirement class, represented in the project used, the number of hours necessary to develop a requirement system. The attribute identifies which detailed documentation (Table 5) this requirement is detailed. In the case of this project, was used the "use case" as form of documentation requirement.

Table 3. Subclass FunctionalRequirement

Item	**Functional Requirement**	**Metrica (Hours)**	**Detailed in the Use Case**
RF01	Create Billing documents in TXT format as specific layout	480	UC01
RF02	Create Service documents in TXT format as specific layout	440	UC02
RF03	Create report with sample information to print messages on phone bills	360	UC03
RF04	Develop new functionality to record messages to be printed on phone bills	280	UC06, UC07, UC08, UC09
RF05	Create different headers for the blocks of services in detail of phone bills	320	UC04
RF06	Create a detailed of calls in phone bills sorted by the date on which the call originated.	320	UC04
RF07	Change document layout of duplicate phone bills.	440	UC05
RF08	Change document layout Installment contract	400	UC06

Instances of non-functional requirement subclass are shown in Table 4. The "non-Functional Requirement Type" identifies the subclass of non-functional requirement. The served attribute indicates where the non-functional requirement will be met.

Table 4. Subclass Non-functionalRequirement

Item	Non-functional Requirement	Type of Non-functional Requirement	Attended in
RNF01	Should be used Cobol language in all cases Batch Billing	Restriction of The Project	RF01, RF02, RF05, RF06,
RNF02	The process online of Billing should provide help screens wherever possible	Usability	RF04
RNF03	The processing time of the whole process Batch of billing can not exceed 48 hours	Efficiency	RF01, RF02, RF05, RF06,

The documentation class, whose instances are shown in Table 5 indicate the document where the requirement will be detailed. In the company used in this experiment, the form of documentation of requirements is the Use Case. The "Rule to Business" column indicates which organizational business rules (Table 6) or environmental (Table 7) are related to the use case. The implemented attribute in the component indicate in which component (Table 7) of the system use case is implemented.

Table 5. Class Documentation

Item	Documentation	Business Rules	Implemented in Component
UC01	Create phone bills in TXT format	RN01	C01
UC02	Gerar Segunda Via de Contas do Faturamento	RN02, RN03	C02
UC03	Create Duplicate phone bills	RN04, RN05	C01
UC04	Form the customer phone bills	RN06, RN07	C01
UC05	Issue online Duplicate phone bills	RN02, RN03	C03
UC06	Issue online Installment contract	RN08	C03

Instances of class business rule are described in Table 6. The column "Type of Business Rules" indicates that the business rule is organizational, it means it is defined by the own organization or a business environment rule that are external to the organization.

Table 6. Class Business rules

Item	Business Rules	Type of Business Rules
RN01	Inhibit the printing of phone bills that have been requested by the user	Organizational
RN02	Get the value of the agglutinating service of Invoice	Organizational
RN03	Get the description of the agglutinating service of Invoice	Organizational
RN04	Summarization of the messages associated with phone bills	Organizational
RN05	Information contained in the sampling report of messages associated with the phone bills	Organizational
RN06	Agglutination Service Invoice	Organizational
RN07	Information calculated move separated by type of phone bills	Organizational
RN08	Authorization to issue the Contract Installment online	Organizational

In table 7 is represented the component instances of the class. The description attribute defines the name of the system component where the requirements were implemented.

Table 7. Class Component

Item	Component
C01	Billing Process
C02	Process duplicate phone bills
C03	Process of issuing documents online

4.2 Result Analysis

Results from the experiment used in a real project, though used only the most relevant part of the scope of it, realize that the ontology can be perfectly used for the basic artifacts of requirements engineering. Since its use has provided an improvement understanding of software requirements, as well as its trace within the scope of the project. Using the ontology, it was noted that the location of a requirement got easier when, for example, a change in a particular software requirement occurs. It can thus identify with more efficiency, data such as customers involved with that requirement, the use case where the requirement is documented and therefore the component of the system where the requirement was implemented. One can easily traverse the model and identify all the artifacts impacted by the change, then.

It was also noticed a gain related to the project planning. Through the associated metrics to software requirements it can be measure the time spent for a possible change in the system built.

5 Conclusions

Requirements Engineering is a process where you define the entire scope as reflected throughout the project. If this process is used correctly it can provide more consistent development of solutions and avoid possible damages from poorly managed conditions. But this process still does not receive due attention.

We can conclude the ontology proposed by this article is another example to avoid future efforts caused by inconsistency of software requirements. These efforts can be completely avoided since it has a better management of software requirements.

The ontology has proved very effective also for the traceability of requirements. It can easily identify impacted artifacts, as well as efforts necessary to adapt the system if there is a change in the software requirements. The ontology also has provided an improvement understanding of the requirements by those involved in the development process.

5.1 Future Work

For future work related to this theme, can demonstrate a practical application of ontology in an organization during the process of requirements engineering. It is important to consider for future studies the expansion of this ontology to cover also the area of management of requirements.

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Requirements for Successful Software Development with Variability: A Case Study

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Abstract. According to state of the art literature, software product lines are an effective way to achieve economies of scale through reusability while coping with the problem of variability in related software systems. Fundamentals of variability management and product lines have been available in the software engineering research field for several decades. Nevertheless, projects to cope with variability in practice tend to fall short of target. The reason for this gap between sound theories and poor practice, common in multiple software engineering subfields, remains unclear. Therefore, an empirical study was conducted in a large-scale software dependent multinational. The results of this case study show a number of factors that impact successful variability practice. These factors can be abstracted into general hypotheses useful for bridging the gap between theory and practice. Based on the sources of discrepancy, this research suggests a practical way to overcome the obstacles on the road towards successful variability management.

Keywords: Variability management, software product lines, software engineering, requirements engineering, case study research, grounded theory.

1 Introduction

It is variability between related software systems that offers a challenge in an otherwise dull world where each software system would be the same as the previous one. At the same time, such variability can quickly turn into a nightmare for those who need to develop or maintain such a set of related software systems. While in theoretical research terms like variability management and software product lines are commonplace, in practice there are still a lot of companies that struggle with variability. We know this for a fact because a lot of companies nowadays do not even fully grasp the notions of variability in software engineering, let alone cope successfully with the problems variability brings about. During the development of previous work [1] we observed these variability induced difficulties in practice as we conducted an exploratory study on the subject of variability in software intensive companies. These observed difficulties revealed an interesting problem in software engineering. How is it

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possible that companies still struggle with variability while in the academic research field there is an abundance of theoretical studies about the problems that can be encountered in practice, and more important, how can we provide companies a way to overcome their problems?

It is our vision that problems of a practical nature should be solved starting from a practical viewpoint. Using a case study as the start of our research ensures to a certain extent that the results obtained are usable in real companies in real life. In the rest of this paper, we report our findings on a real life case conducted in a large scale bank and insurance company. The second section of this paper situates our research within the research field. The third section of this paper discusses the methodological approach we opted for in our study. The fourth section then describes the context of the case study. Section number five offers the results of the case study which serve as recommendations for successful variability management in practice. A sixth and last section recaps the research questions addressed and gives a summary of our work.

2 Related Work

In the past decades substantial research effort has been devoted to solving the issues concerning the variability in related software systems. Out of this effort multiple ways to manage variability have been developed. As early as 1990 variability management was already developed by Kang et al [2] as Feature-Oriented Domain Analysis (FODA). Following this seminal work, multiple variability management approaches have been developed. Some of these were extensions of the original FODA specification like e.g. FORM [3]. Other approaches were developed more independently like KobrA [4] and COVAMOF [5]. More recent variability management approaches that have received considerable attention can to some extent be retraced to this core strand of research. The Orthogonal Variability Model (OVM) approach by Pohl et al [6] provides a good example of this. Albeit not directly connected to FODA in any way, it is difficult to imagine that FODA and its extensions have had no influence at all on OVM. As it is not the scope of this paper to give a complete overview of the variability management literature with his intricacies and interdependencies, we gladly refer readers to recent literature reviews like that of Chen et al [7], where a good overview of the research field on variability has been given. Not all variability management approaches were based on previous ones, neither were they all developed by the same authors. However, the variety and plethora of available approaches indicate that significant attention has been given to the issue.

The notion of software product lines, although not a direct synonym to variability management, is closely related to the issues considered in the strand of research described in the previous paragraph. Software product lines have been introduced in literature at about the same time as variability management has been inducted in research as a research scope. In order to explain software product lines efficiently, we can best take a look at a what has been formulated about the term. In a much referenced work of Clements et al [8] a software product line has been defined as follows: “A software product line is a set of software-intensive systems that share a common, managed set of features satisfying the specific needs of a particular market segment or mission and that are developed from a common set of core assets in a prescribed way.” The Carnegie Mellon Software Engineering Institute has phrased on its website [9] the following on a software product line:" A software product line epitomizes strategic, planned reuse. More than a new technology, it is a new way of doing business. Organizations developing a portfolio of products as a software product line are experiencing order-of-magnitude improvements in cost, time to market, and productivity." Both quotations combined stress the major things about a software product line in our research context. A software product line is a portfolio or set of relating software systems, also called a product family, that is developed with a mission to improve the way to do business, therefore it affects business and goes beyond its ICT context. A software product line has a focus on a specific market segment, in which the software systems are closely related so economies of scale of all sort can be obtained.

The most important thing in a software product line is the variability, as this is the contrasting factor between the instances of the software product line. The management of this variability is key to make the software product line a success. If the basis on which the instances are build, the core asset, offers the proper amount of customization through variability, then the product line can reap the benefits attributed to it in literature. The importance of variability in software product lines also explains the relatedness of software product lines research with variability management research.

3 Research Methodology

In the domain of software engineering, it was acknowledged by Moody et al [10] that there exists a problem of knowledge transfer between theory and practice, also known as the technology transfer problem. In requirements engineering, the part of software engineering where variability problems should be primarily dealt with, Kaindl et al [11] argued that such gap also exists. While these studies propose a number of approaches to bridge this technology transfer gap, we opted for a totally different approach to bridge the gap between research and practice. Instead of bringing theory closer to real life, we wanted to start from real life in order to develop theoretical knowledge. Through case study research [12], an empirical research technique, we wanted ensure that any results found were also of value in a practical context. It can be argued that there already have been several case studies in the domain of software product lines, such as those by van der Linden et al [13], but as stated by Tichy [14], each additional case study is not just a repetition but aims to extend the knowledge previously developed. Our case study proves to be a valuable extension to the body of knowledge already available in that it starts from a failed project instead of a success story like most of the case studies in this field of research. This failure provided us the perfect opportunity to extract lessons learned valuable to anyone who wishes to undertake a similar project in the future.

In order to assess the software product studied in our case, we looked for a framework to check the quality of software products. The ISO/IEC 25000 Software Quality Requirements and Evaluation (SQuaRE) series is a series of standards used for evaluating the quality of software products. Based on the older ISO/IEC 9126 framework, this is a ISO 9000 compliant series of frameworks. We focus on the Product Quality Measurement Reference Model of the Quality Measurement Division (2502n). In this model, four quality categories of software products are identified and related one another. These categories will be used in our case study.

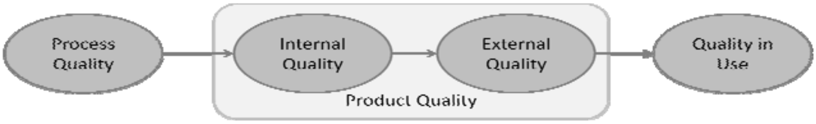

Fig. 1. Categories of Quality in the Product Quality Measurement Reference Model. This shows how the quality categories relate. Process quality is about the quality of the software development process. Internal and external quality are both product qualities, the former refers to the quality of the intermediate products while the latter refers to the quality of the final product's external behavior. Quality in use is the quality as perceived by the users.

The case study approach was supplemented with Glaser and Strauss's grounded theory [15]. Starting from a set of interviews, we coded the transcripts with a qualitative analysis software program to obtain a set of concepts representing the causes of failure of the project according to the interviewees. These concepts were then grouped into categories, on the one hand based on the context of the project itself and on the other hand based on the SQuaRE framework. The project context consisted of a business part, an ICT part and a external (or client) part, and each part was given a separate category in the case specific categorization. The SQuaRE framework categorization corresponds to the quality types defined above. The results of the case study can be found in section five. Before going to the results, the context of the case is described in the next section.

4 The FinForce Case

The case we based our research upon is a project called FinForce (FF). FF was founded in 2001 as a spin-off company of KBC Group, a European bank and insurance multinational mainly active in central and eastern Europe. FF consisted mainly of employees who were transferred from KBC ICT. These employees all had, to some extent, experience in the fields of both professional and/or retail payment services. The services FF provided were aimed towards banks over the whole world that wanted to outsource their international payment transactions. The business case of FF was based on the fact that international payment transactions were complex, albeit standardized to a certain extent. Before the advent of the Single Euro Payments Area (SEPA) initiative such international transactions were very costly for the banks providing them. Taking advantage of economies of scale, FF would have been able to provide a transaction engine to all banks at a reduced price compared to the in house transaction engines while maintaining a considerable profit margin. The unique selling proposition of FF was that it was able to adapt to any situation possible, hence the tagline in the logo 'flexible financial backoffice solutions'.

The application which was used by FF consisted of four different components, each one with its specific task. There were two main components, called the PE (payment engine) and the PSE (professional service engine), which provided functionalities for respectively the retail and the professional part of the transactions. Besides these main parts, FF was completed with a SIM (smooth interface messaging) component and a TSS (transaction support services) component. The purpose of the SIM component was to provide communication from inside the application towards the external interfaces of the client banks. Thanks to the SIM component client banks could retain their own interfaces. The SIM transformed messages from the FF internal format to the client specific format. The TSS component retained all information needed for the international transactions like e.g. account numbers. Combining these parts provided a complete solution to the client banks for their foreign transactions.

The fact that FF consisted of several separate components originated from the fact that although FF was developed from scratch, it was partly based on existing applications inside KBC. Applications like e.g. 'Pay & Receive' and 'Multi-clearing' stood model for respectively the PE and the PSE. A sort of instantiation of the FF application was built for each client with the required adjustments for the interfacing, much like an instance of a product line with that difference that all applications ran on the same mainframe. The current KBC internal application for payment transactions, amongst others, is called IBS (international banking system) and can be contrasted against FF. IBS is used between branches of the KBC Group, with the difference that every branch uses the same internal IBS interface.

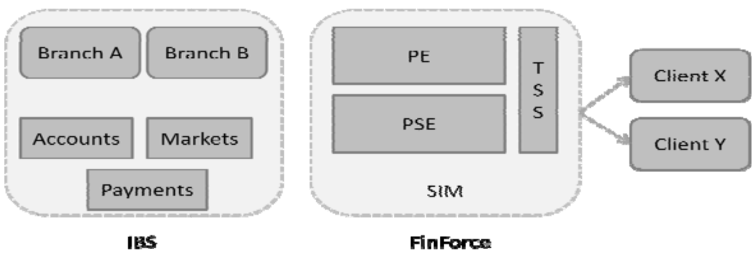

Fig. 2. The IBS architecture for internal branches next to the FF architecture for clients

5 Case Study Results

We conducted three interviews with employees who worked for FF, each of them working in a different division, with a different angle on the project. The different angles were carefully selected in order to obtain an overview on FF as complete as possible. Before selecting specific employees for interviewing, we searched for all possible aspects of FF, and came up with three clearly distinct views, namely the architect's or designer's view, the business side view and the implementation side view. During the interviews the validity of our choice was enforced as one of the interviewees explained the three organizational pillars of FF, which coincided to a great extent with the views we identified a priori. Interviewees were chosen in consultation with someone who did work at FF himself. The setup of the interviews was open ended, as already discussed in the section on research methodology, so we could apply the grounded theory approach afterwards. Some guiding questions were defined, but these merely served the purpose of being some kind of bootstrap. Once the interviews were underway for a couple of minutes, the interviewees continued most of the time out of their own. In the following paragraphs we will explore each interviewee's opinion separately before going deeper into the common, general ones.

5.1 The Design Side View from the Technical Analyst

The technical analyst we consulted did not describe the FF project as a success, but at the same time he stated that it could not be seen as a complete failure neither. The main problem the technical analyst identified in FF was an issue of scoping. This scoping issue surfaced in several ways throughout the FF case. It started as soon as the requirements engineering was done. The requirements were only defined on a very high level, without any details on the more specific levels. The system needed to be flexible such as to be usable for all possible client banks, but to what extent this flexibility and thus variability had to be implemented was unclear. FF was created by several analysts simultaneously, but each analyst implemented the variability as he or she saw fit. Because a lack of central coordination or carefully created delimitations in the requirements, one analyst built in the variability with much ardor by making very small components that could be combined in numerous ways while another analyst built more coarse grained components only leaving a few variability options. At implementation time the creation of FF took too much time because of the issue of over-flexibility and the related issue of tiny components, as most of the analysts believed that small components were mandatory to make FF as flexible as possible.

A lot of the flexibility that was built into the FF application by the analysts proved to be useless at implementation time. This was also due the fact that the analysts did not possess a profound business knowledge. The business side of FF at the same time defined the requirements of FF solely based on former KBC experiences as KBC was the only client at the start of the project. There was no knowledge on how other, possible client, banks processed their payment transactions. The technical analyst we interviewed suggested that it might have been better that some reference visits were conducted to these other banks in order to have a better view on the variability issues. The problem with such visits is that no bank was very eager to share its way of doing business. A last point made by the interviewed analyst was that when FF was being built and the business had to sell the application, the vendors were too accommodating towards possible clients as they promised them that their every wish would be included in FF. Because of this, every time a client was to be connected, a great deal of adjustments were needed in the FF application.

5.2 The Implementation Side View from the System Administrator

The interviewed system administrator was mainly responsible for the SIM component of FF and therefore had a good overview on the interfacing issues. According to the system administrator these interfacing problems were plentiful, and moreover they were the single factor that caused each connection of a new client bank to take much more time than expected. In order to grasp the issue at hand, comparing FF with IBS is useful. While with IBS everyone uses the same interface format, in FF interface mapping was needed (as depicted by the dotted boundary line in **Fig. 2**). The time period it actually took to connect a new client bank was 2,5 times bigger than originally estimated and this was a result of the interfacing issues according to the system administrator. Moreover, he stated that the problem of non-matching interfaces was a result of a bad communication between the representatives of the client banks and the people who needed to implement the application. After an agreement with a client bank had been obtained by the vendors, it were the same vendors who were responsible for the extraction of user specific requirements. Although these user specific requirements were always discussed and extracted by the people responsible, the results of these communications were never clearly passed to the people responsible for the actual implementation. Therefore things were wrongly assumed from both sides, what resulted in problems in the mapping of interfaces.

Another, somewhat related issue cited by the system administrator is the issue of staff turnover. The people who worked on the instantiation for and the connection of a particular client bank were rarely involved in projects for other client banks. Therefore any knowledge developed in the course of one connection was lost most of the time, as this knowledge was mainly tacit of nature. This in combination with the fact that there was some kind of unofficial policy to only address problems if they actually occurred even if they could be envisioned up front made learning from previous experiences hard. The system administrator told us that nowadays a sort of script is developed that can be followed for future instantiations in order to retain some experience. This script is however only used to connect KBC Group subsidiaries, as FF is only used for subsidiaries nowadays. More on this project's focus shift in the paragraph on the general conclusions of the case study.

5.3 The Business Side View from the Client Acquisition Officer

The business side of FF was explained to us by one of the client acquisition officers, who were the vendors of FF. Also on the business side there were several issues which impacted the results of the FF project. First of all there was another communication problem. Unlike the communication problem of the previous section, one between implementers and clients, this problem was situated between the client banks and the client acquisition team from FF. Potential client banks were approached by the client acquisition team and they proposed to the banks the FF business model as it was seen and implemented by ex-KBC staff. The difficulty herein was that potential clients had to understand the context in which the business model was written, a KBC oriented context, while they had to link this to their own business model. If clients had to adapt to another context in order to be able to state their own needs, communication got difficult at least or clients even could altogether lose their interest in FF.

To some extent related to the previous paragraph, another serious obstacle in obtaining clients was the KBC background of FF. Potential client banks were not fond of disclosing sensitive information to what they believed a competitor in the bank market. This is best illustrated with a small anecdote from the interviewed client acquisition officer. He told us: "When we approached potential clients and we wanted to give a presentation, upon booting our laptops the first thing appearing on the screen would be a giant KBC logo, as our equipment came from KBC ICT. Clients would ask straight away what the logo meant, and the first seeds of distrust would be sown."

5.4 The Global Results of the Case Study

In the previous paragraphs, some interesting particularities for each of the views on the project were given. Some issues on the other hand were overarching as they got mentioned in all the interviews conducted. These issues mostly relate to the variability problem. As already mentioned, a big problem was that there was variability on certain places in FF where it should not have been, and there were places where there was no variability but where it was needed. This was a result of poor requirements engineering, but even more from a flawed vision on the system. FF was meant to be the application that would set the standard for all international payments transactions according to the higher management who decided to create the FF spin-off company. Pre-studies conducted in corporation with renown consulting firms spoke of worst case scenarios where there would still be at least 30 client banks within 3 years. It can be argued that the crisis around 9/11 had an unpredictable impact on the business case, but the order of magnitude envisioned still was in sharp contrast with the eventual number of external banks that were connected to FF before the project got drastically clipped in 2007-2008. The over positive attitude towards FF however created the need that FF had to be able to work for everyone and as soon as possible. The broad scope required loads of variability, while the short time span made it impossible to think the project through thoroughly before starting to develop the assets. Variability was thus implemented without any guidelines. The result was that the application was capable to handle a very broad scope, but at the same time making one instantiation for a particular client took so much time to develop that the whole system's costs were way higher than it could possible gain as benefits by its broad scope.

This resulted in a change in scope of the FF project, as it has been mentioned before. From an original international scope in 2001, the scope tightened to a KBC Group subsidiaries only scope in 2007. Even today, while FF got shut down and all activities have been reincorporated by KBC ICT, much of the same problems reappear with the subsidiaries. Out of this observation one of the interviewees concluded that it might have been better to start out with the smaller subsidiaries-only scope, only to gradually broaden it to such an extent that it remained controllable. If this reversed way of working would have been applied, then FF might would have been able to build the knowledge it needed to undertake such a project. We listed all of the possible causes of failure, there are 49 failure concepts in total, and categorized them as explained in section 3. The results from this categorization are to be found in **Table 1**. We are aware of the fact that some of the concepts extracted from the interviews are not easily categorized. Especially in the case specific categorization we see that 14 of the concepts are not specifically mapped into one of the three context parts.

Table 1. We identified 49 failure concepts. These concepts were categorized based on the SQuaRE framework (columns) and based on the internal structure of the case (rows).

	Process Quality	Internal Quality	External Quality	Quality in Use	No Quality	Total
Business	8	0	3	0	3	14
ICT	10	1	2	0	0	13
External	2	0	1	3	2	8
Various	5	1	4	3	1	14
Total	25	2	10	6	6	49

The reason is that these concepts actually overlap the ‘business’ and ‘ICT’ categories in the categorization, hence the label ‘various’. If we take a look to the SQuaRE based categorization, we see that 6 of the concepts do not really categorize themselves into a certain quality. These concepts state facts that do not really have a quality aspect to them, therefore they are labeled ‘no quality’.

Looking into the categorizations in more detail we see that a lot of the failure concepts are process quality related. Inside the ICT category even around 75% of the failure concepts are categorized as process quality. This leads to the conclusion that the quality of the development process should receive enough attention in order to be more successful, as already mentioned in the previous paragraphs. Business and ICT have about the same importance as they account for almost the same amount of failure concepts. This validates the fact that business and ICT should work together as equal partners in order to have success in software projects like the FF project.

6 Summary and Future Work

Variability management is a complex process. Variability should be considered during the whole development project of a software system, especially when the system’s success is critically impacted by the management of the variability, as in software product lines. Our case study showed that it is not only a matter of creating a software product that supports variability, but that every bit of variability should be considered carefully from the requirements engineering on. When quality of the development process is inferior, the product will not deliver the expected benefits. Only when all parts of a company, both business and ICT, are ready to deal with variability, this variability management has the chance to succeed. Communication is of critical importance between users, implementers and developers as variability manifests itself in small details. Leaving room for interpretation can be fatal, as literally mentioned by one of the interviewees. Although it is the product that will be used eventually, it is the development process of the product where most problems are situated. As stated by Deming [16], the most effective way to improve the product quality is to improve the quality of the process that produces the product. For software systems that need to be flexible through variability, this may well be the only way to reach quality.

Based on the observations made and knowledge extracted from the case study we would in the future like to develop a methodology to support variability in the software engineering process. Our special interest goes to the processes in requirements engineering as they form the basis on which everything is build. For requirements engineering multiple variability modeling techniques and languages exist, but most of them are not really tested in practice. Languages like Techne [17] possess high levels of formality, but this degree of formality was far from reached in FF. The question is then which is the ideal level of formality in practice, and can more formalism lead to better results. The hypotheses extracted from the case study will also be validated in other empirical contexts outside the original case in order to improve their strength.

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SPLUP: Software Product Line Unified Process

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Abstract. Software product lines (SPL) are a development paradigm focused on reducing costs through improved organization productivity and enhanced process quality. After careful analysis of existing SPL development methods, we noted that most of them do not provide a sound answer to some typical concerns – e.g. accurate business/domain analysis or efficient change management – of developing business information systems. Therefore, we decided to go forward to an SPL methodology definition that encompasses methods, activities and applicable technologies. The goal of this paper is to present our research approach and the main outcome of our work, an SPL oriented methodology (SPLUP)especially suited for business information systems development.

Keywords: Software Product Lines, Domain Engineering, Application Engineering, Model-driven Development, Methodologies, Unified Process.

1 Introduction

Software product lines are emerging as a viable and important development paradigm allowing companies to accomplish order-of-magnitude improvements in time to market, cost, productivity and quality drivers [11].

Over the past two decades, this approach has been largely applied with great success by worldwide companies - e.g. Philips, Boeing or Nokia - to the development of embedded applications. In the embedded field, the figures are encouraging, encompassing increases of 10x in productivity and quality and 60% cuts on costs [10]. The same principles may be applied to the development of business information systems.

2 Software Product Lines

A well accepted definition of Software Product Line (SPL) is the one provided by Paul Clements *et al*: "*A software product line is a set of software-intensive systems that share a common, managed set of features satisfying the specific needs of a particular market segment or mission and that are developed from a common set of core assets in a prescribed way*" [3].

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In other words, a software product line is a reuse-centric development approach, focused on developing the right infrastructure and assets to enable the production of a set of applications that share common features (applications in the same product line).

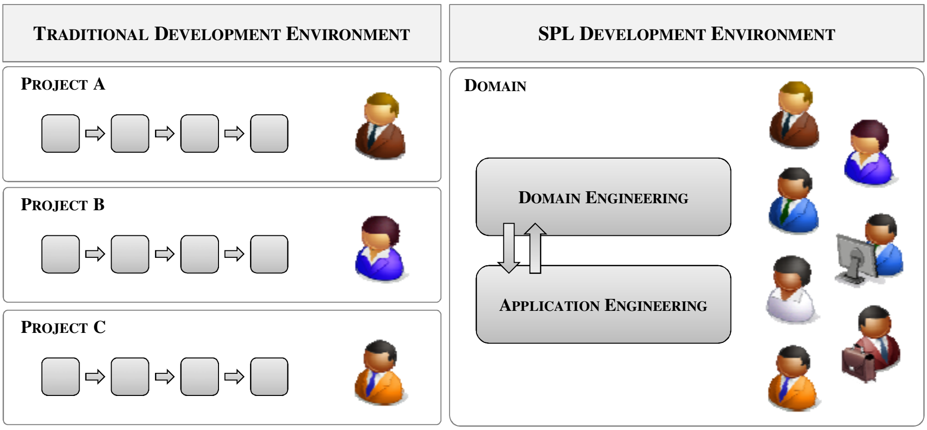

Fig. 1. Traditional vs SPL development environment

As presented in **Fig. 1**, the traditional environment assigns a project to every customer, eventually in different domains with a full effort replication. This diversity has a negative impact on the amount of potential reuse. The same figure (right side) shows a conceptual environment to a product line oriented development. Here, to support the desired reuse magnitude, the SPL is focused on a specific domain.

A domain is a very elastic concept; it can represent a business area, a set of related problems, a collection of applications or an area of knowledge with common terminology [7]. An important characteristic that is mandatory to all referred "domain forms"is the ability to provide the means to set a domain concrete boundary definition that allows setting the scope of the product line.

As **Fig. 1** also demonstrates, an SPL environment includes two interconnected processes: Domain Engineering and Application Engineering.

The Domain Engineering (DE) is the core process of an SPL project. It has the responsibility to ensure that a proper product line is conceived and that the means to operationalize it are available.

Application Engineering (AE) is the process that is responsible for instantiating the product line, which means, to build the member of the application family based on the infrastructure, methods and assets made available by the DE process.

Naturally, these two processes don't make sense alone. The AE team needs the infrastructure production and reusable assets to develop applications and the DE team needs feedback about the product lines features or the infrastructure suitability.

2.1 Framework for Software Product Line Practice

One of the most well-known SPL frameworks is the Framework for Software Product Line Practice (FSPLP) developed in the Software Engineering Institute at Carnegie Mellon University. This framework provides a set of best practices founded on the experiencesof a large number of real implementation projects [11].

Contrasting with other proposals, the FSPLP places a strong emphasis on management.

Fig. 2. FSPLP main activities. From [11]

As illustrated in **Fig. 2** the process names are slightly different from the ones we've mentioned previously. The Domain Engineering is named Core Asset Development and the Application Engineering is entitled Product Development. In spite of the difference in names, the meaning remains the same. In this framework, the interconnection between the processes is formalized with a specialized process - Management. In addition to the two process orchestration, Management has to ensure that the SPLs goals are aligned with the host organization strategic goals.

To accomplish these three main activities – the FSPLP terminology for "three main processes" – the framework establishes 29 practice areas. A practice area *is a body of work or a collection of activities that an organization must master to successfully carry out the essential work of a product line*. The practice areas, identified in Table 1, are divided into 3 groups:

- Organizational Management: practices necessary for the entire product line orchestration effort.
- Technical Management: practices necessary for the development and evolution of both core assets and products.
- Software Engineering: practice necessary for applying the appropriate technology to create and evolve both core assets and products.

The framework warns that this classification is only indicative and shouldn't be literally interpreted because the embodied knowledge isn't separable and redundancies between practice areas are inevitable.

Table 1. FSPLP Practice Areas

Organizational Management Practice Areas	***Technical Management Practice Areas***	***Software Engineering Practice Areas***
Building a Business Case	Configuration Management	Architecture Definition
Customer Interface Management	Make/Buy/Mine/Commission Analysis	Architecture Evaluation
Developing an Acquisition Strategy	Measurement and Tracking	Component Development
Funding	Process Discipline	Mining Existing Assets
Launching and Institutionalizing	Scoping	Requirements Engineering
Market Analysis	Technical Planning	Software System Integration
Operations	Technical Risk Management	Testing
Organizational Planning	Tool Support	Understanding Relevant Domains
Organizational Risk Management		Using Externally Available Software
Structuring the Organization		
Technology Forecasting		
Training		

2.2 Software Factories

Over the past years, the SPL paradigm has been instantiated through several product line oriented frameworks and process models, each of them claiming different perspectives and distinctive competitive advantages. The SPL framework 'Software Factories' is one example of those proposals.

The most referenced software factory definition is provided by Jack Greenfield *et al* in [6]. The authors define a software factory as *a software product line that configures extensible tools, processes, and content using a software factory template based on a software factory schema to automate the development and maintenance of variants of an archetypical product by adapting, assembling, and configuring framework based components.* Hence, a software factory is a development paradigm based on the grounds of the SPL approach that materializes the generic SPL principles, with applicable technologies and special artifacts like Software Factory Schema or Software Factory Templates.

On a very high level perspective, the software factory development process begins by describing all the necessary components and methods to build systems from a product line (Software Factory Schema). Then, based on that information, the software factory developer initiates the correspondent implementation (Software Factory Template). These two elements constitute the production infrastructure that will be used by the Application engineering team to produce applications.

Software Factories are not a methodology. They don't provide any prescriptive steps to execute any project but they provide an important integrated technology view that, properly combined with a development process, can support an SPL project. These technologies include [9]:

- Object-oriented frameworks to support a common set of features and variable mechanisms that should be shared by all family members [for more information see [1] or [5];

- Model-driven development to leverage the abstraction level needed to specify application features (using specially created modeling languages, Domain Specific Modeling Languages - DSML) (for more information see [8] or [2]);
- Automation techniques to eliminate, or at least decrease substantially, the effort spent on repetitive tasks (for more information see [8] or [4]).

These technologies are neither exclusive nor developed for the purpose of Software Factories, on the contrary, many of them are found on several other SPL (or even traditional) projects. Nevertheless, software factories have the benefit of integrating them quite well with a good tool support.

2.3 FSPLP and Software Factories: Different Approaches, Different Intents

FSPLP constitutes an important SPL *body of knowledge*, summarizing experience from a broad spectrum of SPL development programs executed by software companies from all over the world. Software Factories do not provide a knowledge foundation but, instead, take a more technological perspective, materializing the SPL philosophy integrating several existing techniques and technologies.

Although very useful, both frameworks lack coverage to the methodological and practical requirements of an SPL program. This finding motivated us to define the methodology that we present below.

3 Software Product Line Unified Process (SPLUP)

The SPLUP is the main outcome of our research. It consists of a product-line development methodology based, largely, on the SPL practices presented by the FSPLP, model-driven development principles and automation techniques. However SPLUP holds a strong practical standpoint, according to the requirements of a real SPL program.

3.1 SPLUP Foundations

As the name suggests, SPLUP has a substantial inspiration in methodologies based on the Unified Process, namely RUP and OpenUP. This option is justified, essentially, to ease the acceptance by an organization that aims to adopt a well-established methodological approach. It also provides a solid and highly tested process background to our methodology.

Such as any SPL program, SPLUP presents two macro processes: SPLUP Domain Engineering and SPLUP Application Engineering. The two processes are divided into 4 phases – Inception, Elaboration, Implementation and Construction – with associated milestones that should be assured to consider the respective phase complete.

As presented in **Fig. 3**, each process has disciplines that should be carried out along the project lifecycle. Much of our work is centered on the definition of these disciplines and the associated workflows, artifacts and roles.

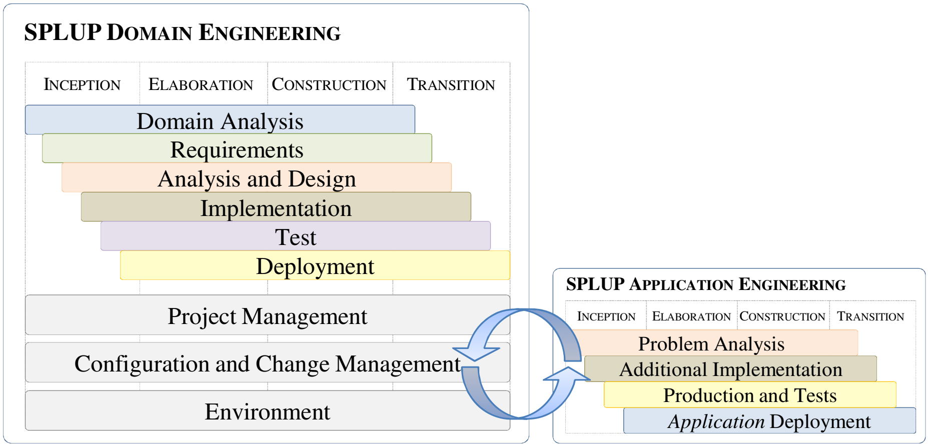

Fig. 3. SPLUP

One weakness that we've found in the existing SPL proposals was the loose definition of the connection between Domain and Application Engineering. Therefore, on SPLUP, we decided to go further and formalize that relation through a dedicated set of activities. These activities concern to three cross-cut disciplines of Domain Engineering: Project Management, Configuration and Change Management and Environment. All the disciplines and processes are briefly explained in the next subsections.

3.2 SPLUP Domain Engineering

The Domain Engineering is the core of the SPLUP. Its main purpose consists in delivering all the necessary assets to the application engineering team to develop applications from the product line.

We decided to support the process into the work structure supplied by RUP disciplines. Thus, our first task consisted in adjusting these disciplines to an SPL context. Then we assigned FSPLP practice areas to these contextualized disciplines in order to achieve further knowledge in each area. Finally, using a technology approach inspired on Software Factories, we used the integrated information to conceive the discipline workflows, artifacts and roles.

3.2.1 Domain Analysis

This is the only discipline we decided to change from the RUP original designation, *Business Modeling*. In SPLUP we are not modeling the particular business that one system addresses. Instead, we are studying an entire domain to achieve the appropriate knowledge to guarantee a proper set of systems definition (product line). We based the domain analysis on two distinct perspectives, the market analysis (focusing the business potential analysis) and the technical domain study (aiming the product line features definition).

3.2.2 Requirements

When the domain analysis is performed, the product line scope is at a draft level. The Requirements discipline is responsible for the scope refinement through a detailed description of all the (mandatory and optional) features presented in the product line systems. It's very important to work on a high abstraction level, so SPLUP considers a feature modeling phase followed by a more technical requirements mapping.

3.2.3 Analysis and Design

This discipline defines how to implement the solution described by the requirements. In this process, three different types of elements should be taken into account:

– Common architecture definition: through an object-oriented framework or any other mechanism that assures the variability requirements;
– Components definition: all the variable features must have a corresponding component that meets the variable mechanisms offered by the common architecture.
– Production process definition: the components and common architecture have to be combined in order to produce a system. This combination has to follow strict a process, the production process, which, for example includes configured and extended tools, Domain-Specific Modeling Languages (DSML) and editors or generators.

3.2.4 Implementation

This discipline is responsible for implementing the elements projected by the solution architect, like the common architecture, the components, tools and extensions to existing tools, DSMLs or generators.

3.2.5 Test

The implemented elements have to be tested independently to assure that the desired functionality is operating as expected and that the correspondent requirement is addressed properly. Besides the independent tests, all elements should be tested together to verify eventual integration issues. Additionally, random applications from the product line should be generated and tested individually.

3.2.6 Deployment

This is the discipline responsible for the appropriate delivering of the production infrastructure for the application engineering team. All the components and tools have to be available to the application team that has to hold all the necessary knowledge to operate them.

3.2.7 Project Management

The SPLUP Project Management is divided into three kinds of processes/activities:

- Product Line technical management: regards activities that relate with product line scoping, buy vs develop analysis and verification of top management objectives alignment.

- Product Line project management: regards activities that relate with planning, risk identification and mitigation, operations control, iterations/phase work management or resource allocation.
- Application project management: this is one important pre-established link between domain engineering and application engineering processes. The main project manager (product line manager) should initiate applications projects through an application manager designation. This manager, reports regularly to the main manager, but accomplishes the application project at his own will. These reports include feedback from the existing infrastructure or new feature requests.

3.2.8 Configuration and Change Management

Product line projects have hard configurations and change management requirements. On one hand there are innumerous artifacts that should be versioned and correctly managed; at the other hand changes may have cross-cut impact on the product line.

The configuration management has impact on both domains and application projects. In domain engineering, versions of architectures, components, DSMLs or tools have to be managed as well as generated applications. One capability must assure throughout the product line life cycle: the teams must be capable of generating enhanced versions of previously produced applications. The change management, who works highly coupled with configuration management, embodies the important responsibility of gathering a *Change Committee* to assess the product line impact and benefits in any new development request.

3.2.9 Environment

As RUP originally sets, the Environment discipline responsibility is to *provide the software development organization with the software development environment -- both processes and tools -- that will support the development team.*

Apart from the original context that SPLUP shares with RUP, on our proposal, the Environment discipline has a particular interpretation. In our perspective, in any SPL, the importance of Reuse inflicts that a related activity should be explicitly included in the development process. Therefore, our methodology defined a special workflow supported by a dedicated role (“Reuse Manager”), whose main job consists in analyzing the project execution and promoting reuse with “Reuse proposals” based on existing assets.

3.3 SPLUP Application Engineering

The application engineering process is responsible for the application production based on the means delivered by the Domain Engineering team. Thanks to this dependency, any generic application process tends to present a high level of abstraction.

Any application project must be developed in a short period of time, eventually with “micro” iterations, because (almost) all components that will be included in the solution are already developed. Moreover, unlike the domain process, in the applications projects the customer has a massive participation and must be the center of attention. These were two of the reasons that guided us to adopt a more agile approach to this process rather than the formal RUP approach that shaped the domain process. Due to the RUP similarities and inspirations we chose OpenUp to support the process definition. Unlike SPLUP Domain Engineering/RUP and due to the high application process specificity, the SPLUP Application Engineering has considerable changes in the disciplines structure when compared to the original OpenUp. Only 4 disciplines were set (as described above) and a discipline intending project management was not included because was considered in the domain process. Just like we did in domain process, the next step was assigning FSPLP practice areas to the disciplines. Then, with the information properly integrated we determined the disciplines workflow, artifacts and roles.

3.3.1 Problem Analysis

The problem analysis holds, as the main responsibility, the concern of finding the best fit of the customer needs with the existing product line. So, a business analyst begins by studying the customer business and needs. This analysis is quicker than the usual because the development team already knows the domain. The business analyst will prepare various prototypes to demonstrate existing product features and support eventual negotiations of demands that aren't addressed in the product line.

On the unaddressed demands, the business analyst must trigger the change request process through the application project manager that is responsible for gathering the Change Committee and ensuring that a response is provided to the customer. Another important responsibility of the business analyst is to create a formal document summarizing feedback about the parameters of existing negotiations, product features opinions or prototype infrastructure production suitability.

3.3.2 Additional Implementation

This discipline is about implementation of accepted development requests, so, it should only be performed under those circumstances. We should denote that, to the SPLUP, the only requests that are eligible to be implemented on any application project scope are increments to existing components or existing components replications with minimal adaptations. Therefore, the involved effort should be very limited.

The developer must start by analyzing the existing documentation about the variability mechanism provided by the common platform and existing components that may have some similarities with the new component. Then, based on that analysis, the component should be developed, documented, tested and deployed.

3.3.3 Production and Tests

The applications production should be very similar to the prototype production and ought to be exclusively, or mainly, restricted to application feature modeling, i.e. restricted to a modeling activity that formalizes the application specification in a domain-specific model.

This domain specific modeling is performed through the configured and adapted DSML editors and languages, according to the production plan, provided by the domain team. At this point, if applicable, the application developer has to be careful about the integration of application specific development, that may, or may not, inflict with the remaining components. So, in the end the application must be intensively tested, as defined in the production plan, to ensure that even after additional development, the application is working correctly.

3.3.4 Application Deployment

The application deployment is all about delivering the produced application to the customer. Hence, the deployment engineer must prepare an installation package (if the production infrastructure does not provide one automatically) and proceed with the application installation in the customer facilities. Then, tests must be run again to ensure that the application is working as expected in the production environment.

4 SPLUP Validation Approach

To validate our methodology, we chose to formulate a case study involving a software house that decided to move from the traditional method to a product line development using SPLUP.

The chosen product line domain was student information management in an academic institution. SPLUP guided the entire process, including the domain analysis, the design and implementation of the product line factory[1] and the resulting application production and deployment. The detailed presentation of this study is available in the MSc Dissertation that sustains this research.

As our intention was, the selected approach allowed us to validate two different but cooperative aspects of SPLUP methodology:

- The process structure and content suitability to the SPL development (disciplines objectives, workflows, artifacts and roles);
- The real potential of the chosen technological integration model (frameworks, DSLs and generators)

5 Future Work

The product line development comprises a complete restructuring of the (traditional) development cycle. This is a quite comprehensive research landscape, especially in an MSc dissertation scope, so we had to dismiss some aspects that we think as future enhancements of this work:

- The FSPLP and RUP methodologies can contribute with higher detail to the existing processes as well as they can enhance knowledge and methods in areas that our work does not cover (e.g. economical evaluations, risk management or process improvement).
- A “reuse-centric” methodology has to embrace techniques beyond code and application blocks reutilization. Despite the fact that SPLUP assumes this overall reuse concern, the methods and techniques are code centered. A future work should complement the existing processes with uncovered reuse fields, as knowledge management or customer relationship management.

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[1] A demonstration of the prototype is available at
`http://www.youtube.com/watch?v=zQg7HmstERE`

– The validation process could be greatly improved with a real SPLUP implementation. From the beginning this option was discarded due to the restricted MSc calendar but we think that a valuable evolution of this work can be the SPLUP real implementation in a set of different environments/domains.

