Thesis

The Impact of Semantic Knowledge Management System on Firms' Innovation and Competitiveness

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Conference papers

Kabir, N. (2012). Effects of Advances in Technology on Tacit Knowledge Transferability. In Proceedings of the 9th International Conference on Intellectual Capital, knowledge Management and Organisational Learning: ICICKM 2012 (p. 113). Academic Conferences Limited.

Kabir N. (2014). Knowledge Management – Time to Rethink the Discipline. In Proceedings of the 15th European conference on Knowledge Management: ECKM 2014 (p. 516). Academic Conference Limited.

Kabir, N. (2015, April). A Semantic Knowledge Management System Framework for Knowledge Integration from Mobile Devices. In European Conference on Intellectual Capital (p. 157). Academic Conferences International Limited.

Kabir, N. (2016, April). Knowledge Entrepreneurship in Emerging Economies. In ICIE2016-Proceedings of the 4th International Conference on Innovation and Entrepreneurship: ICIE2016 (p. 103). Academic Conferences and publishing limited.

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ABSTRACT

PURPOSE

In the knowledge economy, knowledge is increasingly becoming the primary factor of production and foundational component of innovation. Firms must improve their capabilities of handling knowledge in line with its recent explosive growth to stay competitive. This research addresses the effects semantic technology-based knowledge management system (Semantic KMS) can have on firms' performance. Based on existing literature, a conceptual model covering Semantic KMS, KM, innovation, and competitiveness was designed to test the validity of the hypotheses.

DESIGN/METHODOLOGY/APPROACH

A total of 640 survey questionnaires were sent to the companies that practice KM actively. 178 usable responses were received. Pearson's correlation, exploratory and confirmatory factor analyses and structural equation modeling were used to analyze the data.

FINDINGS

The results indicate that Semantic KMS is positively related to the KM effectiveness. Organizational KM is positively linked to innovation and competitiveness directly. In the context of KM, innovation's effect on competitiveness is not convincing. Moreover, the study could not identify that KM has any strong relationship with organizational competitiveness mediated through innovation.

RESEARCH IMPLICATIONS/LIMITATIONS

Being one of the first significant studies of Semantic KMS and its impact, the study adds to the growing literature on the use of semantic technology in various fields. It develops a new theoretical model which has never been tested before. The study used data collected from single respondent of each firm in a snapshot and did not consider feedback effects. It examined Semantic KMS as a holistic system, but in many cases, companies only deploy certain KM related tools supported by semantic technology. A different research approach could investigate the impacts of those tools on relevant business processes.

PRACTICAL IMPLICATIONS

This study demonstrates that deployment of semantic technology is beneficial for companies and allows them to take advantage of the use of advanced technologies in their KM quest. It brings significant benefits to the firm thanks to improved capabilities of the new KMS in knowledge discovery, aggregation, use, and sharing. The study also confirms that for a successful KM initiative, KM processes need to be optimized and supported by KMS.

ORIGINALITY/VALUE

Semantic technology is a set of advanced tools used lately in many information systems. This study is one of the first in-depth research about their impacts on KMS. It will guide KM managers in their decision-making process when they consider developing or integrating new

KMS tools. For academics, this research highlights the importance of investigating KM from the new technology perspective.

Keywords: semantic knowledge management system, semantic technology, knowledge management, innovation, competitiveness.

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ABBREVIATIONS

ACP -	Acquisition Process
AI -	Artificial Intelligence
AMOS -	Analysis of Moment Structures
APP -	Application Process
CA -	Competitive Advantage
CFA -	Confirmatory Factor Analysis
CFI -	Comparative Fit Index
CFI -	Comparative Fit Index
CI -	Cultural Infrastructure
CP -	Conversion Process
CR -	Composite Reliability
CSS -	Cascading Style Sheets
CVI -	Cross Validation Index
DCMI -	Dublin Core Metadata Initiatives
DL –	Description Logic

DOAP -	Description of a Project
ECVI -	Expected Cross-Validation Index
FOAF -	Friend of a Friend
GFI -	Goodness-of-fit Index
GPS -	General Problem Solving
HTML –	Hyper Text Markup Language
HTTP -	Hypertext Transfer Protocol
ICT –	Information and Communication Technology
IMS –	Information Management System
IoT –	Internet of Things
IT -	Information Technology
KBV -	Knowledge-based View
KBS -	Knowledge Based System
KE -	Knowledge Extraction
KM -	Knowledge Management
KMIC -	Knowledge Management Infrastructure Capability
KMPC-	Knowledge Management Process Capability
KMPI –	Knowledge Management Performance Index

KMS –	Knowledge Management System
KPI –	Key Performance Indicators
LO -	Learning Organization
LOD -	Linked Open Data
NIF -	Normed Fit Index
OAI -	Open Archives Initiative
OECD -	Organization for Economic Co-operation and Development
OL -	Organizational Learning
ORE -	Object Re-Use and Exchange
OWL -	Web Ontology Language
PCA -	Principle Component Analysis
PGEI -	Parsimonious goodness-of-fit index
PNFI -	Parsimonious normed fit index
RBV -	Resource-based View
RDF -	Resource Description Framework
RDFS -	RDF Vocabulary Description language
RMSEA -	Root Mean Square Error of Approximation
RMSR -	Root Mean Square Residual

RNI -	Relative Non-Centrality Index
RS -	Research Question
SCA -	Sustainable Competitive Advantage
SEM -	Structural Equation Modeling
SI -	Structural Infrastructure
SKMS –	Semantic Knowledge Management System
SKOS -	Simple Knowledge Organization System
SME -	Small or Medium Sized Enterprise
SPARQL -	SPARQL Protocol and RDF Query Language
SPSS -	Statistical Package for the Social Sciences
SQL -	Structured Query Language
SRMR -	Standardized Root Mean Residual
ST –	Semantic Technology
SW –	Semantic Web
SWOT -	Strengths – Weaknesses – Opportunities – Threats
SWRL -	Semantic Web Rule Language
TLI -	Tucker Lewis Index
URI -	Uniform Resource Identifier

URL -	Uniform Resource Locator
XML –	Extensible Markup Language
XQUERY-	XML Query

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1. CHAPTER ONE. INTRODUCTION

1.1. SYNOPSIS

The emergence of knowledge economy and globalization along with phenomenal knowledge growth and faster technological advancement have created a turmoil that is changing the competitive landscape, market rules, and management priorities fundamentally. Survival of a firm and its ability to harness new opportunities in this turbulent environment largely depend on the adoption of specific strategic approaches towards knowledge, innovation, and competitiveness. The skills and capabilities an organization require to compete with global rivals who possess equivalent or superior differentiating capabilities are more distinctive today than before the advent of the knowledge economy.

A remarkable level of knowledge growth compared to the historical trajectory, rising living standards, access to higher education, and the society's dependence on knowledge-based products and new devices for efficiently functioning have accelerated knowledge diffusion and inventions of increasingly sophisticated technologies.

Innovation in this complex market environment, as many organizations have started to realize lately, is a key enabler and crucial element in the quest of an organization for sustainable competitive advantage. Knowledge in this equation plays a critical role. The ability of an organization to identify, extract, assimilate, use and share knowledge competently and a firm's capability to organize, implement and manage knowledge related activities have a profound impact on its innovation efficiency. The heightened competition in the globalized knowledge economy requires rapid development, implementation, and diffusion of innovative products, services, strategies and business models. Knowledge is an essential resource in every step of the innovation process. For faster knowledge acquisition, efficient use of knowledge assets, and sharing and transferring of critical for the organization knowledge, firms deploy various technologies to manage knowledge-related activities.

Knowledge Management (KM) is the mechanism and systematic approach to managing an organization's tacit and explicit knowledge. A collection of Information and Communication Technologies (ICT) based tools are applied to deal with knowledge-related routine, processes, and activities. These tools, often, are underlying components of a system which is called Knowledge Management System (KMS).

In last several decades, many strategies and instruments have been developed to increase knowledge workers' productivity and enhance the ability of firms to extract more value from knowledge assets as these issues started to become critical for businesses. Presently, the advanced technologies such as Artificial Intelligence (AI), and diverse types of information and communication technologies are bolstering the strength of an organization to manage knowledge resource and work on innovation on a fundamentally different level. Machine learning, data mining, and data analytics are facilitating companies to manipulate big data, find patterns and valuable knowledge, which in turn is getting exercised effectively in decision-making processes. Artificial intelligence agents and semantic technology are getting employed dynamically in knowledge management platforms and programs to improve knowledge related processes, operations, and activities.

Semantic Technology (ST), a group of tools, helps to extract knowledge from both structured and unstructured data. These technologies allow identifying and embedding meaning to data and content, which enables information technology systems to gain the power to analyze and reason much like humans. This capability creates a scope of broader application for knowledge management systems. For example, in the era of knowledge economy, companies increasingly understand the importance of big data, massive amount of structured and unstructured data, as a source of valuable information that can be utilized in decision-making processes by both humans and machines. ST's ability to enhance knowledge related activities have made these technologies at the forefront of advanced technologies that any knowledge management system should employ.

The focus of this study is to evaluate the effects of ST, as an example of rapidly growing and advanced technologies, on the effectiveness of knowledge management and the impact of organizational knowledge management on organizational innovation and competitiveness. Key findings of this research are characterized by the followings: semantic knowledge management system does improve the effectiveness of organizational knowledge management, and together they have a positive impact on firm's innovation and competitiveness.

The study contributes to the field of knowledge management in varied ways. First, it demonstrates the necessity of faster adoption of advanced technologies in KMS. Second, it has developed a research model and tested the instrument that can be used further. Third, the discourse brings better clarity to the understanding of concepts such as knowledge, innovation, competitiveness and ST both for academics and practitioners. Finally, the outcome of the research and the discussion provide new insights for the organizations in their quest for gaining competitiveness through innovation and knowledge use.