6 Conclusions

The research objective - to create a methodology based on product line development - was accomplished. SPLUP embodies the product line development foundations and, on our opinion, addresses a number of questions that aren't considered by the majority of existing proposals:

– It sets the operational aspects of developing product lines, including process organization, disciplines workflows, roles and artifacts or applicable technical areas;
– It is based on the most exhaustive knowledge framework about software product lines, the Framework for Software Product Line Practice;
– Provides a technological view, ensuring that the right techniques and technologies are available throughout the project;
– Offers an integrated model of two distinct process approaches. The SPLUP Domain Engineering is a formal process with strong emphasis on, well supported, mature development focusing a long term project. The SPLUP Application Engineering takes an agile approach into very time limited projects focusing a strong and healthy customer relationship with fast systems delivers with unquestionable business value.
– Thanks to the Unified Process inspiration, it simplifies the transition from a traditional approach to a product line development process.

Also, the developed prototype helped to demonstrate the potential of integrating object-oriented frameworks, domain-specific modeling languages and automation techniques. With the good level of support that existing tools already provide, it was possible, in a very limited period of time, to develop a production infrastructure to enable applications generation exclusively based on existing components (100% codeless).

So, in conclusion, we believe that SPLUP is a realist approach to implement a software product line program. Realistic does not mean that is easy. On the contrary, we think that a software product line approach is an extremely demanding process that can only be applicable in scenarios where, at least, exists a stable domain and a very competent, motivated and experienced development team.

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Goals for an IoT Context-Based Process Modelling Language Regarding Logistics

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Abstract. The Internet of Things (IoT) aims at bridging the gap between real-world business processes and information systems. When attached to physical items, the IoT technologies such as sensor networks transform objects of the supply chain into *smart items*. These items have the ability to capture context data and provide business process management systems (BPMSs) with a representation of things. To adequately describe a business process, process engineers commonly use Business Process Modelling Languages (BPMLs). However, in a larger scope, BPMLs differ according to the application area they are used in, and there is no current language solution to represent IoT context data within a process model. In this paper we introduce the goals for a BPML to represent these data. The language will enable process engineers to model business process behaviour taking into account IoT context data.

Keywords: Internet of Things (IoT), business processes, modelling languages, goals.

1 Introduction

The Internet of Things (IoT) has become an important subject on the enterprise world, regarding business processes, business models and information systems (IS). As our society witnesses the growth of a web-based service economy, the IoT provides a key role for its improvement [10]. Manufacturing, logistics, automotive, energy, health and security are some of the application areas where the IoT has been raising interest. The role of the IoT in the future Internet is to reduce the gap between the physical world and its representation in information systems.

Radio Frequency Identification (RFID) devices and sensor networks are common technologies used in the IoT. They capture and provide context data which can be used to support decision making at high management level. For instance, RFIDs provide identification of objects, and sensors allow reading of environment data. These data allow process monitors to identify unusual aspects within

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their context. Therefore, sensors add a major contribution to the business processes in the IoT. Some of these are considered to be intelligent as they have the ability to execute business logic. This allows the decisions to be made at item level and therefore reduce centralised processing and the amount of exchanged data. These items are usually referred to as *i.e., smart items* [15]. The decomposition of business processes through distributed environments creates a paradigm shift and new challenges. Technical issues such as Internet scalability, identification and addressing, heterogeneity and service paradigms are major obstacles to overcome. Therefore, they are prominent areas of research and have influence on business process modelling [8].

Nowadays, the integration of these technologies into enterprise systems require a significant effort, regarding deployment and configuration of middleware. Also, it is fair to acknowledge that BPMLs are the best way to define and execute complex business processes in these environments [9]. For instance, the Business Process Execution Language for Web-Services (WS-BPEL) has emerged as the standard reference to model the behaviour of Executable and Abstract business processes on Web Services [2]. It defines an interoperable integration model, extending the Web Services interaction model and enabling it to support business transactions. So far it is possible to use information provided by the IoT to support business processes defined at design time that do not foresee deviations. However, business processes in the IoT require specific environment data and it is hard to represent their dynamic behaviour through WS-BPEL [5].

To address these issues, we aim towards a BPML which can represent IoT context data within business process models. In this paper, we present a list of goals for such a language. As a motivation scenario, we focus on logistics and supply chain-related business processes, which commonly use data provided by IoT technologies such as sensor networks.

The remainder of this paper is organised as follows: section 2 describes a motivation scenario; section 3 identifies the goals for the proposed scenario; section 4 discusses related work and section 5 concludes this paper.

2 Motivation Scenario

In the enterprise world the supply chain is known as a network of organisations and business processes for procuring raw materials, transforming them into products and distributing these to customers [12]. According to this definition, there are five major supply chain processes: plan, source, make, deliver and return. Logistics plays an important role in all of them, especially dealing with issues that have an impact on transporting [12]. We will build our scenario based on this kind of logistics business processes.

2.1 Technology Background

The integration of real-world business processes into information systems requires a huge effort. The representation of these processes demand accurate context data obtained from physical devices. However, the data captured by these

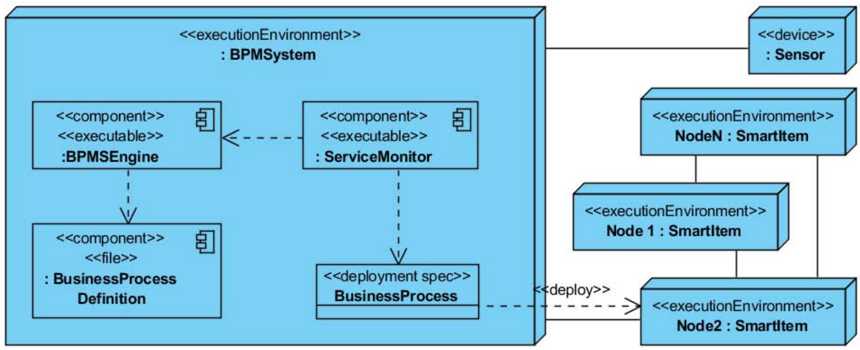

Fig. 1. Simplified architecture of IoT technology devices interacting with BPMSs

devices may not be entirely accurate or non-sufficient to the system it provides. The main goal of the IoT is to fill this gap, creating a better understanding and representation of real-world business processes within information systems. Therefore, technology represents a major role in achieving this goal.

Wireless sensor networks have the ability to capture context data and provide it to information systems for real-time representation of business processes and involved objects. For this purposes, these devices are commonly referred to as *smart items*. Regarding logistics processes, wireless sensor networks characteristics make them the most promising technology [11]. The sensor nodes are extremely small electronic devices with embedded sensing and computing systems that collaborate within a network. They can be configured with specific properties to meet the requirements of the objects they are associated with. Also, some sensors can execute business logic and therefore execute parts of the processes of an information system. Objects become embedded logistics information systems [4]. Sensor networks cover more information features then other devices such as RFID [6]. For instance, CoBIs [3] presents a sensor network that covers the following features: identification, tracing, location tracking, monitoring and real-time responsiveness.

The use of sensor networks demands service-oriented architectures (SOA) regarding interaction with information systems. This implies the need of a service monitor to manage the communication of sensors with information systems. In this approach, sensors can either be simple devices with environment reading abilities which only send information they were programmed for, or have computing power that enables them to execute business logic, make decisions based on acquired data and take appropriate action. Figure 1 shows a simplified schema of a BPMS communication with IoT technology. The node stereotyped as *device* represents sensors with simple reading abilities. The nodes stereotyped as *executableEnvironment* represent sensors with embedded computing power to handle incoming data and requests. Both stereotypes communicate with a centralised information system.

2.2 Logistic Functions

The basic logistics functions are to transport "*the right goods and the right quantity and right quality at the right time to the right place for the right price*" [4]. Information systems provide a set of specific features to address each of these logistics functions, namely *identification, tracing, location tracking, monitoring, real-time responsiveness* and *optimisation*. The *identification* feature accomplishes the *right goods* function. The *tracing* feature provides the system with the *right quantity*. For instance, allows the detection of lost objects. *Location tracking* guarantees the objects to be in the *right place* by tracking the transport itself. *Monitoring* the object's state ensures its *right quality*. The data obtained from these features in real-time allows the overall logistics processes to be observed with detail within information systems. Therefore, *real-time responsiveness* to unforeseen events and other actions can be achieved at the *right time*. Finally, these data provide the basis for optimisation affecting the product's *right price*. For instance, a truck loaded with fruit not reaching its destination in time may have influence on the fruit's quality and therefore, its price. Table 1 illustrates the association of logistic functions, the features commonly supported by IS and sensor networks. These features allow the monitoring and control of

Table 1. Logistic functions and information systems features to implement them. It also displays the sensor networks capabilities towards logistic functions.

Functions	Features	Sensor Networks
right goods	Identification	Full
right amount	Tracing	Full
right place	Location Tracking	Full
right quality	Monitoring	Full
right time	Real-time responsiveness	Full
right price	Optimisation	Full

products. Environment data is provided by smart items. For instance, tracking their location can be used to detect if the associated products have been detoured from a pre-planned route. Tracking their state can be used to realise if the products' condition has changed and whether they are still useful or not.

The following section describes the language goals to support context data in the logistics business processes, concerning their functions and supply chain integrity.

3 Language Goals

In this section we describe the way we organised the goals for a language to model IoT-related business processes for logistics. We also foresee the logistic function that a certain goal will try to address. Following a goal/scenario oriented model

[1], we provide in Table 2 an overall description of our main goals. Use cases and application scenarios for each goal can be found in a fully detailed list in Appendix, at the end of this paper.

Table 2. Goals for a language to model the IoT business processes

Goal	Description	Logistic Function
G-01:	Provide appropriate language constructs to enable process engineers to model and monitor simple device identification	the right goods
G-02:	Allow process engineers to model and control group device identification	the right goods
G-03:	Provide language constructs for process engineers to model master-slave device identification	the right goods
G-04:	Allow process engineers to control the quantity of products monitored by the device	the right amount
G-05:	Control the quality of product monitored by the device	the right quality
G-06:	Control state of the product monitored by the device	the right quality
G-07:	Control location of the product monitored by the device	the right place
G-08:	Control time variants of the product monitored by the device	the right time
G-09:	Control distribution of business logic among devices	

4 Related Work

Process engineers have recognised that using context data effectively is the key to build more adaptable and interoperable web services [14, 13]. Therefore, WS-BPEL is the common solution to model the behaviour of Executable and Abstract business processes on Web Services. However, it is hard to represent business processes in the IoT through WS-BPEL due to issues identified on [5]. In this section we will describe approaches that researchers use to deal with related issues.

"Business Processes are no longer a rote repetition of steps" [7]. They have to capture relevant environment data and adapt their behaviour to address the challenges. As organisations demand greater efficiency, their business processes require environment-driven adaptability. Also, as the pace of changes increases, so does the amount of changing environment state, or context. Therefore, the organisations Business Processes will be required to be more flexible. These concepts pose a challenge for process engineers using WS-BPEL who have to source, track and update context data while maintaining core business logic.

WS-BPEL provides support for *pull-style* interactions where services are invoked at the process's request for data or to perform a task. However, there is a short notation on *push-style* interactions. This limitation reduces the process adaptability to its environment, especially concerning arbitrary changes. To address these, the use of *context variables* was introduced using the WS-BPEL language extension mechanism [7]. Their goal was to provide a mechanism to create business processes that adapt to the business environment, thus, increase processes expressiveness. For instance, a company that offers its customers strict product-delivery guarantees. Each product uses multiple sub-assemblies. As the company receives new purchase requests it orders the necessary components from its suppliers. Not every shipment arrives on time. Instead of finding this when the component fails to arrive on the expected delivery date, the company would like an advance warning so that arrangements could be made. To control this, they track the shipment's estimated delivery date and, if it exceeds a certain threshold, perform an adequate compensation. The estimated delivery date becomes the context variable, whose value influences the process's execution.

5 Conclusion and Future Work

In this paper we introduced the goals for a BPML to represent IoT context data, mostly from logistics processes. These goals will provide an important overview on deriving the meta-model for the language. It will enable process engineers to model business process behaviour taking into account IoT context data.

Current approaches achieve part of these goals through mechanisms to create business processes that adapt to business environment. However, the increased expressiveness on these does not fulfil all the goals necessary for a proper definition of the IoT business processes. Also, standard PMLs have problems modelling specific context data from the IoT into information systems. Therefore, we acknowledge the need of a new language or new language constructs with expressiveness to support the IoT context-based business processes. These constructs must support:

- The declaration of which events processes are interested in receive directly.
- The declaration of which events processes are interested in receive indirectly. In this case, a threshold of conditions is associated with events, which notify processes about any exceptions.
- Support the distribution of business process logic between central IS and IoT-related technologies.
- Support predicted and unpredicted exceptions within business processes, raised from IoT context data.

Concerning our approach, we will then analyse current solutions in order to decide weather we'll extend an existing language or create a new one. Despite our choice, the language must support a translation tool to build WS-BPEL code from our source and vice-versa.

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Appendix: Goals List for an IoT Context-Based Language

Table 3. Goals list concerning the logistic functions

G-01: Provide appropriate language constructs to enable process engineers to model and monitor simple device identification Logistic function: the right goods Use cases: Obtain the device identification, Define device details Application Scenario: A truck loaded with 3 pallets of products is equipped with one device for each pallet. The cargo has to be distributed among 3 different locations. When unloading the cargo, the device provides the identification of the right pallet and therefore the *right goods*.
G-02: Allow process engineers to model and control group device identification Logistic function: the right goods Use cases: Obtain the device group, Define device group, Alert missing component Application Scenario: A van loaded with 6 products distributed among 37 different packages is equipped with one device for each component. For each component the corresponding device is marked with the same group identification. After loading the cargo, the van driver wants to make a cargo-check. One single device provides information about its group and raises an alert if a component is missing. He can repeat the process after arrival before unloading the cargo to ensure he has the *right goods*.
G-03: Provide language constructs for process engineers to model master-slave device identification Logistic function: the right goods Use cases: Define slave device, Define master device, Obtain salve devices Application Scenario: A van loaded with 6 products distributed among 37 different packages is equipped with one device for each component. For each product, one of the devices is marked as a master device. The remaining devices corresponding to the same product are marked with the master device identification.
G-04: Allow process engineers to control the quantity of products monitored by the device Logistic function: the right amount Use cases: Define quantity, Obtain current quantity Application Scenario: A truck loaded with 3 pallets of fruit is equipped with one device for each pallet. The number of crates in each pallet is stored in the corresponding device. When unloading the cargo, the device provides the identification of each pallet quantity and therefore the *right amount*. Alternatively, the weight of each pallet is also stored in the corresponding device. Application Scenario 2: A tank truck loaded with gasoline is equipped with a device to control the fuel level in the container. Before departure, the fuel level is stored in the device. After arrival, the fuel level is compared to the value previously stored. If these values do not match, the device raises an alert.

G-05: Control the quality of product monitored by the device Logistic function: the right quality Use cases: Define device properties, Define properties values, Obtain current values, Out of bound properties Application Scenario: A truck loaded with 12 pallets of fruit is equipped with devices to control and store temperature values, two for each pallet. Also, the devices are programmed with a range of recommended temperature values (minimum temperature: 15, maximum temperature: 20). If temperature in the pallet reaches out of bound values, the device raises an alert, informing the process manager. The pallet with compromised quality is a threat to the remaining pallets and in the worst case scenario all the cargo can go to waste. These data allow the process manager to remove the "bad apple" and assure the remaining products quality.
G-06: Control state of the product monitored by the device Logistic function: the right quality Use cases: Change container state, Alert tampered container Application scenario: The scenario begins when a tank truck filled with gasoline starts its journey towards the destination, a filling station. The device monitoring the container marks it with *closed* state. During transportation, the truck driver makes a stop at a restaurant to have lunch. Unexpectedly, the container's door is opened and the device marks the container with *tampered* state.
G-07: Control location of the product monitored by the device Logistic function: the right place Use cases: Obtain current location, Update checkpoints, Update destination. Application scenario: The use case begins when a truck starts its journey towards the destination. The device monitoring the container is able to control its current location and store the checkpoints defined by the process monitor. During transportation, a road block prevents the truck to proceed on route. The process monitor is notified of this event and updates checkpoints for an alternative route without compromising the route integrity.
G-08: Control time variants of the product monitored by the device Logistic function: the right time Use cases: Obtain arrival time, Update estimated time to arrival Application scenario: A truck loaded with cargo must arrive to its destination within 120 minutes. The expected time to arrival according to the current route is 100 minutes, respecting speed limits. Unexpected construction works on the road, reduces the speed limit for a few kilometres. If the new expected time to arrival surpasses 120 minutes, the device raises an alert and provides an alternative route, if available.

Table 4. Goals list concerning the distribution of business logic, subscription model and exception handling

G-09: Control distribution of business logic among devices Use cases: Define activity execution target @system, @device Application scenario (@device): A truck loaded with pallets of fruit is equipped with devices to monitor temperature, programmed with a range of recommended values (minimum temperature: 15, maximum temperature: 20). If temperature in the pallet reaches out of bound values, the device raises an alert, informing the process manager. In this scenario, the business logic is executed at device. Application scenario (@system): A truck loaded with pallets of fruit is equipped with devices to store temperature values. At arrival, the central system checks the devices temperature logs. If the values compromise product integrity, the system raises an alert. In this scenario, the business logic is executed at system.
G-10: Provide predicted exceptions handling Use cases: Define exception, Compensate exception, Catch exception
G-11: Provide unpredicted exceptions handling Use cases: Define unpredicted exception
G-12: Control push based events Use cases: Define push event Application scenario: A truck loaded with fruit is equipped with devices with temperature logs. These devices are programmed with a range of recommended temperature values (minimum temperature: 15, maximum temperature: 20). If temperature in the truck reaches out of bound values, the device raises an event informing the process monitor.
G-13: Control pull based events Use cases: Define time interval Application scenario: A truck loaded with fruit is equipped with devices with temperature logs. These devices are programmed to read environment temperature every 5 minutes and register it.

Integrative Research Approach for a Risk Evaluation Ontology Design

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Abstract. The present article describes a systemic approach to better support the decision making process by creating a tool based on an ontology for integrative analysis of health and safety risks that can occur in a workplace activity development. The designed ontology creates the possibility to show and characterize the potential work accidents and/or diseases and decide better for an appropriate preventive or corrective measure. The ontology is a structure in four chapters/sub-ontologies (human being subsystem, work duty subsystem, machine subsystem and work environment subsystem) and its content allows the classification of all the concepts used in the health and safety risk evaluation process (risk characterization, impact, health problems, measures etc.), including important relationships between the concepts. In addition, each class will be enriched with different properties that will be used for defining the decision-making tool, to better identify the significant health and safety aspects in a risk evaluation process and to appreciate their impact in order to provide efficient/effectiveness corrective measures (for eliminating or minimizing risk impact). The research results will increase companies' competitiveness by optimizing the resources dedicated to different management systems.

Keywords: Risk evaluation, Health and safety, Ontology, Model, SMEs. Knowledge based systems.

1 Introduction

According to statistics [5] it is estimated that in the World there are approximately 160 million occupational diseases each year; 30-40% of these evolve as chronical diseases that determine permanent work incapacity. For these reasons, occupational diseases are considered as *silent epidemics* because they are hard to diagnose, are discovered late, and cannot assure the reversibility of individual's health. Statistics show that 10-30% of the developed countries employees (workers) and 50-79% of the workers that belong to countries with low and medium economic development level

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are constantly exposed to occupational risk factors or work in non-ergonomic conditions. In conclusion, for each company the problem of risk factors analysis and evaluation, the study of their genesis (appearance, development, manifestation, effects) has to be a key activity for the professional life improvement and/or optimization ("iceberg" model confirms that [14]).

The costs of these negative phenomena are composed on one hand, by their direct effects on treatment and hospitalization of the affected human operators. On the other hand, the costs include the indirect effects regarding the lost of temporary or definite work capacity (considering that work accidents and occupational diseases imply costs of 3% from the GDP in the first case and about 20% in the last case, as average values for the European countries). Also, the social investigations done for the affected workers showed that the psychological stress experienced by them affect their family and also the collectivity (at organizational level) by affecting the health, and the wellbeing of other society members (in accordance with the documents and statistics provided by International Labor Organization) [9].

In the last years, accepting the fact that at European level in the field of occupational health and safety there was important progress reported, there are still some empirical practices and unsolved aspects. The costs of work accidents and occupational disease are still too high and do not split into equal proportions for all parties involved [5]. The money lost by work absence is about one milliard Euros per year. The employers pay for the sick leave, the replacement of absent workers, for their loose productivity, and many of these costs are not covered by the work insurance system [14]. Small and middle size enterprises (SMEs) are mostly exposed to these phenomena, having 82% from the total number of professional diseases and 90% from the deadly accidents (as average values for the European countries) [5]. Sectors like: constructions (civil engineering), agriculture, transportation and medical services involve a higher level of occupational/professional risks than the average, while the young workers, the emigrants, the older workers, and those who work in unsafe conditions are affected in a disproportionate way [4], [13]. The occupational health and safety European strategy (2007-2012) proposes a target of 25% reduction of work accidents and professional diseases. Therefore, the strategy actions sets that must be taken are related to the following aspects. (1) The improvement and simplification of the existing laws and their better implementation in organizations' practice by compulsory instruments, such as exchange of good practices, information exchange, sensitivity propaganda and better practices for employees/workers training and forming. (2) Defining and implementing of national strategies that should address most affected sectors. (3) Occupational health and safety activities have to be included in other fields of national and European politics (such as, education, public health, research) and the new synergies have to be identified. (4) In the future, potential new risks have to be identified and evaluated by a detailed research plan, knowledge exchange and practical exploitation of the results [4], [13]. Occupational Security and Health Agency documents generate a large knowledge base for scientific research on health and safety by promoting: best practices, statistics, publications, legislation, tendencies regarding research activity through the working groups formed at international, European, and national levels [13]. For example, there is an active working group involved in doing researches for the health and safety aspects of

SMEs, including the development of an evaluation scheme (methods and means) and assistance means that are based on the information technology tools [13].

1.1 Brief Research Context Description

The present research is related to the project "*Interdisciplinary researches for an occupational risk evaluation platform development with impact on the organizations' health and safety culture*" (CNCSIS, ID 1022, 2008 – 2011). The project aim is to develop a decision-making tool that can better assist risk evaluators. In addition, the research results will increase companies' competitiveness by optimizing the resources dedicated to different management systems. Therefore, companies usually use the quality management on site (according to ISO 9000 requirements); they sometimes apply a safety and environmental management system (according to ISO 14000), but only a few companies apply integrated management systems. The consequences are related to waste of money (additional costs) and human resources, that can be avoided by an integrative approach like the one proposed in the paper. Therefore, the research project will develop a methodology and an implementation model in terms of *integrated management* (related to health, safety and environment risk evaluation). These preliminary results will be the basis of an occupational risk evaluation platform (as a web application) that is dedicated to those companies that usually allocate small budget to process management, especially the small and medium size enterprises (SMEs) [1], [2]. This tool will provide the information access during all the working processes in order to integratively assess health, safety and environment aspects related to a specific work place/system. Therefore, we propose to design and develop a web application to use an ontology in a collaborative environment (by integrating in an existing management information system the newly created facility) [1].

1.2 Research Motivations and Objectives

Companies' risk evaluators (managers of different hierarchical levels or other specialists) need to know how to balance the contingency of risk with their specific contractual, financial, operational and organizational requirements. In order to achieve this balance, there have to be made a correct and complete risk identification and analysis. The risk management processes suppose to identify different risks and exposures, and then formulate an effective risk management strategy to mitigate the potential for loss [1], [2]. There has to be considered that risk is an important part of any business enterprise. The risks list is virtually endless and so is the list of risk management strategies that managers often deploy during their activity.

Currently, there are different management models that companies can adopt to increase their competitiveness, as ISO 14000 [10], OHSAS 18001 regulations [12] that can be considered as reference points for the environmental management process and for the management system specification for occupational health and safety in companies. The integration of these two aspects is very rare and limited to a formal process, that means the existence of policies, manuals, procedures and registers unification [6].

In the following lines there will be presented an approach for the integrated evaluation and analysis of environmental, safety and health risks with the declared aim to better control these risks and reduce their impact upon the organization processes. The main objectives of the research (project) are:

(1) To design and develop an ontology that represents the concept model based on the terms related to integrated health and safety evaluation (different risk aspects, impact related to work diseases and work accidents, preventive and corrective measures) - this will be also related to the risks evaluation factors that can occur in the work place environment (risks that can be transferred to related areas);

(2) To establish the structure/preliminary architecture of a decision making tool, based on the risk ontology for a complete and complex (integrative) risk evaluation process in the man (together with the work duty subsystem)-machine-environment system - this will also support the implementation of the right preventive measures.

2 The Propos Research Approach for the Ontology Design

Any ontology defines a common vocabulary for researchers who need to share information in a domain [11]. A widely used definition states that an ontology is a formal specification of a shared conceptualization [8]. It consists of concept definitions, relations and rules about a domain. An ontology can be used in knowledge based systems with the potential to employ inference and can be built based on artificial intelligent modelling techniques like frames and first-order logic, as well as based on description logic modelling techniques. Software engineering techniques can also be used to build ontologies [7], [3]. This research attempts to develop an ontology focused on all the terms (different risks aspects, impact related to work diseases and work accidents, preventive and corrective measures) related to the health and safety management, but also to the environmental management by considering the relationships that exist among them. This will generate facilities for a holistic process of risks (analysis, evaluation and minimizing their action where they can occur). To achieve the research objectives (Figure 1) there has been established a proposed research scenario based on a bottom-top approach.

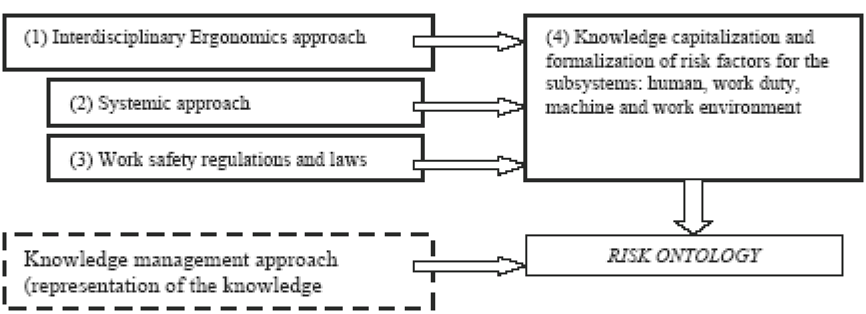

Fig. 1. Schema of the proposed approached for the risk ontology design

The scenario consists of the following preliminary stages: (1) Knowledge capitalization and formalization regarding the occupational risk from the perspective of the interdisciplinary and systemic approach given by ergonomics; (2) Establishment of the occupational risk taxonomy structure; (3) Knowledge management approach support for the risk ontology definition by considering the work accidents genesis (risk factor – effects – prevention and corrective measures). These preliminary stages of the research have to be integrated in stage (4) Knowledge capitalization and formalization of risk factors for the proposed subsystems: human/man, work duty, machine and work environment. The knowledge management software tools will (MindManager) support the risk ontology design and visualization.

2.1 The Concept Model

A concept model was developed in order to understand/explain the main structure of the domain and to facilitate the development of the ontology. Figure 2 shows the important terms and their relationships that should be included in the ontology.

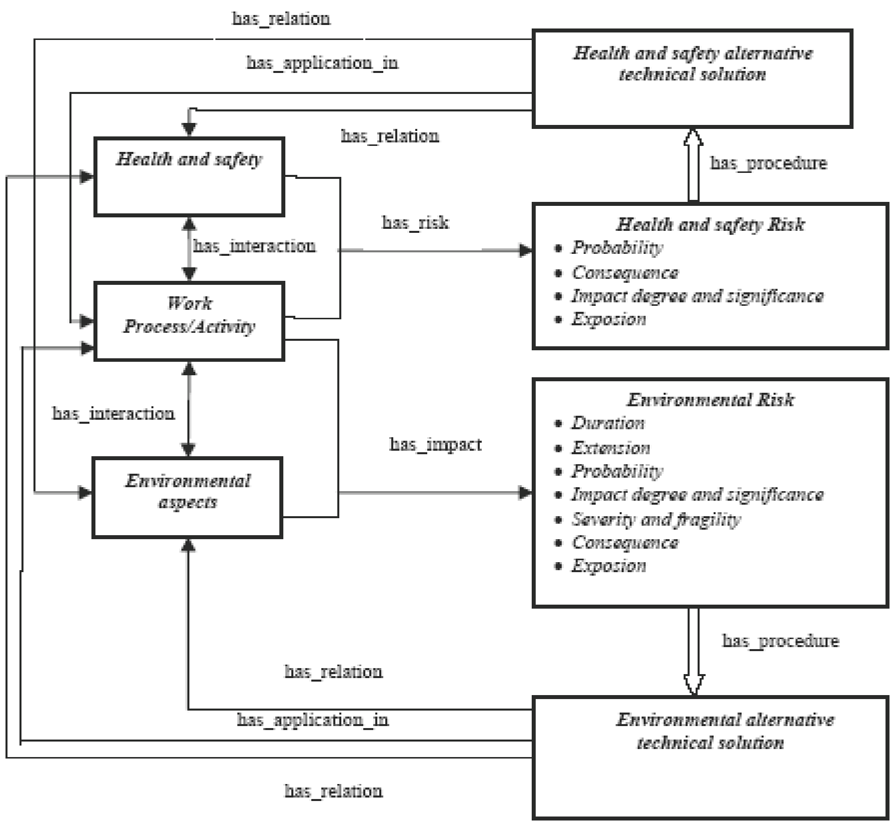

Fig. 2. The concept model structure (after [6])

The concept model is based on the *Work Process/Activity* (detailed description of the work place description together with the specific activities/process that is developed by the individual worker or by a group of workers). Each of these *Work*

Process/Activity is simultaneously related to both environmental aspects (defined by the eco-management procedures and by the audit specific regulation, for example) and health and safety aspects (defined by the specific national laws and regulations). Because of these interactions, all the occupational risks are characterized and analyzed. Moreover, each risk category (related to different subsystems: human/man, work duty, machine and work environment) has some related properties, and, based on the integrated analysis, the concept model will be more precise. Therefore and from the study of the valuation, environmental alternative technical solutions and health and safety alternative technical solutions are given, in order to reduce the risks impact upon the man (work duty) - machine – environment system.

2.2 The Concept Model Implementation Process

The concept model implementation consists in the development of the ontology using appropriate software, in our case MindManager. The knowledge map, which is the basic taxonomy, built for the ontology structure was first structure and build – definition of a basic tree structure. Therefore, there has been described each item of the content that defines the background of the ontology and can be considered as similar to a database (Figure 3).

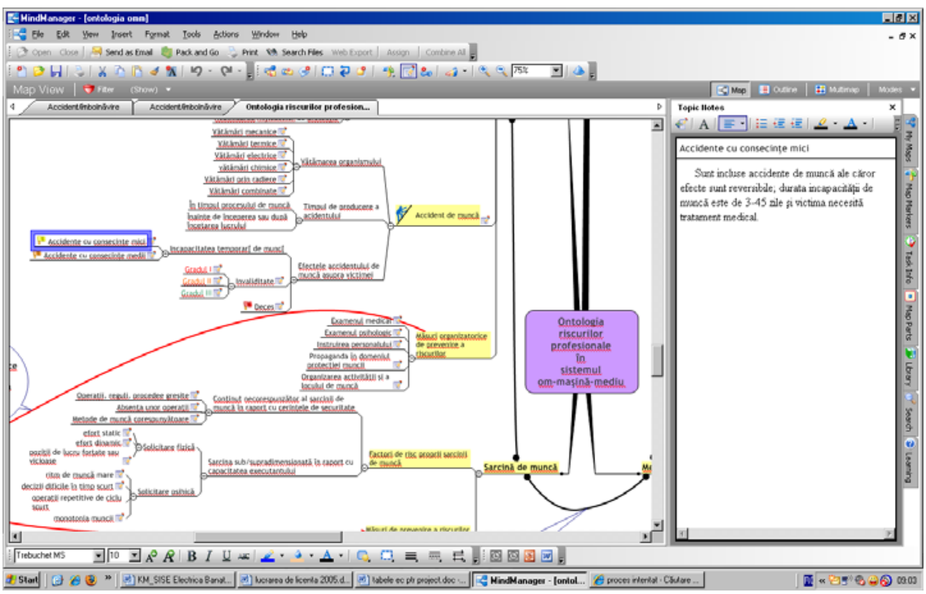

Fig. 3. Screen of the general knowledge map built together with a particular note describing an item of the data base (in Romanian language because of the evaluators specific)

The ontology structure is based on the man (work duty) - machine – environment systematic approach. For each subsystem there were identified and described (including relevant references): the occupational/professional risks, the work accidents and/or diseases and the preventive – corrective measures that can be implemented at the work place level.

The design knowledge map and ontology will allow the analysis and optimization of the different work systems' activities and interdependences relations inside them by considering the technical, economic, social variables (integrative risk analysis). In addition, the proposed approach aims to collect the completely practical cases that can appear in different working systems regarding the occupational risks. Based on this, managers and work safety responsible persons can better analyze, evaluate and prevent the negative events of the working processes of their organization by not omitting some aspects or situations. In this context, safety responsible persons of the organizations (managers from different levels) can better define their strategies, policies and tactics and they can pro-actively act by investments in intelligence, learning, communication, and knowledge in order to develop the safety organization culture. A brief representation of the ontology structure is presented in Figure 4.

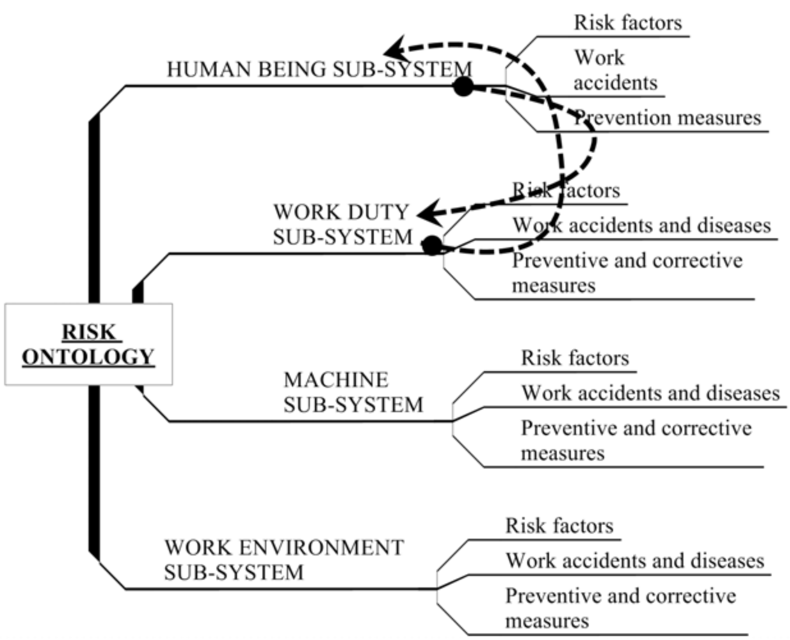

Fig. 4. A basic structure of the risk ontology (the hierarchy tree)

Only the first and the second level are shown because of the great/large number of branches. The other levels/branches or subclasses are particularly built and developed depending of the considered sub-system. Then for each final item of the knowledge map there was defined a specific file (note) that included the detailed description of each item (risk factor, accident, disease, preventive and corrective measure) according to some existing regulation, with some examples and case studies for particular work systems depending of the industry type. These notes are definition elements of the database behind the knowledge map (see Figure 3). The risk ontology (as a preliminary result for the risk evaluation) was first tested and validated inside the real economic environment of a company in the field of electric maintenance services. During the process, there have been identified and better characterized more risks that were collected by the evaluation process developed for the ISO 18001 company certification. Therefore, the risk ontology is a complex, innovative and useful tool, superior to the actual procedure for the occupational/professional risk analysis and evaluation.

This work and research approach facilitates the future research and work for defining the occupational risk evaluation platform that will develop as a web platform in the next year. The preliminary knowledge capitalization and formalization will be transferred as knowledge objects in the new web platform. These will be associated with an on-line questionnaire that will cumulate the results of the risk evaluation (the evaluator has to follow all the items of the defined knowledge management system and decide if the risk exists or not in the analyzed work system).

In practice then, for each occupational risk factor, standards and regulations have established precisely methods and tools for analysis and evaluation. These procedures of the experimental research will be described and will define a separate database that will be part of the web platform, too. The research approach facilitates future works for defining *the risk evaluation platform* that will be developed as a web platform (see Figures 5 and 6). In Figure 5 is presented the intimate process of the risk evaluation (elementary action) that has to be developed by the evaluator.

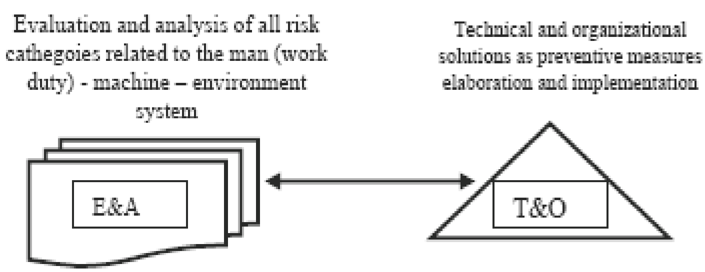

Fig. 5. Description of the intimate process of the risk evaluation using the specific tool

The evaluation - analysis process of all risk categories related to the man (work duty) - machine – environment system will have a double role. First of all, they will lead to the conclusions of the occupational risk diagnosis and to the elaboration of the technical and organizational solutions as preventive measures for the particular work place (in association with its specific work processes). Secondly, they will determine a knowledge capitalization (a library of case studies will be created) process in relation with the experience (wisdom) gained by the evaluators.

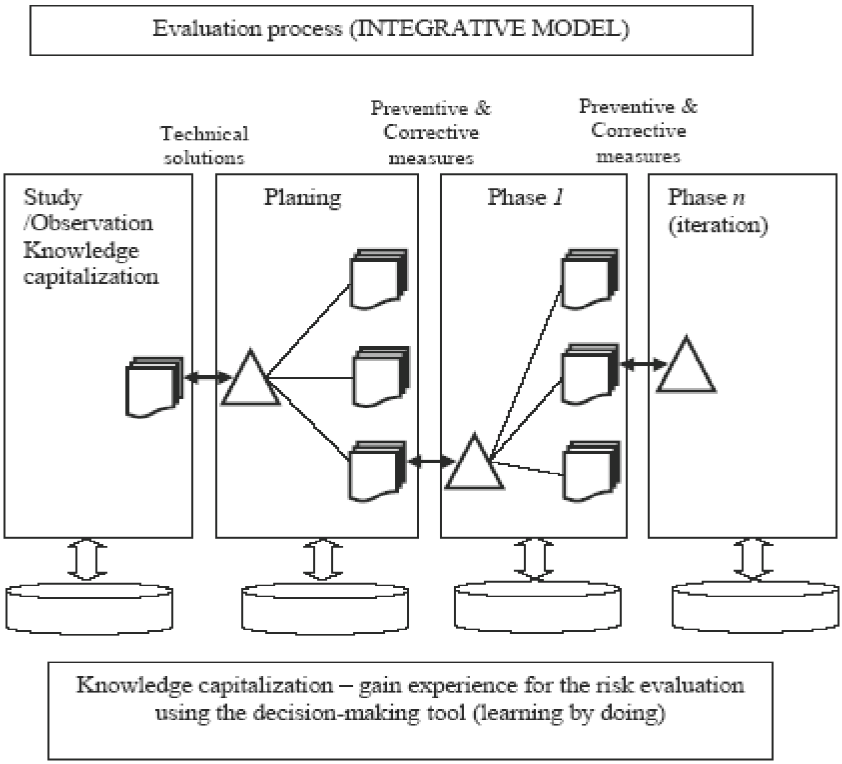

Fig. 6. General Layout of the decision-making tool – the proposed integrative model (after [6])

3 Conclusion

The paper presents some research results regarding the establishment of an integrative model for a web platform development for the occupational/professional risks evaluation. Using relevant references, there have been shown some preliminary considerations regarding the importance of the health and safety problems in companies to underline the importance of the proposed approach. In the second part of the article, there have been described the research stages for building the risk evaluation ontology based on a proposed conceptual model. The ontology is based on a design taxonomy that consists of the following inventories: risk factor, work diseases/accidents related to each risk factor and the possible and allowed prevention measures. This description was structured for the corresponding part of the man (work duty) – machine – environment system. Its development was done using MindManager software. The risk ontology will be considered for the web platform development as a decision-making tool used for the risk analysis and evaluation process particularly in SMEs. This tool will increase the efficiency of such evaluation processes and will be much closer to the preventive strategy imposed by the new strategy adopted in Europe in the field of Security and Occupational Health.

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Some Remarks on ERP System Implementation in Medium-Size Enterprises

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Abstract. Following a generic process model, recommendations are given for the implementation of ERP systems in medium size companies. We focus on those companies because they are confronted with the same tasks as large companies, but medium-size companies command fewer resources and therefore have to act more efficiently to succeed in the implementation of an ERP system. The content of the paper stretches from project management, business process reengineering, application development, reporting and customizing to choosing hardware and key users, data migration, and users' training. While other publications give rather general advice, recommendations in this paper are use-oriented and easy to apply. Furthermore, the recommendations do not depend on any particular ERP system.

Keywords: ERP Implementation, ERP System Maintenance.

1 Introduction

Enterprise Resource Planning (ERP) comprises management, planning, documentation, and control of all business processes and resources of an enterprise [7]. Though ERP is based on an integrated information system, it is much more than just information technology since it affects all parts of an enterprise and is usually subject of Business Process Reengineering [6, 16]. Despite decades of experience in ERP implementation, a considerable percentage of implementation projects fails or at least exceeds time and budget [3]. This holds true not only for large enterprises but also for mid-size companies with fewer users and a less complex IT infrastructure.

Several lists of "Dos and Don'ts" and useful hints regarding ERP implementation have been published, mainly on the internet and – in some cases – in scientific papers. However, some of these recommendations are either generic to the level of common sense or very specific (e. g. [14] relates specifically to upgrading to SAP ERP 6.0). This paper summarizes our recommendations on ERP system implementation with respect to medium-size enterprises. At first, section 2 introduces the major phases of every ERP system implementation. These phases are discussed consecutively in the subsequent sections.

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This paper does not focus on any particular ERP system and it is based on both: personal experience of the authors and technical literature. The term "implementation" does not only cover the introduction of an ERP system from scratch, but also the migration from one ERP system to another as well as major upgrades.

2 Process Models for ERP Implementation Projects

The concept of ERP and the first ERP systems were developed in the 1980s. Since then, many implementation projects have been executed – and a considerable percentage of them has failed. A good project plan is mandatory to avoid failure.

A variety of process models was developed over the years and some of these models are augmented with tools and utilities like checklists and calculation sheets. Some process models are specific for certain ERP systems (e. g. On-Target for Microsoft Dynamic NAV [9, pp. 134]). Other process models are maintained by consultancies and IT service providers (e. g. the Accenture Delivery Methods [2]), and some are derived from generic software development models (e. g. from the Unified Process [11], Model Driven Architecture [4], and even Extreme Programming [19]). The various process models differ in their approach to manage interdependencies between project phases, the handling of changes, the availability of supporting tools, and the consideration of software specifics. The mere number of available process models implies that none of them is suitable for all situations. Therefore it is necessary to carefully select an appropriate process model and to adopt it to the specific needs of the implementation project in question.

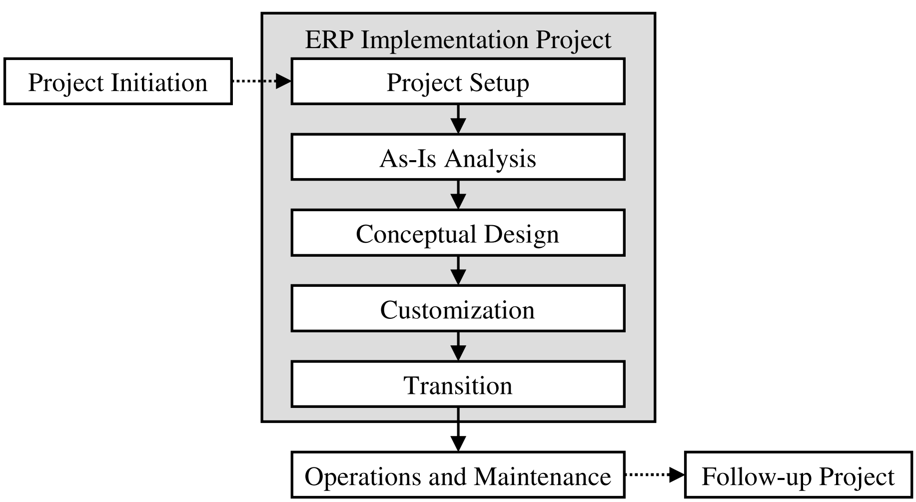

Fig. 1. Generic process model of an ERP implementation project [9, p. 116]

All process models cover the major phases shown in **Fig. 1**. This general model resembles the traditional waterfall model of software development. Despite its simplicity, the model structures our remarks on ERP implementation well.