1.2. INTRODUCTION

The world economy is increasingly transcending to a knowledge-based one (Powell and Snellman, 2004). A distinctive feature of this new realm is the growing importance of knowledge in organizational productivity and growth. The concept that knowledge is a foundational component of innovation and innovation is the linchpin of economic growth is not a novel idea (Nonaka and Takeuchi, 1995). New now is the unprecedented surge of the significance of knowledge in every aspect of business whether it is production, operation, sales, marketing or general management (Foray and Lundvall, 1998). Organizations are paying attention to the fact that the material's share of a product or service's economic value is steadily diminishing seceding it to the intellectual capital, marketing strength, branding, innovative elements and human resources. They also start to realize that to stay competitive it is necessary to develop a sound knowledge base that encompasses contemporary and advanced knowledge pertaining their business fields and exploit it adequately (Cooke and Leydesdorff, 2006). It's obvious that without continuous innovation and creation of new values in this fast-changing technological and economic environment organizations are destined to lose their competitive edge. Drucker (2008), who envisioned the ushering of the knowledge-based economy as early as in the 1960s, emphasized the importance of knowledge for an organization. He asserted that knowledge is the most critical resource for organization's competitive advantage.

Digital revolution bolstered by technological advances is the reason for this fundamental shift towards a new paradigm of knowledge utilization. From the time of its emergence, the Internet with its ubiquitous presence formed a global communication platform boosting the incredible growth of information creation and dissemination.

As a result, the world economy is shifting towards "post-capitalist society" (Drucker,1994) where knowledge is replacing traditional driving forces of the economy: labor, capital, and natural resources as the primary factor. Unsurprisingly, the attention to knowledge in such present socio-economic conditions is bound to intensify. As described below, this renewed focus on knowledge as a factor of production, an underlying tool for innovation and a component of competitive advantage necessitates studying management of knowledge-related activities and tools and technologies that improve knowledge flow processes.

Appropriate use of crucial-to-the-firm knowledge can have game-changing effects on a company's value creation and profitability. Most of this knowledge resides in various organizational silos that include knowledge possessed by the employees, partners, customers, and suppliers. It also comprises external knowledge that is readily available to the firm. Emerging possibilities that are transpiring thanks to the advent of novel technologies such as the ability to extract knowledge from big data are opening new horizons of unprecedented business opportunities for technologically and strategically well-prepared firms. Moreover, efficient management of knowledge related activities such as knowledge acquisition, aggregation, maintenance, and sharing has become imperative to achieve desired effects from organizational knowledge. Undoubtedly, any improvement in these activities brings greater momentum to innovation and competitiveness of an organization.

Companies apply technology-based solutions to maximize the potential of knowledge use and to perfect knowledge-related activities. With the continuous change in advances in technologies, it is tough to judge which technologies should receive priorities and what would be the outcome of using one or another type of technology. The problem also exacerbates with the fact that many of the seemingly promising new technologies might become obsolete a lot faster than expected.

Knowledge management, ever since its emergence in the early 1990s as an approach to organizing and managing knowledge-related routines, processes, and procedure, has deeply penetrated the organizational management practices (Davenport, De Long and Beers, 1998). Lately, it has also evolved into an organizational science discipline (Stankosky, 2005). Instrumental to the adoption of KM by the companies as a potent management tool and a key enabler of KM is Information and Communication Technology (ICT) based Knowledge Management systems (KMS) (McDermott, 2000). As any ICT-based system, KMS, its qualitative improvement, and efficiency primarily emanate from technological change, a process that is evolutionary and continuous. In recent years, semantic technology, a group of Web-based and artificial intelligence-based technologies, is getting increased traction and being applied to improve the capabilities of KM systems (Davies, Warren and Sure, 2011).

Researchers have conducted studies on whether and how different aspects of KM such as KM capability, KM strategy, KM enabler, KM practices, KM capacity, and KM processes influence organizational performance. As measuring the financial performance of an internal organizational process is not always possible, researchers often measure criteria such as growth and improvement of efficiency and effectiveness of some highly relevant and crucial elements such as productivity, innovation, market share, sales and competitive advantage. The impact of IT on the KM is also a well-researched area. However, even though the use of semantic technology in KMS is steadily increasing, the effect of such KMS on broader organizational processes such as innovation and competitiveness is still a less explored area.

Context and Motivation. The context that motivated the researcher to pursue this study includes:

Firms are facing serious problems in extracting and organizing information and knowledge from the massive amount of data (big data) they are producing nowadays. Aggregating knowledge from external sources due to its sheer growth makes it difficult and organizing available knowledge and providing access to it just-in-time to all relevant stakeholders is also becoming problematic. While KM is meant to resolve some of these issues with existing technology it is increasingly becoming harder. One of the solutions, possibly, lies in upgrading the KMS with semantic KMS. However, the evidence is still scarce that shows the viability of this approach. The researcher after observing problems that companies are encountering in managing knowledge and knowledge-related activities using existing KMS and recognizing the lack of empirical studies in this area concluded that further research is necessary in this direction.

This thesis is aimed at filling this void. It is going to examine effects of semantic technology-based KMS on organizational KM. Semantic KMS, the researcher argues, has the capability of providing a critical and profound impact on company knowledge use, innovation and consequently on the organizational competitiveness.

Innovation and Knowledge at the Firm Level. Globalization, technology growth, and the new market environment have fundamentally changed the rules of the game in all the areas of the marketplace. Elimination of trade barriers, the economic prosperity of many emerging countries, and improved communication have given a surge to competition from new entrants. The intensifying competition, rapid technology change and reduced product and service shelf life in this new paradigm started to compel firms to acknowledge the value of innovation. (Tatikonda and Rosenthal, 2000; Drucker, 2002). Many companies in this new circumstance realize that their success bases on innovation (Sawhney et al., 2006) and lasting better performance will eventually owe to superior innovation capability (Mone et al., 1998). Moreover, company competitiveness and even survival might rely on constant innovation (Hurley et al., 1998; Lengnick-Hall, 1992).

Knowledge is one of the principal factors of innovation. Quality of knowledge and on time accessibility to knowledge affect its intensity (Popadiuk and Choo, 2006). Present growth of knowledge and demand for it are solid. It requires new KM strategies to reign in the complexities of knowledge related issues which occur in the process of its use in innovation and knowledge that gets created by innovation (McElroy, 2003; Cavusgil et al., 2003).

Technological advancement in last thirty years has been unprecedented in its speed of change, novelty, and disruptive innovation. Since the early days of ITC adoption, and proliferation of the Internet, companies feel overwhelmed with the deluge of information. Knowledge workers apply various information systems and approach to harness the power of ever-expanding information base with the support of the continuously changing technology. Along with the emergence of new technologies these systems are also going through an evolutionary growth trajectory relentlessly. KMS are also evolving at a faster pace in line with other ITC adopting advanced technologies. The concept of KM and technological aspects related to it, both are relatively new issues in the business management. Despite these rapid changes, it is difficult not to notice that empirical studies demonstrating the impacts of knowledge-related technologies on organizational performance are while growing are still limited.

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1.3. PROBLEM STATEMENT

A critical component of firm's ability to develop competitiveness is innovation. How innovative the company is, on the other hand, hail from its capability of knowledge absorption, use, and creation where advances in technology play a vital role. The ability to exploit the power of the knowledge resource available to the firm and its successful utilization in the company value chain, particularly in innovation, is a continuous problem for companies trying to gain competitive advantage. KM is applied in an enterprise to manage its knowledge and knowledge-related activities throughout its various operational, supply chain, innovation, and sales and marketing processes. KMS is the underlying supporting tool in this effort. In recent years, companies are increasingly deploying semantic technology-based KMS tools to improve the effectiveness of their KM. However, in the literature the evidence showing how efficient this approach is still meager. The central questions of interest in this research are thus: Does semantic knowledge management system influence organizational performance? If it does, how and through which mechanisms this influence takes place?

1.4. SIGNIFICANCE OF THE RESEARCH

This study identifies the value propositions of knowledge management system supported by semantic technology, which we call here "Semantic Knowledge Management System" (Semantic KMS) and Effective Knowledge Management (KM Effectiveness) within the realm of firm's innovation and competitiveness. The study develops a conceptual framework, produces new insights, and shows the subsequent impact of semantic knowledge management system and KM effectiveness on firms' innovation and competitiveness. The research also conducts an incisive and comprehensive analysis of the concepts of knowledge, innovation, competitiveness and semantic technology.

Contribution to Knowledge. The results of this research should add new insights to the literature on competitiveness, innovation, knowledge management, and KMS fields. They should also facilitate the understanding of the importance and contributory factors of Semantic KMS and KM Effectiveness in a firm's innovation initiatives and its quest for competitiveness.

Many organizations use knowledge management actively. However, lately, the enthusiasm around knowledge management started to show a sign of diminishing interest. In surveying the issues relevant to economic cycles, Bain and Company has been monitoring and publishing a list of most popular management tools each year since 1993. KM, as it turned out, has dropped out from the list 0f 25 most popular tools for the first time in 2013 (Rigby and Bilodeau, 2013). KM over this period, on the other hand, has undoubtedly established itself as a growing practice-based discipline (Wiig, 2000). There is at least one explanation that is deeply rooted in the history of KM for this divergence between KM's organizational use and its academic growth.

The ushering of KM as a management tool in the early 1990s can be attributed to the newly found capabilities of information technologies in handling knowledge related activities (Wilson, 2002). The ICT capabilities of that time, however, were not adequate to meet the ambitious demands of the KM needs (Davenport and Prusak, 1998). Failure of some costly KMS endeavors and disappointment from the outcome of many the then introduced systems firmly swayed the still nascent and evolving field's approach to the use and exploitation of tacit knowledge, knowledge embodied in workers' mind, and practice-based knowledge. This new orientation of KM quickly became the dominant scope of the field (Booker et al., 2008). However, the lesser focus of KM to the ICT had far-reaching consequences. The discipline failed to take advantage of the recent repid technological advancement and augment the field by incorporating new subject matters such as big data and business analytics as they emerged. It can be argued that as KMS is an integral part of KM, better efficiency of KM thanks to the adoption of advanced technologies and a renewed focus on the technology-aspects of the discipline will create an opportunity to revive interest in it from the corporate world.