The *Project Setup* covers the setting of well-defined objectives, the development of a reliable project plan, staffing a project team, and providing all organizational and technical conditions to allow a successful project execution. The *As-Is Analysis* serves to develop an up-to-date business model describing the relevant organizational units, business processes, and legacy systems effected by the ERP implementation. Furthermore, the capabilities of the new ERP system have to be analyzed. During the *Conceptual Design* phase, a to-be concept is developed, and all necessary changes of business processes, of business organization and of the ERP system are specified. *Customization* means to configure and adapt the ERP system as well as the business processes in order to accomplish the previously defined to-be concept. Preparing organizational changes is the more critical aspect of this project phase. The last phase of the implementation project is *Transition* also known as “Go Live” which comprises user training, software installation, data migration and setup of support. Afterwards, the implementation project terminates and *Operations and Maintenance* of the ERP system begin. This last phase should contain a continuous improvement process that aims at increasing efficiency by means of a series of minor changes.

3 Project Setup

A first-time implementation project is usually initiated by top management. Thus, management awareness can be assumed. However, this is not true for major upgrades. In some cases, the project is initiated and driven by only one of several business units that consecutively dominates selection and configuration of the ERP system. Experience shows that all relevant organizational units should be represented equally and that top management support is a key factor for success. Considering an ERP implementation as just another IT project is the first step to failure.

High visibility of the ERP project helps to staff the right project team. The project team usually consists of the core team (internal IT/ERP specialists), external consultants, and key users from the business departments. Business departments show a tendency to delegate the less qualified/experienced – and therefore rather expendable – employees to the ERP project. This means saving at the wrong end. Instead, the best trained and most experienced business experts with the ability of strategic thinking should contribute to the ERP project. Only they are able to identify the best way to exhaust the potential of the new ERP system. Their limited availability for daily business during the project will pay off later by increased efficiency of optimized business processes.

The importance of a good project plan has already been emphasized in section 2. Another crucial aspect is change management: ERP implementation is a socio-technical change process that requires management. Change management deals with all aspects of organizational changes. This includes advertising the project, managing employee education, and managing the transition to ERP based business processes (all company-wide) [12]. A change management agent should be announced. Neither the IT department nor the project manager should take on this role. Instead, a manager of a business department or an external consultant should be assigned to this task.

During project setup, the appropriate technical environment has to be provided. This includes workplaces for the project team as well as IT environment. Though the production system is needed in the transition phase only, systems for development, training, and tests are needed much earlier. The project plan has to consider the delivery time for new hardware in order not to endanger the schedule. A general recommendation is to be generous in providing hardware. Hardware prices are relatively low compared to other ERP related expenses, and the migration of an ERP system from one server to another later on requires significant effort.

4 As-Is Analysis

ERP implementation projects lead to long-term consequences for business execution and are typically combined with business process reengineering. The as-is processes are usually historically evolved and only partially documented. Consequently, the functional requirements for a new ERP system are vague. Therefore, a thorough as-is analysis is necessary. Although this is – or should be – publicly known, some companies omit this analysis and start directly with creating a (mainly) functional requirements list. Since the requirements list is the basis of selecting an ERP system, it should be compiled with care. If the requirements are solely derived from the as-is business processes, the opportunity will be missed to optimize business processes and capitalize on the capabilities of modern ERP systems. It is usually not ambitious enough to just automate the as-is processes since it will increase efficiency only slightly.

Key users are experts in their business. They should play the central role in analyzing and optimizing business processes. Different opinions should be discussed until an agreement is reached. The key users will advocate the new system more convinced and more convincingly if they have participated in its selection and configuration. This at least is our experience from German companies.

There is another risk when requirements lists are not derived from an unbiased as-is analysis: Requirements may be wrongly prioritized [8]. Some key users may favour a certain ERP system right from the start, e. g. if they were in charge of the old system that is about to be replaced. They may try to establish the priorities of requirements in order to steer the ERP system selection towards their preferred result.

5 Conceptual Design

Due to the complexity of the conceptual design, this section covers just a few aspects. The main tasks of conceptual design are the selection of the ERP system to implement, and the development of a to-be concept for all affected business processes. There is a strong interdependence between ERP system implementation and Business Process (Re-)Engineering [13]. ERP system implementation is a chance to introduce efficient business processes. Since there is extensive literature on

Business Process Engineering (see e.g. [10, 18]), we focus on the ERP related aspects of conceptual design.

Selection of a system and a vendor is usually based on three aspects: suitability, sustainability, and cost. The requirements defined during the as-is analysis (see section 4) are applied to check whether a candidate system comes with the required functions and is of high software quality. Sustainability is checked based on the system architecture (which ought to be object-oriented, open, customizable, and web-based) and on the vendor's financial stability. Cost estimation should be based on the Total Cost of Ownership [1].

To a certain extent, all ERP systems can be configured to cover a variety of business processes. However, this flexibility is limited. Thus, the question of customer specific development arises. We agree with [5] on avoiding the development of specific applications as much as possible. In most cases it should be preferred to adopt the business process to the ERP system over extending the ERP system in order to map "traditional" business processes. Often, the adopted process is even better than the traditional one. The operating costs will be lower, no side effects will occur, and all processes will run consistently. The key users should contribute most to the definition of new processes.

When optimizing business processes, particular attention has to be paid to a smooth data flow between all participating departments and software systems. Multi-tenant infrastructure is a special case: The ERP system is used by several companies or profit centers ("tenants") which are strictly separated from each other for the sake of data safety and data secrecy. If there are business relations between these tenants, an inter-tenant document exchange will have to be established in order to transfer all relevant data electronically. Furthermore, a procedure for inter-tenant replicating and updating master data (e. g. materials) has to be developed so that all tenants access the same master data.

If a company is part of a group, consolidation will be required in costing, accounting, and controlling. Consolidation is more than accumulating data from different tenants. Tenants may apply different internal currencies and exchange rates changing over time. That is why values in different currencies have to be converted to values in consolidation currencies. So, exchange rates should be edited equally and simultaneously in all tenants (best via automatic download from the internet and automatic distribution to all tenants to be consolidated). Furthermore, the values of transactions between the group's companies must be marked to be optionally excluded afterwards. Currency differences may not be fully avoidable but one should be aware of why, where, and when they may appear and know how to deal with them.

The consolidation may not work within the ERP system because of the strict separation of the tenants. Consequently, it is recommended to ask the ERP system consultancy for a consolidation strategy and for a(n external) software product for consolidation. In addition to many other reasons, reference customers of the ERP system's provider should be visited for verifying a proposed consolidation strategy.

Conceptual design also initially determines the users' access rights: They should never be granted on the level of single users, but on group level only. User groups may be derived from the company's organisational structure. No "anonymous" users (e. g. "sales" or "trainee") should be created, since it would not be possible to trace the distinct person who has edited data. In multi-tenant environments, it has to be carefully considered which user is granted which right in which tenant (especially for avoiding the editing of data in a tenant erroneously chosen).

6 Customization

Once the utilization concept for the new ERP system is defined, it has to be configured and integrated into the IT landscape of the enterprise. From a technical perspective, there are typically three different types of customization in an ERP implementation:

1. **Codeless Configuration:** This type of configuration requires a thorough understanding of the ERP system and the future business processes, but it does not require writing source code. Instead, codeless configuration is done in an integrated and often graphical environment provided by many modern ERP systems. Alternatively, global control parameters are set. Advantages of codeless configuration are the relatively small effort, the dispensability of software developers, and the high probability that these configurations can be maintained when upgrading to future releases of the ERP system. Codeless configuration should be done by in-house IT specialists supported by external consultants.

2. **Application Development:** It might be necessary to fill functional gaps with specific applications. These applications should be developed by external partners. It usually doesn't pay off to establish the necessary expertise in-house. As mentioned in section 5, customized applications should be avoided if possible.

   Interfaces to other software systems occupy an exceptional position in application development: An effective integration of the ERP system into the IT landscape of the company is a key success factor. In most cases, interfaces to product data management (PDM), manufacturing execution (MES) and warehouse management systems (WMS) are needed.

3. **Key Performance Indicators and Reports:** ERP implementation projects always have to deal with reporting: Standard reports provided by the ERP system must be reconciled with company specific reports already in use. This reconciliation has to be done with care. Otherwise, inconsistencies and misinterpretation will arise which lead to dissatisfaction, repeated "incidence reports", long explanations, and thus additional effort. Reports should not overlap with regard to their content. If this occurs nonetheless, they will have to follow the identical definition and to be executed over exactly the same set of data.

   The expertise for report development should be gathered in-house – in contrast to application development. Key users should be provided with training and appropriate tools to create reports. Most ERP systems provide these tools themselves or they support the application of external business intelligence software.

Testing the customized system is an important task. The test should not be limited to the parts of the software directly affected by customization: Even an out-of-the-box ERP system should not be expected to work error free. At least one successful trial run of each business process is highly recommended. However, testing the main processes could be enough because they cover approximately 85 % of the business transactions.

Test scenarios and test processes should be defined prior to the test. Tests should be documented with text, screenshots and diagrams. The documentation may then be applied as (a basis for) a user's guide.

We recommend testing in small teams of two up to four key users. If the teams are larger, there will be too much idle time, a waste of resources, and no efficient testing. If the teams are smaller, there will be no synergy and tests possibly will be biased. The teams themselves can define tests for their sub-processes, and get other teams to in turn test their own subsequent sub-processes. Nevertheless, the testing should be controlled periodically.

7 Transition

ERP implementation may be done either with a "Big Bang" or in a phased approach (where phases are based either on modules or business units). The phased approach seems to be more secure at a first glance, but is significantly more complicated to realize due to the complex interdependencies between modules and business units [15]. Therefore, we recommend a Big Bang transition at least for key modules. Transition comprises data migration, system activation and user training.

The change of fiscal or calendar year is the best occasion to activate the new ERP system: The year-end closing will be performed in the legacy system, and all transactions of the new fiscal/calendar year will be executed in the new ERP system.

Data migration from the legacy to the new system is an important part of the transition: Data can be transferred either manually or automatically. Manual data migration requires a great amount of personnel for typing in data. It is time consuming and flawed with non-systematic errors which are hard to identify. Therefore, we recommend preparing automated procedures for data migration. Computer programs have to be written which read data from the legacy system, transform data, and write transformed data into the new ERP system. Moreover, automatic data transfer can be executed multiple times for test purposes.

While the migration of master data is rather easy, it is hard to transfer transaction data, since transaction data structures are more complicated and intertwined. Beyond that, the structure of transaction data differs from one ERP system to another. Therefore, the mapping and conversion of record fields do not suffice but structural transformation is needed. The effort to migrate transaction data should not be underestimated.

When starting the final data transfer, data must not be changed in the legacy system anymore. Hence, business activities have to be suspended until the new system is activated. The time needed for performing the data migration is determined by trial runs. Two days up to one week for data migration may be considered normal.

The activation of the ERP system and its performance should be successfully tested in dry runs several times. Shortly after activating the new ERP system, there is no way back to the legacy system because the data in the new ERP system evolve whereas the data in the legacy system do not. Often, the data in the new ERP system are more detailed than in the legacy system. Thus, data migration back into the legacy system is impossible or at least causes data loss. After the activation of the new ERP system, the legacy system can stay available for some users in read-only mode for plausibility checks.

User training and providing a company specific user's guide is another important aspect of the transition phase: The first training involves key users and IT personnel only, takes place immediately after the ERP system is chosen, and is conducted by the vendor of the ERP system. The training of the key users should take place away from the office in order to avoid distractions. It is important to teach the interrelations between all relevant modules (sales, material management, production, accounting etc.).

After all business processes are defined and the system is customized, the key users train the remaining users. The training should not start earlier, because it could be confusing if preliminary versions of the processes were taught. If too much time elapses between training and operating the ERP system, many already trained procedures will be forgotten.

ERP systems are not widely applied in Asia yet. Therefore, most Asian employees are not yet experienced in operating ERP systems [17]. Thus, training them is even more important. Since Asian employees often do not give direct negative feedback, it is imperative for them to perform prepared exercises and answer compiled control questions. Thus, their understanding can be assessed and deepened if necessary.

Detailed and up-to-date documentation should back up the training and be available for every user. The documentation should cover all business processes. The key users may themselves document the processes they are responsible for. Each guideline must contain purpose, preconditions and potential outcome of the business process. The execution of most business cases can be described by a sequence of screenshots and a few explanatory words. Complex or important processes should be documented in detail. The documentation may be augmented by lists containing dos and don'ts. Moreover, there should be a general guideline explaining how to log on/off, how to find records, how to execute transactions, how to export data, how to use online and context-sensitive help, and so on.

8 Operations and Maintenance

Once the transition phase is completed, the ERP system is used on a daily basis and is essential for the survival of the company. Due to the tremendous importance of the ERP system, it has to be maintained carefully by the IT department. System maintenance covers many tasks: Regular tasks are e. g. daily checks of backups and log files, weekly reporting, monthly checks of users' access rights, yearly reengineering of business processes and system configuration, and refreshment trainings. Sporadic tasks are e. g. creation and decommission of users, change of access rights, client installations, hardware upgrades, ad hoc data analyses, troubleshooting, and communication with the system vendor.

As a rule of thumb, the number of IT specialists needed for internal maintenance and support should equal the number of users divided by 100 and rounded up. A lack of manpower for maintenance and support reduces efficiency of ERP, strategic issues are neglected, and significant costs are induced. We recommend employing two teams of equal size: one for operative tasks, the other for long-term tasks. Members of one team should be able to act as substitutes for members of the other – especially if there are two "teams" consisting of only one person respectively.

Even skilled internal personnel will not know every technical detail of the ERP system. Hence, external maintenance and support are needed. If the system operates more than twelve hours per day, extended external maintenance and support is recommended, even if costs increase progressively. The procedure of incident management has to be settled with the vendor during the design phase already. The most important criterion for good maintenance and support is a guaranteed response time relative to inquiries. Incident classification and initial support as well as investigation and diagnosis should be provided within 24 hours. Resolutions should be achieved within two work days for 85 % of the issues.

External maintenance and support causes annual costs ranging between 15 % and 25 % of the license price. These costs seem to be high but external maintenance and support guarantee the ERP system running smoothly. If the ERP system crashed, business activities could not be maintained. That would cause financial damage much higher than the costs for external maintenance and support. Costs for external maintenance and support should be weighed up against losses caused by a potential crash of the ERP system.

An important aspect of system maintenance is release management: If there are no functional or monetary reasons for skipping releases, a release change is recommended. A new release should be adopted relatively early for the company to benefit from advanced functionality. However, the position of a pilot customer should be avoided since new versions often have to deal with start-up difficulties. In general, a release change should be treated like the implementation of a new ERP system.

9 Summary

In Western and Central Europe, Enterprise Resource Planning is state-of-the-art not only for large, but also for medium-sized enterprises. Although there is comprehensive know-how about ERP implementation in the field, many implementation projects face serious issues and exceed their schedule and budget. This paper presented a collection of "Dos and Don'ts" for successful ERP implementation in medium-sized enterprises. From our point of view, key success factors are top management support, involvement of the business departments and a well-considered project plan which takes the company's specifics into account and is carried out thoroughly.

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ERP Post-implementation Issues in Small-and-Medium-Sized Enterprises

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Abstract. This paper focuses on ERP post-implementation issues in Small-and-Medium-Sized Enterprises (SMEs).We conducted a case study in a small Norwegian retail company. We studied the enterprise in the period after going live with their new ERP system. Certain challenges were observed such as security risks because of inaccurate configuration of the system, difficulties with operational issues such as sending invoices and getting sales reports, inaccurate inventory, insufficient training arrangement, workarounds, conflicting incentives among customer, reseller and consultant. There were human consequences for end users since the implementation of the system caused stress among some of the employees. This study has implications for other SMEs planning to implement ERP systems.

Keywords: ERP post-implementation, SME, workarounds, performance dip.

1 Introduction

This study focuses on the post-implementation phase of an Enterprise Resource Planning (ERP) implementation project carried out in a Small-and-Medium-Sized enterprise (SME). ERP systems are integrated software solutions offered as off-the-shelf packages from different vendors [1]. The systems are used to manage organizational resources by integrating information flows across departments and functional areas.ERP systems have become increasingly popular and have been implemented in companies of all sizes. Research has proved that companies can achieve benefits from ERP systems by getting seamless information flow, increased efficiency, reduced costs and faster customer response [1]. However, ERP systems are technical complex, difficult to configure, and imply organizational and human challenges when implemented in companies [2]. Moreover, many implementations have gone far over budget, have taken longer time than estimated, and some have even failed [3]. Especially in SMEs, poor outcomes of an ERP implementation may threaten the existence of a company [4]. Normally, SMEs have limited resources and internal information technology (IT) competencies available compared to larger companies. Accordingly, ERP implementations in SMEs are risky.

So far, there are few research studies focusing on ERP implementation projects in SMEs. Especially there is a scarcity of research focusing on issues in the ERP post-implementation phase. It is therefore important to assemble more knowledge about how SMEs tackle and survive complex ERP implementations. Our research focuses

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on the post-implementation phase of an ERP project in a small Norwegian enterprise operating in the boat equipment retail industry. The following research question has guided our research: *How do SMEs experience the post-implementation phase of an ERP implementation project?*

2 ERP Post-implementation Issues and Related Research

The ERP literature is quite comprehensive, and in this section we briefly review studies related to ERP implementations, and particularly focus on post-implementation issues. We start with the literature on lifecycle models and critical success factors since success in the post-implementation phase is normally dependent upon how former phases of the project has been planned for and carried out.

Several empirical studies have identified critical success factors for ERP implementation projects [4]. Most of the critical success factors identified in this literature are also relevant for SME, however, previous research suggests SMEs to pay more attention to critical actors such as external consultants and internal project participants involved in the implementation project [5].

In the ERP literature, lifecycle models are developed to illustrate central phases during an ERP implementation project. These models consist of three to six different stages and have similarities in terms of emphasizing pre-implementation, implementation and post-implementation phases [3, 6]. There are certain challenges connected to each of those, and the decision a company makes while selecting software and signing a contract with a vendor and consultant, may lead to good or bad outcomes in the post-implementation phase.

We define the start of the post-implementation phase to be when the system goes live and has been rolled out to the end users. If we follow Markus' and Tanis' life cycle [3], both phases III (Shakedown) and IV (Onward and upward) would belong to the post-implementation phase. In this phase, stabilizing of the system starts and bugs need to be solved. In addition, the training of users may continue and further data converting from old systems to the new one will normally carry on.

Ross & Vitale [6] studied how ERP implementation projects in fifteen different firms generated business value. This research study describes the stages of this project as an "ERP journey", going through challenging phases of design, implementation, stabilization, continuous improvement, and transformation. In the stabilization phase, the company must get back to normal operations as fast as possible to avoid a long "performance dip" [6]. In this phase, when the systems are "going live", major organizational changes were introduced which again caused problems. The main issue was that the new system also required changes in business processes, and consequently it was not possible to implement those separately because they were very much interdependent. Impact on individuals was highly underestimated. Firms without former implementation experiences went through longer stabilization periods and performance dips. In worst cases, several errors occurred in ordering and shipping to customers, and some transactions could not be accomplished. Some people worked a lot of overtime, and overexerted themselves.

With long performance dips, companies may lose sales, and staff may try to avoid the system by working around it; e.g. going back to old routines and systems. The concept of workarounds is defined as: “computing ways for which it [the system] was not designed or avoiding its use and relying on an alternative means for accomplishing work” [7 p. 216]. Workarounds are not unusual in ERP implementations [8]. ERP systems do often discipline the organization in terms of increased control and higher levels of centralization, imposing new and specific routines for carrying out tasks [9]. This may cause resistance among users since cultural changes are challenging to implement (e.g. introduce discipline through an ERP-system into an undisciplined organization). Several empirical studies of ERP implementation illustrate how the technology causes changes in organizational routines, roles and data [9]. For instance, transactions in the ERP system dictated steps which were quite different from old routines. Even if new routines are good routines that improve practice, they may create resistance if the learning curve is steep. In the study of Volkoff et al. [9], the loss of flexibility by introducing an ERP system created challenges. Before the system was implemented, the users had several ways of performing a routine. Because of the system’s disciplining effect, flexibility was replaced by standardization which again reduced the variety in how a routine could be accomplished.

Workarounds may not only have negative effects for the organization. Users may also create new routines to respond to weaknesses in the new ERP system. Resisted systems might then be reinvented in use and create improvisational learning processes within the organization [10]. Related concepts to workarounds in information systems (IS) are “bricolage” and “tinkering”, describing how work really gets done by constructing ad hoc solutions, going beyond formal procedures. For example, in studying appropriation processes of IT-systems supporting collaborative work, Ciborra [11] observed the tendency of “drifting” which describes discrepancy from intended use towards context-based user patterns. The concepts of “bricolage” and “tinkering” in this setting describe improvisations to fix ad hoc problems for getting the technology appropriated to work practice in a local context. This way of learning, can sometimes be better than for instance formal training programs which in some cases may interfere with real learning processes [10]. Informal learning processes occur through daily use of systems and are integrated with social practice in the organization, and individuals prefer to learn from their trusted colleagues and not through formal training programs.

3 Research Site and Method

The research site is one of Norway’s largest boat equipment retailers. The company has shops in six geographical locations of Norway. Approximately 50 employees work in this firm, and the business has an annual turnover of 130 million (NOK). The company sells all kinds of accessories to boats such as life vests, wet suits, sailor cloths, equipment for sailing ships, mooring equipment and lines, booms, and engine fixtures. In addition, they offer services of boat lay ups and boat maintenance. The sales channels are internet, mail orders, and traditional shops.

The new ERP project started in 2005, and the goal was to replace the existing legacy systems with a more efficient, integrated and competitive ERP solution. The CEO had experience from the boards of several SMEs, and knew that ERP implementations are riddled with problems. He also had experience from previous IS acquisitions, among these a CRM system. The CEO and the CIO attended an annual ERP user conference in 2005-2008. This conference gave an overview of the EPR vendors and systems, and guidelines for how to acquire ERP systems.

The company aimed to increase effectiveness by providing a better e-commerce solution, better logistics, and improved integration across their departments and shops. E-commerce supported by the web shop solution was recognized as the most critical system. It was important to obtain a competitive position in the market since many customers preferred to order online. One objective was to transform the older architecture to a more modern technical platform that supported integration of different systems as well as automation of core processes. Thus, the company looked for a new system that enabled integration with their web-solution, the point-of-sales (POS), and the CRM-system. Secondly, they needed a system that externally supported integration with financial institutions. Additionally, the new ERP system should hold sufficient logistic functionalities and a good document repository. The project team surveyed vendors, and compiled a short list in the middle of 2008.

Competence building in advance of the project was central. In the beginning of the project, the company had to tackle an array of different challenges such as tough negotiations with vendors, retailers and consultants. The company's business networks were used to get an overview of the reputations of ERP retailers and consultants in the marked. The firm organized auditions to identify the consultants with the best ERP skills by requiring them to solve case scenarios. In that way, the most competent people could be selected for the job. In addition, the company wanted to develop a long term partnership with the consultant. In sum, the pre-implementation phase was a long and challenging period for the company. To choose the most sufficient actors for implementing and supporting the system, seemed to be just as critical as selecting the system itself [5].

We chose a *single* case study to gain a more comprehensive in-depth study of the ERP post-implementation process in one organization. A single case study is an important source for providing detailed descriptions of specific organizations. Moreover, a case study was suitable because of the exploratory design of this research and the nature of the research question; e.g. *how* do SMEs experience the ERP post-implementation? A second reason for choosing a case study approach was that we felt the existing body of literature did not adequately describe the phenomenon under investigation [12].

We have used a combination of qualitative interviews and a quantitative survey as primary data sources. We conducted ten semi-structured interviews with six different participants. These participants were all leaders at the six different locations of the firm. The interviews were conducted face-to-face or by using Skype, and lasted one hour or more. All the interviews were digitally recorded, and fully transcribed. Based upon the emerging themes from the interviews, a survey was set up and sent out to all employees, and thirty-seven of fifty employees responded. The data from the survey was valuable add-ons to the interviews for supporting emerging themes. We also observed the intranet discussion forum where employees discussed problems with the ERP system. The process of data collection and analysis proceeded iteratively, allowing themes to emerge and then to be examined more deeply as relevant. We combined existing theories and concepts from the literature (e.g. ERP lifecycle models, workarounds, performance dip) with empirical findings to get a broader understanding of the phenomenon of ERP post-implementation issues in SMEs.

4 Research Findings

We have categorized our findings into four main themes: 1) workarounds, 2) training, 3) incentives among the actors, and 4) culture of openness in the company. We saw that the company had some of the key characteristics of a SME, such as limited competence, skills and personnel resources to assign to the project. Such limitations turned out to be a major factor in this case. The CEO explained that *"We should have specified the [requirements] better, but we had no chance to specify this [properly]. We did the best we could, but it was by far not good enough"* This comment does illustrate the complexity problem facing a SME company embarking upon an ERP implementation.

The company experienced a "performance dip" which lasted longer than expected. The project team was aware that challenges would arise during the ERP implementation; however, they did not recognize the compass of additional issues arising in the post-implementation phase. The most serious problems were security issues due to incorrect configuration of the system, problems with extracting transaction data to get sales reports, difficulties with sending invoices, inaccurate inventory due to point-of-sales workarounds, and lack of satisfactory ERP competence among the users due to insufficient training arrangement.

The first three of these issues relate mainly to the technical configuration of the system, and was tackled by hiring the consultant for one day per week after the system went live. The last two issues (belonging to the four main themes) did, however, have severe ramifications for the organization and will be further discussed below.

4.1 Workarounds

There were several instances of workarounds. Most instances were due to sales employees not being able to carry out transactions in the Point-of-Sale (POS) system. The CEO explained: "*[An employee] tries to register an order, but the system will not allow it. If the item is not registered, you cannot sell it. So, you stand there, and the customer stands there. The customer gets annoyed, and the employee gets sad or angry."* The manager of one of the retail shops corroborated this: *"Sometimes you just have to [make a workaround] to make the sale"* Several interviewees noted that it was not an option to make the customer wait until they figured out what to do in the ERP system.

The interviews with the employees revealed that workarounds were quite common. In the start, the system was new to the users, and they did not know completely how to use it, and what were the correct procedures. Employees had quite creative ways of handling challenges. The CEO pointed out that such errors early in a process eventually lead to many errors in the database. He further added that they will have to count all the items in the warehouse, and correct the database manually. Managers of the retail shops were quite frustrated with this situation. The manager of one of the retail shops commented: *"We see that [problem] daily, when [the system] says that we have 10 items in stock, and we cannot find any"*.

Eventually, with the help of the consultant and key personnel from the main office, the company was able to come up with solutions and new routines. They established a help telephone service, manned by an external consultant, to assist the employees in using the system. The employee survey indicates that the situation improved significantly during the first year.

4.2 Training

One of the most prominent finding was the lack of training in the ERP system and the Point-of-Sale (POS) system. The CEO had determined that the training offered by the vendor would not be appropriate. He was very critical to the training quality, and believed that they could provide a more adequate program by themselves. The company therefore decided to decline the vendor's offer for user training courses.

Three of the retail shop managers indicated that the training had not been good enough. The two other shop managers thought that the training had been fairly good, and that it was best to learn to master the system by using it. One of the shop managers was particularly critical to the training. He had experience from several ERP system implementations and knew how challenging such projects are. He commented that *"I have a clear conception of how a decent training system should be. What happened in [the company] was very ad hoc."* He suggested that training courses should have been addressing the various functions, for example separate courses for the supply and for retail functions. The poor training quality was corroborated by the survey responses from the employees, and most of them seemed to be quite critical to the training. One employee commented that "*The start–up was extremely hectic, everything was in chaos. … It resulted in a lot of discussion and uneven learning, since no-one was certain about anything. A lot of routines were not ready, and we had to figure out what to do as we came into trouble. When the people at the top are confused, we also get confused"*. The CEO had produced manuals and training videos to improve and support the employees' learning processes. The videos show step by step how to perform various processes. These resources were put on the server, and became accessible for anyone. Another action was that super users, who mainly were located at the main office, would visit the retail shops and give training seminars there.

4.3 Reseller and Implementation Consultant Incentives

The company went through a long process to select the ERP system, the reseller and the implementation consultant. The project team arranged auditions with the potential resellers. Several of the resellers and their consultants performed poorly at these auditions. The CEO also used his business network to assess the proficiency and the track record of the resellers. In this way they were able to select a very proficient consultant. The consultant was selected because of his comprehensive experience with the system, and his good track record in other implementation projects. The CEO noted that the consultant clearly had a much higher competence than what would be feasible to build up internally. Even if they managed to build that competence internally, it would likely be located to just one person. Such ERP-skilled employees are in strong demand, and if that person decided to leave, it would be a significant problem for the company. The CEO further added that *"Computing is not what we make a living from. It is just a cost."*The company therefore decided to establish a long term relationship with the consultant, where he would work for the company one day per week in the post-implementation phase. He would primarily do further configuration and additions to the code.

The CEO noted that the consultant was quite popular with other SMEs, and that this gave him a quite strong bargaining position. He was therefore allowed to encrypt the code he made. According to the CEO, the consultant wanted to make it difficult for the company to replace him. The CEO believed that this was common practice among implementation consultants. The documentation of system modifications is therefore lacking.

As presented above, the company declined the vendor's offer for training courses. The CEO stated that there was no competition between the vendors regarding training quality. He added that: *"The revenue flow has been achieved for the vendor as long as we keep the system. Because then you generate cash-flow every year. Thus, they have no incentive for lifting us from [good enough] to very proficient."*He further noted that: *"they sell [expensive] general introduction training packages. They sell courses, but then it is the income from the courses that is the goal. … [They do not] have an ownership to the results in the customer company."* The project team conjectured that once they had acquired the system, the vendor would primarily be motivated by generating revenue from the courses. They would not really be concerned with the proficiency of the customer. He also believed that such courses would be mostly general introduction topics and that the company could do better in-house.

4.4 Culture of Openness

One interesting feature of the company has the very flat organizational structure. It is a short way from the individual employee to the top management. This is illustrated by the way the intranet is set up. When a PC is turned on, it will pull up the company news page. Any employee can post news on this page. They also have a discussion forum on the intranet with topical areas such as accounting, web-shop, POS, error reporting etc. Any employee can post to this forum. The CEO has promised to read all entries. He believes that it would give employees a sense of being heard. He noted that *"The [employees] have an enormous competence. They are closest to the customers, and they are closest to the products. How do you become a learning organization? … How do you lead the information to the top, and how do you make it a consequence downward?"*

We examined the discussion forum, and found that it was used extensively. One tread had more than 400 responses. Several of the key personnel had several hundred contributions. There was a quite informal tone, personal quotes and humoristic avatars in the user profiles. One of the retail shop managers noted that he felt that "everyone has access to everyone", and he saw this as very positive, but he also noted that he believed that it meant a lot of extra work for key personnel. Indeed, many employees have indicated that the ERP implementation project was a stressful period for the company. The CEO attributed two people leaving the company to the stress level. He also commented that he was rushed to hospital in an ambulance last year because of the stress level.

5 Discussion

This case explores the post-implementation phase of an ERP system in a retail SME. We discuss the most prominent issues in more detail. Firstly, the use of the system was hampered significantly by workarounds. The workarounds led to significant problems and many errors in the data-base, and interfered with the work processes of other employees. These errors would require significant manual work to correct the data-base. These workarounds stemmed to a large extent from the employees' lack of skills in the appropriate routines, due to inappropriate training. We conjecture that the limited IT management competence and IT personnel resources contributed to this problem.

Several studies have demonstrated that SMEs generally have little competence related to ERP implementation [13-15]. The CEO of this company did have significant experience from previous implementation projects, and had knowledge about ERP implementation in other SMEs. This company therefore had a better competence related to ERP issues than what can be expected in a typical SME. They took many steps to build the internal competence on ERP acquisition and implementation. They therefore were able to identify an appropriate ERP and a competent implementation consultant. However, the training of the users was not good enough. We saw that the company decided to manage the training in-house, but that did not work out very well. Clearly, the employees did not acquire sufficient skills in the new routines that the new system required. We argue that the company underestimated the challenges in providing sufficient training quality.

Secondly, we saw that there were significant differences between the incentives of the company and the consultant. The company needed to go into a long term relationship with the consultant, and it will continue for several years after the implementation. The CEO had determined that the specific consultant was very proficient and the best one that they could hire. Skok And Legge[16] found that consultants are very important to ERP implementations. They also found that consultants often would follow their own agendas. Haines and Goodhue [17] report similar findings, and noted that such agendas may do more harm than good for a company. The consultant was in a strong bargaining position and could thereby be allowed to encrypt his code. This meant that the documentation of the code modifications would not be available for others at a later stage.

We also saw that the CEO did not trust the vendor to provide appropriate training. He believed that their main motivation was to generate revenue from the courses, not necessarily to make the users very proficient.

Thirdly, we saw that the company had a flat and very informal structure. The employees were able to vent out their frustrations openly, and bring the problems and reasons for frustrations to the surface. They were therefore able to create a cooperative climate to solve the challenges on the intranet. We conjecture that this eventually alleviated the problems related to the use of the system, and to the creation of good solutions.

6 Conclusion and Implications

This SME faced many challenges when they implemented a new ERP system. We have focused on the post-implementation phase in this article. We found that the company did not believe that the vendor's standard training courses would be good enough, and decided to manage the training themselves. This proved to be more challenging than the company had believed, and they failed to provide adequate training. Lack of skills in the appropriate use of the ERP led to many workarounds, which again led to many errors in the data-base, and costly and time-consuming manual corrections. This led to a general level of frustration with the system, and a high stress level in the company.

This is an exploratory study, and it will serve as input for subsequent qualitative studies of ERP post-implementation in SMEs. Specifically, issues relating to the supply of appropriate training, and the incentive differences between consultants and the customer companies should be explored further.

The results also have some relevance for practice. Lessons learned from this case study could be transferred to other companies and support them in a challenging ERP post-implementation process. As this case illustrates, creating an appropriate training program is a crucial task that may have severe ramifications if not handled properly. SMEs usually have limited resources and internal IT competencies compared to larger enterprises [15]. Such companies acquiring an ERP system will probably be directing most of their internal resources towards the very challenging tasks of selecting the appropriate vendor and consultant, and managing the implementation process. The challenges of setting up an appropriate training program should not be underestimated. The ramifications of an inappropriate training should also be acknowledged, both in terms of costs and strain on the company. We cannot generalize the findings, but the case should still serve to enlighten SMEs about the challenges in the post-implementation phase of an ERP project.

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Business Process Orientation in Greek SMEs: Analysis of Manufacturing Processes and Their Enterprise System Implementations

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Abstract. The use of best practice manufacturing processes by Greek SMEs is examined, along with the corresponding process implementations with packaged enterprise systems (ES). The study analyzes individual processes from an implementer's perspective, focuses on deficient process use cases, and explores the causes of such deficiencies. Production master data, and planning, scheduling, execution, costing, and Business Intelligence processes are analyzed on a sample of 15 Greek SMEs which have successful implementations of a single ERP system. Deficiencies are observed in production planning, scheduling and standard costing. They can be attributed to the lack of knowledge and experience, and to the business culture of the companies. A broad business process reengineering is also required before these processes can be implemented. The results suggest that, under low process and ES use maturity conditions, an analysis of individual processes is necessary before the evaluation of higher-level business process orientation and business process maturity indicators.

Keywords: Business process orientation, enterprise system, ERP system, Manufacturing, SME, Greece.

1 Introduction

This study addresses the practices of small and medium-sized enterprises (SMEs) which have packaged enterprise systems (ES) in using manufacturing business processes. It extends similar analyses of sales and purchasing processes [1,2]. It is motivated from observations on ES implementations of Greek SMEs, which suggest that ES are not used to their full potential of integrating, optimizing, and informating the enterprise as described by Davenport et al. [3]. Several business process use deficiencies occur such as the following ones: Processes which are generally considered to be best practices are not used; processes are carried out without using the ES; processes are used in a non-systematic way; process results are not always posted into the ES, hampering information extraction for decision support.

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Although the above issues of ES implementations in Greek SMEs are apparently known to ES implementers, they have not yet drawn broad attention for a systematic analysis. The present study addresses the following research questions:

- Do companies use best practice business processes?
- Do companies carry out these processes with their ES?
- In case of process and/or ES non-use, what are the causes of such deficiencies?

The study contributes to Markus and Tanis' [4] research question, according to which, despite the wide ES adoption rate, "it is not yet known how widely these technologies have been *assimilated* ([5]) in organizations, for example, how extensively they are used within the organization, how faithfully they are used, and how effectively they are used".

2 Review of Prior Research

Some field studies are here reviewed which address business processes and cover the following subjects:

- Deficiencies of business process and ES use [6-8]
- Use of individual business processes in ES implementations [7-10]
- Business process orientation and process/ES maturity [10-16]
- ES use and metrics of business process performance [17, 18]

Shang and Seddon [6] analyzed process use deficiencies for medium-sized organizations. The examined deficiencies, according to the authors, were due to inappropriate process changes during ES implementation. The sources of the observed deficiencies can be summarized as follows: Inefficient business process reengineering (BPR); inefficient ES configuration and use of default ES configurations in particular; complicated process models, demanding excessive work for data entry and processing, even for relatively small jobs; bureaucratic processes with excessive crosschecks, lacking flexibility in exception handling such as missing data or check point handling; end user difficulty in adapting to the new roles and extra work such as systematic data entry; uneven quality of different modules of a single ES implementation.

Peng and Nunes [19] presented an ontology of ERP post-implementation risks which contains references to use deficiencies of operational and analytical processes. Peng and Nunes [7] and Pan et al. [8] measured ERP post-implementation risks using this ontology, and reported deficiencies for instance in master production scheduling (MPS) and material requirements planning (MRP), which were attributed to deficiencies in independent demand forecasts, bills of materials, and inventory.

Beretta [9] defined the business process as a flexible structure which allows for the organization of information and activities under a value generation goal. He argued that process-based performance measurements can optimize the design and execution of processes, and allow for a better exploitation of the advanced potentiality of the ES. The author described the application of his approach to the redesign of a maintenance process in a big chemical plant.

Hammer [10] presented a process and enterprise maturity model, whose dimensions are process enablers and enterprise capabilities, and gave examples of the application of his model in individual process evaluations. Similarly, several process orientation studies, as for example [11-16], defined dimensions and metrics of process orientation, which cover qualitative aspects of process use. These studies measured overall process orientation (on groups of processes) based on company personnel judgements. With respect to the role of ES, information and management systems are a process enabler in Hammer's [10] model, and the degree of process integration due to the ES use is a dimension of Reijers' [14] and Kohlbacher's [11] process orientation constructs. The role of ES is not referred to, at least explicitly, in Škrinjar et al.'s [15], and Kohlbacher and Gruenwald's [12] process orientation constructs, while it is separated from process orientation in Kumar et al.'s [13], and Trkman et al.'s [16] studies.

The studies of Gattiker and Goodhue [17], and Wieder et al. [18] measured business process performance indicators on groups of processes, evaluated subjectively by company personnel. Wieder et al. recognized the need to study individual processes.

Some features of the approach of the present work with respect to the previously mentioned studies are the following ones: Firstly, the research questions of present study have not been addressed in the other studies at least systematically. Shang and Seddon [6] provided some examples related to the second and third research questions. Secondly, the present study, analyzes individual processes, and uses objective measures in addressing the first two research questions. Finally, the present study focuses on SMEs and a non-"big" ES system. With respect to SMEs, only [6] covered medium-sized companies running SAP and PeopleSoft ERP systems, while the other studies used samples of big, mixed, or non-stated company sizes.

3 Analysis Framework

A framework for analyzing business process use practices of SMEs, and especially deficiencies has been proposed [1]. Aspects of this framework which are relevant for the present study are reviewed in the following.

Company process and ES practices, and especially deficiencies, can be analyzed by reference to a set of best practice processes which are in principle relevant to the company activities in the functional area under consideration. The processes and the degree of analysis in sub-processes and functions are selected by the investigator. The process reference set may and typically does include processes which have not been included in the ES implementation plans. The systematic use of all the processes of the reference set and their implementation with the ES is assumed to represent an optimal practice. Departures from this optimality are deficiencies. This can be considered as a special case of Markus and Tanis' [3] *optimal success* concept, applied to the business process level, and evaluated from an external to the company point of view.

For each process of the reference set, the practices of a given company are checked, namely whether the company uses the process and whether it carries the process out using the ES. There are processes whose implementation is impossible or very difficult or inefficient without the ES. In these cases, process and ES use are connected.

Furthermore, the use of special categories of processes can indicate the degree of ES use maturity. As far as the present study is concerned, decision support and Business Intelligence processes are considered.

4 Research Methodology

The field data of the present study come from a sample of 15 Greek SMEs, henceforth referred to as the Companies (with a capitalized initial). They are the companies of the studies [1,2] which have manufacturing units. All the Companies use the same ES. The ES was produced and implemented by a Greek SME ES manufacturer.

The ES under consideration is an applications suite which includes fully integrated ERP, CRM, business to business e-commerce, and BI applications, based on Oracle technologies. The present study refers to the ERP and BI applications. The manufacturer's policy was to offer turnkey solutions to its customers and encouraged them to provide their special business logic for each business process. For each Company and process, a considerable amount of ES customization was done.

A reference set of manufacturing processes has been developed. Data were collected using a questionnaire and extensive discussions with a single informer, the principal ES Implementation Consultant who carried out all the implementation projects of the Companies. Data collection covered organizational and decisional features of the Companies, ES implementation project features, process use and process ES implementation (i.e., whether each process of the process reference set was used, and whether it was carried out using the ES by the sample Companies), the causes of deficient process and ES use, and the particular method of process implementation, in cases where various methods were available. The choice of a single knowledgeable informer aimed at ensuring complete and low-noise data, measured from a single point of view, which was necessary given the relatively small Company sample size.

The Companies have annual turnovers with minimum, maximum, and median values of 2, 40, and 10 million Euros respectively. Twelve Companies are family businesses. Two Companies have a purely make-to-stock (MTS) production, four Companies have a purely make-to-order (MTO) project-based (job shop) production, and nine Companies have mixed MTS and MTO productions.

At the data collection time, the Companies had used the ES for about 6.5 years on the average.

5 Results

The process reference set is given in Table 1. It includes manufacturing processes which are in general relevant for SMEs, and covers master data, planning, scheduling, execution, costing, and BI.

The analysis results for the 15 sample Companies are summarized in Table 1 as well. For each process, the number of potential users is given, i.e., the number of Companies for which the process in principle applies. Next, the number of Companies which carry out the process with and without the ES are given. Processes whose implementation without the ES is difficult, inefficient or impossible are marked with a non-applicable (n/a) sign.

Process and ES use deficiencies are discussed in the following. The discussion of the causes of deficiencies is based on the Implementation Consultant's judgments.

Manufacturing Master Data. Product configuration presents great complexity for the products of the 4 job shop Companies, and is carried out with CAD software. This is due to the complexity of the actual projects, which in most of the cases leads to bills of materials (BOMs) with more than 300 materials. For one Company, the output of the CAD software automatically creates the final product BOMs in the ES.

Routing definition in two thirds of the cases is not complete, since standard times and capacities are missing. Routings support production planning and scheduling, as well as product costing (cost center and standard time definition). These data become important and have to be defined in case a company decides to implement production scheduling and/or standard costing.

Production Planning. Going from one planning level to the next (Table 1, processes 2.1 through 2.4) requires finer tuning and detailed scheduling of actions. BOM-based purchase material planning is usually well suited under the MRP paradigm. Production order planning is more difficult, due to the "flexible type" and the size (i.e., many orders with small size) of the usual productions of the Companies, which is also typical for most of Greek SMEs. *Flexible type* means that an order which is accepted and released for production can change the actual production schedule. This is a typical behavior due to the small size of the Greek market, where demand is mainly composed of many small orders.

MPS, MRP-based purchase order planning, MRP-based production order planning, and CRP are used by respectively six, six, four, and three Companies. The basic causes of deficiencies are the following ones: Companies have a particular business culture of using empirical rules in production planning, and have difficulty in adopting "automated" methods. Furthermore, many companies lack the skills of a knowledgeable process planner to use and manage efficiently such tools. The lack of knowledge for MRP implementation by Greek SMEs has been pointed out by Argyropoulou et al. [20] as well. Many Companies also work with small intercalated production orders, in an effort to satisfy the corresponding sales orders. This is probably intensified by the small market size in Greece, as noted earlier. Finally, the right use of these "automated" planning methods needs systematic actions and discipline in their application, a prerequisite, which apparently, is not suitable for the business culture of several Companies.