This study is an endeavor to bring new insights to the discourse through an empirical research that shows KMS using semantic technology can be a potent tool for firms to increase their innovation capabilities and consequently improve their competitiveness.

1.5. ORGANIZATIONAL KNOWLEDGE

The faster changes in the competitive landscape with new trends, disruptive innovation, and revolutionary marketing strategies are the direct result of new knowledge, new combinations of different knowledge and use of knowledge in a distinctive way.

Knowledge is a critical component of every single business process no matter how small or how large the process is. The increasing saliency of knowledge in the organization and economy first attracted the attention of the scholars in a major way in the late 1950s and early 1960s (see Penrose, 1959; Machlup, 1962; Drucker, 1962).

Since then over half a century has passed and knowledge by this time from being a valuable enabler to the productivity has continued its upward move. It is now a vital economic input and one of the primary sources of economic activities in the developed countries.

The Resource-Based View (RBV) of the firm.

The concept that knowledge is a core resource for gaining competitiveness rooted in the idea of the resource-based view. Resource-based view first postulated by Penrose (1959) argues that firm's ability to develop competitive advantage largely relies on the endogenous resources and capabilities that the company possesses and its ability to deploy these resources and develop skills to utilize them effectively.

One of the primary tasks of the corporate management is to work on optimization and enhancement of these assets and abilities and maximize economic value (Grant, 1996). Empirical studies have proved the validity of this theory and its power to explain differences between the competitive positions of the firms and their performances within an industry (Hoopes et al., 2003). The performance differences between firms take place due to the unique and particular collection of resources and competencies available to the firm that influences its evolutionary and strategic growth opportunities (Barney, 1991; Wernerfelt, 1984; Dierickx and Cool, 1989). These resources can be physical, human or organizational (Barney, 1991) and tangibles and intangibles (Gupta and Roos, 2001; Mathews, 2003).

Intangible assets are the essential source of sustainable economic value creation in many industries. Firm's success capacity hinges on the internal process performance supported by intangible resources such as culture, interpersonal relationships within company managers, reputation and knowledge (Barney, 2001). Reed and DeFillippi (1990) suggested that tacitness, complexity, and specificity of a firm's skills and resources create barriers that hinder other companies to imitate it. These resources provide better opportunity to develop competitiveness as they are often rare, complex, and difficult to imitate (Hitt et al., 2001), and there is no immediate substitute for them (Duening, Hisrich, and Lechter, 2009). Unique knowledge possessed by a firm is one of the resources that entirely corresponds with these characteristics.

Knowledge-based view of the firm. The knowledge-based view of the firm is an extension of RBV. This theory regards Knowledge as the most valuable resource of a firm (Grant, 1996a; Sveiby, 2001b; De Carolis, 2002). According to this view, firms differ in performance due to their knowledge base, access to the required knowledge, ability to grow their knowledge stock, and capabilities of integrating, absorbing, using and creating new knowledge (Kogut and Zander, 1992; Grant and Spender, 1996; Grant, 1996). In present knowledge economies, where many organizations are engaged in knowledge-based activities such as knowledge production, use, and distribution, focus on knowledge is not just natural, it is critical to the survival of the firms (OECD, 1966). Moreover, knowledge combined with intellectual capabilities and skills are the key enablers of production process improvements that encompass from R&D to manufacturing and from sales and marketing to customers' care. These improvements contribute to a significant portion of the products and services value and are directly attributed to the intangible capital (Abramovitz and David, 1996).

As a production output in many products and services knowledge constitutes a significant portion, especially, in knowledge-based industries where the level of knowledge component is substantial. Moreover, comparing to other industries knowledge-intensive industries are characterized by high value-added products and services and increased productivity (Lee and Gibson, 2002: 360). Because of this, OECD countries emphasize more on the investment in knowledge industries to spearhead economic growth (OECD, 1996).

1.6. COMPETITIVENESS

Competitiveness means that the firm has the resources and capabilities required for sustaining financial growth in the market where other players with equivalent but differentiating resources and capacities are also located (Fagerberg et al., 2003). Competitiveness gained through technology deployment carries long-term effect and produces more meaningful results than the other factors that influence on competitiveness.

The ability to recognize opportunities for growth in the market before the competitors is cultivated from accumulated knowledge within the organization, acquired knowledge from external sources, and management's expertise to exploit this unique resource. A learning organization with technological competitiveness can use the available market opportunity better than the rivals (Teece et al., 1997).

Competitiveness originates from the development of indigenous differentiating capabilities that are needed to sustain growth in an environment beset by national and international competitors. Such capabilities are often built using innovation.

1.7. IMPORTANCE OF INNOVATION

Innovation is the cornerstone of any knowledge-based firm's competitive advantage. A company invests not just in its existing products and services to achieve sustainable growth. Often a new product or service through innovation brings high returns and sustainable growth to the company. Most stakeholders of the companies are aware of this implied promise of innovation which is the reason why business executives are increasingly paying more importance to innovation initiatives (Andrew et al., 2009; Barsh et al., 2007; Capgemini, 2008; IBM, 2006; Jung and Waiboer, 2007). Whether it is a mere improvement of an existing product or an entirely new product, developing and subsequent launching of an innovative product or service require proficiencies like understanding of the market trend, customer demand, potentials of new technologies, practical skills, and having knowledge of the competitive environment. These expertise and abilities count on the internal knowledge resource of the firm, ability to extract knowledge from external sources, and the firm's absorptive capacity (Cohen and Leventhal, 1990).

Innovation consists of a complex process and its outcome. As a process, it starts with the generation of new ideas, continues with the development of the new product, process or service and completes with the phase of their implementation. Innovation processes had been described as discovery and creation (Dosi, 1988), production and emergence (Gupta et al., 2007), development, solving and implementation (Myers and Marquis, 1969) or introduction and application (West and Farr, 1990). Although the process seems linear, it is a phenomenon characterized by convergence and divergence of a continuous order. It is also coupled with decision making from various departments, stakeholders and management of an organization (Van seven et al., 2007).

At every step of this process, it requires foundational knowledge base, knowledge acquisition, and aggregation along with clear strategic vision. The objective of an innovation outcome is to introduce new products or services to the market to make an economic gain. If the innovation's outcome is a new or improved process, the goal is to increase productivity or reduce cost by optimizing the business routines, processes and procedures (Urabe, 1988; Greve and

Taylor, 2000). Innovation outcome can also be new ideas, new combinations, solutions to problems, new strategy and business models (see Gupta et al., 2007; Schulze and Hoegl, 2008; West and Farr, 1990; Obstfeld, 2005; Dosi, 1988; Myers and Marquis, 1969). Whatever is the outcome of an innovation initiative, organizational learning and Knowledge Management tools can play a pivotal role in this process (Crossan et al., 1999).

Increased complexity of the innovation and market demand for faster implementation compel companies to seek knowledge from external sources by hiring new talents and through knowledge partnerships that include mergers and acquisitions, alliances and outsourcing (Powell et al., 1996). Better knowledge flow, knowledge sharing and transfer within various departments of the organization and with different external agents create opportunities of new knowledge generation and recombination, which is also a precursor to innovation (Inkpen, 1996; Birkinshaw et al., 2008; Tsai, 2002).

Not to mention that innovation is also a tool for entrepreneurs to create and exploit new opportunities. From entrepreneurial standpoint, it is considered that innovation derives from market and technology knowledge combined with entrepreneurial vision (Drucker, 1985).

1.8. KNOWLEDGE MANAGEMENT

Knowledge Management is about knowledge flow within the organization and the processes of aggregation, assimilation, creation, and dissemination of knowledge. It ensures among other things secured access and retrieval of knowledge. KM helps improving knowledge resource, capabilities around it and identifying core organizational competencies. Its central strategy is targeted towards facilitating workers' learning, absorbing, recreating and sharing knowledge.

In today's knowledge economy and heightened global competition where customer needs, market expectations, technology and corporate environment change in lightning speed, organizational workers must have speedy access to relevant knowledge to make the right decision immediately (Sunassee and Seway, 2002). KM helps to achieve this goal.

1.9. KNOWLEDGE MANAGEMENT SYSTEM AND ICT

KMS is used as a generic term for ICT-based knowledge activities and support tools. There is no constraining boundary in considering what tools and programs constitute a KMS. KMS is a result of an evolutionary process that is continuing. The precursors to the present KMS are executive information systems, decision support system, and expert systems (Prusak, 2001).

A review of KMS in literature shows various tools which have been used in KM activities that include: artificial intelligence, competency management systems, search systems, decision support systems, and digital repositories. It also includes group support systems, data mining tools, intelligent agents, data warehousing, virtual collaboration, knowledge maps, knowledge portals, knowledge-based systems, learning support systems, and others (Nevo and Chan, 2007).

One of the biggest benefits of organization-wide KMS implementation is it connects knowledge located in disparate silos of an organization. The aggregation of this seemingly unrelated knowledge could work together as a base for a new innovative field within the organizational ecosystem. The KM system itself is a combination of technologies that have the potential to activate new creativity in the organization.

1.10. ADVANCED TECHNOLOGIES

Advanced technologies are continuing to push boundaries and enhance human abilities. A noticeable and unprecedented growth is taking place in the capability to find, receive, extract and use information thanks to new technologies such as mobile devices, faster and ubiquitous access to the Internet and numerous tools like Siri, Google search, enterprise resource management, customer resource management and other cloud-based programs.