Table 1. Manufacturing process reference set and analysis results (PU: Number of process and ES potential users; ESU: Number of ES users; PrU: Number of process users, where the process is carried out without the ES)

#	Process Category / Process	PU	ESU	PrU
1	**Production master data**			
1.1	**Product configuration**			
1.1.1	Product configurator for MTO products	10	6	4
1.1.2	Use of configured product features in planning and costing	10	10	n/a
1.2	**BOMs & Routings**			
1.2.1	BOM versioning	15	15	n/a
1.2.2	Routings	15	15	0
1.2.3	Routing versioning	15	15	n/a
1.2.4	Routing standard lead times and capacities	15	5	0
1.3	**Factory structure**			
1.3.1	Multilevel hierarchical production structure	15	15	0
1.3.2	Work centers	15	15	0
1.3.3	Allocation of machines to work centers	15	15	0
1.4	**Calendar**			
1.4.1	Calendar (working days, shifts, manpower) per factory	15	5	10
1.4.2	Calendar (shifts, manpower) per work center	15	5	10
2	**Production planning**			
2.1	MPS	15	6	n/a
2.2	MRP - purchase order planning	15	6	n/a
2.3	MRP - production order planning	15	4	n/a
2.4	CRP	15	3	n/a
3	**Production orders**			
3.1	**Production order issue**			
3.1.1	Manual issue of production orders	15	15	n/a
3.1.2	Issue of production orders with respect to sales orders (MTO)	13	13	n/a
3.1.3	Issue of production orders based on MRP	15	4	n/a
3.1.4	Material allocation upon production order issue	15	15	n/a
3.1.5	Material allocation upon purchase receipts for job shops	4	4	n/a
3.1.6	Raw material lot monitoring	15	6	9
3.1.7	Serial number monitoring of finished products	13	13	n/a
3.2	**Production order scheduling**			
3.2.1	Automatic scheduling based on optimization algorithms	15	1	n/a
3.2.2	Semi-automatic or manual scheduling	15	3	12
3.3	**Production order execution**			
3.3.1	Real time monitoring of production execution with respect to schedule	15	4	11
3.3.2	Real time monitoring of man- & machine-hours	15	8	7
3.3.3	Productive and non-productive times monitoring, monitoring of idle time causes	15	8	7
3.3.4	Data collection methods (e.g., barcodes) for consumptions, waste	15	6	9
3.3.5	Production warehouse - WIP monitoring	15	15	0

Table 2. Manufacturing process reference set and analysis results (cont.) (PU: Number of process and ES potential users; ESU: Number of ES users; PrU: Number of process users, where the process is carried out without the ES)

#	Process Category / Process	PU	ESU	PrU
4	**Product costing**			
4.1	Standard costing (standard BOM, standard lead times)	15	3	12
4.2	Production cost accounting	15	15	0
4.3	WIP costing	15	15	0
4.4	Costing per production order & task	15	15	0
4.5	Multiple costing scenarios & cost distribution scenarios	15	15	n/a
4.6	Analysis of production orders cost in various costing elements such as material, labour, subcontracting, overheads, depreciation, etc.	15	15	0
4.7	Automatic posting of production post results to inventory and extended ledger module	15	15	n/a
5	**Production Business Intelligence**			
5.1	BI analytics	15	14	n/a

Production Orders. To work properly, item allocation to production orders requires a correct ES representation of physical stock including work-in-progress (WIP) materials. Item allocation is the by default function of the ERP system upon production order issue, and is used by all the Companies. However, in practice it is often cancelled by the Companies, because of deficiencies in the above mentioned prerequisites of stock representation. In these cases, Companies de-allocate the stock, and re-allocate it just before the actual consumption. In case stock is not available, they de-allocate stock from other production orders in progress.

The ES management of incoming raw materials in lots is followed when high quality standards and traceability are necessary prerequisites of final product output certificates. It requires a well-managed warehouse with application of well accepted WMS principles. Although the process applies for all lot-based materials, the Companies consider that its ES implementation is counter-productive price-performance-wise.

Automatic scheduling is particularly difficult, since it requires a perfect organization and functioning of procurement, inventory management, and production planning. The causes of non-use are the same with those mentioned in production planning. An additional cause is the inherent high complexity of the production scheduling algorithms. In principle, its implementation is easier in MTS than in MTO production. This is due to the fact that MTS productions usually have larger and longer production batches. Only one Company uses automatic scheduling.

Semi-automatic scheduling is carried out using various auxiliary software tools provided by the ES, and is finalized manually. It is in principle easier to implement than automatic scheduling, but still demands a serious investment in BPR as well as development of the right ES software tools. Furthermore, it requires accurate manufacturing master data (BOMs, routings, standard lead times). Three Companies succeeded to use semi-automatic scheduling, but this happened on the average, after three to four years of ES use.

Real time monitoring of production execution in comparison with schedule refers to the process of collecting (usually, in real time) production data (raw material consumptions, waste, finished product packaging etc.) as well as man and machine hours spent to fulfill a production order. Real time monitoring of these data, in order to be accurate and efficient, needs investment in suitable equipment (e.g., barcode readers, heavy duty industrial PCs, industrial network protocol, PLCs etc.) which is often considered a nice to have feature rather than a necessity. At the same time, some managers still believe that the monitoring of personnel time has negative effect on people's behavior. Nevertheless, half of the Companies have adopted a real time monitoring of personnel time per production order.

Product standard costing. Standard product costing is based on standard BOM and standard production lead times. It is important for sales quotation and order costing and pricing, especially for MTO/project-based products. Its ES implementation demands maturity in manufacturing processes and often considerable BPR. More specifically, it requires standardization, systematic data (consumption, waste, and time) measurement and posting to the ES, followed by statistical analysis of historical data. Only three Companies have implemented the process through the ES.

Decision support and BI. The process reference set contains decision support processes. The more important ones are standard costing and production planning. Tactical and/or strategic decisions can be supported by manufacturing BI analytics, which are used by almost all the Companies. This high adoption rate is mainly due to the promotion effort of the ES implementer. Additionally, BI adoption is supported by the fact that BI analytics provide immediate results to manufacturing key users. Most commonly used analytics are the following ones: Analysis of production cost per order, gross profit results and profit margins per production or customer order; analysis of machine and personnel productivity, and of non-working times; production quality indicators; comparison of actual and scheduled production results.

Dynamic analysis of process adoption. The observed deficiencies are not in general early post-implementation ones given that at the data collection time the ES had been used for about 6.5 years on the average. Some dynamic analysis results are as follows: Processes 2.2, 2.3, 2.4, 3.3.1, 3.3.2, 3.3.3, 3.3.4, 4.1, and 5.1 have been adopted using the ES on the average about 3, 4, 4, 4.5, 1, 1, 4, 5, and 3.5 years respectively after ES going live by the adopter Companies.

6 Discussion and Conclusion

This study along with [1, 2] draws attention to two fundamental issues of process orientation, which have not been extensively addressed, namely the non-use of best practice processes and/or the non-implementation of these processes with an ES. For this purpose, a low-level field analysis of individual processes is proposed from an external to the companies perspective, supported by extensive questionnaires and discussions for each process with knowledgeable informers, such as ES key implementation consultants.

Manufacturing processes and their corresponding ES implementations over a small sample of Greek SMEs were studied. Deficiencies were found in manufacturing planning, scheduling, and standard costing. In production planning and scheduling, the lack of knowledgeable personnel is critical, and makes part of the resource poverty conditions which affect SMEs in general [21, 22] and Greek ones in particular [23]. In connection to these deficiencies, a business culture of using empirical and non-systematic methods was also observed. A broad BPR followed by ES configuration and customization is needed for these processes.

We think that process use deficiencies such as those presented in this study apply in general to Greek SMEs. Deficiencies may be even greater for other ES implementations in this market. In fact, the ES implementer of the present study provided turnkey, fine-tuned manufacturing solutions for its customers. However, many competitive ES in the Greek SME market, which have actually a much higher penetration compared to the ES under consideration, are "preconfigured" lower cost solutions. It is therefore plausible to suppose that other ES may have increased process use deficiencies, due to misfits between company business logic and preconfigured ES models.

This study should be extended to other functional areas, more ES, bigger company samples, and systematic dynamic analyses. The role of financial, market, and cultural differences among different sectors and/or countries should be also investigated. The points of view of the implementer and the companies could be compared. Additionally, the role of company size could be investigated. Process use deficiencies and their causes may be substantially different in SMEs from those in bigger companies. A possible difference between small and medium-sized companies, which has been shown to exist with respect to ERP adoption criteria [22], could be investigated as well.

The results of this study suggest that, under low process and ES use maturity conditions, the analysis of individual processes can clarify process use deficiencies and their causes. If processes are used, higher-level process and ES maturity measurements [10], and process orientation measurements [11-16] can give complementary information for individual processes.

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A Decision Support System for ERP Systems Implementation in Small Medium Enterprises (SMEs)

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Abstract. Small medium enterprises (SMEs) face considerable challenges in implementing enterprise resource planning (ERP) systems, however due to their benefits ERP systems are becoming an essential and integral part of SMEs business strategy. This study investigates the implementation of (ERP) systems in SMEs and the role played by certain critical success factors (CSFs) in its successful implementation. Based on primary data collected, the relationship between the variables of time, coast and performance realised is established. A simulation model based decision support system (DSS) has been proposed and developed. The DSS model developed assist in decision making process during implementation by running different implementation scenarios and opting for most optimised solution which give higher performance at a reasonable cost at optimum time. By drawing upon this model, we can relate to how SME can better utilise and prioritise different CSFs and resources by choosing the best implementation strategy before real life implementation thus saving time and money.

Keywords: Enterprise resource planning, Small medium enterprises, Critical success factors, Modelling and Simulation, Decision support systems.

1 Introduction

The last decade has seen the use of Enterprise Resources Planning (ERP) systems increasing many folds. This may be due to increased competition, globalisation and need for greater visibility into business functioning. ERP systems have risen up to the expectations of industry. ERP systems is an information system that manages, through integration, all aspects of business including production planning, purchasing, manufacturing, sales, distribution, accounting and customer service [23]. It allows seamless integration of information flow and business processes [7] across functional areas within a company.

ERP systems have greatly enhanced and revolutionalised the operational working of organisations by making them productive, competitive and integrated. However, despite all the advantages, ERP implementation is still a very time consuming, detailed and complicated process. Wang et al. [33] suggested that average over cost for implementation is 178 percent and implementation period is 2.5 times longer than anticipated. Also, it has been observed that 66 to 70% of ERP implementation projects fail to achieve their corporate goals [4, 18]. The literature provides numerous

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examples of failed implementation such as Whirlpool, Hershey, Waste Management, Inc., and W. L. Gores and Associates [32]. In the context of small medium enterprises (SMEs), because of their limited resources and market share, a failed implementation can have catastrophic consequences for SMEs which may even lead up to bankruptcy. SMEs also face limitations in implementing new IT systems due to a lack of modern information technology, old legacy system and lack of perceived usefulness towards new technology. In order to assist SMEs in implementing ERP systems successfully, there is need for a better understanding of the implementation process with particular emphasis on the factors that play a key role in implementation.

This paper explores the key considerations and role played by certain factors in successful implementation such as management support, project management, vendors support, data/infrastructure and users. Based upon the findings, this paper addresses the next stage in improving understanding of the ERP implementation systems by proposing and developing a simulation based decision support system, and discussing its implication, benefits and functionality. This paper has five main sections. The next section provides a literature review of ERP implementation. Section 3 describes the methodology used in collecting data and analysis. Section 4 describes the finding from the data analysis and running simulation model and section 5 presents conclusion and recommendations for future research.

2 Literature Review

Enterprise Resource Planning (ERP) system integrate all information and processes of an organisation into a consolidated system that addresses how people and organisation access, gather, store, summarize, interpret and use information. Van Hillegersberg et al. [30] define ERP systems as configurable information system packages that integrate information and information based process within and across functional areas in organisations, however, ERP implementation is an extensive, meticulous and a costly process. The complexity and high cost of these systems have restricted their use/implementation to larger companies since the smaller SME's are unable to invest in these systems. However, as the market for ERP systems in large enterprises begin to mature and decline, and small medium enterprises (SMEs) began to recognize and appreciate the functionality and significance of ERP systems [16], ERP system providers are focussing their attention on SMEs, by developing ERP system that are simplified version and most important are low cost.

ERP systems are the subject of number of studies [9] and different aspects of implementation have been studied in detail such as uncertainty management using ERP systems [15], specific methods of ERP requirements analysis [17], the relevance of local characteristics (cultural, social value, management style) the ERP has to cope with [19], pre-implementation issues [3] and critical success factors [1].

ERP systems are implemented to integrate the functioning of organisation and to create single central database for information collection and sharing. In order to achieve this level of integration researchers have stressed upon the role of certain factors also called as critical success factors [1, 27]. Bullen and Rockhart [4] define critical success factors (CSFs) in IS (information systems) as “the key areas of activity in which favourable results are absolutely necessary for a particular manager to reach the goal". Successful project managers must focus their resources and time, "on those things that make a difference between success and failure". There exist a amount of literature proposing different critical success factors (CSFs), such as Top management support [17], project champion [21], users [21] and external expertise [34]. However, most of the studies simply mention these factors or list them in order of adaptability but fail to mention the role CSFs can play in improving the process or interrelation between these factors. To study and comprehend the effect of critical factors on the implementation, researchers have developed and proposed different process models [2,20,22], but none of those models considered the CSFs. Parr and Shanks [21] develop a project phase model for ERP implementation project and studied the relationship between implementation phase and CSFs. While Akkermans and van Halden [1] and King and Burgess [14] also proposed models based on CSF performances. These proposed simulation model based on qualitative data analysis tends to encourage exploration of more appropriate implementation strategies.

In order to explore different implementation strategies and to make the best use of available resources while saving time and cost, and keeping in consideration the performance of CSFs, a simulation model for SMEs has been proposed. This simulation model functioning as a Decision Support System (DSS) for ERP implementation can assist in facilitating the operational decision making in different phases of ERP implementation while evaluating and enhancing the whole process. This simulation model aims to enhance the decision making ability of implementation team by providing them means to study performance relationship between CSFs, implement different implementation scenarios and assisting in finding the optimize solution without actually doing in real life while saving time and resources.

3 Research Methodology

The primary purpose of this research is to design and develop a simulation based decision support system to assist in ERP implementation by focussing on critical success factors. The primary data for the study is collected using survey questionnaire. The questionnaire is designed to collect data such as cost of implementation, data migration success rate, time spent on implementation and performance realised for each CSF.

Research Sample

For the purpose of the study, SMEs that have implemented ERP systems form the research sample population. These SMEs were selected through ERP vendors websites (such as Oracle.com, SAP.com), Thomson Data and small business association website. Further information on ERP implementation in these SMEs was obtained from company website and personal contacts with ERP consulting firms. The research sample location is based in UK and North America as this region has the highest concentration of small medium enterprises. There 23 million functioning SMEs in USA and they employ 50% of private workforce [32]. Similarly, SMEs provide 64% of all Canadian private sectors [13] and in European Union they provide 67% employment [10].

Data Collection

The survey questionnaire was sent out, via email, to the SMEs that have one complete ERP implementation experience irrespective of the implementation results. Table 1 contains the summary of the collected data. The company column refers to the number companies who participated in this study. The criteria column represents time, cost and performance realised. Each CSF (including top management support, users, project management, database/infrastructure and Vendors support) is itemised, classified and evaluated on the basis of cost, time, performance realised and role they played in achieving the implementation targets and utilisation of the system thus giving overall performance of the implementation.

Table 1. Summary of Data Collected

Company	Criteria		CSF1-M	CSF2-U	CSF3-PM	CSF4-D	CSF5-V	Total
1	Time	Days	45	30	180	180	30	465
		Week	6.42	4.28	25.71	25.71	4.28	66.4
	Cost	Percentages	10	25	25	20	20	
		Value ($)	40,000	100,000	100,000	80,000	80,000	400,000
	Performance Realised (%)		10	20	25	20	5	80
	Result	Successful						
2	Time	Days	14	56	21	70	21	182
		Week	2	8	3	10	3	26
	Cost	Percentages	10	22	18	35	15	100
		Value ($)	50000	110,000	90000	175,000	75,000	500,000
	Performance Realised (%)		7.5	10	10	12.5	10	50
	Result	Successful						
3	Time	Days	28	28	21	15	15	107
		Week	4	4	3	2	2	15
	Cost	Percentages	22	30	15	22	11	
		Value ($)	20,000	30,000	10000	20,000	10000	90,000
	Performance Realised (%)		15	10	25	20	10	80
	Result	Successful						
4	Time	Days	14	28	21	21	30	114
		Week	2	4	3	3	4.28	16.28
	Cost	Percentages	10	25	15	35	15	
		Value ($)	18000	45000	27,000	63,000	27000	180000
	Performance Realised (%)		15	20	10	17.5	7.5	70
	Result	Successful						
5	Time	Days	10	45	35	28	14	132
		Week	1.42	6.42	5	4	2	18.84
	Cost	Percentages	10	30	10	30	20	
		Value ($)	20,000	60,000	20,000	60,000	40,000	200,000
	Performance Realised (%)		15	25	10	12.5	7.5	70
	Result	Successful						
6	Time	Days	90	90	90	90	90	450
		Week	12	12	12	12	12	60
	Cost	Percentages	10	10	20	20	40	
		Value ($)	50,000	50,000	100,000	100,000	200,000	500,000
	Performance Realised (%)		21	15	21	16.5	16.5	90
	Result	Successful						
7	Time	Days	14	76	28	21	21	160
		Week	2	11	4	3	3	23

Table 1. (*continued*)

	Cost	Percentages	3	27	8	50	12	
		Value ($)	9000	81,000	24,000	150,000	36,000	300000
	Performance Realised (%)		21.25	16.5	18.75	16.5	16.5	90
	Result	Successful						
8	Time	Days	21	52	28	28	28	157
		Week	3	7.4	4	4	4	22.4
	Cost	Percentages	5	20	6	54	15	
		Value ($)	11250	45,000	13,500	121,500	33,750	225000
	Performance Realised (%)		21	21	21	21	17	100
	Result	Successful						
9	Time	Days	7	35	14	14	14	84
		Weeks	1	5	2	2	2	12
	Cost	Percentages	3	5	8	76	7	
		Value ($)	2550	29700	6800	40000	5950	85000
	Performance Realised (%)		20.25	17.75	19.75	17.75	15.25	90
	Result	Successful						
Mean	Time	Days	25.88	48.88	48.66	51	29.22	203.64
		Week	3.69	6.98	6.95	7.28	4.17	29.07
	% Of Total		12	24	24	25	14	100
	Cost	Percentages	8	22	14	38	18	100
		Value($)	24533	61188	43477	85944	56411	271553
	Performance Realised (%)		16.22	17.8	16.38	17.13	12.25	79.78
	Result	Successful	20.7	22.25	20.47	21.41	15.31	100

Data Analysis

The data is analysed using regression analysis to study the relationship between the dependent variables (cost and performance realised) and independent variable (time) for each CSF. Fig. 2 illustrates the relationship between time and cost, and time and performance realised. The overall cost of the implementation increases with implementation time period. However, it is interesting to observe that performance increases up to certain point and after that it levels off and in some cases even decreases.

Simulation Based Decision Support System

Simulation Model

The primary purpose the research is to design and develop a simulation model that can assist in decision making. The purpose of this simulation model is to explore possible outcomes using a realistic model of a situation without doing in real life. According to Shtub [26] a model is simplified presentation of the reality. By making simplifying assumption it is possible to develop a model of the problem which is simple enough to understand and analyse, and yet provides a good presentation of the real problem.

Designing and Developing a Research Instrument

Model is a continuous simulation model, developed in MS Excel VBA. As shown in Fig.1, the implementation process is modelled as five CSFs representing phases or locations. The amount of time spent on each CSF is subject to associated processing logic developed from data analysis using regression analysis. As the implementation progresses through each location and number of days for each CSF are countered and processed, and after implementing the last CSF the final results is obtained in terms of projected time period, cost and performance realised.

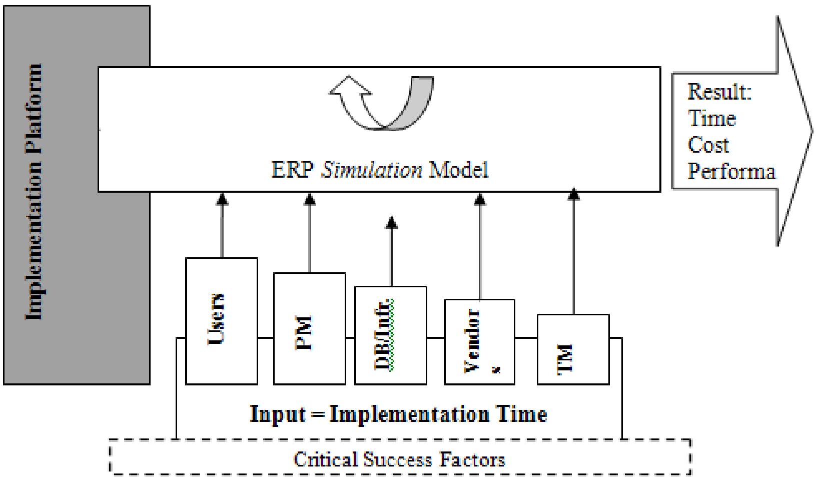

Fig. 1. Simulation Model

Simulation Model Verification

The verification process involved two methods of verification. First method involved comparing outcomes from running simulation model with the results from ERP system implementation in the real world. The results were found to be consistent and supportive to facts that by varying the independent variable of time, the resulting cost and performance realised also changes. The overall results were found to be consistent with the results from the real life implementation. Second method of verification involved consulting professionals working on ERP systems implementation and allowing them to employ the simulation model to assist them in their practice. This process not only helped to observe real life application of the model but also the feedback from the professionals assisted in enhancing the model.

4 Research Findings

The analysis and testing of the simulation model confirms that the model is valid for the data collected and confirms practical observations. The analysis of the simulation model also suggests that model can assist in developing strategies that enhance the implementation experience and ensure the implementation targets are achieved. The analysis from the application of simulation model reveals the following:

1. Simulation results suggest that relationship (Fig. 2) between the time, cost and performance realised is such that implementation cost increases as project duration increase while the achievement increases up to certain level and then level off and in certain situation it even decreases. This relationship between the variables is based on the following formula that gives final cost and performance realised;

Cost: y = 626.94x (where x= time input and y= total cost)

Performance Realised: y = -.0075x^2 + .8447x (where x = time input and y=performance realised)

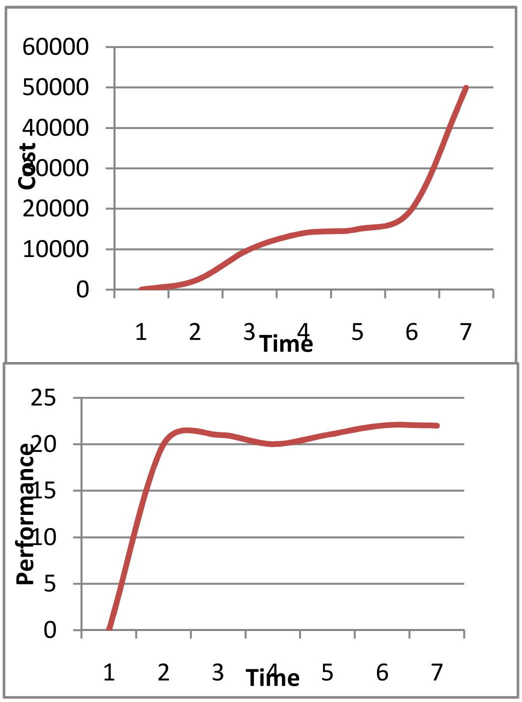

Fig. 2. Relationship between Time-Cost and Time-Performance

2. The examination of performance achieved (Fig. 2) by the systems reveals that longer implementation duration or too much efforts does not necessarily mean higher performance attained. They can be unproductive in term of performance attained since performance, as observed, after certain time tends to level off and any further efforts or time spend can only be waste of resources.

3. The study of ERP implementation and allocation of resources during this process suggests that organisation should focus on implementing one CSF at a time, or also called sequential implementation. This method gives more control over the implementation process allowing SMEs to focus on particular CSF such from top management, to users, to project management, then to database/infrastructure and finally vendors support.
4. Simulation results suggest that keeping track of day to day activity can be useful in monitoring and evaluating the performance of the process (Table 2). This can assist in a situation when a project is not going as planned and necessary actions can be taken, such as effectively allocating resources, monitoring cost factor or reviewing implementation strategy.

Table 2. Day-to-day activity scenario from model

Days	CSF 1 - Top Mana		CSF 2 - Users		CSF 3 - Project M		CSF 4 - Databas		CSF 5 - Vendor's	
	Cost	Achiev	Cost	Achiev	Cost	Achiev	Cost	Achie	Cost	Achiev
3	1880.82	3.928	2874	2.893	2070	2.83	2697	3.62	4116	2.632
6	3761.64	7.623	5748	5.606	4140	5.509	5394	7.02	8232	5.117
9	5642.46	11.09	8622	8.14	6210	8.036	8091	10.2	12348	7.457
12	7523.28	14.32	11496	10.49	8280	10.41	10788	13.1	16464	9.652
15	9404.1	17.32	14370	12.67	10350	12.64	13485	15.9	20580	11.7
18	11284.9	20.08	17244	14.66	12420	14.71	16182	18.4	24696	13.6
21	13165.7	22.62	20118	16.47	14490	16.63	18879	20.7	28812	15.36
24	15046.6	24.92	22992	18.11	16560	18.41	21576	22.7	32928	16.97
27	16927.4	26.99	25866	19.56	18630	20.03	24273	24.6	37044	18.44
30	18808.2	28.83	28740	20.83	20700	21.5	26970	26.2	41160	19.76

Since project implementation cost is determining measuring factor of success or failure of the system, it is essential that the cost factor should be carefully monitored. Data sheet of day-to-day activity created in simulation model can be a source of useful information. As it shows the detail of the daily expenses of each CSF, which can assist implementation team to better plan and forecast their resources.

5. Simulation results suggest that implementation team should not base their decision on the finding from one observation or limited experience rather they should focus on acquiring more data and observation since this will give more consistent results.
6. The empirical findings indicate (Fig.3) that top management support plays critical role in successful implementation. According to data collected 68% respondents' 'strongly agreed' and 19% 'agreed' that the top management support crucial role during implementation. The level of the support may vary but its presence is very important.

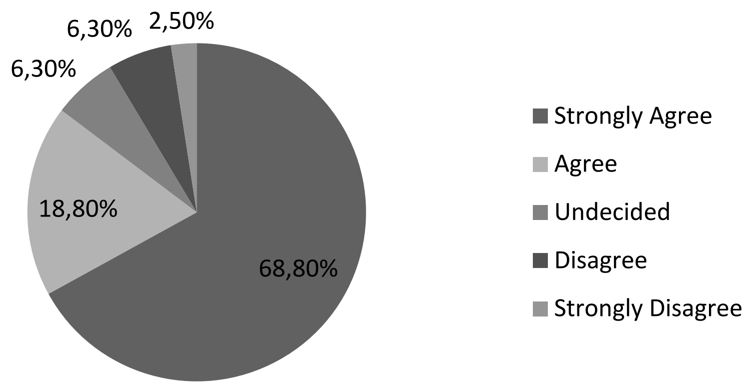

Fig. 3. Top management support

Table 3. Overall performance realised; CSF User has highest performance contribution

	CSF1-Mgmt	CSF2-Users	CSF3-PM	CSF4-Data/Infrastructure	CSF5-Vendors support	Total
Performance Realised (%)	16.22	**17.8**	16.38	17.13	12.25	80
Percentage Contribution	20.7	**22.25**	20.47	21.41	15.31	100

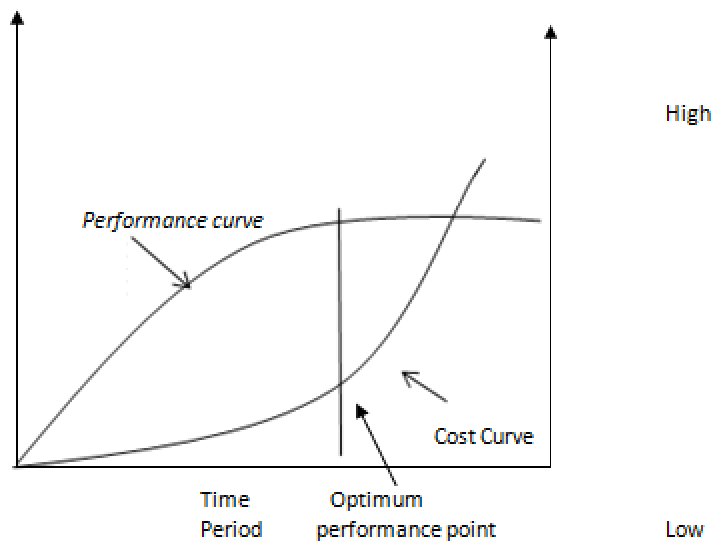

Fig. 4. Optimum performance point

7. The weigh the CSF 'user' carry in implementation process suggest that any information technology system is about the final users of the system. Hence focussing on the 'users' can improve the implementation process and utilisation of the system.
8. Simulation model can be useful in locating 'optimum performance point'. It is a point where maximum performance can be realised at reasonable cost as indicted in figure 4.

5 Conclusion and Recommendations

ERP system implementation is an important undertaking in an organisational lifecycle. It requires complete transformation of business process and the decision to implement an ERP system in a SME usually has profound impact on the organisation. This study began with examining the role of CSFs in ERP implementation and establishing a relationship between the variables that affect the performance of the CSFs. On the basis of relationship logic a simulation model is developed that can serve as an implementation guide for any SME considering ERP implementation. Integrating the implementation framework with simulation model and prioritising CSFs, a SME can meet the goals of reducing cost and time, while increasing desired success level. Simulation model can also assist by proposing best implementation time frame where the highest performance can be achieved at optimum cost. Research finding also suggest that implementation team should focus to achieve more during initial days since cost tend to increase at fast pace as implementation progresses and performance tends to level off. Implementing and prioritising CSFs according to their performance can play a critical role in achieving success. This study contributes a deeper understanding of the role of CSFs and simulation model during implementation. Given the significant role ERP systems play in attaining strategic advantage for an organisation, our findings contribute towards successful implementation of ERP systems in SMEs.

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A Comparative Study of the Impact of ERP Systems Implementation on Large Companies in Slovakia and Slovenia

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Abstract. Based on a literature review, it can be stated that there had been very little research published focused on enterprise resource planning (ERP) systems post-implementation period. This paper tries to contribute to filling in this gap in theory. The aim of this paper is to analyze whether a significant difference in the impact of ERP systems implementation on overall IS/IT costs can be found, as well as on the proportion of the IT/IS costs attributed to IT and other departments, on efficiency as profitability, on effectiveness as productivity, and on the availability of IS/IT services. The research is based on data from large Slovak and Slovenian companies. The models control for the extent and successfulness of the ERP system implementation and for the IT focus of the company.

Keywords: Enterprise resource planning (ERP) systems, post-implementation impact.

1 Introduction

According to [2], an enterprise resource planning (ERP) system is an integrated set of programs that provides support for core business processes, such as production, input and output logistics, finance and accounting, sales and marketing, and human resources. An ERP system helps different parts of an organization to share data to reduce costs and to improve the management of business processes. Although the field of enterprise resource planning (ERP) systems is rather well-established (and e.g. [15] consider ERP systems to be a cost of entry to doing business), according to the literature review [6], there had been very little research focused on ERP systems in the post-implementation period. This paper aims at this gap in theory. A recent paper [5] looks into impact of ERP implementation on efficiency and effectiveness in

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Chinese companies. The mechanism of achieving ERP post-implementation business benefits is described in [17]. Our research question is whether evidence can be found that the impact of ERP systems implementation differs between two countries. The impact is evaluated based on the overall IS/IT costs, on the proportion of the IT/IS costs attributed to the IT and other departments, on efficiency as profitability, on effectiveness as productivity, and on availability of IS/IT services after the ERP systems implementation. This paper deals with large enterprises because of the high adoption rate in companies of this size. The presented models control for the extent (number of process areas covered, percentage of functionalities used) and successfulness (staying on budget) of the ERP system implementation and for the IT focus of the company (having a formal information strategy and a CIO or similar). The analysis is conducted using Slovak and Slovenian data. Although [8] and [14] discussed issues related to ERP systems in Slovakia, [7] and [11] did so in Slovenia, none of them dealt with anything similar to our research question. The paper is organized as follows: the second section describes data and methodology, the third section presents the results, and fourth section provides conclusions.

2 Data and Methodology

The research is based on a questionnaire survey conducted in Slovakia and Slovenia in May and June 2007. Questionnaire forms, accompanied by a cover letter, were mailed to randomly selected companies. Lists of addresses and information about the number of employees were retrieved from the respective statistical bureaus. Unlike in [3], we focus on large companies. Regarding the random sample, 300 questionnaires were sent to large companies in each of the countries.

The definition of company size used in this paper is consistent with the definition of SMEs [9], i.e. companies with 10 to 49 employees are considered to be small, companies with 50 to 249 employees are considered to be medium-sized enterprises, and companies having 250+ employees are considered to be large companies. In total, 79 companies (with ERP systems in use) responded out of 600 mailings, i.e. the return rate was 13.2%. However, since we did not have prior information about which organizations actually had ERP systems in use, we also have to consider the adoption of ERPs when calculating response rate. Considering the adoption of ERP systems by large companies in these countries according to 2007 Eurostat estimates, the overall response rate was 21.5%. Table 1 provides information on number of respondents that had ERP systems in use, 2007 Eurostat estimates of ERP adoption for large companies, the theoretical number of companies from the research sample that were supposed to have ERP systems (since the sampling was random, the theoretical number is calculated as a product of number of questionnaires sent out and the 2007 Eurostat estimate), and the response rate calculated as the number of respondents that had ERP systems in use divided by the theoretical number of companies with ERP systems in the sample.

Table 1. Descriptive statistics of responding companies

Country	No. of respondents with ERP	No. of questionnaires sent out	Percentage of ERP adoption (Eurostat)	Theoretical no. of companies with ERP in sample	Response rate
Slovakia	32	300	47.27%	141.81	22.57%
Slovenia	47	300	75.42%	226.25	20.77%
Total	79	600		368.06	21.46%

When focusing on the post-implementation period, it may be expected that the extent of implementation, the extent of use, and the successfulness of the implementation will affect the impact of the ERP system. ERP implementation quality was found to have a significant impact on ERP post-implementation success e.g. in [18].

The extent of implementation was measured in the number of process areas covered by modules of the implemented ERP system. The question used to measure the extent of implementation was "Which ERP modules were implemented?"; the possibilities were finance/controlling, human resources, manufacturing and logistics, sales and distribution, and other. In order to have as few independent variables as possible, we decided to sum up the answers for the first found enumerated process areas, leaving out other modules, which are not really comparable to the former ones.

The extent of use of the ERP system was measured as a percentage of functionalities used. The related question was "Can you estimate the % of the implemented ERP system functionality that is being used?"

The question related to staying on budget was "What was the actual total cost of implementation?" with possibilities "lower than estimated", "equal", and "higher than estimated", while for the first and third possibility we asked by how many percents. There were three Slovenian companies in the sample that claimed to spend less than estimated (by 4%, 10%, and 20%) and they will be treated as staying on budget. Because some respondents did not answer the question and some of those who answered the question by stating they had gone over budget did not provide percentages, there will be two models used for each dependent variable. In the first model, there will be a binary variable coding: staying on budget and going over budget; in the second model, there will be a percentage of actual ERP systems implementation costs compared to planned costs.

In addition to these independent variables, information strategy and representation of IT department at the board level (i.e. CIO or similar) are used as independent variables.

The adoption of ERP systems was estimated on the respondent's company ERP system stage, the stages included (1) an ERP system is being considered, (2), an ERP system is being evaluated for the selection of a specific solution, (3) an ERP system is being configured and implemented, (4) an ERP system was recently implemented and is now being stabilized, (5) an ERP system is being used and maintained, and (6) the first ERP system was already replaced with a new one. Stages 4–6 describe the post-implementation period, i.e. the ERP system is truly in use; therefore, only companies in these stages are analyzed in the paper. We are aware that some studies focus on early stages of ERP implementation, e.g. [1] or on later stages in the life cycle, e.g. [12].

The reason for excluding the third stage is a possible short-term negative impact of the implementation. A recent study [13] shows that after ERP implementation in a retail chain "sales and inventory turnover initially drop by 7% and recover in 6–12 months".

Regarding dependent variables, respondents were asked to estimate the impact of ERP compared to the situation prior to ERP implementation. There were six areas:

a. Overall IS/IT costs – measured on a 1–5 Likert scale, where 1 means poor rating/higher costs, 3 stands for unchanged, and 5 translates to good rating/lower costs.
b. Proportion of costs attributed to the IT department out of overall IS/IT costs, measured in as a percentage.
c. Proportion of costs attributed to functional departments out of overall IS/IT costs, measured as a percentage.
d. Efficiency/profitability – measured on a 1–5 Likert scale, where 1 means poor rating/decreased, 3 stands for unchanged, and 5 translates to good rating/increased.
e. Effectiveness/productivity – measured on a 1–5 Likert scale, where 1 means poor rating/decreased, 3 stands for unchanged, and 5 translates to good rating/increased.
f. Availability of IS/IT services – measured on a 1–5 Likert scale, where 1 means poor rating/decreased, 3 stands for unchanged, and 5 translates to good rating/increased.

The coding was used this way because these issues are usually not publicly shared, i.e. asking about them in greater detail might prevent respondents from answering completely. In this paper, there will be only five of them analyzed because b = 100% - c. This relationship actually decreased the sample the most. Only rows with c missing and the rows with the sum of b and c being equal to 100% were kept.

3 Results and Discussion

The research results are provided in subsections in order to group two models for each dependent variable.

3.1 Overall IS/IT Costs

Overall IS/IT costs after ERP systems implementation fell. They differed between the countries, the average value for was 3.75 in Slovakia and 3.42 in Slovenia. They were also significantly influenced by percentage of functionality used; there is a positive correlation between the two. Trying to avoid the well-known problem of the statistical power in information systems research pointed out in [4], it is worth to point out that it is likely that the number of process areas covered has a bearing on the overall IS/IT costs as well; there is a positive correlation between the two.

Table 2. Analysis of overall IS/IT costs considering staying on implementation budget or not

Source terms	DF	Sum of squares	Mean square	F-ratio	P-value
Percentage of functionalities used	1	7.204001	7.204001	6.30	0.015561*
No. of process areas covered	1	4.571217	4.571217	4.00	0.051333
Staying on budget	1	1.126117E-02	1.126117E-02	0.01	0.921361
Country	1	5.53862	5.53862	4.85	0.032673*
CIO	1	1.753955	1.753955	1.53	0.221619
Information strategy	1	0.8068178	0.8068178	0.71	0.405103
S	47	53.72861	1.143162		
Total (Adjusted)	53	71.42593			
Total	54				

Table 3. Analysis of overall IS/IT costs considering percentage of implementation budget spent

Source terms	DF	Sum of squares	Mean square	F-ratio	P-value
Percentage of functionalities used	1	6.816774	6.816774	5.86	0.019514*
No. of process areas covered	1	4.545845	4.545845	3.91	0.054115
Percentage of planned costs spent	1	0.1955593	0.1955593	0.17	0.683752
Country	1	5.345638	5.345638	4.59	0.037411*
CIO	1	1.777762	1.777762	1.53	0.222732
Information strategy	1	0.5985761	0.5985761	0.51	0.476874
S	46	53.52934	1.163681		
Total (Adjusted)	52	71.20755			
Total	53				

3.2 Proportion of Costs Attributed to the IT Department Out of Overall IS/IT Costs

The proportion of costs attributed to the IT department out of overall IS/IT costs differs between the two countries; it is 85.71 % in Slovakia and 38.25 % in Slovenia.

Table 4. Analysis of IT department spending considering staying on implementation budget or not

Source terms	DF	Sum of squares	Mean square	F-ratio	P-value
Percentage of functionalities used	1	22.72164	22.72164	0.03	0.860082
No. of process areas covered	1	437.4237	437.4237	0.61	0.441889
Staying on budget	1	59.0394	59.0394	0.08	0.776415
Country	1	13630.8	13630.8	19.03	0.000195*
CIO	1	107.2322	107.2322	0.15	0.702103
Information strategy	1	133.5439	133.5439	0.19	0.669612
S	25	17908.77	716.3508		
Total (Adjusted)	31	35255.72			
Total	32				

Table 5. Analysis of IT department spending considering percentage of implementation budget spent

Source terms	DF	Sum of squares	Mean square	F-ratio	P-value
Percentage of functionalities used	1	17.20488	17.20488	0.02	0.880119
No. of process areas covered	1	344.6376	344.6376	0.47	0.501620
Percentage of planned costs spent	1	63.18077	63.18077	0.09	0.772712
Country	1	12573.74	12573.74	16.98	0.000388*
CIO	1	62.45172	62.45172	0.08	0.773989
Information strategy	1	55.29794	55.29794	0.07	0.786975
S	24	17770.56	740.44		
Total (Adjusted)	30	34090.77			
Total	31				

3.3 Efficiency/Profitability

The efficiency/profitability after the ERP system implementation differs between the two countries. It stayed almost unchanged in Slovakia (3.20), while it increased in Slovenia (4.05).

Table 6. Analysis of efficiency/profitability considering staying on implementation budget or not

Source terms	DF	Sum of squares	Mean square	F-ratio	P-value
Percentage of functionalities used	1	3.038125E-02	3.038125E-02	0.06	0.803948
No. of process areas covered	1	1.100276	1.100276	2.26	0.139599
Staying on budget	1	0.5686716	0.5686716	1.17	0.285560
Country	1	9.889468	9.889468	20.28	0.000043*
CIO	1	5.665458E-03	5.665458E-03	0.01	0.914609
Information strategy	1	0.4685068	0.4685068	0.96	0.331884
S	48	23.4042	0.4875875		
Total (Adjusted)	54	35.74545			
Total	55				

Table 7. Analysis of efficiency/profitability considering percentage of implementation budget spent

Source terms	DF	Sum of squares	Mean square	F-ratio	P-value
Percentage of functionalities used	1	4.473013E-02	4.473013E-02	0.09	0.767616
No. of process areas covered	1	1.023085	1.023085	2.02	0.161800
Percentage of planned costs spent	1	0.1632305	0.1632305	0.32	0.572902
Country	1	9.293112	9.293112	18.35	0.000090*
CIO	1	1.712412E-03	1.712412E-03	0.00	0.953874
Information strategy	1	0.3918355	0.3918355	0.77	0.383520
S	47	23.79978	0.5063782		
Total (Adjusted)	53	35.25926			
Total	54				

3.4 Effectiveness/Productivity

The effectiveness/productivity after the ERP system implementation differs between the two countries. It is lower in Slovakia (3.68) than in Slovenia (4.10).

Table 8. Analysis of effectiveness/productivity considering staying on implementation budget or not

Source terms	DF	Sum of squares	Mean square	F-ratio	P-value
Percentage of functionalities used	1	0.4074365	0.4074365	0.80	0.374419
No. of process areas covered	1	0.7672316	0.7672316	1.51	0.224569
Staying on budget	1	0.2110279	0.2110279	0.42	0.521837
Country	1	2.340677	2.340677	4.62	0.036709*
CIO	1	0.1557622	0.1557622	0.31	0.581908
Information strategy	1	8.059368E-02	8.059368E-02	0.16	0.691840
S	48	24.32901	0.5068544		
Total (Adjusted)	54	28.54545			
Total	55				

Table 9. Analysis of effectiveness/productivity considering percentage of implementation budget spent

Source terms	DF	Sum of squares	Mean square	F-ratio	P-value
Percentage of functionalities used	1	0.4699838	0.4699838	0.91	0.345714
No. of process areas covered	1	0.7725542	0.7725542	1.49	0.228098
Percentage of planned costs spent	1	5.166007E-02	5.166007E-02	0.10	0.753557
Country	1	2.319174	2.319174	4.48	0.039681*
CIO	1	9.817106E-02	9.817106E-02	0.19	0.665317
Information strategy	1	6.881585E-02	6.881585E-02	0.13	0.717137
S	47	24.34708	0.518023		
Total (Adjusted)	53	28.53704			
Total	54				

3.5 Availability of IS/IT Services

The availability of IS/IT services after ERP systems implementation increased in both countries, but was less so in Slovakia (4.00) than in Slovenia (4.44). Despite the p-value above 0.05, we should not rule out the relationship and make the mistake that [4] warns about.

Table 10. Analysis of availability of IS/IT services considering staying on implementation budget or not

Source terms	DF	Sum of squares	Mean square	F-ratio	P-value
Percentage of functionalities used	1	0.3484685	0.3484685	0.68	0.412284
No. of process areas covered	1	0.1268115	0.1268115	0.25	0.620086
Staying on budget	1	0.2831717	0.2831717	0.56	0.459554
Country	1	1.911092	1.911092	3.75	0.058736
CIO	1	0.0730262	0.0730262	0.14	0.706622
Information strategy	1	2.673471E-02	2.673471E-02	0.05	0.819761
S	47	23.93335	0.5092202		
Total (Adjusted)	53	27.87037			
Total	54				

Table 11. Analysis of availability of IS/IT services considering percentage of implementation budget spent

Source terms	DF	Sum of squares	Mean square	F-ratio	P-value
Percentage of functionalities used	1	0.3984081	0.3984081	0.77	0.384671
No. of process areas covered	1	0.1460362	0.1460362	0.28	0.597709
Percentage of planned costs spent	1	0.4256681	0.4256681	0.82	0.369017
Country	1	1.887636	1.887636	3.65	0.062319
CIO	1	0.0576829	0.0576829	0.11	0.739923
Information strategy	1	4.586341E-02	4.586341E-02	0.09	0.767203
S	46	23.7903	0.5171803		
Total (Adjusted)	52	27.81132			
Total	53				

4 Conclusions

Implementation of ERP systems seemed to decrease overall IS/IT costs compared to the situation before the adoption. It is probably possible to decrease these costs even more by paying more attention to expected maintenance costs when selecting the ERP system. (According to [10, 16], organizations tend to choose ERP systems with little consideration for the maintenance costs.) Slovak IT departments spent about twice as much as Slovenian IT departments. ERP systems implementation slightly increased the efficiency/profitability, effectiveness/productivity, and availability of IS/IT services, so it may be concluded that ERP systems implementation seems to have a positive effect in all investigated areas. Most importantly, we found evidence showing ERP systems implemented in two countries at the same time (even when controlling for the extent of implementation, extent of use, successfulness of implementation, and IT focus of the company) may lead to different outcomes. The results were more positive in Slovenia. There could be several possible reasons for this, such as better information systems education or higher budgets for ERP systems implementations in Slovenia but a more reasonable explanation is that the adoption rate of ERP systems was about 60 % higher in Slovenia (i.e. 75.42% versus 47.27% in Slovakia) meaning that the vendors were more experienced, thus the outcomes were better.

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A Meta-model Integrating Software Reengineering in the Context of BPR Projects

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Abstract. A meta-model is proposed in this paper dealing with different concepts involved in reengineering operations. This meta-model, in which both business process reengineering and software reengineering are considered, is accompanied by an approach to analyze and diagnose processes and software components. A prototype has been developed supporting this approach and has been designed on the basis of the proposed reengineering meta-model. These ideas are validated by a case study which is presented in this paper, related to a process in the high education field. The context of this case study is described, then the corresponding instances of the meta-model are presented and some improvement results are exposed.

Keywords: Business Process Reengineering, Software Reengineering, Meta-model, Business Process.

1 Introduction

Technological change and globalization nowadays oblige contemporary firms to be efficient in order to ensure their sustainability. Change is generally defined as any transformation of an enterprise or a part of an enterprise in order to track changes in its environment [1].

Multiple methods of change management exist in literature [1] such as TQM (Total Quality Management) which provides a gradual improvement in business processes but is very spread out over time, benchmarking which consists in learning how successful companies are organizing their processes and BPR (Business Process Reengineering) to which we are interested in this paper.

BPR (Business Process Reengineering) is defined as the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical contemporary measures of performance, such as cost, quality, service, and speed [2].

Our paper focuses on Reengineering which concerns both business processes and software components. More precisely, we focus on issues concerning modeling and meta-modeling of business processes within BPR projects integrating software reengineering. The proposed solution is a meta-model which deals with different concepts involved in reengineering projects including both aspects of reengineering.

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This meta-model for BPR, integrating software reengineering has been instantiated in a case study related to the area of Higher Education. This allowed to locate the project in its organizational context and to facilitate the understanding of processes, their modeling and the way in which the software components can evolve.

This paper is organized in the following way: in section 2, related works are presented. In section 3, the meta-model integrating software reengineering in the context of BPR projects is presented. In section 4, an approach of BPR integrating software reengineering is presented. The validation of the meta-model integrating software reengineering in the context of a BPR project is presented in section 5. In section 6, a prototype for processes and software diagnosis in BPR projects is presented. Finally, a conclusion and future works are presented.

2 Related Work

Several methods of conducting BPR projects are defined in literature [3-6], mainly including the steps of vision, initiation, diagnosis, re-design, implementation and evaluation. Several problems arise during BPR projects undertaken by contemporary companies. Some of them were addressed by a number of works [7, 8] proposing classification structures for modeling techniques and meta-models of business processes. But they are rarely accompanied by an approach to guide their users in BPR projects. In addition, business process meta-models defined in literature [9-12] don't take into account the context of BPR projects and software components are not taken into consideration.

In fact, such components are generally considered separately through software reengineering. Software reengineering was defined by Chikofsky and Cross in their 1990 paper [13], as "The examination and alteration of a system to reconstitute it in a new form". Gahalaut et. al, precise that transformations are applied under the process of Re-engineering after analyzing the software to apply changes incorporating new features and provide support for latest environment [14].

Business process reengineering (BPR) and software reengineering often are implemented separately, in an uncoordinated fashion. Yet practitioners realize that BPR can be informed by software reengineering and that software reengineering can benefit from the application of BPR concepts [15]. The process of integrating BPR and software reengineering presented in [15] involves tasks related to the description of business environment characteristics, but also tasks related to the description of performance characteristics of software systems. All this information gathered together will give the possibility to properly conduct reengineering.

3 A Meta-model Integrating Software Reengineering in the Context of BPR Projects

The proposed meta-model, presented in figure 3, allowed to complete the meta-model for BPR proposed in [17]. It is composed of two sub-meta-models: a reengineering sub-meta-model corresponding to the context in which Business Processes (BPs) and software applications will be restructured, and a sub-meta-model inherent to the functioning of BPs and existing software applications of the enterprise. In a first part, we will present the first sub-meta-model of reengineering. In the second part, we will present the sub-meta-model related to business processes and also software applications.

3.1 Reengineering Sub-meta-model

This sub-meta-model can itself be divided into two sub-meta-models: BP reengineering sub-meta-model and software reengineering sub-meta-model. BP reengineering sub-meta-model is presented in [17]. Software reengineering sub-meta-model, represented in figure 1, allows identifying different concepts related to software reengineering [16]:

- Software reengineering operation: It corresponds to an action of software reengineering launched by one of the BPR actions.
- New or existing software application: We talk here about respectively proposed or improved software applications.
- Software Reengineering Form: A software reengineering operation may need one or many forms of software reengineering. These forms must have a given order of execution.
- Comprehension: Understand a software application, produce documentation, collect knowledge and/or analyze by different metrics.
- Improvement: introduce some change according to a need of renovation, migration and/or adaptation to new constraints or new standards.
- Forward Engineering: Software Engineering with its different classic phases. This is a software reengineering form that generally comes after comprehension.
- Reverse Engineering: In reverse engineering, requirements, design and structure of the legacy system must be extracted. It consists in examining without changing the global functionality [18].
- Design recovery: This is one of the activities of reverse engineering. It consists in collecting design information, and to store it in a repository.
- Re-documentation: It is the creation of a semantically equivalent representation in the same abstraction level. It can be data flow, data structure and control flow [13].
- Analysis: It deals with some measures. Measuring consists in affecting values to attributes of real world entities in a way that allows describing them.
- Metrics: These are reengineering tools which measure and prevent the degree of comprehensiveness of software applications.
- Redevelopment: It is the analysis and the modification of a software application involving a reverse engineering step, then a forward engineering step.
- Restructuring: This is a transformation from a representation to another one which is semantically equivalent without change in abstraction level [19].
- Transformation: It consists in making one or more changes to a system representation without changing the level of abstraction.
- Migration: It's characterized by the evolution of global properties of the software application (programming language, execution platform, programming style).

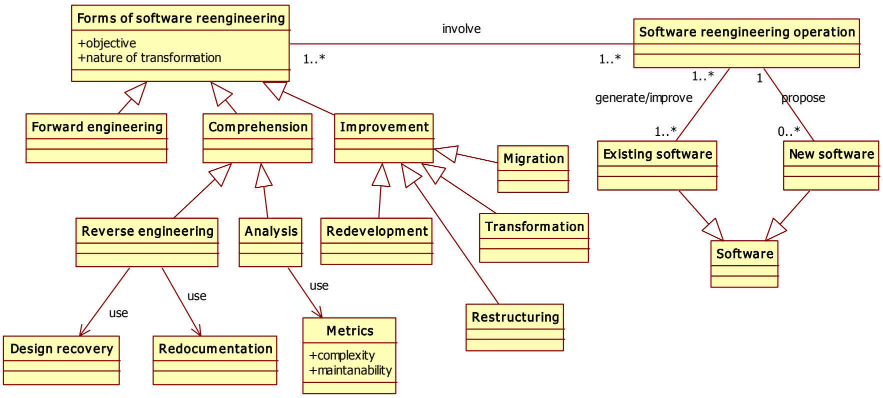

Fig. 1. Sub-meta-model for software reengineering

3.2 Context Sub-meta-model

This sub-meta-model can itself be divided into BP context sub-meta-model and software context sub-meta-model. The BP context sub-meta-model is presented in [17]. The software context sub-meta-model, presented in figure 2, includes knowledge generally related to the business environment, while focusing on concepts related to BPs and concepts related to software. This illustrates the knowledge that helps in identifying software to be considered in reengineering operations. It is, for our work, a description of how the software applications of the company function. The concepts that have been added in this work are the following [16]:

- Software Resource: includes some useful properties, necessary for reengineering, such as: software age, programming language, and programming style.

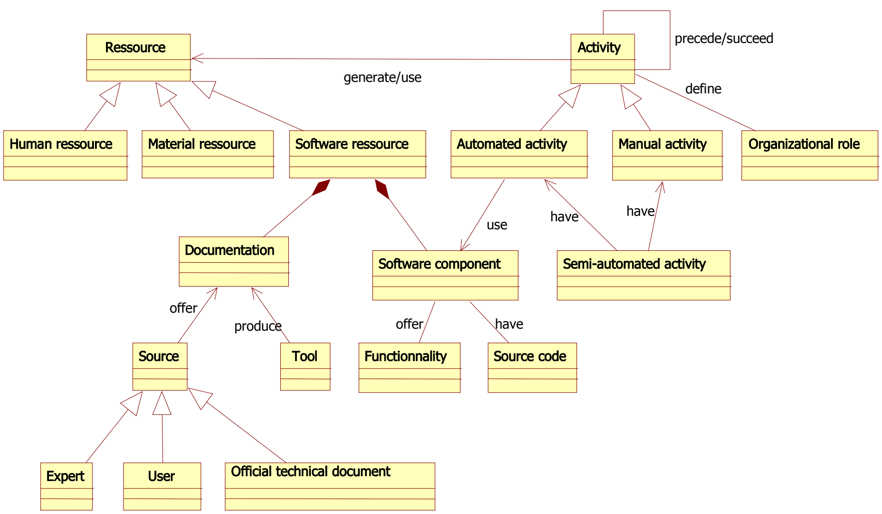

Fig. 2. Sub-meta-model for software context

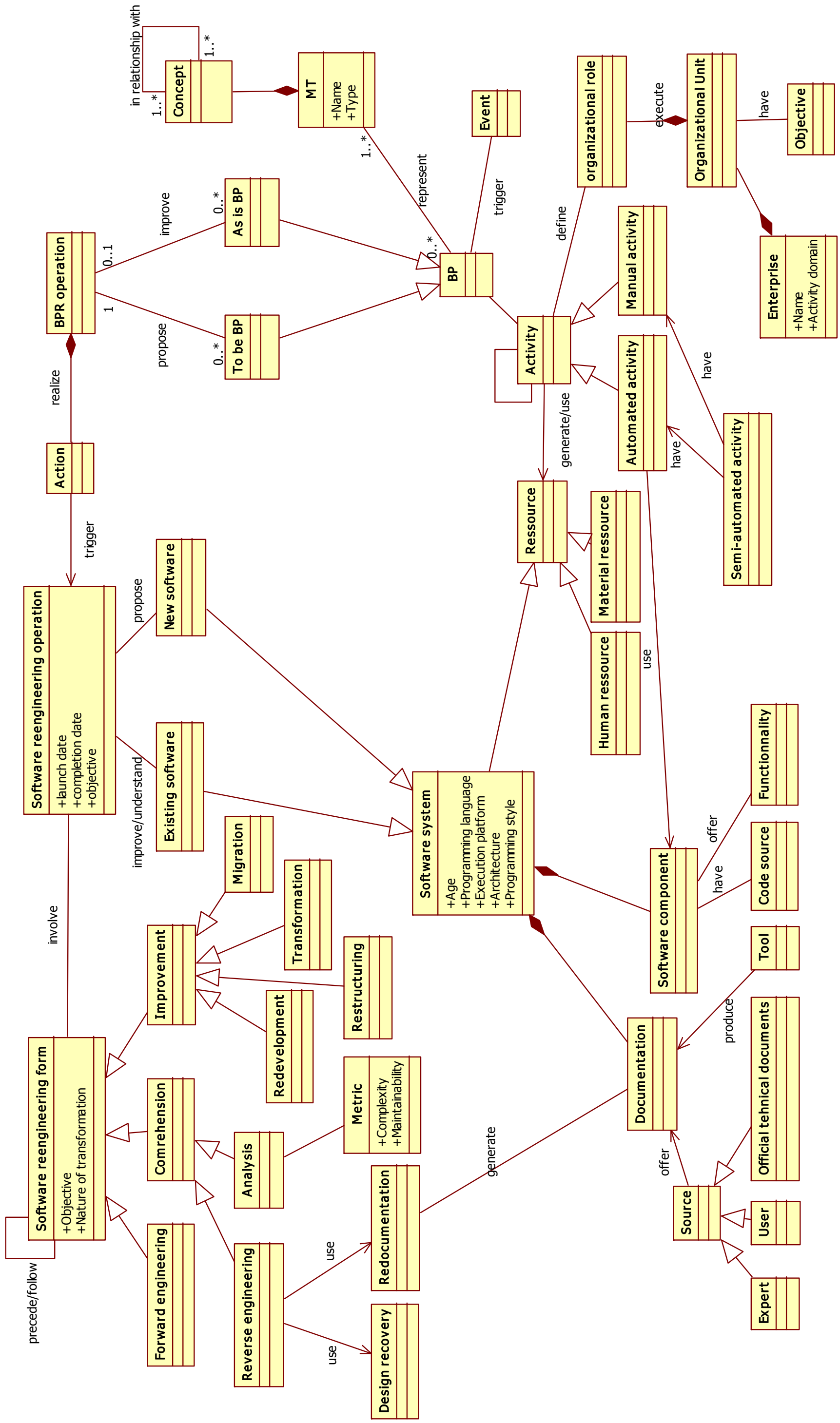

Fig. 3. Meta-model Integrating software reengineering in the context of BPR projects

- Documentation: These documents are numerous and of various kinds: technical documentation, user manual, procedure manual, release notes, etc.
- Source: These are sources of documentation. They include experts, users, official documents and also software source code.
- Tool: These are tools that can produce, extract and generate documentation for a software application.
- Expert: is the expert in the field of the software application.
- User: It is the user of the software system.
- Official technical documents: manuals, specification documents and design documents.
- Source Code: It is composed of instructions written in a high-level programming language.

4 Approach of BPR Integrating Software Reengineering

We propose below an approach taking into account the software applications used by processes to be reengineered [16]:

1.0 Vision
- 1.1 Compose the BPR team (execution responsible, departments heads, etc.)
- 1.2 Identify BPR opportunities
  - 1.2.1 Identify the needs of change required to meet the needs of customers and/or the needs of the business
  - 1.2.2 Aligning BPR strategy with the strategy of the company.

2.0 Initiation
- 2.1 Identify Business Processes (BPs) to be reengineered.
- 2.2 Identify needed ICT.
- 2.3 Fix the objectives (performance indicators) for each BP.

3.0 Diagnosis
- 3.1 Understand and document existing BPs
- 3.2 Identify and evaluate the existing software for each BP.
- 3.3 Assess the use of ICT for each BP.
- 3.4 Identify software applications to be reengineered.

4.0 BPs Redesign
- 4.1 Explore redesign alternatives for each BP
- 4.2 For each alternative:
  - * Propose software reengineering operations.
  - * State the features and specifications of the desired target system.
  - * Develop a bench test and validation suites for target systems.
  - * Develop new BPs.

5.0 Implementation
- 5.1 Implement new software (development process based on prototyping)
- 5.2 Implement new BPs with continuous control of behavior and performance.

6.0 Evaluation
- 6.1 Diagnosis of new BPs.
- 6.2 Diagnosis, testing and validation of new software.

5 Validation of the Meta-model Integrating Software Reengineering in the Context of a BPR Project

The considered case study concerns university where bringing together a change to business processes and software applications was required [16]. So we begin by describing this case study, then we present the instantiation of the meta-model integrating software reengineering as part of the BPR project.

5.1 Description of the Case Study

This case study deals with the process "deliberation of students results", which is subject to an operation of BPR, in many Tunisian universities adopting the new LMD system (Licence Master Doctorat). In fact, the service "relationship with students", received several complaints from the administrative staff of the university about the difficulties in the use of the existing software (named "Ines") concerning the management of students (enrollment, management of sections, deliberation of results, etc.). We classify these difficulties into two categories:

- Difficulties related to the former system and still exist in the new LMD system:

* The software Ines requires manual refreshment for the calculation of formulas each time a new data is entered.
* The calculation of students' averages requires the intervention of the administrator, to verify the results.
- Difficulties specific to the LMD system:
* No credit management.
* Difficulties in managing modules and teaching units.
* Lack of vision on the three years of license studies for each license student.

We could collaborate with the responsible of this process in the ISG of Sousse (High Institute of Management of Sousse); in the University of Sousse, in order to apply the approach presented in this work. This experiment allowed to instantiate the proposed meta-model integrating software reengineering as part of a BPR project.

5.2 Instantiation of the Meta-model

The use of the proposed meta-model, in the case described above, allowed to instantiate each sub-meta-model. More precisely, in relation with software context and software reengineering, the following instances were obtained:

1) Instance of the software context sub-meta-model presented by the UML object diagram of Figure 4.
2) Instance of the software reengineering sub-meta-model presented by the UML object diagram of Figure 5.

The recommendations obtained in the case study were helpful to decision makers. In fact, the concrete result consisted in adopting SELIMA software which is well adapted to the new LMD system.

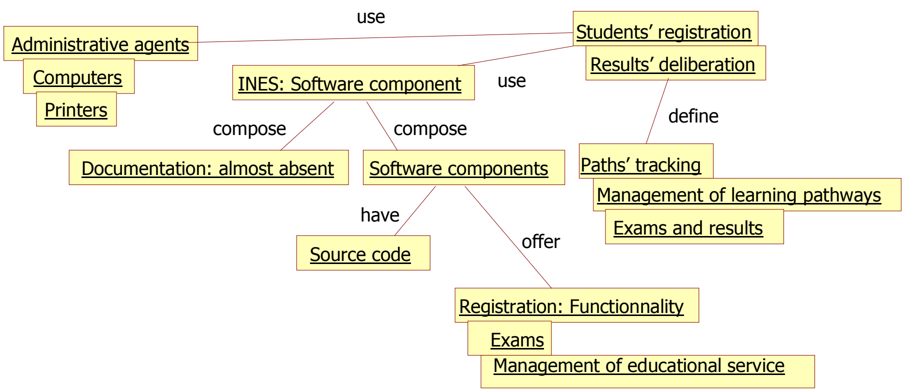

Fig. 4. Instance of the Software context sub-meta-model

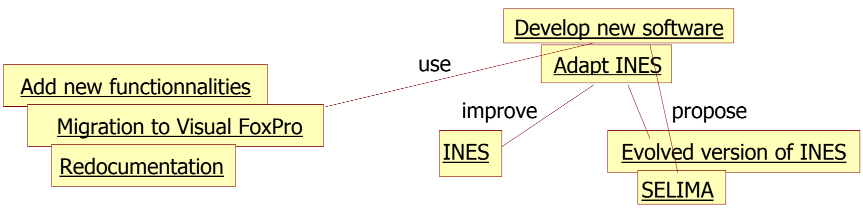

Fig. 5. Instance of the Software reengineering sub-meta-model

6 Prototype of Processes and Software Diagnosis in BPR Projects

The proposed prototype provides a quick guide for incorporating software reengineering in a BPR project. It allows the members of the reengineering team to describe and share relevant information about company resources (software and processes) and reengineering actions, according to the context. Indeed, the main features offered by this prototype are [16]:

- Identify the processes considered by the BPR project: this feature consists in determining the knowledge related to processes operating at the company,
- Identify software considered by the BPR project: this feature consists in determining the knowledge related to software used by the processes already identified,
- Introduce and describe the reengineering actions to be undertaken and specify the actions that involve software reengineering operations,
- Propose a synthesis report on the introduced knowledge
- Guide the user to locate the software applications to be reengineered and the most appropriate forms of software reengineering, based on the state of the source code, on the status of documentation and on a correspondence between objectives and forms of software re-engineering established in the work of masters of Sana Guermazi [20].

The overall architecture of the prototype is given in Figure 6.

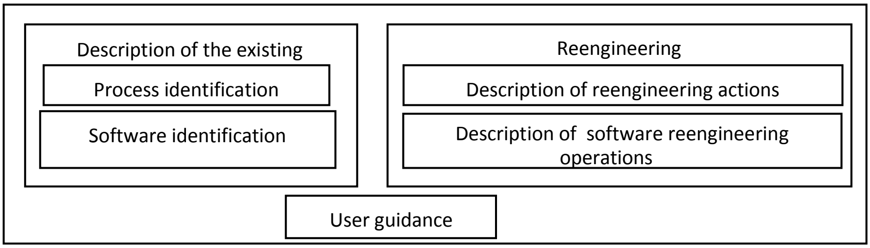

Fig. 6. Architecture of the proposed prototype

7 Conclusion and Future Works

A meta-model for BPR integrating software reengineering has been proposed in this paper. It has been tested in the field of higher education and showed the contribution of the proposed approach. Indeed, this instantiation could show the contributions of the presented meta-model: better understanding, assistance in modeling and recommendations related to the way of reengineering software components used by the considered process. This has in fact proved the validity of our meta-model.

The instantiation of the meta-model allows giving indications for what should be chosen as actions to be executed for each step of the proposed approach. This user guidance is moreover based on an objectives typology and a mapping between objectives and actions presented in the work of Guermazi [20]. This mapping is taken into consideration in user guidelines offered by the prototype in order to indicate to him what is recommended in the current step of the considered reengineering project.

This work is still open to a number of future works.

In fact, we studied in this paper the interdependence between software reengineering and process reengineering. It would be interesting to go forward and to study the mutual interdependence between software reengineering, process reengineering and global reengineering of information systems.

Moreover, we developed in this work an environment that supports the diagnostic phase of the proposed methodology. Possible perspective consists in covering all phases of the methodology in the developed environment.

It would also be interesting to apply the proposed approach in other areas, such as software development in general, RUP, or the process of development based on COTS.

Another future work will concern the completion of this meta-model by including other concepts related to Business Intelligence and more generally related to data considered by business processes and associated software components.

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Toward a Foundation for Analysing Organizational Roles in Enterprise Systems: A Case Study of a Vendor

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Abstract. Gaps between enterprise systems and organizations have long been of primary concern to both researchers and practitioners. While much attention has been paid to the fit of business processes, enterprise systems vendors have recently begun to focus on representing organizational roles in their systems as a mean of closing the gaps between system and organization. This paper presents findings from a case study of how a large enterprise systems vendor represented role-related concepts in its enterprise model and system with emphasis on role content and role relationships. A key finding from the study was that while the majority of role-related concepts were represented in the vendor's enterprise model, the implementation of roles in both the model and the actual system lacked support for remodelling and reassignment of the tasks contained in the roles.

Keywords: Enterprise Systems, Enterprise Modelling, Organizational Roles, Vendor.

1 Introduction

Throughout the past three decades enterprise systems have developed from a focus on material requirements planning (MRP) over enterprise resource planning (ERP) to encompassing and supporting most business processes in the modern business organization [1]. With the increased inclusion of business functionality gaps between the functionality provided by the enterprise system and the needs of the customer organization are common [2].

There are generally two ways of closing these gaps; either the organization has to adapt to the standard functionality of the enterprise system or the system has to be customized to fit the organization [2, 3]. Customization of the system requires significant knowledge of the inner workings of the enterprise system which often necessitates the use of consultants, incurs additional cost for the organization, and increases the risk of failure of implementation [4].

Previous research has primarily focused on closing the gaps between the *business processes* of the enterprise systems and organizations. However, in recent years some of the major enterprise systems vendors (e.g., SAP, Oracle, and Microsoft) have begun to include and focus on the concept of *organizational roles* to close the gaps between the system and the organizations [5].The role concept has been extensively

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researched in the fields of organizational science and Information Systems (IS) but research into the application of organizational roles in the context of enterprise systems has been scarce. This paper attempts to remedy this scarcity by addressing: How an enterprise system vendor represented the concept of organizational roles in its enterprise model and subsequently implemented the concept in one of its systems.

The paper consists of the following parts: 1); Theory and related work; 2) the methodology for conducting the research described in the paper 3) presentation of the findings, and 4) conclusions and discussion in the context of implications and future research.

2 Theory and Related Work

In an effort to minimize gaps between enterprise systems and organizations both practitioners, and researchers have paid much attention to the modelling and fit of business processes [6]. Process models, such as ARIS [7], has frequently been applied when modelling enterprise systems [8, 9], which is not surprising given that many enterprise systems have their origin in the manufacturing industry.

However, Katz and Kahn [10] describe the very definition of an organization as a system of roles and understanding organizational roles in the context of enterprise systems may be viewed as an alternative foundation for understanding the needs and requirements of organizations. Representing roles on the user level has also been associated with improvements in the interaction between the users and the system by tailoring presentation of information to the individual role [9, 11, 12].

Despite an intuitive understanding of the notion of “playing a role” and common use of the role concept in the IS field no common definition of the term has been agreed upon [13]. Zhu and Zhou [13] even go as far as stating that: “The actual situation of role applications in information systems is definitely in a chaos” [13]. In an effort to understand the use of the role concept, we must thus clarify the relating terms composing the concept of organizational roles in the context enterprise systems.

At times, the term position is confused with the notion of role. The two differ in that a position is concerned with hierarchical relations and privileges, while a role is concerned with the obligations of the position [14]. Despite the definitional difference between a position and a role, the terms are used interchangeably in much of the academic and practical literature. Worley et al. [9] introduces the term ‘actor’ as synonymous of an individual and describes the relationship as “the actor occupies a position (job description) characterised by one or several roles” [9]. This is illustrated in Fig. 1 by relating a position to one or more roles.

In an organizational structure roles are commonly grouped into *departments* [15]. In some approaches to enterprise modelling [e.g. 16] the composition of roles into organizational units is argued as creating a larger role resulting in collective behaviour and thus behaviour at different levels of abstraction. While the idea of collective behaviour in departments is certainly a valid perspective, the concept of a role is reserved for individuals in the analysis in this paper.

Some of the main expectations towards an organizational role relates to the notion of the *work* an individual has to carry out as part of fulfilling the expectations of a role. Furthermore, the rather broad concept of work may be divided into smaller units of *tasks* or *activities*[14]. In the context of IS the notion of work is often equated to describing the relationship between the role and the individual tasks – effectively defining a role as a collection of tasks and activities [e.g., 9, 16]. This is illustrated in Fig. 1 by relating a role to one or more tasks/activities. These tasks and activities simultaneously form the elementary parts of a *business process* [17] that describes the coordination and timing of the tasks in sequence [18], some of which may be dependent on the *industry* in which the organization operates.

2.1 Role Content and Relationships

Based on this discussion of the role concept, we can derive that the simplest relation between a role and an individual is when an individual holds only a single position, the position is associated with only a single role, and the tasks of a role are constant over time. Although this simple and static constellation is theoretically possible it is often more complicated. So for the purpose of analysis of the case study distinction is made between the tasks contained in a role, termed *role content*, and the relationship between position and roles, termed *role relationships*.

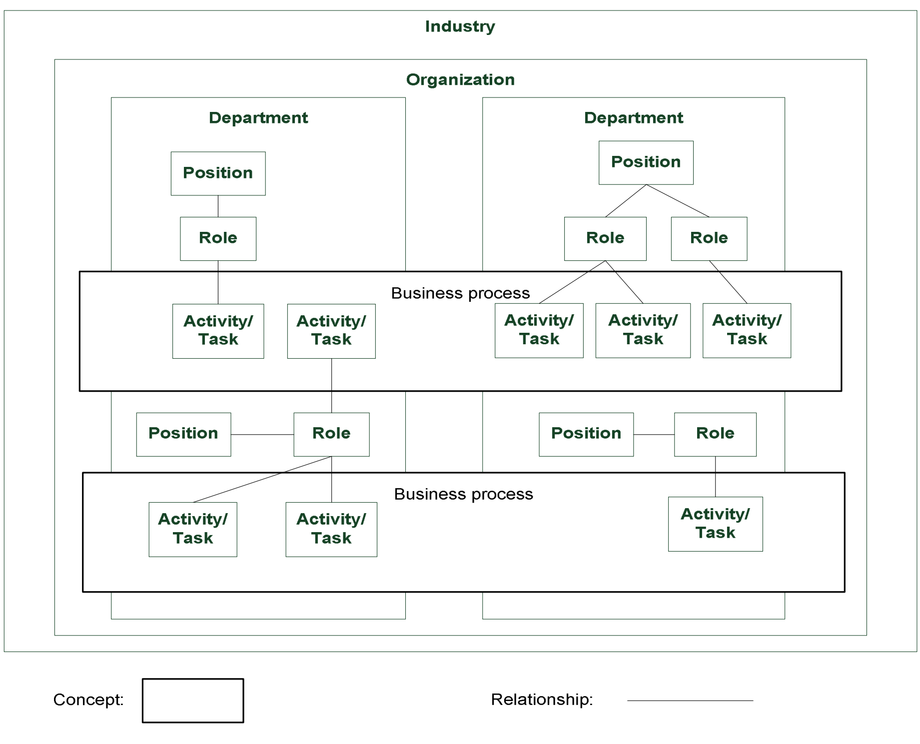

Fig. 1. Role-related concepts and their relationships based on a theoretical generalization.

A fundamental aspect of the tasks contained in a role is the division of work between the roles in an organization, often referred to as *specialization* [15]. The division of work between roles and the related tasks changes over time with the evolution of goals and processes in the organization [19]. Ideally, the enterprise model and the enterprise system should thus support *remodelling* and *reassignment of tasks*.

A single position often occupies multiple roles simultaneously (e.g., a professor who occupies the roles of a conference organizer, researcher, and lecturer), also referred to as *role aggregation* [8]. This multiple relationship entails that an enterprise system must support the association of multiple roles with a single position. The roles associated with a position will often change over time, also referred to as *role transition* [20], thus requiring support for including new roles and abandoning existing ones.

3 Methodology

The research described in this paper was carried out as a case study [21]. This methodological approach is particularly appropriate for problems and research areas that are in their early formative stages [22]. The enterprise model of Microsoft Dynamics was chosen as enterprise model for the case and Microsoft Dynamics NAV 2009 was chosen as the system for the case.

Firstly, documents describing and documenting the enterprise model were collected from the vendor's website to gain insights into the vendor's official motivations for using and representing roles in its enterprise systems. The document analysis [23] was carried out with emphasis on understanding the definitions relating to and surrounding the role concept in the enterprise model to establish a foundation for analysis of the case study.

Secondly, a software version of the enterprise model and a demo version of the enterprise system were obtained from the vendor to observe and compare the role-related concepts in the enterprise model with the implementation of the concepts in the system. The software version of the enterprise model also served as a means of validating the statements made in the online documentation in regards to the properties and features of the model.

Finally, a semi-structure interview [24] with the manager responsible for implementing the role concept in the enterprise system was conducted to elaborate on the background related to implementing the concept in the enterprise system. At the time of the interview the manager had left the vendor, so in order to triangulate the statements of the manager and to elaborate on some of the specific implementations in the system a second interview was conducted with a so-called 'user experience developer' at the vendor. Both interviews were recorded, fully transcribed, and summarized through the use of notes.

4 Role-Related Concepts in the Enterprise Model

The vendor's enterprise model contained a total of 61 personas, which were defined as "a typical view of the people that can occur within an organization defined primarily by the collection of roles they have”. Each persona was linked to a job position and contains information, such as ‘demographic’, ‘psychographics’, and ‘goals’. In the literature, personas has been used for describing properties, such as goals, technology attitudes, and work activities, of fictitious users for the purpose of communicating requirements when designing information systems [25].

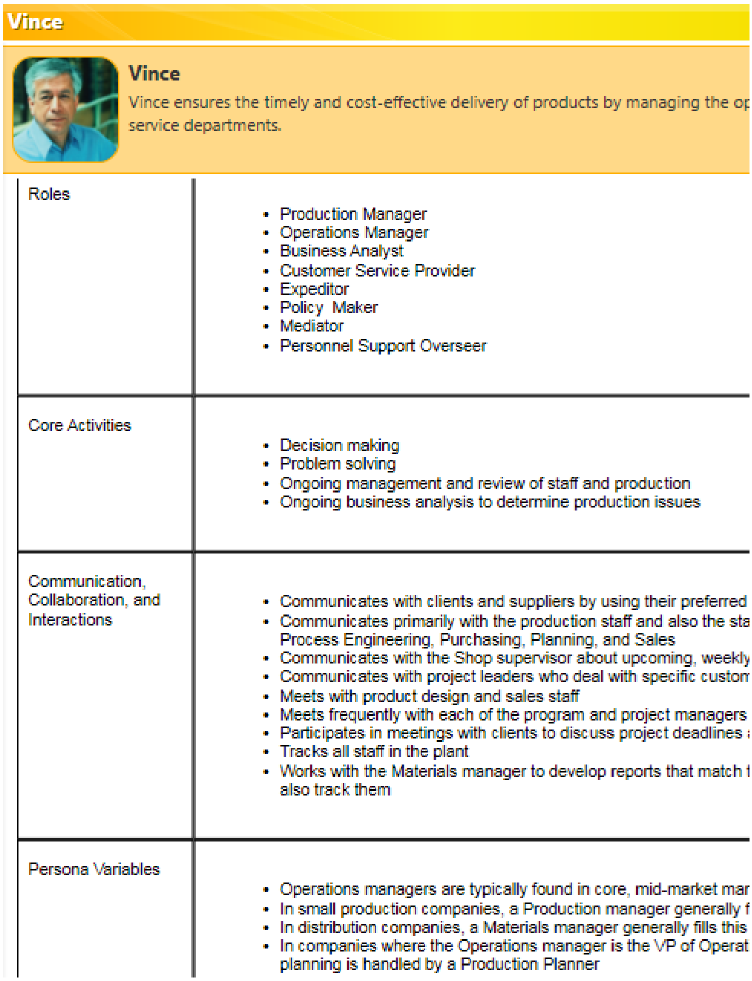

Fig. 2. Persona from the vendor’s enterprise model. Copyright of Microsoft Corp.

The vendor’s representation of personas in the enterprise model was generally consistent with the perspective from the literature but besides the aforementioned properties, the personas also contained a number of roles. Each role was defined as a specific grouping of tasks and activities, such as ‘manage inventory’ or ‘generate financial reports’, that a persona was responsible for or participated in (see Fig. 2).

A few roles were included in more than one persona and the 61 personas in the model contained a total of 233 unique roles. Excerpt from a persona in the enterprise model is shown in Fig. 2

The personas were grouped into departments which were part of either 'large' or 'small' organizations in the model. The 'large' organizations did not mirror differences in industry. However, for 'small' organizations, the vendor model suggested to differentiate between 'retail' and 'service' industry.

The model also contained (business) processes such as 'consolidate orders' or 'route shipments' and each of the processes consisted of a structure of activities, as shown in Fig. 3. Although the names of some of the activities in the processes suggested a link to the activities described in the personas, there were no explicit relationships between them.

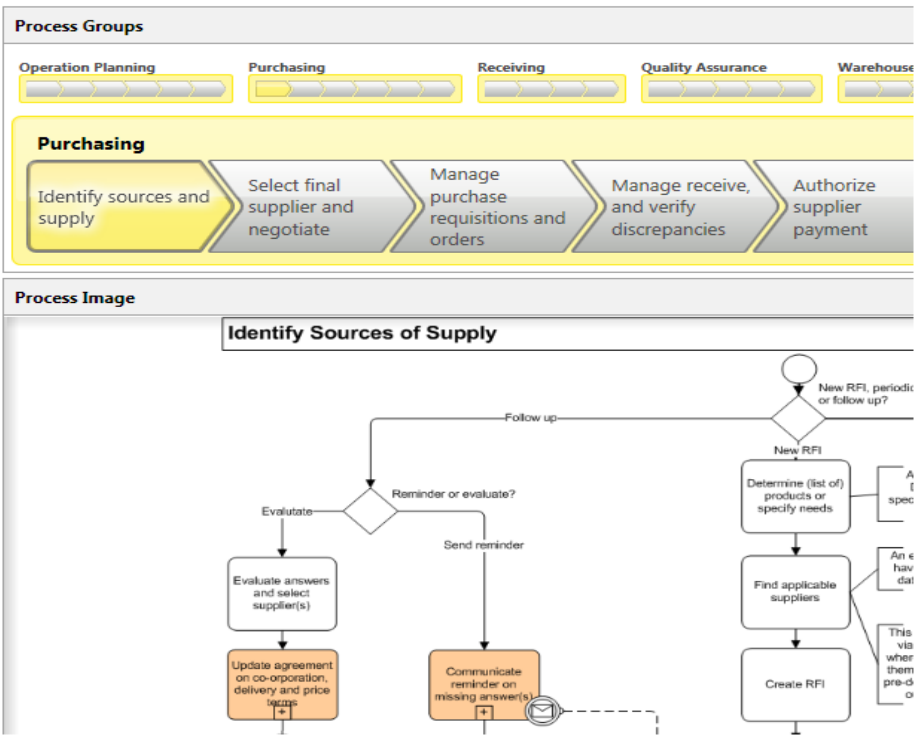

Fig. 3. Processes and activities/tasks in the vendor's enterprise model. Copyright of Microsoft Corp.

5 Role-Related Concepts in the Enterprise System

The enterprise system contained 21 out of the total 61 personas in the form of 'role-centers'. A role-center is the "home" of the user and contains activities and tasks based on a corresponding persona. Besides activities and tasks the role-centers also included integration to information from other systems giving them resemblance to enterprise portals [12]. The 21 role-centers covered 116 of the total 233 roles in the enterprise model, but the roles themselves were not explicit in the system – only the role-centers were, as illustrated in Fig. 4.

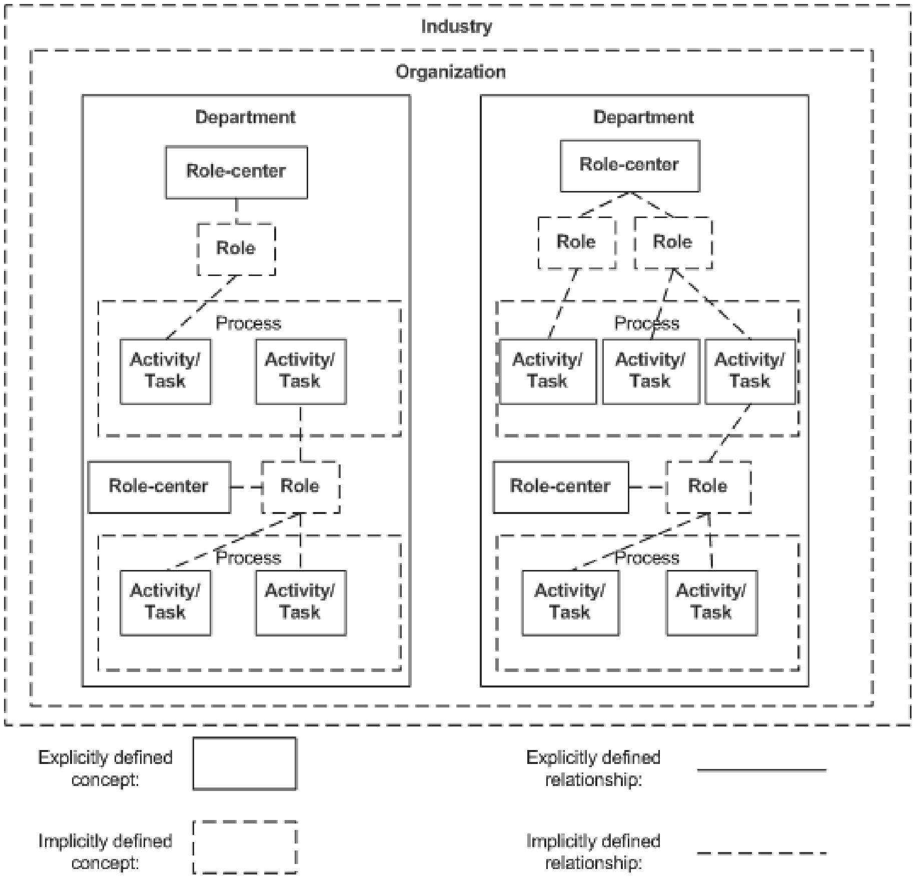

Fig. 4. Role-related concepts as implemented in the vendor's enterprise system

The names of the role-centers were based on the name of the primary role contained in the persona. Fig. 4 shows the role-related concepts as they appear in a standard implementation of the enterprise system with a distinction between explicitly and implicitly defined concepts and relationships.

6 Role Content and Relationships in the Enterprise Model and Enterprise System

As previously described, each persona had multiple roles and thus supported the aggregation of organizational roles to a single position. In the implementation of the roles in the system each user login was assigned to a role-center and the assigned role-center could be changed by an administrator. All roles were pre-assigned to the role-centers and roles could not be added or omitted. The original idea behind the roles was that the user should be able to join the different roles together (Former Manager), but neither the enterprise model nor the enterprise system supported transition of roles from one persona to another. Since a user could only be assigned to a single user profile at any given time and a user profile was linked to only a single role-center, all the roles of an end-user were aggregated into a single user interface.

There were no apparent industry specific variants of roles in the model but some of the personas contained ‘persona variables’, reflecting alternative collections of roles depending on the organizational structure in which they were part (see Fig. 2). In the system there were specializations of three role-centers, reflecting differences in the ‘CEO’, ‘Shop Supervisor’, and a ‘Shipping and Receiving’ persona.

In the enterprise model it was not possible to remodel the described tasks and activities or reassign the tasks and activities to other roles or personas. Remodelling and reassignment of tasks and activities in the enterprise system was not supported explicitly either and required customization of the code base of the system. Table 1 contains a comparison of the supported role dynamics in the enterprise model and the system.

Table 1. Role content and relationships

Role content	**Vendor’s enterprise model**	**Vendor’s enterprise system**
Role specialization	Persona variables	Role-center variations
Remodelling of tasks	-	Required customization
Reassignment of tasks	-	Required customization
Role relationships	**Vendor’s enterprise model**	**Vendor’s enterprise system**
Role aggregation	Multiple roles in one persona	Multiple roles in one role-center
Role transition	-	Associate login with a different role-center

7 Conclusion and Discussion

This paper contributes to some foundations for analysing how enterprise system vendors address the representation of organizational roles in their enterprise models and enterprise systems by emphasizing how role-related concepts are explicitly or implicitly represented and how role content and role relationships are supported.

Comparison between the vendor’s enterprise model, the system, and the generalized role-related concepts showed that most of the concepts were represented but that representation of organizational structure and industry in the roles and personas was limited. The role concept itself was implemented in the system but only implicitly and the differences between industries and the variance in organizational structure, as reflected in the enterprise model, were not implemented in the system.

The comparison also showed that although the enterprise model implied a connection between personas and processes the lack of explicit relations between the activities contained in the personas and the activities contained in the processes essentially caused a disconnection between roles and processes in the model, which was also inherent in the system.

The support for role relationships in terms of aggregation was present by means of aggregating multiple roles into the same persona in the enterprise model and into the same role-center in the system, but neither the enterprise model nor the system supported explicit remodelling of tasks or reassigning tasks to different roles or personas. The lack of support for reassigning or remodelling tasks is potentially an issue when deploying the system in customer organizations as fitting of the predefined tasks and roles to the organization relies on customization of the code base rather than configuration.

While the introduction of organizational roles as a concept in enterprise systems could potentially reduce the gap between enterprise systems and organizations, the absence of support for remodelling or configuring role content and relationships may lead to an increased need for customization – resulting in higher cost of deployment. Future research will thus need to address the fit between predefined standard roles and customer organizations. Furthermore, the implications of using personas as representations of users in enterprise modelling should be further investigated. Finally, further research is required on actual implementations in customer organizations of enterprise systems that are adapted to organizational roles.