One of the biggest problems that corporations in this environment encounters is the speed of change that surpasses the adoption capability. Globalized competitions and market needs are forcing companies to produce new products and improve the old ones in a lightning speed reducing the life cycle of technology products to an astonishingly small timeframe. It is creating a tremendous pressure on the companies in managing change. The quandary that firms face continuously is how to find and deploy the right technology on time and not left out behind by the competitors. At the same time, they also worry about the possibility of procuring a soon-to-be obsolete technology. To navigate through this complexity and take intelligent decisions firms need to master the task of technology sourcing with agility, speed and thorough understanding of disruptive technologies.

The same questions bother the companies about KMS as well. Firms must assess and deploy new technologies as they emerge to mitigate the risk and improve KM related productivity. Artificial intelligence, machine learning, cloud technology and semantic technology are some of the technologies that are pursued actively by vendors to bolster the capabilities of KMS. Recently, semantic technology (ST), a set of tools and technologies, has also started to receive increasing attention.

1.10.1. Semantic Technology

The volume of data in corporate repositories and other silos are increasing at an exponential pace. Much of these data are unstructured, located in multiple areas, and difficult to access and extract any meaningful information out of them. The challenges are also exacerbating with the expanding interaction between organizations with customers and employees using the social media and networks.

Semantic technology is a group of technologies that are logical, multi-dimensional and highly promising technological platform. The goal of this family of technologies that include Machine learning, expert systems, data mining, semantic search and natural language processing is to facilitate making sense of large structured and unstructured data. Semantic Web technologies are tools that are used to describe and link data located in various organizational silos and on the Web. The concept of semantic technology also comprises Semantic Web Technologies, which are practical tools for implementing ST (Obrst, Janssen and Ceusters, 2010).

Semantic technoloy is set to achieve the objective of transferring part of human tasks and decision-making to the machines through providing meanings to the Web-based content that are perceivable by interacting programs. The idea behind it is if a machine can make sense of the data it will be able to work with these data more effectively.

Semantic technology facilitates structuring data, define meanings to the data and link them for useful discovery, integration, maintenance, automation, and reuse – the very similar mission that knowledge management systems are required to perform (Davies, Lytras and Sheth, 2007).

1.11. RATIONALE FOR THE RESEARCH

In the current era of globalization and knowledge economy, innovation, competitiveness, and technology are receiving increasing attention from the corporate management. Management now realizes that innovation capabilities create the base for competitive advantage (Freeman, 1994). It is also evident that sustainable competitiveness can be achieved by faster and continuous introduction of novel products and services along with adoption of new processes and streamlining of the old ones (Sen and Egelhoff, 2000). The questions that derive from this include: what is the link between technology, innovation, and competitiveness, is there any empirical proof justifying any connection? What is the theoretical foundation concerning this link? The first motivation of this thesis is to find clear answers to these complex questions.

Several aspects call for further research on this subject: firstly, the emergence of growing importance of innovation initiatives in the firms (Jung and Waiboer, 2007). Secondly, the recent realization of the fact that knowledge is one of the essential resources for innovation and thirdly, the implication that knowledge management contributes to a better innovation process (Andreeva et al., 2011, Zhou et al., 2009). Moreover, innovation process is intricate, time-consuming and requires vast resources; any insight that can enhance the process will contribute to lowering innovation cost and improve innovation outcome. The second motivation for this research is to bring clarity to the apprehension whether knowledge management is indeed a valuable instrument for innovation success.

Knowledge management systems are complex information-based infrastructure. KMS requires substantial investment and if not done right may cause a considerable financial loss. Many firms experienced disappointing result from the implementation of KMS that ultimately did not function as anticipated (Akhavan and Pezeshkan, 2014). Furthermore, the technology related to KMS is constantly changing. Any improvement to the system that will have a positive effect on the knowledge management will ensure firstly, better acceptance from the relevant audience and secondly, enhance firm's capability to attain competitive advantage. Our third motivation is to examine the efficiency and effectiveness of the KMS that has incorporated semantic technology and provide practical insights into the use of knowledge management systems.

Innovation, knowledge management, KMS, and semantic technology are all developing fields that sport conceptual ambiguity, inconsistent results from empirical studies, conflicting definitions, and dubious interpretations. Moreover, the link between these disciplines and subjects with the strategic concept of competitiveness are sporadically studied and shows an apparent gap that needed to be filled. The fourth and final motivation is to find clarity in this link and produce new insights.

1.12. RESEARCH OBJECTIVES AND QUESTIONS

The central goal of this thesis is to further our understanding of how and through which mechanisms semantic technology-based knowledge management system impacts on firm performance.

1.12.1 Objectives.

A set of practical objectives have been defined to achieve this goal that include:

Objective 1. Executing a systematic, detailed and trenchant literature review of the related concepts: knowledge, innovation, competitiveness, knowledge management, knowledge management system and semantic technology. It is required to determine the current gaps in literature in the direct and indirect impacts of semantic knowledge management system on organizational knowledge management and the relationship between organizational knowledge processes, organizational knowledge management readiness and organizational innovation and competitiveness.