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Integrated Intelligent Systems and Value Creation: Results from the Public Transport

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Abstract. Public transport contributes to the welfare of the citizens and improves the social development of the countries. The contribution of Public Transport to the GNP is estimated to be around 1% in Europe. Worldwide, local authorities dedicate between 15 to a 20 per cent of their yearly budget to urban transport. Intelligent Transport Aid Systems (ITA Systems) are integral real time control systems for monitoring transportations networks. The main objective of this research consists of examining the relationship between the investments in Integrated Intelligent Transport Aid Systems (ITA Systems) and Value Creation in Urban Bus Companies. Results show that the investment in Intelligent Transport Aid Systems created value and generates a better performance in firms operating urban transport along time.

Keywords: Intelligent Transport Aid Systems, value creation, public transport industry, efficiencies.

1 Introduction

To cover the increase of demand in the Public Transport, the public authorities in Europe intend to increase the levels of security and quality in the transport systems, by developing and integrating new technologies that would lead to value creation for customers, public authorities and transport companies. Public Transport, besides of being competitive in price, must offer comfort and security to the passengers. The actual demand implies that the new requirements for the use of public transport should focus in a better service, higher quality and versatility, with strict environmental restrictions and competitive pricing.

The effectiveness in the management of the systems is the only option that allows covering the demand of the citizens' mobility [1]. To fulfill those requirements, IT and communication networks are basic elements, where Intelligent Transport Aid Systems (ITA Systems) is the key application to improve the monitoring of the

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transport networks.ITA Systems are specific traffic management systems based in an intensive use of IT and communications technologies. They allow avoiding the problems associated to traffic jams in urban and inter-urban transports.

The application of these systems started in Japan in the seventies and in Europe in the nineties as a sustainable alternative to the problem created by the increasing mobility demand, especially in urban and inter-urban areas. This way the ITA Systems increases the sustainable mobility by improving the efficiencies in the transport and providing a higher level of security for final users [2].The main objective of this research consists of examining the relationships between the investments in ITA Systems and the value creation in urban bus transport companies.

The selection of this research in basically inspired in: 1) the practical non existence of studies that put into relation the impact of IT and communication technologies over public urban transport; 2) the new trend that dissociate social welfare, in terms of GNP per capita, with the intensive use of private transport in the urban areas of important western cities, as for example, New York or Zurich and 3) the lack of indexes that allow in a satisfactory and concise way, the introduction of IT and the generation of efficiencies (value creation) applied to the public urban transport and specifically to the ITA Systems

2 Theoretical and Empirical Background

This section summarizes the most relevant approaches as revealed in our literature. Value creation is the primary aim of any business entity. Creating value for customers in the public transport industry helps to sell services, while creating value for employees, public authorities and shareholders, in the form of a positive working environment, offers a better political image and increases in stock prices. This ensures first, a more efficient human resources structure, second, a positive influence to renew success in the concession and third the future availability of investment capital to fund operations.

From a financial perspective, value is said to be created when a business earns revenue or return of investment that exceed the expenses or the cost of investment. But some analysts insist on a broader definition of “value creation” that can be considerate separate from traditional financial measures. Value creation is increasingly represented today not only by high earnings rates, but also by intangible drivers, like innovation, people capacity and ideas. When broadly defined, value creation is increasingly recognized as a better management goal that strict financial measures of performance, many of which tend to place cost-cutting that produces short-term results ahead of investments that enhance long-term competitiveness and growth. In the Public Transport industry the first step in achieving an organization wide focus value creation is to find out the sources and drivers of value creation within the industry, the company, and the marketplace.

As soon as managers define in a proper way what creates value, it will help then to focus capital and human resources on the profitable opportunities for growth. If quality and time delivery of the services are what customers consider an important value, then the skills, systems, and processes that deliver quality services are highly appreciated for the organization [3]. If innovation and high performance are what customers consider as an important value, then the skills, systems, and processes that create new services with superior functionality make a difference [3].

As a summary of these assumptions, we can assure that a consistent alignment of actions and capabilities with the customer value proposition is the core for the execution of the strategy. In the Public Transport industry, as in most part of other industries, the intangible factors that drive value creation are technology, innovation, managerial capabilities, employee relations, customer relations and community relations. According to [4], the link between these intangible assets and value creation is corporate strategy. It is important to note that the investment made to enhance intangible assets (R&D, employee training) usually provides indirect rather than direct benefits. In this way, focusing on value creation forces an organization to adopt a long-term perspective and aligns all of its resources toward future goals.

[5] Analyses the impact of telecommunication systems over urban transport in the sector of private transport. He locates his analysis in the management of fleets, the local authorities and the environment. The implementation of IT and communication applications in the urban transport, would provide a positive impact in the management of the public transport (management of fleets), in the perceptions of users on local authorities and in the environment. The positive impacts derived of the implementation of communication networks would be related with the timetables for the journeys, operational costs, service quality, security, environmental improvement and the decrease in energy consumption. [6] Analyses the effects that a group of Acts produce in the public transport efficiency. [7] Indicates that the changes promoted by the implementation of new technologies have a positive influence in the dynamics of the public transport industry. The changes would be determined by a generalized improvement in the quality of the service offered, and the way this public service is offered. These changes should improve the final results of the transport systems, by promoting a change in the sector. In order to find out the driving forces related to the generation of efficiencies derived from IT investments and the implementation of Intelligent Transport Aid Systems in the public urban transport, it is useful to observe which ones are the main relevant objectives for an ITA System.

According to [8] and [9], the implementation of an ITA System would promote a higher operational security in the management of public urban transport companies, associated with an improvement in the customer satisfaction (users) and bus drivers, and an increase in the real demand, based in a more competitive schema of the final supply. Both come to the conclusion, that the main objectives and premises to be reached by implementing a Intelligent Transport Aid Systems are: 1) An increase in the service quality by improving the travel times, a better adaptability of the supply and demand, and a better information “on line” to the users; 2) A decrease in the operational costs and a reduction in the needed investments to optimize the service supply, less buses for the same degree of supply, a decrease in the number of drivers; 3) A greater efficiency in the traffic management structure produced by a decrease in the number of operational people, a greater reliability in the decision making process, greater flexibility and more transparency; 4) Better control of the fleets with a decrease in the number of breakdowns, a decrease in accidents and a more positive environmental impact. An increase in the reliability of the decision making process by offering a higher degree of flexibility an transparency; 5) A decrease in the negative impacts in the environment generated by pollution and noise.

According to the previous statements, we could affirm, taking into account the objectives marked in both references, that the implementation of an ITA System: should increase the service quality, should decrease the operational costs, should generate a great efficiency in the structure of traffic management and a higher and more accurate traffic control. All these aspects would promote an increase in the real demand, and it would accelerate the returns of investment, together with a considerable increase in value creation.

2.1 Hypotheses

By having taken into consideration the different approaches indicated in the previous theoretical background, we offer to the effects of this research the following hypotheses,

H1. *The implementation of an ITA System improves the efficiency in firms operating public urban transport by bus*

This hypothesis is sustained in the objectives established in [8] and in [9]: a decrease in the number of buses for the same level of demand, a decrease in the number of drivers, a decrease in the operational costs and a decrease in the energy consumption. [10] support that the implementation of IT in the organizations improves the operational efficiency and the functional effectiveness. [11] Stress how IT increases the productive capability and therefore the efficiency in the organizations [12] and Newman [13] confirm that an increase in the use of public transport decreases the consumption of energy in the cities. [5] In his research on public transport states that the introduction of IT and communications technology in transport firms increases the quality of service and the regularity and punctuality of the runs. [14] Affirm that IT has an impact in the final profitability and productivity in the organizations. [15] Proof how the implementation of IT decreases the operational costs in firms.

H2. *The implementation of an ITA System improves the quality of service in public urban transport by bus*

The objectives appeared in [8] and in [9] in which this hypothesis would be sustained are the following ones: an improvement in the travel times of the service, best information for the final user on public transport, best adaptation of the supply to the demand, a positive perception by users (less number of accidents and breakdowns). The following studies would support the results in the empirical study: [17] defend that IT increases the quality of the service. [17] Also show in an illustrative way, that some intangible values, coming from IT investments, would have an impact in the improvement of some aspects: in the quality of products and services, in the relationship with the final customer. [18] Stresses how the implementation of IT improves the quality and service by promoting a differentiation in the customer. [5] affirms that the implementation of IT in transport firms improves the quality of the service, and the regularity in the frequencies pre-established for the transport. [19] sustain that the introduction of IT in firms improves the relationship with customers.

H3. *The implementation of an ITA System improves the effectiveness in the personal of firms operating in the public transport by bus.*

The objectives offered in [8] and in [9] sustain this hypothesis: it improves and optimizes the human resources productivity.

The following studies would in principle support the results in the empirical study: [20] defend the theory that the investments in IT improve the productivity in the organizations. [21] Support in their study that the most important effects of IT in firms consist of the decrease in the coordination costs of the economic activities in the organizations, and the improvement of processes in firms. [22] Affirm that the investments in IT and human resource training actions produce competitive advantages in the organizations. [23] Check how the qualification of the employees constitutes a key aspect to achieve better results from IT investments.

H4. *The implementation of an ITA system improves the information related with relevant business data in firms operating public transport by bus.*

The objectives appeared in [8] and in [9] in which this hypothesis would make sense are the following ones: a higher reliability in the decision making process, more flexibility and transparency and a better technical control in the fleet, an increase in the efficiency in the traffic management. The following studies would support *a priori* the results of the empirical study: [24] affirm that the investments in IT produced in specific processes in the organizations are potential sources of competitive advantages. [25] Proofs how IT promotes the achievement of competitive advantages by putting together the flows of information amongst organizations or amongst different administrative units inside the organizations. [26] Indicate in their research that IT is a potential source for generating competitive advantages since they improve the existent processes. This improvement is translated into best precise and updated information. [27] In the report "Information Technology Outlook" indicates how IT offers a level of relevant information for the business of all the firms. [2] affirm how the introduction of ITA Systems collaborate in all the managerial and distribution processes in the transport of people, by offering real time information related to traffic and travels, management of the public transport, management of the urban transport, management of the demand, assistance to the driver and planning the journeys.

The technique for the analysis applied to the empirical study is based in the use of structural equations containing latent variables and errors of measure. In the proposed model, we consider the value creation (VC) as the result of a series of factors that appear measured through economic indicators (EI), quality indicators (QI), Human Resource indicators (HRI), and general and business indicators (GBI). As it has been pointed out in the explanation of the hypothesis, we defend that an ITA System produces a group of efficiencies that lead to Value Creation, and can be measured by a group of economic indicators (H1), quality indicators (QI), Human Resource Indicators (HRI) and Business indicators (H4). At the same time, they promote value creation (costs, differentiation and perception) (H5).

3 Results

We offer a summary of the results obtained for each of the hypotheses in our analysis.

H1. The Implementation of an ITA System Improves the Efficiency in Firms Operating Public Urban Transport by Bus

RESULTS IN THE ESTIMATIONS FOR THE EI INDEX

	Estimation	P-v
EI10 <= LIEE	1.000	0.000
EI9 <= LIEE	0.949	0.114
EI8 <= LIEE	0.903	0.051
EI7 <= LIEE	1.046	0.025
EI6 <= LIEE	1.173	0.018
EI5 <= LIEE	1.293	0.006
EI4 <= LIEE	1.211	0.014
EI3 <= LIEE	0.752	0.071
EI2 <= LIEE	0.575	0.105
EI1 <= LIEE	1.632	0.005

Fig. 1. Results in the estimations of the economic index (EI)

The obtained value for the parameter that relates the efficiency and economic index with efficiencies is 0,127 positive and, one of the highest values of the four obtained in the hypothesis testing. Empirically it is verified, as it is shown on fig. 1, that there is a positive association between the implementation of an ITA System and the improvement in the efficiency of public urban transport by bus. The result of this relationship coincides with some studies that relate information and communication technology investments (IT) with final results, and with the main objectives searched by the implementation of an ITA System. The obtained results in the empirical analysis are aligned with other previous pieces of research [8, 9, 14, 15]. They all show that the implementation of IT in organizations improve the operational efficiency and the functional effectiveness and increases the capacity of production and therefore the final efficiency and profitability of the organizations. Besides some other papers exclusively centered in public transport [12,13, 5] would be aligned with the obtained results. [12] and [13]conclude that specifically for the public transport industry, the increase in the number of users' decreases the energy consumption in cities and [5] affirms how the implementation of IT in transport firms increases the regularity and punctuality of the paths. Besides, this result matches the objectives pursued for the implementation of an ITA system defined in [8] and [9]. According to both reports, the implementation of an ITA System would imply a decrease in the number of buses for a same level of the demand, associated to a decrease in the number of drivers and to a reduction of operational and energy consumption costs.

H2. The Implementation of an ITA System Improves the Quality of the Service in Firms Operating Urban Public Transport by Bus

RESULTS IN THE ESTIMATIONS OF THE QI(QUALITY INDEX)

	Estimation	P-v
QI10 <= LIC	1.000	0.000
QI9 <= LIC	1.089	0.056
QI8 <= LIC	1.197	0.062
QI7 <= LRH	1.442	0.054
QI6 <= LIC	1.524	0.037
QI5 <= LIC	1.397	0.041
QI4 <= LIC	0.717	0.115
QI3 <= LIC	1.013	0.119
QI2 <= LIC	0.917	0.061
QI1 <= LIC	0.986	0.052

QI = QUALITY INDICATORS

Fig. 2. Results in the estimations of the quality index (QI)

The value obtained for the parameter that relates the variable IQ, (indicator of quality) with efficiency is 0,099, also positive and of small value in relation with the parameter related to the efficiency in the H1, previous hypothesis. Empirically we verify that there is a positive association between the implementation of an Intelligent Transportation Aid System and the improvement in the quality of service of the firms operating public transport by bus. The result of this relationship matches different studies related with the investments in IT, and with the main objectives pursued by the implementation of an ITA System. The obtained results in this empirical study would be identified with a group of previous literature, as for example [16] that state that IT increases the quality, and this increase offers at the same time an increase in productivity, and [17] that state how some intangible values, coming from IT investments have a tendency to improve the quality of products, services, and customer attention. Porter [18] also stresses how the implementation of IT in organizations improves the quality and the service differentiated to the customer and Perez [5] in a specific work on public transport affirms that the implementation of IT in firms improves the quality of service. Lastly, [19] confirm that the implementation of IT in organizations improves the attention to the customers. Besides this results are congruent with the objectives followed by the implementation of an ITA System defined in [8] and [9]. According to both reports, the implementation of an ITA system would promote higher and better information to the user of public transport, a better adaptation to the supply and demand, and a positive perception by users in all respect to public transport (less number of accidents and breakdowns).

H3. The Implementation of an ITA System Improves the Efficiency of the Human resources in Firms Operating Public Urban Transport by Bus

RESULTS OF THE ESTIMATIONS OF THE HUMAN RESOURCE INDEX

	Estimation	P-v
RH10 <= LIRH	1.000	0.000
RH9 <= LIRH	-0.394	0.769
RH8 <= LIRH	-0.100	0.935
RH7 <= LIRH	2.365	0.318
RH6 <= LIRH	4.514	0.297
RH5 <= LIRH	-0.198	0.809
RH4 <= LIRH	3.150	0.305
RH3 <= LIRH	2.065	0.376
RH2 <= LIRH	3.333	0.300
RH1 <= LIRH	3.475	0.295

HRI = Human resources indicator

Fig. 3. Results of the estimation of the HR index (HRI)

The value obtained for the parameter that relates the variable HRI (human resource index) with the efficiencies is 0,134. Positive and the most elevated of the four obtained related to the hypotheses. As we have shown, we can empirically verify that there is a positive relationship between the implementation of an Intelligent Transport Aid System and the improvement of the efficiency of human resources in firms operating urban public transport by bus. The result of this relationship fits with a group of studies related with investments in IT, and with the main objectives pursued in the implementation of an ITA System. The results obtained in this empirical study would match with different previous empirical studies, as the ones coming from [20] that check how the investments in IT improve the productivity in organizations, or [21] that affirm that the most important function in IT is the reduction of the coordination costs coming from economic activities inside the organizations and improve the processes and the organization of firms. Apart from this, [22] affirm that together the investments in IT and the training of people offer efficiencies in the organizations. [23] Also proof that the training efforts in the workers is a key aspect to get a best profiting of the investments in information and communication technologies. Apart from this, this result is congruent with the objectives followed by the implementation of an ITA System defined in [8] and [9]. According to both reports, the implementation of an ITA system would lead to an improvement in the productivity of the personal and to an optimization of the final services.

H4. The Implementation of an ITA System Improves the Information Related to the Data of Interest in the Business of Firms Operating Urban Public Transport by Bus

RESULTS OF THE ESTIMATIONS OF THE GENERAL BUSINESS INDEX

	Estimación	P-v
GN10 <= LIGN	1.000	0.000
GN9 <= LIGN	0.706	0.007
GN8 <= LIGN	0.577	0.036
GN7 <= LIGN	0.186	0.434
GN6 <= LIGN	0.535	0.005
GN5 <= LIGN	0.642	0.004
GN4 <= LIGN	0.155	0.573
GN3 <= LIGN	0.008	0.979
GN2 <= LIGN	0.770	0.001
GN1 <= LIGN	0.449	0.083

GBI = INDICATOR OF THE GENERAL BUSINESS INDEX

Fig. 4. Results of the estimations of the general business index (GBI)

The value obtained for the parameter that puts into relation the variable Global Business Index, GBI with efficiencies is 0,087. Positive and the smallest of the four obtained for this hypothesis. Empirically we can verify that there is a positive relationship between the implementation of an Intelligent Transport Aid System (ITA System) and the information related to the data of interest on the industry of firms operating urban public transport by bus. The result in this relationship matches a variety of research analyzing the final firm's results dealing with IT investments, and with the main objectives followed by implementing an ITA System. The results obtained in the empirical study would be supported by the previous literature review, as [24] who affirm that the investments in IT centered around specific processes in the organizations are potential sources for the generation of competitive advantages, or [25] who states that IT generates competitive advantages by linking the processes of the flows of information amongst different administrative units inside the organizations. [26] also validate in their research that IT are potential sources for competitive advantages since they have the power of improving the existent processes. This improvement allows the obtaining of more precise and updated information. Apart from this, the [27]indicates how IT offers a level of relevant information for the business in all the firms. [2] Support that the implementation of ITA System would benefit the management processes related to transport, offer real time information and would facilitate the planning of the traffic processes. This assumption is also congruent with the objectives followed by the implementation of an ITA system defined in [8] and [9]. According to both reports, the implementation of an ITA System would drive to a higher reliability in the decision making processes, more flexibility and transparency, a better technical control of the fleet, and as a result of all of them, an increase in the efficiency achieved in the management of the traffic.

4 Conclusions

Public Administrations and industries related to transport and new technologies are performing important efforts to promote the citizens mobility, based in a higher use of public transport, especially in cities. The main reasons to promote the use of Public Transport is to count urgently with a sustainable, effective and efficient citizen's mobility, and simultaneously with a positive effect in air pollution and energy costs reductions.

To increase the use of public transport in an urban environment, it is needed to build an optimal level of supply, combined with a Government support, and desired levels of quality. The transformation of the model or behavior of people in relation to transport in cities can be reached by improving the profitability of firms operating urban public transport.

Our research tries to empirically explore and validate if the use of a certain technology, Intelligent Transport Aid Systems (ITA Systems), in the public transport is the source for the generation of Value Creation in a regulated scenario, as it is the case of public urban transport by bus in the most important cities in Spain.

This kind of analysis is important since there are not concrete pieces of research that put into relation and validate from an empirical point of view the effects of IT applied to the management of public transport in general, and in particular the implementation of Intelligent Transport Aid Systems (ITA Systems) in firms operating urban buses.

The basic conclusions for this study, supported in different kinds of hypotheses, are the following ones:

- Intelligent Transport Aid Systems improve the efficiency and the profitability of firms operating urban public transport by bus (H1)
- Intelligent Transport Aid Systems increase the quality of the service and the image of public transport in firms operating urban public transport by bus (H2)
- Intelligent Transport Aid Systems improve the efficiency in the management of human resources in firms operating urban public transport by bus (H3)
- Intelligent Transport Aid Systems increase and improve the quality of information for firms operating urban public transport by bus (H4)

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The Modernization of Public Accounting in Portugal: Effects of the Introduction of the Principles of New Public Management

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Abstract. Presently living in a period of fast economic changes, governments have found the need to adopt measures that promote the rationalisation and profitability of the available resources. As a member of the European Union and simultaneously of the European Economic Community, Portugal is obliged to meet the convergence criteria set out in the Pact of Stability and growth, and therefore forced to introduce reforms. This study includes some the recent reforms introduced in Portugal in the scope of the new public management, and the revision of the literature available on the subject.

Keywords: accounting, management, NPM, public sector.

1 Introduction

The New Public Management (NPM) emerged during the eighties / nineties, as reaction to the traditional governance philosophy of Max Weber. The NPM advocates a more efficient and rational administration for the public administration. Its defenders such as, David Osborne and Ted Graeler, believed there was a need for reinventing governance and introducing the spirit of entrepreneurship, so as to transform the public sector and abolish bureaucracy.

The NPM, like other public management theories, is directed towards results and efficiency, achieved through an improved budget management, competition in the public sector organisations, as is the case of the private sector, and emphasises economic and leadership principles. The new public management sees the citizens as clients, similar to the private sector.

1.1 The New Public Management: Philosophies and Concepts

Essentially, the NPM is a management culture, orientated for the customer, and for accountability and results. The main objective of the implementation of the NPM is the achievement of more transparency, more efficiency and better quality, as well as the reduction of expenses. The philosophy of the NPM is based amongst others, in the following:

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- A management culture directed towards the client;
- More Transparency, with the aim of allocating resources and the results;
- Best organisation, achieved through the decentralized control and mechanisms that offer a great variety of alternative services;
- The NPM suggests the establishment of contracts between the various agents (public/private or others)[1], with the aim of achieving better results for the public administration;
- The NPM is trying to introduce in public management the same tools used in the private sector, but in a different manner.

NPM is one of the tools for the reform of the public sector. It is made up of various elements, which are used by the governments all over the world, as fundamental tools in changing the public sector, that is:

- Less State – reducing the services provided by the State;
- Separating the decision taking levels - separating the strategic level from the operational level: the politicians decide "what" the administration decide "how";
- Reducing the Management – combining management by objectives, levelling of the hierarchy, project management, performance pay, modern leadership methods;
- New attitude of the services – orientated towards the client: satisfaction the centre of all priorities, behavioural changes;
- New control model – based on well defined objectives, measuring of results, and transparency in the allocation of the resources;
- Decentralization - Task, accountability, competence and programme / project budgeting;
- Management Quality – that assures high quality services, through the qualification, competition and transparency;
- Closeness to the product - considering all administrative services as products, highlighting factors such as: characteristics, costs, necessary resources and delivery dates.

2 The Information Tools

According to Valiño Castro [11], there are some peculiarities in the public sector that the application of information tools difficult. In fact, while private enterprises aim at maximising profits, public entities follow certain objectives, where the social predominates over the economic. If we add to this the complexity of the activities and size of the public organisations, with which the private enterprises cannot compare, determining the objectives and the population to which they are targeted, immediately we will find a variety of particularities.

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[1] See, for example, public/private partnerships. According to Public/private SGPS, SA (2007), 'a PPP (Public Private Partnership) is, by definition, a long term relationship between public and private entities aimed at providing a particular service, possibly needing or not the conception, finance and construction of public infra-structures for that effect'.

An important factor still has to be added, the political factor, which we cannot ignore; very often "it is important" that the objectives be vague and imprecise. And finally there is another also important factor: the public sector's lack of experience in assessing efficiency and efficacy.

On a theoretical level, the difficulties mentioned above did not prevent the design of formulas to achieve a certain level of efficiency, efficacy and quality; although for the latter we need to wait for a greater development of the previous ones.

The information tools available most adequate for the application of the previous techniques, are Analytical Accountancy[2] and Budget by Programme [11, 4]; both complement each other.

2.1 Public Accounting at the Service of Management

The purpose of accountancy is to provide useful information for decision making. For this it is essential that it adaptable to the needs of those requiring it. The current demands result from the new public management techniques, which emerged during the nineties, point out the following [11]:

- Public service focussed on the client not the administration;
- Aim for efficacy, efficiency and quality, measured in terms of results instead of outputs, aiming also to minimize costs ("value for money");
- Medium and long term planning and control of the results;
- Decentralization of responsibilities, in many instances creating agencies that act with autonomy in management, and reflecting, in the great majority, reforms in the working system;
- Imitation of private sector practices, introducing competitively and creating in some instances internal markets, in other contracting the services of the private sector.

The new use we aim to give the accounting information requires the application of analytical or cost accounting system, which includes the achievement indicators. This does not exclude financial accounting; it complements it like in the private sector.

A very important issue is the application of the accrual system, based on what the Anglo-Saxons call "accrual accounting", which implies the acceptance of profits gained and costs incurred, independently of its receipts or payments, and should be included in the financial statements of the period in question" (POC).

The decentralization of responsibilities requirement demands also the creation of accounting sub entities, with independent budget provisions. The necessary conditions should be created to allow the comparison between public entities as well as between private entities.

The integration of the accounting information, with the information from the budget system is also necessary. This co-ordination also includes the need of information for planning, based on multi-annual accounting and budget systems. [11].

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[2] The Analytical Accounting is set in the Public Accounting Legislation (Law No. 8/90, of 20 February), not in general use in the Portuguese Public Administration. Considering the scope of this paper, we will not deal with this topic.

In Portugal, there is an Official Accounting Plan for the Public Sector (POCP), in force since 1997[3]; this shows that the accounting standard in the public sector is very recent in comparison to other European countries such as Spain and the greater experience of the Anglo-Saxon world, both in the theoretical aspect as well as the academic and professional aspect.

With the POCP we aim at integrating the various aspects – budget, asset and analytical accounting – in a modern public accounting capable of meeting the information needs of Public entities while simultaneously providing management support [7].

The POCP is compulsory for all organs of the central, regional and local administration, with the exception of public companies and the Social Security. It is also applicable to non profitable organisations, if these are mostly funded by the state Budget.

This new Accounting System includes, essentially, the outlines of the recent Public Accounting developments on an international level, when changing from a merely budget accounting (digraphic), to an accounting system similar to business accounting – asset and analytical accounting.

Regarding the organisation method, we found the POCP is very similar to the Official Accounting Plan (POC) in force, but this is not the case regarding the contents, where the differences are significant. The same as for Spain [7].

Its theoretical efficacy occurred mid November 1997[4], however Decree No. 116/99, of 10 February defined the practical implementation methodology, observing the following presumptions: a) selection of a set of pilot organisations who have to maintain the accounting system adopted in parallel to the POCP in 1999 and the final POCP as from the year 2000; b) the rest of the entities would have to get ready for the application of the POCP and wait for its implementation, to be set by the commission for the Accounting Standardization of Public Administration (CNCAP)[5]; c) the entities with sector plans would have to show plan projects for approval based on the POCP [8].

The POCP brought a new public accounting with very ambitious objectives; however, the greatest obstacle to its implementation results from the fact the methods of functioning, organic laws, budgets, execution of budgets, etc., vary considerably in public entities. The present legal context emphasises those differences.

Besides that, there is a tendency for the organisations to isolate themselves which from the point of view of public management is detrimental, because the general management of public assets is not taken into account, independently of the organisation that owns them or to whom they are assigned. Insisting on this assumption could lead to a barrier of Public Administration (AP), because the budget provisions to which it is subjected may lead to the feasibility of the means.

The POCP may be a powerful support tool in this process, in as far as, if used by all institutions making up the P A, can provide fast and reliable information while at the same time permitting the consolidation of the financial information.

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[3] The POCP was approved by DL No 232/97, of 3 September.
[4] Art. 6º refers that the law comes into force 60 days after publication.
[5] Created by Decree-law No. 68/98, of 20/3.

The POCP and the respective sector plans approved till now (for the local government, Education, Healthcare and Social Security)[6] have been gradually applied; therefore many of the public sector entities had to carry out significant internal reorganisation, to create the conditions for its implementation [9].

Presently, the majority of the services and autonomous funds, already apply or are about to apply the POCP or a sector plan. However, the greater difficulties are found in the integrated services, those without administrative and financial autonomy (Law No. 91/2001, of 20 August, art. 2nd, no. 2), where this accounting reorganisation is more difficult, due to the lack of resources.

Therefore, we believe the adoption of the POCP or sector plans for the organisations that form part of the Administrative Public Sector (SPA) is urgent, even if, at the moment, it means an increased effort on the part of the managers and officers, but in the future the benefits resulting from this will be felt [8].

2.2 The Budget as Management Tool

2.2.1 The Budget and the Budget Cycle

According to Horngren et al [5], a budget is the quantitative expression of the future action plan of the administration for a set period. It may include financial aspects quantifying the financial and non financial aspects of that plan and works like a project for the organisation to follow in the coming period. The budgets referring to the financial aspects quantify the expectations of the administration regarding future income, cash flow and financial position.

The financial statements are done to show past periods, but can also be elaborated to show future periods. A well managed enterprise normally shows the following budget cycle [5]:

- Planning the performance of the organisation as a whole, as well that of the respective sub units. All the managers agree with what is expected from them.
- Establishing a reference parameter, that is, a set of specific expectations in relation to which the actual results can be compared.
- Analyse the plan variations, following if necessary, with the respective corrective actions.
- Re-planning, taking into consideration the *feedback* and the change of conditions.

The **general budget**[7] includes all financial projections of the individual budgets for each unit of the organisation, in a single set of budgets for a set period, covering the impact both the operational as well financial decisions.

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[6] The Official Accountancy Plan of Local government – POCAL; the Public Official Accounting Plan for the Education Sector - POC-Education; the Official Accounting Plan of the Ministry of Health – POCMS and the Official Accounting Plan of the Institutions and of the Solidarity System and Social Security – POCISSSS, were approved by the following legislation, respectively: DL No. 54-A/99, of 22 February; Decree No. 794/2000, of 20 September; Decree No 898/2000, of 28 September; DL No. 12/2002, of 25 January.

[7] The term general with the word budget refers to the fact that this covers in general all the budgets.

Thus, the budget is another great supporting tool for management. In order to achieve its aims, that is, programming, the assessment and the control from the point of view of efficacy and efficiency, should be a budget by programmes or objectives. Therefore, if planning is not done by objectives to assist in its execution, assessing the results is impossible and, consequently also, the measuring of efficacy and efficiency. The is no sense in spending more time on this [11].

2.2.2 Budgeting by Programmes

The budget by programmes tries to make use of the power of a resource – the budget -, which is shared by all departments of an organization. The aim is to give impetus to this common tool turning it not only into a management tool, but also a truly useful management information system. To achieve this, a progressive change has to be made, from a strictly economic and financial budget point of view, up to a stage that will permit using the information for public decision making [12].

The introduction of the budget by programmes will not only provide a more efficacious budget tool but also a powerful management information tool. The use of a budget by programmes aims ultimately to become a management by objectives system[8]. Based on these common targets, allocating each management centre the particular objectives that make up its contribution for the general objectives (strategic and operational) of the organisation.

With the budgets by programmes we try to define the impact of specific programmes on the objectives set by the entity. The budget by programmes places emphasis on the planning, the increase of information and in the study of the various alternatives to reach the same objective. This type of budgeting reflects the planned management under the triple classification organic-economic and functional.

It is therefore essential that each management centre has previously defined and budget the tasks, activities and functions as well as having available the analytical accounting tools necessary to allocate the resources to the outputs of the entities [13].

The quantification of the economic resources associated with a program or action is only one part of the information necessary for budget management. According to [12], each programme should have a detailed report which includes:

- The objectives for the programme.
- The resources for the programme, both financial and human.
- Periodicity of the resources set in different years.
- Financing these programmes.
- Product indicators (*output*) of production.
- Impact indicators (*outcome*) of production.
- Environment indicators.

We aim, with this, that the indicators contained in the budget information, become the base to the construction of more complex indicators and developed into other information management systems, such as the balanced scorecard. This way the budget becomes a supplier of data not only for economic and financial management, but also for the more complex integration and management systems. The integration scheme between the budget and the indicator systems is shown as follows.

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[8] In point 3.2.5 of this chapter, we study this topic.

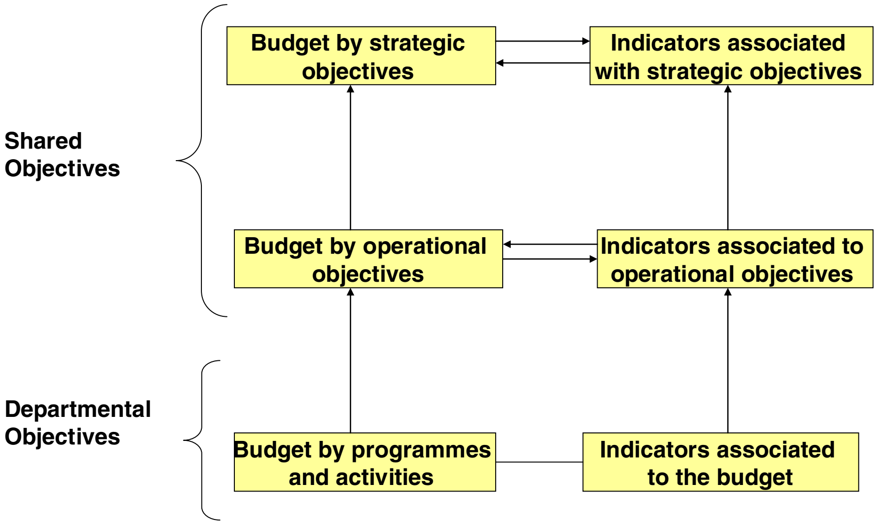

Fig. 1. Integration Scheme between the budget and the indicator systems. Source: [12]

The introduction of a budget programme brings with it the need for analysing and assessing the set of budget programs, and also what information will be supplied by other platforms or systems. This implies the creation of specialized units specializing in the analysis of programmes, units with specific knowledge of the departments it controls, but also of the global issues of the organisation.

2.2.3 The Budget by Programmes and the Public Finances in Portugal

In Portugal, we carried out a reform of the budget management and public accounting, keeping with the following guidelines of the financial administration; standardizing accounting criteria; decentralized budget management; centralization of financial resources; General Treasury of Finances; as the state bank; computerising all the stages.

During the Government Financial and Administration Reform, (RAFE), a process of electronic correspondence was begun, whose application was developed for the services include a package made up of the following programmes: SIC, Accounting System Information; SRH, Human Resources Management System; SGR, Receipts Management System. These applications have a high degree of integration amongst themselves, sharing common information and exchanging information. Presently these applications are used throughout the Public Administration, and proving to be very fruitful. This process aims to: simplify collection agreements, through a single document; decentralising the accountability of the departments in the administration for the income, settlements and accountancy; centralization and integration of all the information regarding the budget and accountancy; integration of Treasury and of the autonomous financial departments

The budgeting by programmes is set out in article 18 and Law No. 91/2001, of 20 August Law of the Budget Framework. In order to achieve this new model of budgeting, which is public management by objectives, not just as a mere agglutination of the concrete programmes and projects, but rather based on the political guidelines, as well as the objectives that the government aims to achieve, and subsequently to what is set out in Article 21 of Law of Budget Framework, approved in 2003, by DL No. 131/2003, of 28 June, the set of rules concerning the definition of the programmes and measures to be set in the State Budget and of the respective structures, as well as its specification in the budget maps and monitoring the execution.

The programmes appear as a set of decisions and advices previously taken, both in the sector section, and horizontally, to cover the whole Administration. The budget programs have to always be integrated by measures[9], even if it applies to only one single Project or activity. There is a unique functional classification for each budget programme. The budget programmes should show not only the respective financial amounts but also the indicators that will permit the assessment of its economy, efficiency and efficacy and in the case of the investment and development, the how it shared by the region (artº 3º of DL nº 131/2003).

The structuring by programmes should be applied to the following expenses: investment expenses and budget development of the integrated services and of the budgets of the services and autonomous funds and of the social security budget; investment expenses co financed by community funds; expenses corresponding to the laws of military programming or any other programming laws; expenses corresponding to supply of services contracts in a private financing regime or another type of partnerships between the public and private sectors (artº 15º, nº 3, of Law nº 91/2001).

One thing is true: an adequate co-ordination between accountancy and the budget results in a key issue of this process. Both complement each other. Accountancy should serve as support to the preparation phase of the budget and assist the same.

For the existence of a permanent equivalence between budget classification and the asset classification, the need arose to review the economic classifier of the public income and expenses. Note that the preparation of the budget and the state accounts is based in this type of assessor, in the same way that the execution of the budget is based on this classification.

Thus, the two orders justify the need to revise the economic classifier of public income and expenses: the first concerning the need to get budget type information, in different form than those set by the classifiers from 1988[10] and, a second, in respect of the conclusion of the process of reforms of public accounting that, being substantiated in the plan of the asset and analytical accounting, was now necessary to complement the budget accounting plan (....). It was equally essential to make an adequate revision of the budget accounting framework through the conceptualisation of the new model of management to be applied to all the Public Accounting. The new approach to the conception of public expenses in a microeconomic plan became the application of the efficiency and efficacy of the analysis criteria and the economy in the use of the

[9] And also by projects or actions.

[10] DL nº 112/88, of 2 April – economic classifier of public expenses and DL No. 450/88, of 12 December – economic classifier of public receipts, revoked by DL nº 26/2002, of 14 February, approving economic classifier of public revenues and expenses, in force for the budgets of 2003 and subsequent ones.

financial resources, based on a relationship of cost/benefit of the services provided and of the tasks met on the level of each organisation of the Public Administration (preamble of DL nº 26/2002, of 14 February).

3 Conclusions

There has been bureaucratic reforms in many countries and market based public administration criteria have been introduced.

In this study we showed some the information tools implemented in Portugal during the last years, as a result of the reforms made in the scope of the new public management.

In a period of fast economic changes, the introduction of such tools imposed more discipline in the Portuguese public sector not withstanding having found resistance to the change, namely regarding the acceptance of the new criteria of accounting.

The budget by programmes is presently used in public investments, but the tendency is to take it further to cover the state budget.

The role of the new public accounting is very important, considering that Portugal has to meet the convergence criteria set in the Stability and Growth Pact and, as such as to include those criteria based on solid accounting bases.

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Knowledge Repository Framework for Crowdsourcing Innovation Intermediary: A Proposal

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Abstract. A crowdsourcing innovation intermediary performs mediation activities between companies that have a problem to solve or that seek a business opportunity, and a group of people motivated to present ideas based on their knowledge, experience and wisdom, taking advantage of technology sharing and collaboration emerging from Web2.0. As far as we know, most of the present intermediaries don´t have, yet, an integrated vision that combines the creation of value through community development, brokering and technology transfer. In this paper we present a proposal of a knowledge repository framework for crowdsourcing innovation that enables effective support and integration of the activities developed in the process of value creation (community building, brokering and technology transfer), modeled using ontology engineering methods.

Keywords: open innovation, crowdsourcing innovation, knowledge repository, ontologies.

1 Introduction

Globalization, the developments of the internet and of the technology in general, are being the leverage to new ways of people to communicate and interact. This new world and new markets, in a daily change, are forcing enterprises to pay more attention to costumers needs, and therefore, to become more competitive and innovative. To face all these challenges, companies can not only depend on their internal skills [1].

Chesbrough argues that a company many times invests in R&D that turns out to be of no use to it, but that doesn´t means that founding would be useful to other company of the same industry or even from another industry sector. Additional profit can be made from commercializing internal and external R&D, taking advantage of the abundant knowledge that already exists in the market [2].

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Open innovation is a new paradigm that proposes the use of external and internal ideas, and internal and external paths to market, as means to reach advances in technology used by companies[3].

Open innovation is thought to bring a number of benefits such as faster time to market for products, access to unique knowledge external to the organization, less cost of innovation, better adaptation of products and services to customer needs, commercial utilization of knowledge or technology that otherwise would have been wasted, shared risk in product and service development, and enhanced company image and reputation. The ideas and expertise can be found outside a company's boundaries and exported from within, and can create significant value for the company [4].

Collaborative software is being used by all kind of people and for all kind of tasks, from entertainment to business. Information, knowledge, experience, wisdom is already available in the millions of the human beings of this planet, the challenge is to use them through a network to produce new ideas and tips that can be useful to a company with less costs. The knowledge within a crowd and its capability to best solve problems than an individual, even an expert, is a subject that has been studied since the beginning of the nineteen century. Since then, there are many examples and demonstrations that, the probability of a heterogeneous crowd to best solve a problem is higher than an expert of the area [1]. The World Wide Web facilitates this kind of contributions, opening space to the emergence of crowdsourcing innovation initiatives.

Crowdsourcing innovation is a way of using the Web 2.0 tools to generate new ideas through the heterogeneous knowledge available in the global network of individuals highly qualified and with easy access to information and technology [5]. Adams and Ramos [6] discuss crowdsourcing innovation as a promising way of innovation outsourcing, especially for MSME's.

Ramos et al. [7] presented a conceptual crowdsourcing innovation intermediary model that integrates three modules in the process of creating value to a company: community development, brokering and technology transfer.

In this research work, we propose a conceptual knowledge repository framework for crowdsourcing innovation intermediaries composed by those three modules. This framework is being modeled using ontology engineering methods.

Ontologies are presented as a conceptual model for the systematization and formalization of knowledge in a particular area of knowledge. This conceptualization is rendered concrete with the definition of terms and concepts from the domain of knowledge in analysis, their relationships, organization and hierarchy, and allows the sharing and reuse by different people and systems of such knowledge [8-11].

This paper is organized in 5 sections. In the introduction was justified this research work presenting open innovation and crowdsourcing innovation concepts. The next section characterizes crowdsourcing innovation intermediaries and their business models. After, it is made a literature review of the ontology subject, its types and application areas. In section four we present a proposal of a conceptual knowledge repository for crowdsourcing innovation intermediaries which integrates the knowledge created by the community, the activities develop in the innovation brokering and in the technology transfer. Finally we made some conclusions of the research done and present the future work.

2 Crowdsourcing Innovation Intermediaries

In June of 2006, Jeff Howe, a US journalist, introduced the term crowdsourcing, in an article in *Wired Magazine* [12], as a way of using the Web 2.0 tools to generate new ideas through the heterogeneous knowledge available in the global network of individuals highly qualified and with easy access to information and technology. Although, this concept has been used a quite time, the creation of the *Wikipedia* and of many examples of free software, like *Linux*, are examples of crowdsourcing activity.

Howe [5] breaks crowdsourcing into four models: collective intelligence or crowd wisdom, crowd creation, crowd voting and crowd funding, laying out examples that businesses can tailor to their own circumstances. Although, noting that successful crowdsourcing project often use a combination of these approaches.

Innovation intermediaries are organizations or groups within organizations that work to enable innovation, either directly by enabling the innovativeness of one or more firms, or indirectly by enhancing the innovative capacity of regions, nations, or sectors. Intermediaries are more than simple agents or brokers that just act as broker or agent between two or more parties. They are also engaged in other activities. Intermediaries' activities can be classified into three categories: interorganizational networking activities, technology development and related activities, and other activities [12].

A crowdsourcing innovation intermediary is an organization that mediates the communication and relationship between the seekers – companies that aspire to solve some problem or to take advantage of any business opportunity – with a crowd that is prone to give ideas based on their knowledge, experience and wisdom.

For crowdsourcing innovation intermediary the crowd is composed by groups of specialists in different areas, such as individual researchers, research team, labs, post-graduate students and highly qualified individuals.

It has being appearing some crowdsourcing innovation brokers, for example, Innocentive, yet2.com, Nine Sigma, IdeaConnection, some focus their business model in community development, others in brokering and others on technology transfer.

Ramos et al. [7] proposed a model that integrates these three modules in the process of creating value, and call them (1) knowledge network, (2) innovation brokering, and (3) innovation incubator. The module (1) integrates activities related with knowledge transfer to the network by each participant, the knowledge construction through the network, and the community building. The second module takes care of the knowledge management related with tasks like companies' needs and challenges proposals, the intellectual property management, and the innovation incubator has activities of consultancy, technology observatory, and funding opportunity tracking. They justify that for MSMEs the need for an integrated service is even more pressing.

3 Ontologies

Ontologies have proliferated in the last years, mostly in Computer Science and Information Systems areas. This is essentially justified by the need of achieving a consensus in the multiple representations of reality inside computers, and therefore the accomplishment of interoperability between machines and systems [8].

There are several definitions of the concept of ontology from where can be assemble that it has an informal and formal notion associated to it. Gruber [9]definition clearly shows these – "*An ontology is a formal, explicit specification of a standard conceptualization*".

3.1 Definition

An ontology is a conceptualization of world view with respect to a given domain. This world view is conceived by a framework as a set of concept definitions and their interrelationships, that may be implicit, existing only in someone's head or tool, or explicit which includes a vocabulary of terms and a specification of their meanings.

The specification of that world view by means of a formal and declarative representation, with semantic interconnections, and some rules of inference and logic, will perform the formal ontology. The formal representation will facilitate the interoperability between heterogeneous machines and systems.

Ontologies have been developed with the promise of providing knowledge sharing and reuse between people and systems, by building a conceptual framework of a given knowledge domain to be represented. This framework will be formalized through a specific ontology language which will clearly express a controlled vocabulary and taxonomy, enabling the knowledge sharing and reuse.

The vocabulary is a list of terms or classes of objects, respective definitions and relationships between each other, provided by logical statements. They also specify rules for combining the terms and their relations to define extensions to the vocabulary.

The taxonomy or concept hierarchy is a hierarchical classification or categorization of entities in the domain of an ontology. The taxonomy should be in a machine-readable and machine-processable form in order to permit interoperability.

The full specification of an ontology domain establishes a conceptual framework, composed by the vocabulary and the taxonomy, for discussion, analysis, and information retrieval in a domain.

Ontology development requires an effective ontological analysis of the content the world view domain that it intends to represent. This analysis will reveal the terms and concepts of the domain knowledge, their relations, organization and hierarchy. Thus, they clarify the structure of domain knowledge, so, it can be called a content theory [10].

As the objective of ontologies is to facilitate knowledge sharing and reuse between various agents, regardless of whether they are human or machines, then it can be said that ontologies are a prerequisite and a result of a consensual point of view on the world. It is a prerequisite for consensus because to have knowledge sharing agents must agree on their interpretation of a domain of the world. And it is a result of consensus because the model of meanings was built as result of a process of agreement between agents on a certain model of the world and its interpretations. Therefore, it is an essential requirement that any ontology can progress over the time [11].

Briefly, an ontology provides an explicit conceptualization that describes the semantics of the data. As Fensel [11] stated "*ontology research is database research for the 21st century where data need to be shared and not always fit into a simple table*".

3.2 Types of Ontologies

Over the years, researchers of this body of knowledge, tried to clarify, classify and typify the concept of ontology, in terms of its definition, components, and application areas. It seems to have some consensus that the types of ontologies, by subject or content matter are:

- Domain or content ontology – represents the knowledge valid for a given type of domain (e.g. enterprise, medical, electronic, mechanic).
- Meta-data ontology – provide a vocabulary for describing informational content (e.g. Dublin core describes on-line information sources).
- General or common-sense ontology – provides basic notions and concepts about describing general knowledge about the world and so they are valid across several domains (e.g. time, space, state, event).
- Representational/frame ontology – ontologies that provide representational entities without stating what particular domain it represents. Do not commit to any particular domain.
- Task/method/problem solving ontology – provide terms specific for particular tasks and problem-solving methods. It defines primitives by which the problem solving context can be described and domain knowledge can be put into the problem solving context.

4 Knowledge Repository Framework

Knowledge repositories (KR) are a crucial component for the sharing, reuse and knowledge transfer, and thus for improving the performance of any organization. The intermediary of crowdsourcing innovation requires a KR to represent and integrate all the knowledge created by its processes.

Knowledge repositories are a subject that has been studied for a long time by researchers. However, KR's implementation projects still fail in assuring its effective use by employees of the organization, sharing and reuse of knowledge. The major difficulties identified in literature [13] are:

- the weak incentives for sharing knowledge given by the organizations;
- the quantity of information returned by the repository, motivated by bad choices in the design of the repository;
- the cost associated with projects implementing repositories;
- and to specify the requirements for reuse and sharing of knowledge in each situation and its implications for the design of the repository and related interventions.

So, it is necessary a KR framework based on the real needs and motivations of the potential users of the repository, which implements effective strategies for retrieval and dissemination of knowledge and that also analyze the value and usefulness of content provided by the KR.

The ontologies are presented as a conceptual model for the systematization and formalization of consensual knowledge in a field of knowledge. This conceptualization is rendered concrete with the definition of terms and concepts from the domain of knowledge in analysis, their relationships, organization and hierarchy, and allows the sharing and reuse by different people and systems of such knowledge [14-20]).

Various ontologies have emerged, particularly in the areas of business and enterprise (cf [14], [15], [21], [16], [17]). [22], [23], and more recently [24], proposed ontologies for the process of innovation management, but they represent only the component relating to the process of generating ideas. At the best of our knowledge, there is no ontology defined that represents the entire process of creating an intermediate value of crowdsourcing innovation.

Thus, an ontology of crowdsourcing innovation for intermediaries will be an useful instrument to understand this phenomenon and thus will also be a facilitator for the emergence of such intermediaries. Regarding the types of ontologies described in the previous section we are going to develop a domain ontology to represent the crowdsourcing innovation body of knowledge.

Based on the crowdsourcing innovation intermediary framework presented by Ramos et al. [7]we developed a generic sketch of the conceptual framework for the KR (Fig. 1).

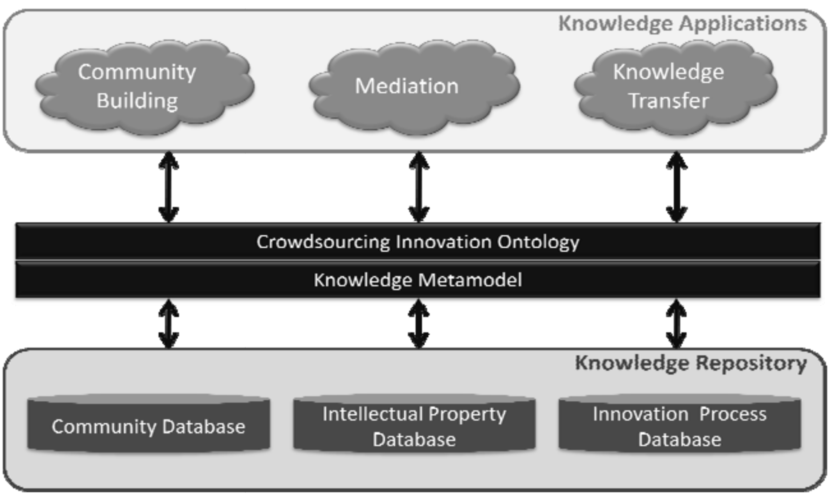

Fig. 1. Generic conceptual KR framework

The main characteristics of this framework are (1) the construction of collective memory of the community, and the storage of explicit knowledge captured and exchanged by the various online learning activities and social matters; (2) to capture and to disseminate explicit knowledge created and exchanged in the activities of intermediation, such as contract negotiation, project management, marketing, and intellectual property management; (3) capturing and making available the knowledge created in the process of technology transfer, supporting the development of acquired technology in commercial or organizational high-value innovations; and (4) guarantee interoperability between different systems of crowdsourcing innovation.

A crowdsourcing innovation broker can benefit from a structured and integrated KR that allows managing information and knowledge created by the three value creation processes: knowledge community building, intermediation, and technology incubation.

The KR will be both the enabler of the community's collective memory and the repository of the explicit knowledge captured and exchanged in the various learning and social activities online. The knowledge services of this module are centered in providing access to the crowd by tracking and profiling users, managing and moderating virtual communities, and creating proper incentives, and evaluating ideas and solutions posted. The KR will also capture explicit knowledge created and exchanged in the activities of intermediation, such as contract negotiation, project management, challenges delivery and IP commercialization. The knowledge transfer module will facilitate the diagnosis of the seeker and the commercialization of the solutions. It will gather, store and manage knowledge about activities that assist in the transfer of IP acquired in a business or organizational innovation, including specific consulting, tracking of funding and partnerships opportunities, making information on market trends available, and supporting the management of innovation projects for the corporate clients.

5 Conclusion and Future Work

The intermediation of crowdsourcing innovation is a recent research subject that promises to be a way of helping companies to access external innovative ideas and solutions to take advantage of structured knowledge repositories and to support their networking efforts along the value chain.

Knowledge and information in a company augment expressively every day, becoming increasingly difficult to integrate them in an effective way for the decision-making process. Besides being available, knowledge must be disseminated by people in the organization before they need it, so that the organization can anticipate events rather than reacting to them.

Knowledge repositories are a crucial component for the sharing, reuse and transfer of knowledge, and thus for improving the performance of any organization. Although being a subject that has been studied for a long time by researchers, KR's implementation projects still fail in assuring its effective use, sharing and reuse of knowledge by employees of the organization.

This research project intends to contribute to leverage KR usage and helpfulness to the decision-making process by proposing a new conceptual architecture of KR, specially guided to crowdsourcing innovation intermediaries.

The development of the KR architecture will be sustained by the development of a crowdsourcing innovation ontology. Ontologies have been developed with the promise of providing knowledge sharing and reuse between people and systems, by building a conceptual framework of a given knowledge domain to be represented.

This framework is a consensus conceptualization of a given domain, which permit the accomplishment of interoperability between systems and persons.

Thus, the development of the ontology will be an instrument to help to understand the phenomenon of crowdsourcing innovation, and will also be a facilitator for the emergence of such intermediaries.

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On-Line Training and Certification Solution for Business Process Managers

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Abstract. The aim of this paper is to present an opportunity for improving business process management (BPM) by skills and competencies development. Trainees will know how to better identify, document, management, measure, analyze, implement, optimize, automate, maintain business processes in their companies as a part of their life-long learning and in the context of continuous improvement processes by using the facilities created on a e-learning platform for training and certification processes. The proposed approach is linked with the pedagogical materials development in the field of Business Process Management (together with the certification procedure using European Certification and Qualification Association schema) in accordance with the market needs identification using a marketing survey (applied for companies of the West part of Romania for new competencies identification). The expected research results consist of the Business Process Management certification and qualification program sustained by an e-learning platform.

Keywords: e-learning platform, business process management, skills, certification.

1 Introduction

In the Global Knowledge - TechRepublic 2010 Salary Survey, one of the questionnaire questions was *"What skill set will your company be looking to add in 2010?"* The skills listed by respondents were (related to the information technologies practice development): project manager, IT security professional, network administration, specialist on virtualization and cloud computing, business analyst, *business process improvement specialist*, web developer, database manager, windows administration specialist, and desktop support personnel. With project management and business analysis skills appearing in this skills list, it is no surprise that skills related to business process improvement are also there [2]. Business process improvement and business analysis go together when they act in practice. Business analysts identify areas for improvements to business processes, while business process improvement or management use specific methods, tools, techniques and technologies to help

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companies optimize their business processes [1], [5]. In addition, specialists from the Aberdeen Group argue that the top reasons business is driving BPM activity is *the need to reduce operating costs and to improve cash flow* [6]. The main barrier for the Business Process Management (BPM) adoptions and implementation was the lack of knowledge about the concept. The main constrains of the business dynamics are related to companies need for real-time insights and faster decision making (based on a powerful information technology solution) to adapt to new business patterns. According to Gartner Inc. specialists (http://www.gartner.com), among the competencies required for successful BPM initiatives include *process skills, tools and process assets, and transformation skills.*

Business Process Management (BPM) represents a holistic management approach based on continuous improvement processes, change management theories, and support by modern information and communication technologies/systems. This approach aim to attend an optimal balance between organization's external environment dynamics and its internal processes functionalities based on innovation, flexibility and agility [1]. Agile BPM helps organizations achieve business results by addressing requirements for continuous process optimization, collaborative process workflows to support team-based initiatives, and to extend business processes beyond the enterprise. BPM Institute and the Association of BPM Professionals agree on a common definition of the concept and its relation with the continuous improvement process [11]. Figure 1 shows the diversity and the complexity of the BPM (process phases and factors). Wolf and Harmon describe BPM current market situation and tendencies [10].

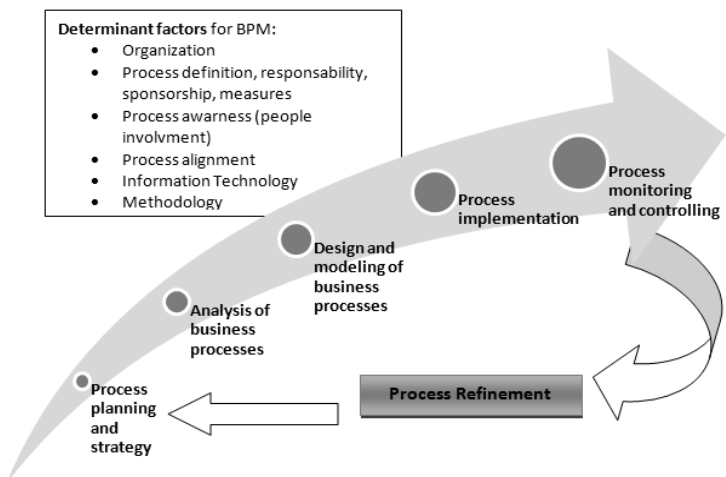

Fig. 1. A Business Process Management Framework (adapted from Treat, 2006).

Romanian companies of all sizes need constantly improve their BPM by optimizing costs, improving efficiency and achieving greater business agility. In the context of this paper, a possible approach for the BPM development in a company by taken the advantages of a specific training program in the field (increasing human resources performance) will be presented [3].

The proposed approach core is linked with the BPM multimedia training materials development (together with the certification procedure using European Certification and Qualification Association schema – e-learning facilities) in accordance with the specific market needs identification (marketing survey applied for companies of the West part of Romania for the new competencies identification). BPM knowledge (incorporated in the CertiBPM training program) is not country-dependent, but it is developing at a global scale. Many European companies train people in various methodologies of business process management. Existing university and market courses of this knowledge area are not directly comparable, because they cover different knowledge areas. The availability of an independent European certification and self-assessment system, will give the possibility to assess if one meets a certain level of expertise and competencies that can be used in every EU country.

2 The CertiBPM Skills Development Process

The motivation for the CertiBPM project lies on the Romanian market training needs satisfaction in BPM. The competencies improving processes for the employees of Romanian companies will have a positive impact upon their results. One of the steps to this improvement is to educate employees, industry representatives in the BPM field of knowledge. Various BPM courses, books and literature from different vendors exists, which show different aspects BPM, but there is no coherent course for the specific Romanian market. The proposed approach is related to the transfer of innovation process from SI and AT to RO. It consists of: Transfer of Education, Training and Certification concept of ECQA into the university and manufacturing domain in Romania. Aspects of the project impact are: (1) CertiBPM will build on BPM knowledge and competencies in different industrial sectors, which are represented by the consortium members due to their activities with national and international enterprises; (2) Transfer of the ECQA concept and platform into the Romania. (3) Implementing the CertiBPM job-role and examination committees for certifying training bodies and exam tools in multilingual environment. (4) The important knowledge of CertiBPM and the important system of an uniform European certification will be very useful for Romanian manufacturing industry, especially for automotive and telecommunication industries [3].

The core of the results envisaged is a skill set which clearly fit the competencies required for becoming a BPM specialist (basic level and advanced level). For all the skill elements training material will be provided in several languages (English, Slovenian, Romanian, and Austrian) and will be upload on an e-learning system. A pool of test questions will be defined, which provides the basis for the trainees' certification process.

The CertiBPM qualification and certification addresses itself to employees from companies departments related to: Quality management (as TQM), CRM (Customer Relationship Management), ERP (enterprise Resource Planning), SCM (Supply Chain

Management), and enterprise information system's specialists etc. who want to complement and/or certify their advanced BPM skills. The target group typically has abilities for self-development and self-learning, creativity, innovative initiatives etc. One of the biggest challenges is to conceive a training program that covers the complete skills set that better satisfy the target group specific needs. Table 1 shows the adopted working procedure for the establishment of the CertiBPM skill card and Figure 2 shows a knowledge map of the skill set which provides the basis for the future research and development activities (the training materials development). It is the result of an initial consolidation of our experiences in research, education, as well as in collaboration with industrial partners, and other business organizations (e.g. Chamber of Commerce, students' organizations, clusters in the business environment etc.).

Table 1. CertiBPM skill card establishment methodology

No.	Stage of work (research developed)	Results / Time / Responsibility of
1.	CertiBPM specific procedure for transfer of innovation (from SI to RO)	Kick-off meeting in Timisoara, January 2011 (duty of all partners)
2.	Translation of the existing materials from SI into English; Recommended relevant references; Collecting and processing training feed-back on SI market	Preliminary training materials; Training feed-back report; February – June 2011 (duty of SI partners)
3	Reference collecting; Information about existing training programs and BPM organization in RO	Reference data base report; Report regarding the BPM state in RO February – April 2011 (duty of RO partners)
4	Training needs identification (observations, interviews and marketing research)	The marketing niche definition and characterization; Project advertizing in RO; February – April 2011 (duty of RO partners)
5	Skill card definition: units; elements; performance criteria	Preliminary definition of the CertiBPM skill card, May 2011 (duty of all partners) - Virtual meetings
6	Complete skill card definition and content description; harmonization of the partners' involvement.	Complete skill card definition with brief description of the components (project meeting in Maribor SI) – June 2011

As it can be seen in Figure 2, the skill card is represented by a map (using the MindManager software) with the main branches consists of the skill units and the second branches that are the correspondent skill elements. The third braches are allocated to the performance criteria of each element (that are in direct relation with the questions that shall be settled for the examination process related to the certification of the job role). This representation of the skill card allowed an optimal visualization of the completely developed work (in different project stages) and the harmonization and integration of the partners for attending the project objectives. The skill set map was a good tool of communication between the partners and the information technology specialists involved in the project, too.

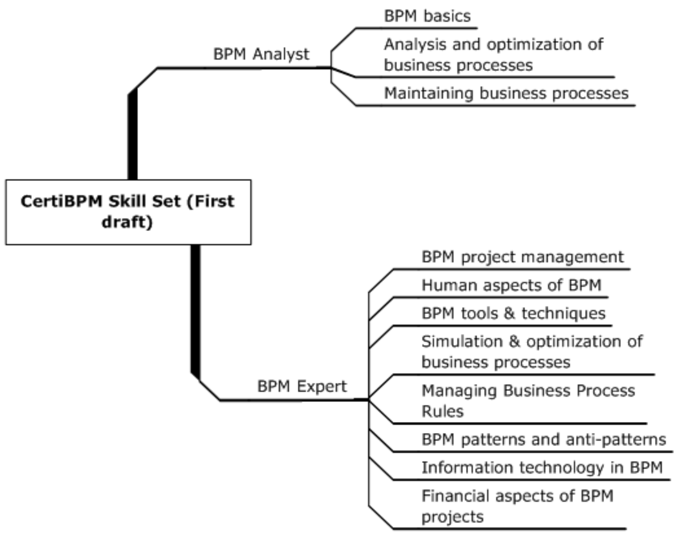

Fig. 2. CertiBPM skill set map

3 BPM Training Need Identification – The Case of Romanian Companies

The aim of this chapter is to present the research methodology and results for the BPM training needs identification by considering a sample consists of companies from different industries located in the West part of Romania (Table 2 shows the research sample structure). Small and medium size enterprises and big companies were considered for the research sample. Companies were selected randomly and for each of them one executive was interviewed together with other middle and low-level managers. 24 organizations were interviewed but 102 questionnaires fill-up were received and process (sample size n=102). The telephone, e-mail and face-to-face structured interview method were adopted to obtain responses to the study's survey instrument. Although it was a resource intensive option, it was chosen over the standard methods of administrating paper or online surveys for various reasons: (1) to be able to clarify respondents' queries; (2) to avoid the situation whereby a busy executive or senior manager delegated the task of fill-up the survey to a secretary; and (3) to ensure that most of the responses collected were complete and usable for data analysis. The research was developed from September to December 2010 and it is consider as a preliminary one. Other companies will be included in the research sample. From this research sample, we expect to form the group of trainees to be included in the proposed CertiBPM training program.

For the structured interview method approach a questionnaire has been developed. The questionnaire structure follows the first draft of the CertiBPM skill set (Figure 2,

Table 2. The research sample structure

Field of economic sector or industry	No of companies	%	No. of respondents	%
1. Automotive	6	25	28	27
2. Telecommuni-cations, Electronics, Energetic	4	16.67	18	18
3. Manufacturing Machinery	4	16.33	13	13
4. IT and software developers	5	21	22	22
5. Logistics Distributions	5	21	21	20
TOTAL	24	100	102	100

as described in the project proposal). In the beginning of the questionnaire, the research aims and a brief introduction in BPM (based on references) have been explained. The items considered for the BPM analyst and expert (second branches in Figure 2) were detailed and then the respondent has to answer the following question: ***Do you consider an opportunity for your organization to be involved in a training program related to …?*** All questions on BPM training needs identification were measured on a six point Likert scale (1=”fully disagree” – 6=”fully agree”). In order to facilitate interpretation, scores were aggregated after data collection as follows: score 1 or 2 = “Disagree”, score 3 or 4 = “Neither agree nor disagree” and score 5 or 6 = “Agree”. Figure 3 shows a part of the knowledge map developed for building the questionnaire used in the research.

The research methodology allows a depth analysis of the skills needed to be trained in a BPM training program (skills analysis method [4]). Table 3 is the skill matrix build as a quick and effective way of identifying the BPM training needs. For the results’ presentation there have been consider the respondent structure by their industry/economic field as shown in Table 2. The survey results have defined the companies’ needs for specific topics of BPM (in accordance with their practical needs and their business development) that were expressed as skills need for their employees. The skills matrix (Table 3) was built by cumulating the responds per each economic sector (the vertical columns data). As it can be seen companies from logistics, distribution (total score 11) expressed their total need for the debate subjects related to the BPM training program. Also, representatives of IT and software developers companies (total score 9) and from the automotive industry (total score 8) expressed their training need more related to the BPM Expert. In addition, the skills matrix has offered information about the training needs related to each subject/question. The results shown that manufacturing and logistics companies are interested in BPM Analyst module, but all the companies need training for maintaining the business processes (A3). The most needed training modules from the BPM Expert are E1 (BPM project management), E2 (Human aspects of BPM) and E7 (information technology in BPM).

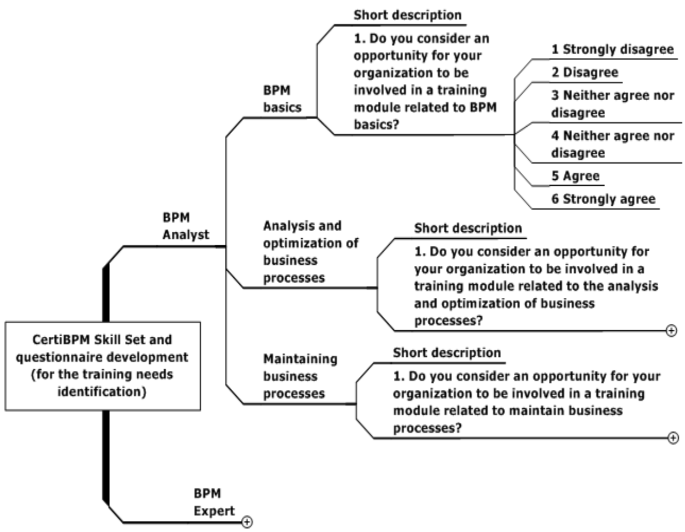

Fig. 3. The questionnaire structure used for the training needs identification

Table 3. The skill matrix with gap indication

Sector*/ Questions	1	2	3	4	5	Total score	Specific needs**
A1	-	-	X	-	X	2	-
A2	-	-	X	-	X	2	-
A3	X	X	X	X	X	5	2
E1	X	X	X	X	X	5	4
E2	X	X	X	X	X	5	4
E3	X	X	X	-	X	4	4
E4	X	-	X	X	X	4	3
E5	-	-	-	X	X	2	1
E6	X	-	X	-	X	3	2
E7	X	X	X	X	X	5	5
E8	X	X	-	-	X	3	1
Total score	8	6	9	6	11		
Specific needs**	4	4	2	3	4		

*) *As shown in Table 2.*

**) *Results from the individual discussions with industrial representatives from each company (issues that were related to specific gap problems – qualitative expressed training needs).*

4 The ECQA Qualification and Certification IT System

This chapter gives an overview of the system and the platform proposed and implemented by the European Certification and Qualification Association [7].

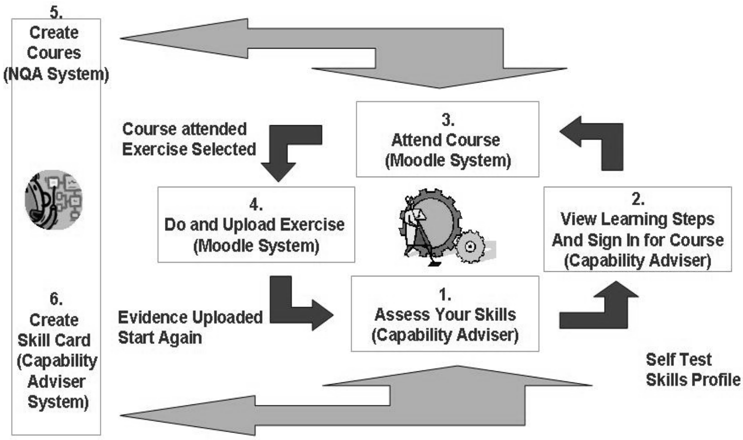

Fig. 4. Integrated European Skills Acquisition System

The European Certification and Qualification Association has set up a partnership of experienced partners in 18 European countries to create a pool of knowledge for specific professions. This pool can be extended to further professions. All the professions that have been configured in this system up to now, are based in the information and communication technology (ICT) area, and are thus closely related to Software Development. As the integrated product development, processes are increasingly related and/or linked to software development, new job role from the BPM domain will profit from this basis [8]. Figure 4 gives an overview of the uncomplicated but efficient skill acquisition process supported by the ECQA platform: If there is a need, a person can attend a course for a specific job role online through an advanced learning infrastructure as described in the following. The student starts with a self-assessment against the skills. Then she/he can sign into an online course. Here she/he is guided by a tutor and does a homework which is corrected by the tutor. Finally, the homework and the real work done in her/his project are sufficient to demonstrate the skills. The learning platform is based on the web-based public domain learning management system Moodle (www.moodle.com). The so-called Capability Adviser supports the assessment process, which is a web based assessment portal system with a defined database interface to connect the systems. Network Quality Assurance NQA is a web based team-working tool, which was developed in the previous project EU IST 2000 28162. So far, many professions have been configured in the platform (www.eu-certificates.org).

The European Certification and Qualification Association platform of knowledge is enhanced on an annual basis. Existing skills sets are being reworked and new skills sets are added. Joint knowledge is being configured in form of a job role with standard content structures like skills set, syllabus, learning materials and online configuration, as well as sets of test questions. So-called Job Role Committees decide upon the content for a specific skills set. These committees are composed of academics and industrialists. The job role committee for the Innovation Manager, for instance, created a skills set of an innovation manager together with a set of online courses etc. People can register from their work places [7], [8].

Nowadays and according to the Bologna Process, it is very important that training courses are internationally recognized and those successful course attendees receive certificates that are valid for all European countries. The EU supported the establishment of the European Qualification Network (EQN), from which the ECQA has evolved, with exactly this target in mind. This has resulted in a pool of professions in which a high level of European comparability has been achieved by a Europe wide agreed syllabus and skills set, a European test questions pool and exam systems (computer automated by portals), a common set of certificate levels and a common process to issue certificates [7], [8], [9]. Quality criteria to accept new job roles in the ECQA, to accredit training organizations and certify trainers, as well as to certify attendees have been developed. The existing skills assessment portals (already used by more than 5000 students in different learning initiatives) are extended to cover the new requirements of the ISO 17024 (General Requirements for Bodies operating Certification of Persons) standard. Among the international certification organizations that provide ECQA - compliant certification is the ISQI (International Software Quality Institute, www.isqi.org). Considering the ECQA platform structure and development, and its specific use for European certification, the Romanian researchers (from Politehnica University of Timisoara, UPT) have planned to use also the UPT Virtual Campus facilities for upload the training program in Romanian language and better access those materials (www.cv.upt.ro). In this context, the multimedia training materials and other e-learning facilities will be developed in Timisoara, too.

5 Conclusion

The described approach is a classical one for skill set provision (qualification - certification) on the ECQA platform (www.ecqa.org). The presented CertiBPM skill card (training program structure) is the result of many virtual and face-to-face meetings of the partners involved in the project. The certification procedure allows total and partial certificates. The defined skill set map is complementary to the academic programs in the field of production management that exist on the Romanian market. The *main opportunities* from the European certification of the BPM profession/competencies in the case of Romania are: (1) it offers the possibility for having a EU certificate for the trainees that follow the training program and pass the examination process successfully (more than 70 percents of the answers are correct). This certificate offers them competencies that are compatible on the EU labor market. This opportunity can be attractive for PhD. students and young researchers, too; (2) the qualification and certification can be used by other employees that want to update and develop their knowledge in the BPM field for better align themselves to the new trends (new business processes and requirements of the market); (3) the different skill units of the training program can be introduced in some master program courses (in their syllabus) and so, students can be easy trained for being certified. Professors from academia can become ECQA trainers for CertiBPM, too. Universities and other training bodies can become collaborators of the ECQA and they can benefit from the established schema and experience gained.

The presented paper is linked with the research activities of the project: *CertiBPM - Certified Business Process Manager* LLP-LdV/TOI/10/RO/010, founded with support from the European Commission. The presentation of this paper is connected with the *dEUcert project - Dissemination of European Certification Schema ECQA* (contract no. 505101-LLP-1-2009-1-AT-KA4-KA4MP), that has been funded with support from the European Commission, also. This paper and communication reflects the views only of the authors, and the Commission cannot be held responsible for any use, which may be made of the information contained therein.

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BAM - Business Alignment Methodology

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Abstract. Information flows across the organization are complex and procedures employed to understand, share and control organizational knowledge and experiences should be properly supported by collaborative environments. Nevertheless, few collaborative methodologies had been proposed to describe and evolve business processes. In the future, business processes models should be the result of cross-team and cross-departmental collaboration, with involved business people sharing their personal knowledge and formalizing it. This paper focuses on a methodology for business process discovery and the importance to integrate local information into coherent and sound process definitions. Business Alignment Methodology (BAM) is a methodology that provides guidance about how organizational practices and knowledge are gathered to contribute for business process improvement against current BPM approaches.

Keywords: Business Process, Business Process Discovery, Collaborative Work, Modelling, Methodology.

1 Introduction

The transformation of industrial economies into knowledge/information-based service economies has triggered not only a predominance of knowledge work but also a continual reconfiguration of tasks to cope with changes or unexpected events [1,2]. Consequently, contemporary organizational thinking has evolved to embrace paradigms supported perspectives based on emergence, self-organization and evolution [3].

The evolution of Information Systems (IS) has been marked by the importance given to models and modeling activities as a means of facilitating the communication among operational actors. The high inter-dependence between IS and organizations structure, culture and processes, as well as the need of aligning IS and organizations, has lead to an expansion of the IS field that include organizational analysis and (re)design activities as part of the systems development process. From this expansion, emerged Enterprise Modeling (EM).

Enterprise models reflect organizational knowledge about business processes and structures. Due to the nature of current work environments, such models

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should emerge and evolve based on knowledge sharing processes among organizational actors [4]. The time when senior managers defined and controlled enterprise models according exclusively to the enterprise strategy is coming to an end. Enterprise modeling methods and techniques should both support the strategic goals of the organization and take into consideration the specific views, needs and goals of the individuals integrating the organization.

People are concerned with their personal workflows and resources, as well as their personal development, satisfaction and creativity. From an actor's viewpoint, the organization should provide individuals with the needed resources. It also should be able to help them in understanding and optimizing their contributions to organizational processes and respective goals. These concerns require the development of actor-centered modeling frameworks to support business process discovery and modeling efforts.

There is a vast literature about principles and theories behind EM frameworks [5]. Several EM frameworks allow graphical depictions of organizations in terms of different perspectives that can be grouped in activity or resource-related perspectives [6]. Nonetheless, EM has three main limitations: (1) EM have a mechanistic view of organizations, which disregards the complexity and adaptiveness of both organizations and its human actors; (2) Model building processes are mostly manual, and can not keep up the pace of organizational changes, and (3) EM does not allow to identify business practices, which typically diverge from the business process description, which is the base of such practice. Addressing these limitations is the main focus of the present paper.

Few EM frameworks had been specifically proposed to describe and evolve business processes. Existing frameworks don't provide the right methods for business processes discovery, modeling, monitoring and improvement. They don't allow to gather current experience and knowledge for business processes discovery and improvement purposes. Moreover, they don't provide any support to the underlying collaboration mechanisms of operational actors that enable them to discuss and agree on changing practices and processes. These are the main reasons for high rates of failure and disappointment in many approaches, methods, and techniques used for Business Processes Management (BPM).

Business Alignment Methodology (BAM) is a methodology for business process improvement which sets out principles and strategies for improving the quality of business processes. This methodology provides guidance about how organizational knowledge and work practices are gathered and discussed to improve business process. A key driver of BAM, concerning business process improvement, is the ability to facilitate the alignment of business processes and daily work practices. In this regard, this paper focuses on the process discovery phase, particularly on the collaboration processes that allow to integrate local information about work practices into coherent and sound process definitions. A brief discussion of existing approaches for business process discovery [7] allows to identify weaknesses and propose improvements included in this methodology.

The remainder of this paper is organized as follows; section 2 presents the state of the art about business process discovery methods. Section 3 briefly describes the phases of the proposed methodology, emphasizing on the business process discovery phase. Section 4 presents a case study performed in a Portuguese organization. Finally, Section 5 concludes and introduces future work.

2 Business Process Discovery Approaches

Organizational science has been governed over the last 50 years by an intellectual paradigm that aimed at understanding organizations functioning and the influence that environmental conditions have on it [3,8]. Several ways of diagnosing organizational problems in order to create competitive advantage and profitability, were developed. Under this paradigm, reality is assumed to be objective and its interpretation, an unconflicting matter. Organizations are regarded as machines, brains or systems which process information regardless of its context.

This intellectual paradigm is being replaced by a new paradigm that regards reality as something that is negotiated, organized and constructed by peoples interpretations of what happens around them [8]. Reality is neither totally objective or subjective. Rather, is it objectified, that is, socially constructed in a way that makes it seem objective. The new paradigm emphasizes context-dependence, as well as knowledge creation and organizational change. Contemporary views are centered on organizational agents and in how these agents continually (re)create and change the organization.

Traditional methods to discover business process requirements, based on the interpretation paradigm, include: an initial meeting, interviews, questionnaires, observation and ethnography. However, these methods are usually costly, take a great amount of time to complete and introduce a high percentage of human error [9]. There are several reasons why traditional BPM approaches do not achieve expected goals:

– Top-down approach that provides a broad organizational perspective, however with lack of detail.
– Different people have different viewpoints and it is difficult to achieve shared process definitions.
– Organizations structures, rules and practices are constantly changing, it is important to provide mechanisms to align business process descriptions with actual structures, rules and practices.

Recently, several authors have proposed automated process discovery techniques [10] [9]. Nevertheless, these techniques are restricted to records created by Process-Aware Information Systems (PAIS), which are not always available. From our perspective, Business Process Discovery (BPD) requires hybrid techniques to detect process problems and the root causes for these problems [9]. Interviews allow to gather viewpoints from selected key actors, while collaborative methods allow to discuss such viewpoints among a larger number of actors enabling asynchronous discussions that reduce the need of face-to-face discussions. Regarding business processes, main benefits of collaborative tools are: uncovering several viewpoints of the same activities, an enhanced visibility of business processes to operational actors and deeper analysis of business processes.

It is important to emphasize the difficulties common to ethnography and collaborative methods. In particular, when it comes to bridging the gap between business and IT view on business processes, results from these methods may have to be processed and structured to develop more accurate business models. We consider that a good collaborative tool that provides structured data of business processes for IT engineers should allow to discover, share, analyse and improve business process descriptions from non-structured and personalized information. Whereas the proposed approach allows non-structured annotations and discussions as well as personalized information, it provides the means to enable accurate, precise and structured representations of business processes.

3 Methodology

It is argued that existing business process (BP) methodologies do not offer the necessary flexibility or agility that new approaches require. Process-centric approaches tend to emphasize process (workflow, decision, information, activities) as the dominant dimension [11], but an activity-agent-product centric approach must also capture aspects about interactions between human, activity and informational components. Recent research in BPM pays more attention to flexibility as a way of coping with the unpredictability of business processes [12] [13]. Based on this new context, BAM methodology represents a multidisciplinary approach that allow business analysts to improve business processes discovery, monitoring and analysis, paying attention not only to process but to product, information and human dimensions through work practices.

Although business processes do involve different actor perceptions, this flexibility is important to adjust business processes in response to changes in the organization, in order to reach a global view of the real organization. BAM approach addresses the impact of individual knowledge, collaboration and knowledge sharing from a business perspective by examining actions at individual, group and organizational levels. To assists business analysts in creating, sharing and learning business process, the methodology proposes a two-dimensional approach. The two dimension, *Practice* and *Process* (figure 1), will ensure the proper structure to articulate individual, group and organizational knowledge with business analyst knowledge acquisition. The *Practice* dimension explores day-to-day work based on practitioners descriptions. The methodology proposes to assist organizations in its efforts to assess and manage problematic situations of specific daily practices, and develop and implement solutions that help manage these problems. The *Practice* dimension covers real information needed to systematically support or reject many of decisions about the business process models. In the *Process* dimension, business analysts based on information of the *Practice* dimension formulate business process reviews and iterative business process improvement efforts.

The present approach integrates collaborative methods into a methodology that allow discover and improve business descriptions. There are three phases outlined in the methodology: (1) *Business Process Discovery*, (2) *Business*

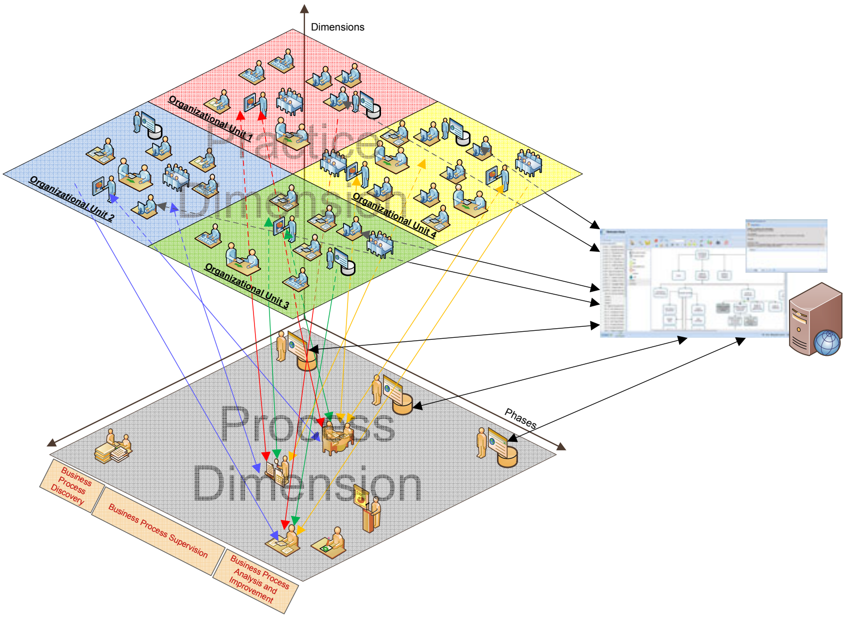

Fig. 1. Overview of the Business Alignment Methodology (BAM)

Process Supervision and (3) *Business Process Assessment and Improvement*. *Business Process Discovery* phase main goal is an initial process specification through interviews and collaborative methods. *Business Process Supervision* phase involves provides assurance that daily practices follow the base business process model or reveals the need to take corrective actions because real activities performed by operational actors are different from those specified in the business process model. In *Business Assessment and Improvement* phase, initially, business analyst and managers analyse real business performance and produce assessments focused on business processes issues, respectively. After that, the results gathered during assessments enable improvements and consistent refinements of the base business process model creating a new version. Each phase includes specific working methods and goals that are presented in the following subsections. Since the focus of this paper is on business process discovery methods, we only describe in detail the business discovery phase. The other two phases only have a brief description of methods and goals.

3.1 Phase I — Business Process Discovery

The first goal of a *Business Process Discovery* (BPD) is just to get personal descriptions of business processes. Operational actors have knowledge of their actions, nevertheless their knowledge is personal and to a certain extent tacit, hence it is hard to formalize. In fact, most organizations simply do not know their end-to-end processes accurately or in detail, since their process knowledge is tacit and decentralized [14]. On the other hand, organizational knowledge crosses functional divisions and outside the organization (clients, suppliers). Therefore, organizational processes embody specific accumulated knowledge that is not confined to particular individuals or groups. This knowledge, which is explicit, must be transmitted but this is not enough. Business process modelling approaches should consider the effect of continuous business processes improvement as a reaction to fast-changing environments in the business world.

BPD phase aims at developing an organizational profile of people, activities, technology, and information in order to understand business processes. This phase includes two main sub-phases: (1) *Learning (Eliciting) Business*(LB) and (2) *Modelling Business* (MB).

Learning Business. Initially, the sub-phase *Learning Business* include interviews where the business analyst interacts with operational actors as key to the success of business discovery. At an organizational level, the methodology proposes to assist organizations in their effort to assess and manage problematic situations based on daily actions and implement solutions related to these problems. Table 1 lists the tasks performed for each of the activities performed by involved actors.

Table 1. Learning Business Process Activities

Activitiy	Tasks performed in this activity
Kick-off meeting	discuss the BPD program issues with operations actors, since the focus are daily experiences
Interviews and questionnaires	Interact with operational actors to identify problematic situation
Business process specification	Create an Initial Description of Business Processes

The BAM methodology was designed for explicitly addressing the social dynamics of business process specification. It is based on social interactions as proposed in a two-dimensional space. The *Practice* dimension covers information needed to systematically support or reject many process decisions based on the result of daily experiences. The exact process representation concerns activities, resources, decision points and work flows (topology). In the *Process* dimension, business analysts capture best practices from the *practice* dimension which leads to business process reviews and improvement. The dynamic interplay between these two dimensions (*practice* and *process* dimensions) shows the synergy between activities performed by key operational actors and activities described by business analysts involved in BPD. In BAM there are several roles that represent the different responsibilities, which occur during learning business process (see Table 2).

Table 2. Learning Business Process Roles

Role	Responsability
Business analyst	Responsible for operational actors relationship and learning business process features.
Operational actors	They are responsible for reporting their daily actions and determining the priority of business process

Modelling Business. After an initial business process definition, business analyst starts modelling business processes. The sub-phase *Modelling Business*, from the knowledge management point of view, involves several stakeholders (business analyst, process owner, organizational unit responsible and operational actors) into three interrelated activities (see Table 3): (1) *model construction*; (2) *model revision and evaluation* and (3) *model approval.*

Table 3. Modelling Business Process Activities

Activity	Tasks performed in this activity
Model construction	transforms tacit and implicit knowledge and specific contextual situations into more structured and documented forms
Model revision and evaluation	critical review of existing knowledge about business processes.Participants present alternative proposals which result from associating different facts and new meanings. Business process model discussions and negotiations to correct these models.
Model approval	conclude the interaction process and collaboration among the parties involved in business process model specification by approving or rejecting the model.

The *model revision and evaluation* activity will use the annotation as a mechanism to capture the update proposals made by business actors. Annotations are used mainly to make proposals to correct the model (corrective maintenance), to capture changes in action or interaction contexts (adaptive maintenance), to make free comments that could anticipate problems (preventive maintenance) and promote continuous process improvement (perfective maintenance). If business actors detect any misalignment between the model and their knowledge of activity current states-of-affairs, they can make a textual or graphic annotation with the correction proposal. Booth dimensions (*practice* and *process*) involve the same actors (business analyst, organizational unit responsible, process owner and operational actors). Table 4 describes roles involved in the *Modelling Bussiness* sub-phase.

Table 4. Modelling Business Process Roles

Role	Responsability
Business analyst	annotation and reviewing rights over practices of their organizational units, also have rights to annotate and review processes related with their work.
Organizational unit responsible	has modelling responsibility of the practices within his organizational unit
Process owner	at process dimension, modelling responsibilities are attributed to process owners
Operational actors	conclude the interaction process and collaboration among the parties involved in business process model

3.2 Phase II — Business Process Supervision

In the *Business Process Supervision* (BPS) phase, formal control mechanisms are designed in order to ensure that operational actors carried out real business activities as described by business models. Control mechanisms consist of three main activities: (1) compare real business activities with base business models (2) annotations/reviews and (3) identify new business descriptions. Each annotation/review should be adding or validating new features to improve the business process. During this phase, The organizational unit responsible and operational actors will analyse improvements against oldest daily practices. From iteration to iteration, operational actors confidence will increase and results will start appearing. The milestone that marks the end of this phase and the beginning of the *Business Assessment and Improvement* phase is crossed when business analysts and operational actors agree that: business process model describe the detailed behaviour that address real needs, major problems have been solved, business process practices provides some useful value to the organization and these practices are stable enough to implement a new and improved business process version.

3.3 Phase III — Business Process Assessment and Improvement

Business Process Assessment is a mean for organizations to identify their strengths, weakness, existing improvement activities and key areas for improvement. It enables organizations to determine the current state of their business processes and to develop improved models. In the begin of the *Business Process Assessment and Improvement* (BPAI) phase, the business analyst analyse change proposals and through a comparison between base business process models and proposed changes, a new set of models is build to correct work that is not proceeding well, by showing where adjustments need to be made. In the end, the results gathered during assessments enable improvements and consistent refinements in order to produce an improved set of business process models. This phase ends when all the involved actors agree that: the objectives set during BPD (and modified throughout the second phase) have been met; and especially if all participants are satisfied with the new business process model version.

4 Case Study

This section summarizes the results of the BPD within a Portuguese organization. The objective was to uncover, discuss and improve Financial, Human Resource and Project Management processes in order to assure a proper implementation of SAP ®. The underlying goals was to (1) discuss current work practices in order to improve them; (2) synchronize business process descriptions with pretended work practices and (3) identify and/or cross-department flows. The organization is characterized by a highly hierarchical structure where procedures within each department, service or division are explicit and registered in manuals but cross-departmental processes have never been defined and are executed in an ad-hoc fashion, resulting in inefficiencies, errors and great deal of confusion among the employees. A core team of two employees were given the roles of business analysts with the responsibility of uncovering the business processes. Their selection stemmed from the fact that they had experience with business analysis tasks and were already familiar with traditional BPM approaches, as well as their limitations. The team decided to apply the BPD phase of the BAM methodology. The team started interacting with the head of the units and subunits but extended these interactions with other operational actors including selected members of the units at different hierarchical levels and two directors.

5 Conclusions and Future Work

This paper described a methodology for Business Process Improvement with focus on *Business Process Discovery* phase, particularly on collaboration methods. Incorporation of multiple viewpoints into the business modelling process also contributed to learn and change business processes specifications. Embedding a annotation-review-approval process named PROASIS, a supporting tool improved participation, providing a structured support to disseminate business process models, express opinions and negotiate perspectives.

The proposed methodology is the result of several other case studies for business process improvement. Preliminary results show that it stimulated the involvement of all actors in validating (and thus updating) the enterprise model, aligning it with the reality in an interactive and shared way. So, annotations and reviews fit the requirement of being a suited mechanism to generate, debate and insight about the organization in order to propose changes and improve the organizational business model.

In the future, we will focus on incorporating new features in the methodology in order to: (1) model daily actions (practice model) and (2) align practice model (*practice* dimension) with business process models (*process* dimension). Future work will also include new efforts to gather empirical data on its use that will help refine the methodology.

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A Model to Evaluate the Relational Capital of Organizations (SNARE RCO)

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Abstract. We consider social networks as artifacts that are part of organizations. The relational capital value of a social network represents a contribution that should satisfy demands which are conducted by social entities. It is not always possible to capture this value in accounting systems of organizations because it is almost invisible in conventional forms of information systems. There are several evaluation models, but there is a lack of models for evaluation of relational capital that combine techniques derived from social network analysis of organizations. The SNARE, short for "Social Network Analysis and Reengineering Environment", is a project that has been developed in recent years with engineering artifacts to represent social networks, and allows researchers to design and build real scenarios for social networks relational knowledge discovery. We propose SNARE RCO as a model to evaluate the relational capital of organizations.

Keywords: social network, organization, relational capital, evaluation.

1 Introduction

In the field of organizations, human capital, relational capital and structural capital are essential knowledge of organizations. By *human capital* it is denoted the knowledge, skills and experience of individuals [1]. It is understood by *structural capital* the procedures, processes and internal structures that contribute to the implementation of the objectives of an organization [1]. Finally, the *relational capital* is the value of social relationships in a given organization that contributes to achieve its objectives. I.e. the value of internal and external relationships of an organization [1].

The intangible value of the organization is generated from informal, noncontractual activities that help build business relationships and contribute to operational effectiveness [2]. From these noncontratual activities can result intangible deliverables. *Intangible deliverables* can be seen as knowledge and benefits extended or delivered by an individual or group, that are noncontractual but still have value for the organization. The combination of all intangibles of an organization, i.e. *human*, *structural* and *relational capital*, is called *intangible capital* or *intellectual capital* [3]. The value of intangibles can be difficult to identify through financial transactions and the use of nonfinancial indicators is a way to provide intellectual capital measurement

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[3]. It is not always possible to capture intellectual capital in accounting systems of organizations because they are almost invisible in conventional forms of information systems [3]. Also, there is a lack of standard metrics for relational capital evaluation of organizations [4].

Social network systems identify existing relations between social entities and provide a set of automatic inferences on these relations, promoting better interactions and collaborations between these entities. The SNARE, short for "Social Network Analysis and Reengineering Environment", is a project that has been developed in recent years. It has engineering artifacts to represent social networks [11] and allows researchers to design and build real scenarios for social networks relational knowledge discovery [10, 12]. In this paper we propose SNARE RCO as a model for evaluation of the relational capital of organizations.

This paper is organized in five sections. Section 2 overviews intellectual capital evaluation challenges. Section 3 proposes the SNARE RCO model as a way to compute the relational capital value of a given organization. Section 4 shows a sample of computed interaction relational scenarios using SNARE RCO. Finally, Section 5 presents our preliminary conclusions.

2 Intellectual Capital Evaluation Challenges

There are still three basics challenges associated with intellectual capital (IC) [7], in essence how can we: value (measure) intangibles in a better way; create more value (i.e. invest and manage) from intangible capital; and retain more (conversion) of this capital? These questions are still a challenge. Mary Adams and Michel Oleksak [3] argue that *"In Europe and Asia, a number of tools have been created by governments as part of competitive initiatives to help training managers in small and medium-sized enterprises (SMEs) so that they can leverage their knowledge capital"*. However, to date, there is no dominant model for intellectual capital assessment [3]. Also, Zadjabbari argues that "*there is a lack of standard metric method to measure this kind of knowledge and assets*" [4].

Measurement can be seen as a result of observations that quantitatively reduce uncertainty. A reduction, not necessarily elimination of uncertainty will suffice for a measurement because it is an improvement of prior knowledge [5]. Even when some amount of error is unavoidable, it can be an improvement on prior knowledge of a system [5]. There are strong mathematical foundations for considering measuring this way. A measurement doesn't have to eliminate uncertainty [5], for that we consider the measurement definition from Hubbard: "*A quantitatively expressed reduction of uncertainty based on one or more observations"* [5].

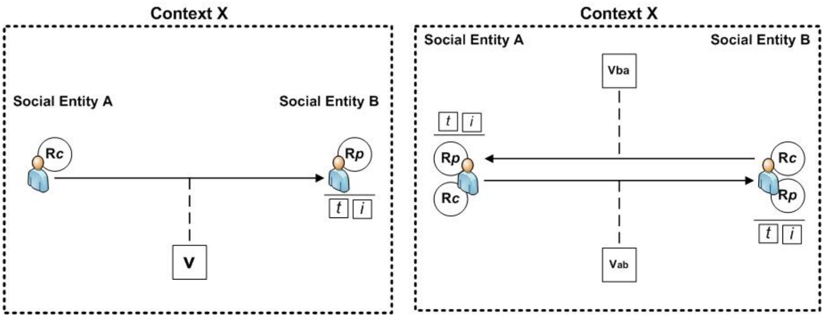
An overview of intangible measuring theories can be found in [8] and also in [9]. According to Sveiby the main problem with measurement systems is that it is not possible to measure social phenomena with anything close to scientific accuracy [8]. All measurement systems have to rely on proxies, such as dollars, euros, and other indicators [8]. The common reason for measuring and reporting is to improve internal performance, i.e. management control. However, the problem is that people do not like to be measured [8] and there is no standard intellectual capital measures/metrics because every company needs a unique understanding of which intangible assets are really valuable for the organization [3]. Some of the indicators are financial but it is possible to use nonfinancial indicators to provide the most basic parameters for intangible capital. Depending on the nature of the business there are hundreds of indicators, the most important question for the manager is how to choose the appropriate ones to build a unique performance measurement system [3]. In the current business performance methods, e.g. European Foundation for Quality Management model [6], or Skandia model [13], measuring indicators are not standard and are not widely used in organizations, although, in some models, the real asset values of different types of intellectual assets are not clearly defined [4].

There are several intellectual capital evaluation models. However, there is a lack of models to evaluate relational capital that combines techniques derived from social network analysis with organizations. One reason for this may be the division of organizational knowledge assets in three areas: human capital, structural capital and relational capital. That is, the separation of these factors assumes that the relational capital is independent of human capital and structural capital. But in fact, it is not. The challenge is to find a unique metric to evaluate the relational capital of an organization starting from the analysis of its social network and including assessments of human and structural capital.

3 A Model to Evaluate the Relational Capital of Organizations

We consider social networks as artifacts that are part of organizations, then, the value of a social network represents a contribution to satisfy a given *demand*. This demand is conducted by its social entities. In this sense, the value of a relation reflects the link between a thing (a good or service) and the two social entities that are connected in a given context. Then there is an offer made by a *Social Entity producer* and a demand from a *Social Entity consumer*. Consider Figure 1 a). In a given context *x*, the social entity A has a *consumer* role (Rc) and social entity B plays the role of *producer* (Rp) of a given good or service. In this case, the good or service can be tangible (t) and/or intangible (i). The value *v* of the good or service provided by the social entity B is formed from the *demand*. I.e. from the satisfaction that the good or service represents to the social entity A *consumer*. In a given context, there is a function to compute the connection relation value between social entity A and social entity B.

Naturally, the social entity B can assume a consumer role and the social entity A can play a producer role. In a dyad, the roles may be commutative and Figure 1 b) depicts this fact. V*ab* represents the value of connection *Social Entity A – Social Entity B*, and V*ba* represents the value of connection *Social Entity B – Social Entity A*. So, to identify and assess the relational capital of an organization it is necessary to identify the value of relations among its social entities which are social network members. Even when a social entity is an isolate node in the organization network, it holds tangible (e.g. goods or services) and/or intangible (e.g. competences or skills) value which can stimulate future connections (*demands*), thus contributing to the whole relational capital value of the organization.



a) b)

Fig. 1. RCO Supply and demand relation logic

The aim of measuring and evaluating is to reduce the uncertainty of the **Relational Capital Value (RCV)** of a given social network based on one or more observations. To observe and evaluate the RCV of a given organization, our model proposes three kinds of assessment inputs: organizational, network and social entity. These inputs are dynamic, i.e. defined by the observer. In subsection 3.1 we describe the process of classifying these inputs, and in subsection 3.2 we describe the method to evaluate the relational capital of an organization, i.e. how to compute the organization RCV.

3.1 Classifying Parameters

It is necessary to define a set of parameters, namely: Organizational Valuable Factors (OVF), Network Valuable Factors (NVF) and Social Entity Valuable Factors (SEVF). These are factors that depend on the target organization. For each factor, a weight can be defined according to its importance. These weights are multiplied by the values of the parameters. OVF, NVF and SEVF weights ranges are defined by the observer. To illustrate the following examples we considered weights ranging from 1 to 5.

Organizational Valuable Factors (OVF) are attributes of the organization that may contribute to the evaluation system. The definition of those attributes in accordance with the objectives of analysis should be performed by the observer (e.g. a management expert). However, to illustrate the concept, we include three intellectual capital properties: number of active customers; number of partners; and number of brands. Table 1 exemplifies the applied system of weights and the calculation of its total (OVF).

Table 1. Organizational Valuable Factors

Organizational Valuable Item	Value	Weight	
Number of active customers	275	1	
Number of partners	15	5	
Number of brands	4	5	
	OVF =412500		(275*1)*(15*5)*(4*5)

Network Valuable Factors (NVF) are properties of the organization network. These properties can be derived from classical analysis of social networks. Two key characteristics of a network are size and density, so, to illustrate this example, we chose different combinations of these values (See Table 2). *Size* is measured by number of nodes: if there are n nodes, then the maximum possible number of undirected links is n (n-1)/2. We considered n = 200. *Density* is the proportion of ties in a network relative to the total number possible.

Table 2. Network Valuable Factors

Network Valuable Item	Value	Weight	
Size	19900	1	
Density	0.32	5	
		NVF = 31840	(19900*1)*(0.32*5)

Social Entity Valuable Factors (SEVF) are properties that are assigned to each social entity. The observer can use properties from classical analysis of social networks such as *centrality indegree*, *centrality outdegree*. Also, must be considered human capital properties. These properties are role dependent and they result from other previous organization analysis such as questionnaires or other evaluation techniques. The definition of those properties should be performed by the observer in accordance with the objectives of analysis. However, to illustrate this application, we considered 5 human capital properties: analytical problem solving, creativity and innovation, problem diagnosis and solution, technical expertise and time management. Table 3 shows the filling properties process and calculation of SEVF for

Table 3. Social Entity Valuable Factors

Social Entity Valuable Item	Value	Weight	
Network properties (np)			
Centrality indegree (Absolute)	23	5	
Centrality outdegree (Absolute)	16	2	
		np=147	(23*5)+(16*2)
Human capital properties (hcp)			
Analytical Problem Solving	8	1	
Creativity and Innovation	7	2	
Problem Diagnosis and Solution	8	2	
Technical Expertise	10	3	
Time management	2	2	
		hcp=72	(8*1)+(7*2)+(8*2)+(10*3)+(2*2)
		SEVF=10584	(np*hcp)

a given social entity. At this stage the organizational valuable factors, network valuable factors, and the social entity valuable factors were computed. Now we have to define a weighting system to compute the relations value. For this it is necessary to define **Relation Type Values (RTV)** and **Relational Levels Values (RLV)**. These relations must be actionable for observers after the results are disclosed. To illustrate this, we choose two types of collaborative relations as described in Table 4. These questions were extracted from Cross [14] and for each relation type between two social entities, we defined values to be used to compute the dyadic relational capital, and, finally, relational levels classification. A relational level is a classification to characterize the proximity between two social entities. The average value (*Regular*) can be assumed by default. However, the link level between two entities can enhance the relational capital of the organization.

Table 5 describes relational level values from our framework to be used in order to compute the dyadic relational capital.

Table 4. Relation Type Values

Relation Type	Value
Collaboration/Information relation type *E.g. "From whom do you typically seek work-related information?"*	2
Collaboration/Problem solving relation type *E.g. "Who do you typically turn to for help in thinking through a new challenging problem at work?"*	1

Table 5. Relational Level Values

Relational Levels	Value
Very near	5
Near	4
Regular	3
Far	2
Very far	1

Finally, to allow calibration processes, our system defines four weights: Organizational weight (Ow); Network weight (Nw); Social entity weight (SEw); and Relational weight (Rw). These weights are used in the RCV formula. See (1) in the next section.

3.2 Evaluating Relational Capital

The **Relational Capital Value (RCV)** of an organization is computed according the formula:

$$\boldsymbol{RCV} = Ow * \boldsymbol{OVF} + Nw * \boldsymbol{NVF} + SEw * \boldsymbol{SEVFsum} + Rw * \boldsymbol{RVsum} \tag{1}$$

(Ow= organizational calibration weight, OVF= organizational valuable factors product, Nw= network calibration weight, NVF= network valuable factors product, SEw=social entities calibration weight, $SEVFsum$=social entities valuable factors sum, Rw=relational calibration weight and $RVsum$ = relational value from all network connections)

Where:

$$\boldsymbol{OVF} = \prod_{i=1}^{totalOVF} \boldsymbol{vOVI_i} * \boldsymbol{wOVI_i} \tag{2}$$

(totalOVF = total of organizational valuable factors, vOVI = value of organizational valuable item and wOVI = weight of organizational valuable item)

$$\boldsymbol{NVF} = \prod_{j=1}^{totalNVF} \boldsymbol{vNVI_j} * \boldsymbol{wNVI_j} \tag{3}$$

(totalNVF = total of network valuable factors, vNVI = value of network valuable item, and wNVI = weight of network valuable item)

$$\boldsymbol{SEVF}_{(X)} = \left(\sum_{n=1}^{totalNP_x} \boldsymbol{vNP_n} * \boldsymbol{wNP_n} \right) * \left(\sum_{h=1}^{totalHCP_x} \boldsymbol{vHCP_h} * \boldsymbol{wHCP_h} \right) \tag{4}$$

($totalNP_x$= total of network properties of social entity X, $totalHCP_x$= total of human capital properties of social entity X, vNP = value of social entity network property item , wNP = weight of social entity network property item , vHCP = value of social entity human capital item and wHCP = weight of social entity human capital item)

$$\boldsymbol{SEVFsum} = \sum_{s=1}^{totalSE} \left(\boldsymbol{SEVF}_{(s)} \right) \tag{5}$$

(totalSE = total of social entities from the network and $SEVF_{(s)}$ = network and human capital valuable factors from social entity s)

$$\boldsymbol{RVsum} = \sum_{c=1}^{totalC} \left(\boldsymbol{RTV_c} * \left(\boldsymbol{RLV_c} * \boldsymbol{SEVF}_{\boldsymbol{SocialEntity}_{\boldsymbol{Producer}}} \right) \right) \tag{6}$$

$\forall$ *connection* $\boldsymbol{C}\,(\,\boldsymbol{SocialEntity}_{\,\boldsymbol{Consumer}}\,,\ \boldsymbol{SocialEntity}_{\,\boldsymbol{Producer}}\,)$

(totalC = total of network dyadic connections, RTV_c = relation type value of connection c, RLV_c = relation level value of the connection c, $SEVF_{Social\ Entity\ Producer}$ = network and human capital valuable factors from connection social entity with role producer)

4 SNARE RCO Simulated Scenarios

To demonstrate the calculation of the relational capital using SNARE RCO model, we have defined 7 relational scenarios based on the existence of three social entities.

These scenarios are depicted in Figure 2. We used SNARE Explorer [10-12] as a simulation tool which implements our model in real-time. For each scenario, SNARE Explorer computes the network RCV. The calculations history and the monitoring graphic produced by SNARE Explorer are depicted in Figure 3. In the 7 scenarios, during the observation, we keep OVF (arrow #2), NVF (arrow #3) and SEVF Sum (arrow #4) constant. As we can see in Figure 3, the network RCV (arrow #1) evolution is strongly correlated with RV Sum increase (arrow #5). We also defined a ratio between network relational value sums and social entities valuable factors sums. In Figure 3, depending on the scenario this ratio is observable and ranges from 0 to 6.

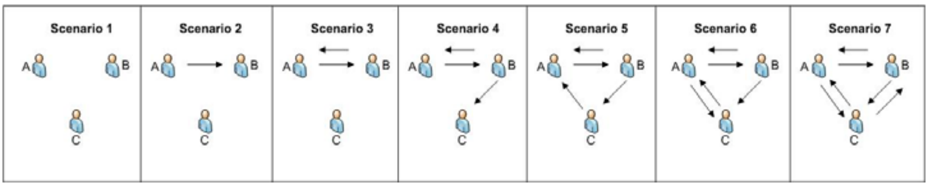
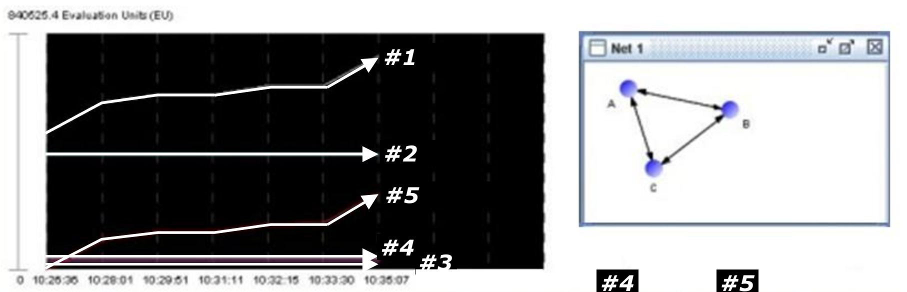


Fig. 2. Seven possible interaction scenarios of a triad



Date	Time	#1 RCV	#2 OVF	#3 NVF	#4 SEVF Sum	#5 RV Sum	Racio
30/Mai/2011	10:35:07	764.114	412.500	31.840	45.682	274.092	6
30/Mai/2011	10:33:30	657.314	412.500	31.840	45.682	167.292	3,662
30/Mai/2011	10:32:15	655.292	412.500	31.840	45.682	165.270	3,618
30/Mai/2011	10:31:11	627.068	412.500	31.840	45.682	137.046	3
30/Mai/2011	10:29:51	625.046	412.500	31.840	45.682	135.024	2,956
30/Mai/2011	10:28:01	596.822	412.500	31.840	45.682	106.800	2,338
30/Mai/2011	10:26:36	490.022	412.500	31.840	45.682	0	0

Fig. 3. Graphical evolution of RCV

5 Conclusions

To propose this organization's relational capital assessment framework it was necessary to research various methods of assessment. There are several evaluation methodologies for studying aspects such as economic impact or operational impact. However, there is a lack of assessment methodologies that combines techniques derived from social network analysis with organizational aspects and its relation with intellectual capital. One reason for this may be the division of organizational knowledge assets in three areas: human capital, structural capital and relational capital. That is, the separation of these factors assumes that the relational capital is independent of human capital and structural capital. But in fact, it is not. So, from our point of view, to evaluate the relational capital of an organization it is necessary to combine metrics that derive from assessments of human capital and structural capital. On the other hand, evaluating "intangibles" is a subjective process of reflection and depends on the focus of analysis. For this reason, most evaluation systems in organizations focus on skills evaluation, e.g. evaluating skills tends to be easier than evaluating relations.

The key challenge remains: the need for a relational capital evaluation system to answer questions like: *What is the value of this network?* This is not an easy answer. Our research lead us to conclude that any metric for assessing the relational capital of an organization should also include aspects of human capital and structural capital. From the various organizational evaluation models we found, they do not consider the analysis of the organization from this integrated network perspective.

From our point of view, to define the relational capital of an organization a system should combine techniques derived from social network analysis, with aspects of organizational assessment, and must consider dynamic properties from the social entities intellectual capital.

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Knowledge Applications Development for SMEs Business Management System Improvement

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Abstract. This paper presents some research results based on the concept of collaborative infrastructure (as virtual enterprise business network), in order to unify existing standards for supply chain management and to provide support in various decision making manufacturing supply networks processes. It intends to facilitate and enhance the required knowledge management processes linked with the business process management. The virtual enterprise business network expected to improve small and medium-sized enterprises (SMEs) involvement in new product manufacturing networking efforts, enables better and faster decision processes and promotes the development of the business services. As the new product development paradigm requires evaluated software tools, a knowledge base method built and used for the human resources (HR) selection as part of the business management process is proposed.

Keywords: Knowledge Management, Knowledge Application, Knowledge Base, Human Resource, Virtual Business Network, SME's.

1 Introduction

In order to meet their new products/services market requirements, companies need to focus on their core competence and join industrial networks developed on the *virtual enterprise* (VE) concept [1]. Selection and recruitment of *human resources* (HR) is very important to increase enterprise competitiveness in a VE system and represent a step in the VE forming process [2]. The basic idea of a *virtual enterprise network* (VEN) is to establish a dynamic organization by the synergetic combination of dissimilar companies with different core competencies, forming a consortium to perform a given business project in order to achieve maximum degree of customer satisfaction. In this emerging business model of VEN, the decision support functionality, which addresses issues such as selection of business partners, coordination in the distribution and the prediction of production problems, is an

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important domain to be studied [2]. The technological revolution in the field of Information and Communication Technologies (ICT) equipments and Internet in this era has lead to the creation of a new term: Virtual Business Network that can be defined as a business that does not have a physical identity and is operated entirely online (on the World Wide Web). We propose a system which allows SMEs to extend their business networks within any Cloud infrastructure, creating customary virtual environments able to run the applications without any change, but responding always to the business company's typical requirements: Quality of Service (QoS), High-Availability and Security. A virtual business or business process is not the equivalent of outsourcing. Outsourcing is outsourcing, the act of turning a specific function over to a third party provider to implement and support, for a fee. The virtual business/business process is the act of decentralizing an operation for the greater benefit of the company. A virtual business/business process, then, can be implemented and managed utilizing internal resources or outsourced. The determining factors for the decision of retaining or outsourcing a process are rooted in the overall business objectives of the SMEs, as well as its ability to provide the defined service most efficiently and effectively relative to an outsourcer. In addition, today, Business networking serves many purposes: sales, general marketing, recruiting, job-hunting, knowledge exchange, and business development (strategic alliances, joint ventures, channel sales, etc.). Developing and implementing these strategies will require HR, partnership and collaboration among the private, public and academic sectors as well as other agencies and organizations that strive to link these together. In this context, a general requirement for an infrastructure support is that the enterprises must be able to inter-operate and exchange information and knowledge in real time so that they can work as a single integrated unit, although keeping their independence/autonomy.

In addition, Knowledge has become the most important economic factor for permanent competitive products and services [3]. The SMEs activities request a large amount of data, information and knowledge collecting from all sources and then transferring knowledge at each enterprise level. We consider here that knowledge is using information (as a consequence data) to generate new ideas or solutions. In this context, we present some research results based on the concept of collaborative infrastructure in an industrial holding based on a temporary and dynamic alliance of SMES. This intends to facilitate and enhance the required knowledge management processes linked with the business process management at the industrial group level. The virtual enterprise network is expected to reduce SMEs` involvement in networking efforts, enable better and faster decision processes and promote the development of the business services. Today, the SMEs play an essential role in the European economy (EU). They are a source of entrepreneurial skills, innovation and job creation. In a single market without internal borders it is essential that measures to encourage SMEs rely on a common definition in order to improve consistency and effectiveness and limit distortions and competition. This is especially necessary considering the interaction between national measures imposed by the EU to support SMEs in areas such as regional development and the search for funds. The enterprises marketplace value represents the element that distinguishes its business performance from all others [4]. It is generally accepted that the value of every organization falls into one of three major categories of value discipline [5], [6], [7]:

- *Customer intimacy,* when companies try to understand their customers' needs, and try to do everything possible to accommodate their customers. These companies are definitely not cheap, because personal service is an expensive commodity; however, their customers prefer to use them because they feel they are sufficiently rich to justify the extra cost. The *customer intimacy* concept was a slogan adapted in service-oriented organizations with the idea to develop a detailed profile of the customer and taking advantage of being able to cross-sell and up-sell, and to create customer loyalty. The challenge for SMEs is that even when loyal customers do not pay their bills, fixed costs such as wages, rent and rates still need to be paid. On the other hand, the enterprises should ensure that managers and other senior staff keep their eyes and ears open for signs of brewing trouble, such as chance comments from customers that business is slowing down. But competitive threats may increase as the new medium allows larger firms to mimic the traditional strengths of SMEs in serving niche markets, developing *customer intimac*y and exploiting local knowledge [8]. The customer intimacy and availability of high skilled people, good work practices, beautiful graphical design, adequate project management, good client communication and mutual understanding will become much more important for SMEs in the future.
- *Product leadership,* as companies that could be described as 'leading edge', because their value is that can keep you ahead to the customers of other similar companies. These companies are always on the top with new innovative products, new ideas that can keep their customer interest. The basic philosophy is about the products that push performance boundaries. The *Product Leadership* is an approach to the market, dedicated to providing the best possible products from the perspective of the features and benefits offered to the customer [8]. Increased competition and shorter product lifecycles have determined SMEs to focus more on *Product Leadership* as a *business strategy*.
- *Operational excellence*, as companies that excels at operational efficiency. Successful organizations usually excel in at least one value discipline but also meet a minimum threshold of competence in the other two [9]. An enterprise pursuing an operational excellence strategy would want an HR function concerned with administrative efficiency. SMEs that follow an operational excellence strategy need a workforce that: identifies with business processes, is trainable, can learn rapidly, willingly follows the battle plan, and is short-term focused, possesses a mindset that seeks to avoid waste and minimize costs, and is driven by incremental improvement [10].

All companies tend to have a stronger affinity to one of the three categories. A modern organization needs to understand how to interact with its customers and how it would like to interact with its customers. After this, the e-enterprises can start to develop a strategy to improve customer relationship management (see Figure 1) and other e-business solutions, as enabling technologies and core technologies [7]. In addition, the SMEs must protect, optimize, and grow their network platforms using a lifecycle approach that creates business value and operational excellence [11]. Currently, enterprises invest heavily to leverage the Internet and transform their traditional businesses into e-businesses. The SMEs` managers are increasingly under pressure to justify e-business costs. The perspectives of this kind of manufacture and economy are named in brief *new digital economy (e-economy).*

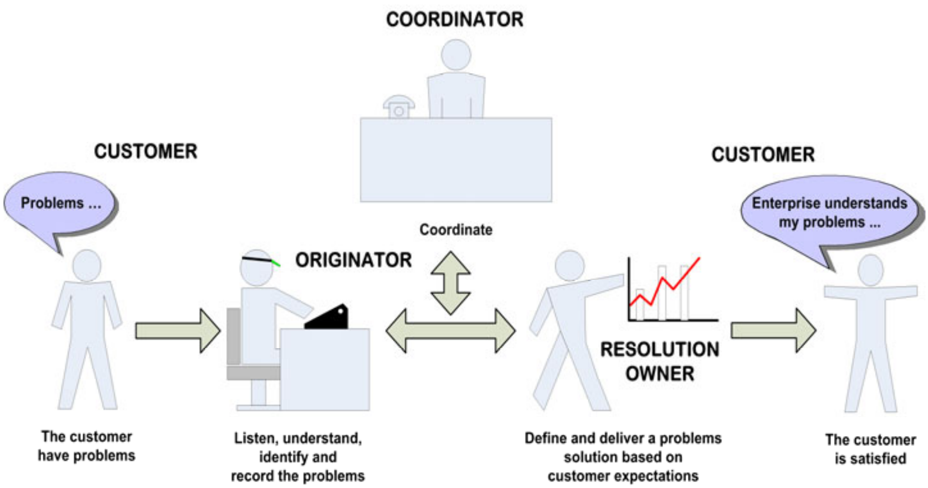

Fig. 1. The SMEs Customer Relationship Management

In this paper, we propose a knowledge base method built and used for the HR selection as part of the business management process and it is shown how the risk level depending on probability and severity of its consequences can be established.

2 Virtual Business Network for SMEs

Today, SMEs feel the need to focus on their core competence and join in virtual industrial groups, dispersed geographically to meet requirements of their new products/services [2]. Hereby, the concept of virtual enterprise based on a virtual enterprise network support for a virtual enterprise business network appears. The basic idea behind a virtual enterprise network is to establish a dynamic organization by the synergetic combination of dissimilar SMEs with different core competencies, thereby establishing a *best of everything* consortium (industrial group) to perform a given business project and to achieve maximum degree of customer satisfaction. In this context, a virtual enterprise network (VEN) is a way for businesses to achieve a virtual scale enabling them to operate as if they had more resources and capacity than they did actually have. Traditional infrastructures type Internet/Intranet/Extranet have now a fast dynamic, marking the transition to new generation networks to provide higher speeds to the user (end to end), for different types of transactions and a reduction in the number of servers by passing information between two nodes. The proposed general architecture for a virtual business network in the PREMINV e-platform (see Figure 2) uses Internet technologies or a provider network for an industrial holding (with headquarters and branches), with SME's components, geographically dispersed. A virtual enterprise network for an industrial holding is necessary to combine a group of users (i.e SMEs) regardless of their geographical position but in such a manner that it flows together to provide the best performance.

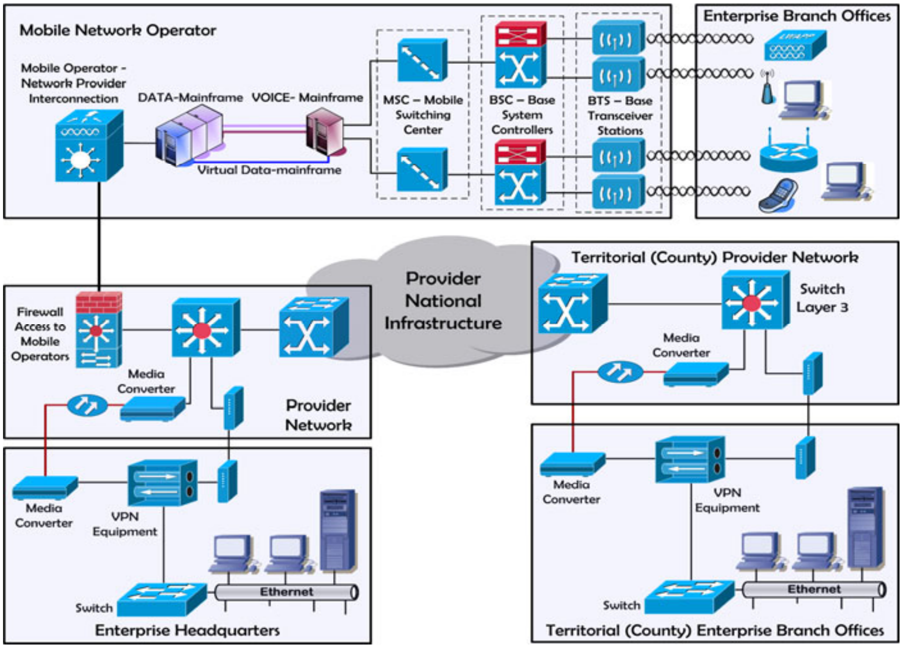

Fig. 2. VBN Solution For an Industrial Holding in the PREMINV e-platform

The second advantage of a virtual network consists [2], [7] of administrative solutions which accompany the products, allowing users moving from one group to another through a simple reconfiguration of the equipment. A virtual local network is a logical grouping of local network components without regard to their physical grouping. A clear trend is now evolving to Intranet and Extranet defined logic, which will lead to the reintegration of the various networks in single logical subdivisions with no physical boundaries. Structures that allow the approximation of this goal are virtual private networks. Recently, virtual private networks can be used in different ways to support business processes, representing the ideal solution if it is not efficient in terms of construction costs of a particular network for a firm with a workforce highly mobile, or for small firms that cannot justify the cost of their telecommunications network. Virtual private networks can be purchased from a telecommunications company and as an alternative; they can be created by using existing network infrastructure as the Internet or public switched telephone network, and software through the tunnel crossing [1].

3 KApps in VBN for SMEs: A KB to Support HR Activity

Today, we define knowledge management as being the process by which an organization generates wealth, from its knowledge or intellectual capital. In this context, wealth is present when a Virtual Enterprise uses its own knowledge to generate more efficient and effective processes [2], [12]. Traditional applications in the enterprises use massive amounts of data on operation and customers that are unused in data warehouses. To turn stored data into valuable information, companies are now questing knowledge applications (KApps). The business advantage in having KApps, lies in the ability to analyze large amounts of data from any business model, determine the personalized preferences of all potential customers, then reach them with relevant information, wherever they may be [13].

Traditionally, we have a query-and-response paradigm for applications. For the new generation of applications, logic is reversed: the *what-if-system* does not wait for the end user to have the question, the system just asks the question for the end-users and sends them the answer. In this way, one could anticipate a whole set of questions. Knowledge-driven applications have the potential to expand the use of information, by transforming existing huge data collections into revenue-generating assets.

International competition intensifying because of the amplification process of globalization and progress in the efficient HR management (HRM) is an expression of recognizing HRM as one of the most important factors for success, globally. Increasingly more companies recognize the international management of human resources development. There are considerable differences of opinion and interpretation on HRM in SMEs within existing research (e.g. the status of management in SMEs has been seen differently), [14]. The influence of international factors on the development of a company is already known, such as cultural diversity, international labor migration, development of market relations and competition in an international setting, etc. However, it has become undeniable that things are viewed, perceived and implemented differently in different countries, where not only culture, but also economic, political, and social contexts should be taken into account [15]. A knowledge based system (KBS) in the human resource (HR) domain should respond to challenges such as management of entities in HR (organizational units, people, jobs, competences) by continually recording the experts' knowledge, expertise profiling and by building community oriented competency repositories, expertise gap analysis, expertise planning and development, etc. [16]. HR needs to make an enthusiastic contribution and not be seen as pointing out the problems without any strategic thinking [17]. HR professionals should maintain diligence for individual variances in personal impact from an organizational change to support morale levels of those workers more significantly impacted by a change [18]. Recruitment is the work of identifying people who have those characteristics required to attract vacancies in their organization. Results are influenced by the selection-recruitment method. Among the methods applied there can be mentioned: advertising, network knowledge, using recruitment advisers, seeking employees, potential employee's files, marketing activities. Recruitment criteria can be competence, seniority, teamwork, development potential candidates, etc. In general, the phases of recruitment are: *Define the job* (that results in a job description that is detailed job requirements and the types of skills needed to meet these requirements and ideal candidate profile), *Attracting candidates* (Recruitment can be internal or external organization. External recruitment is conducted in educational institutions, consulting firms and through recruitment, placement office jobs announcements in the media, based on recommendations made by employees of the company) and *Selection of candidates* (They may be asked to send a CV, a motivation letter (of intent) and letters of recommendation). Among candidates who have submitted these documents considered as interesting group of candidates to the firm may be asked: *An interview* [(by phone or face to face) that can be before various tests (medical, aptitude, intelligence, training, etc.)] and a *series of interviews* (with supervisor, HR manager, general manager). Almost all organizations use the interview as a method of selection and at least two specialists' interview candidates - a specialist in HR and head directly to the prospective employees. For jobs that require a higher degree of qualification it is customary to take a third interview with a manager from the upper hierarchy of the organization. The interview has a dual purpose: to inform the candidate on the company, job vacancies and requirements and to enable the applicant to submit information as possible regarding his professional background and aspirations for the future [15]. Based on these assumptions and using expert systems generator VP-Expert (version 2.1, by Brian Sawyer, Educational Version, distributed by Paperback Software International) we created the knowledge base *EVALPERS.KBS* as support for candidate's selection after an interview (see Figure 3).

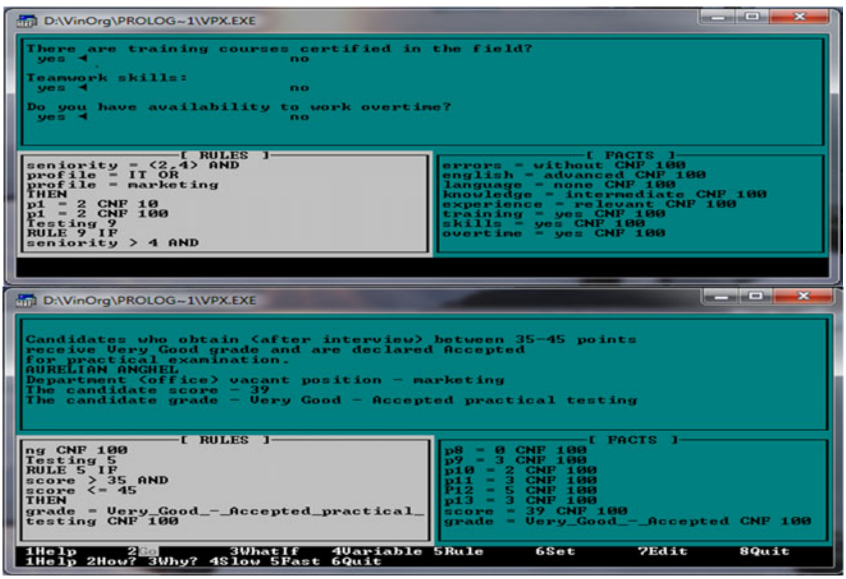

Fig. 3. The Knowledge Base *EVALPERS.KBS* Query and Show Results for an Enterprise Marketing Department Candidate

Figure 4 shows the mechanism of the application. Production rules form the knowledge representation model used in this work. In the *EVAL.KBS* knowledge base (KB) there are *if-then* structure rules excluding the rules for inference engine operations, such as:

```
RULE 42
  IF      knowledge=advanced      AND
          profile=IT
  THEN    p9=9;
```

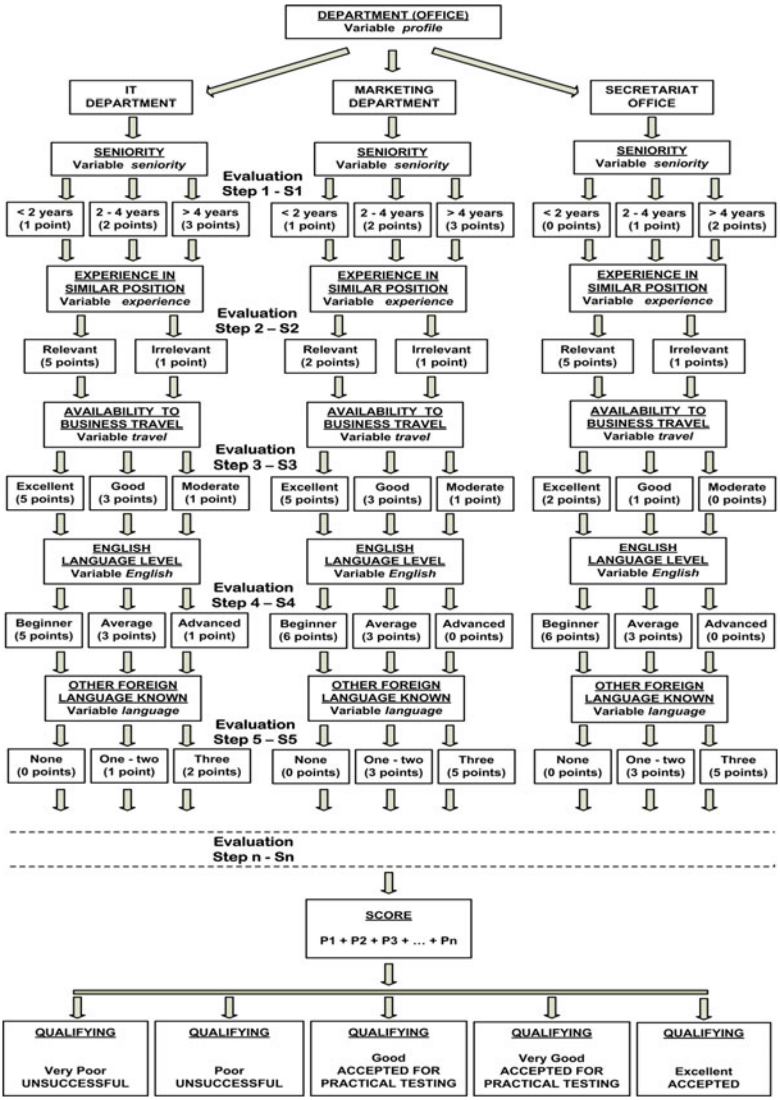

Fig. 4. The Knowledge Application Evaluation Mechanism

RULE 43
IF knowledge=intermediate AND
profile=IT
THEN p9=5;
RULE 44
IF knowledge=general AND
profile=IT
THEN p9=1;

RULE 45
IF knowledge=advanced AND
profile=marketing OR
profile=secretariat
THEN p9=5;
RULE 46
IF knowledge=intermediate AND
profile=secretariatOR
profile=marketing
THEN p9=3;
RULE 47
IF knowledge=general AND
profile=marketingOR
profile=secretariat
THEN p10=1;

The direction of rules application is back chaining return. The Knowledge Base includes a series of rules relating to the candidate's evaluation criteria. The application was designed to carry personnel evaluation after an interview, on the premise that an enterprise is hiring in three departments (offices): Information Technology (IT), Marketing and Secretariat. The candidate present at the interview must answer some questions. Depending on the answers he/she gives, human resource specialists choose the appropriate response in the application, give a score and, at the end of the evaluation, the final score obtained is assigned a grade. Although the steps taken by the application for evaluation are the same in all cases, evaluation criteria are different, being adapted to the specifics of each activity. The evaluation mechanism of the application is presented in Figure 4. Candidates are characterized as their evaluation result score: *VERY POOR* (candidates are declared *UNSUCCESSFUL), POOR (*candidates are declared *UNSUCCESSFUL,* but can be contacted in the future), *GOOD (*candidates are declared *ACCEPTED* for the practical examination), *VERY GOOD* (candidates are declared *ACCEPTED* for the practical examination, but have priority over those who obtained grade GOOD), EXCELLENT (grade given, in general, to those who have an impressive business card which has no relevance for the practical test.).

4 Conclusion

The research results focus on an e-platform development to support virtual business processes. This application could be oriented on SMEs knowledge resources used during the product development process as well as for an HR selection by considering the support of a VEN based VBN for an industrial SMEs holding. The validation of the presented solution meant to establish the risk level in collaborative infrastructures is related to knowledge bases used at the SMSs level. *This work was supported by CNCSIS –UEFISCDI, project ID 1022, PNII – IDEI, contract no. 629/2009 in Romania,* with the main purpose to integrate the knowledge management processes from university to industrial partners in a proposed collaborative e-platform.

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