Objective 2. Identifying the factors and variables that link the corresponding concepts and define their relationships. A detailed review and analysis of prior empirical investigations literature will provide the basis for this and next four objectives.

Objective 3. Developing the hypotheses that show the relationships between the factors of the various concepts.

Objective 4. Formalizing the relationships of the factors and the hypotheses by defining a theoretical model.

Objective 5. Conceptualizing the Research model.

Objective 6. A pilot project to validate the conceptual model will be performed. If necessary, changes will be made to the model by analyzing the collected data. A questionnaire will be prepared. 3-4 interviews, and a survey of around 20 participants will be conducted. The analysis of the data collected should provide valuable feedback to find if the construct needs any correction.

Objective 7. Conducting empirical research and collect primary data. The survey questionnaire will be sent to some executives, those who are related to knowledge or innovation aspects of the company. The goal is to receive minimum 200 responses. Once the data is collected works on next three objectives will be performed.

Objective 8. Performing data analysis, testing and validating hypotheses.

Objective 9. Conducting critical analysis and synthesis of research findings and drawing insights from them.

Objective 10. Based on the findings and insights, drawing conclusions, making recommendations to practitioners and academics and providing ideas for future investigations in this area.

1.12.2. Questions

Question 1. Does semantic knowledge management system influence organizational performance?

Question 2. If it does, how and through which mechanisms this influence takes place?

1.13. CONCEPTUAL FRAMEWORK OF THE RESEARCH

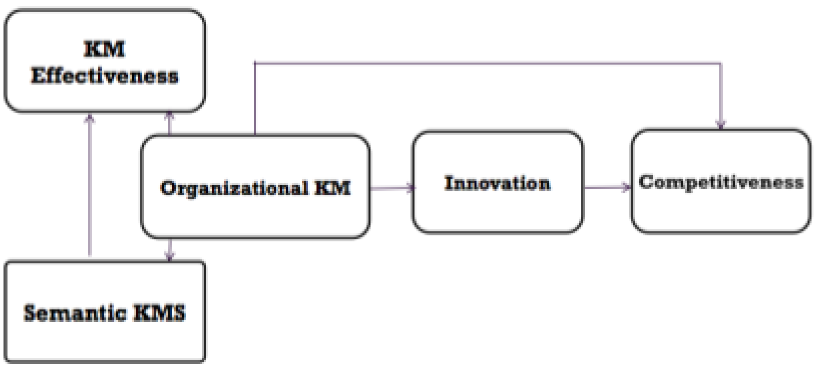


Figure 1: Conceptual framework

1.14. BRIEF OUTLINE OF THE RESEARCH METHOD

The research process followed the methodology described by Saunders, Lewis and Thornhill (2009). To develop the conceptual framework, a thorough review of the prior empirical research models has been conducted. References to some of these works that explain the justification for the selected variables and paths are covered, and the process is analyzed in detail in Chapter 2. The research methodology, which was undertaken to systematize and successfully conduct the research, elaborated in Chapter 3.

1.15. HYPOTHESES FORMULATION

Hypothesis formulation brings objectivity to a research work. It becomes a guideline and a searchlight for the research endeavor. It clarifies where should be the emphasis of the study and what kind of data needs to be collected for conducting an investigation. A given hypothesis requires finding evidence through experimental or empirical research (Belle, 1958). This research consists of 5 hypotheses.

It is technology that has enabled the advent of KM (Hendriks, 2001). Each stage of improvement in KM's capabilities has been instigated and supported by advances in technology. Semantic technology has brought game-changing enhancement to the core areas of the knowledge management system (Grobelnik and Mladenic, 2008). As KMS is the underlying technological tool intertwined with KM activities, any significant functional improvements of KMS should also exert a positive influence on KM. Based on prior literature (see Davies, Lytras, and Sheth, 2007; Joo and Lee, 2009; Lee et al., 2005; Huang and Lin, 2009; Kalender and Dang, 2012; Joo, 2011; Kumar, 2012) and this assumption we develop our first hypothesis as follows:

H1 – Semantic Technology-based Knowledge Management System is positively related to the effectiveness of the Organizational Knowledge Management

Knowledge is the primary constituent of the innovation. Innovation occurs because of the recombination of knowledge (Galunic and Rodan, 1997). In each stage of the innovation process knowledge plays a prominent role (Scarbrough, 2003). At ideation level, which is the first phase of the innovation process, a prior knowledge base of the domain and knowledge extracted from multiple sources create the foundation for a new idea creation. At Research and Development

(R&D) level, knowledge aggregation and knowledge use are significant activities. At diffusion level market knowledge, customer knowledge and knowledge of competition are necessary. KM as the underlying tool is used for streamlining the processes with a systematic methodology and maneuvering of knowledge activities required for the innovation process. Effective management of these activities elevates firm's innovation capabilities. Based on this assumption and prior literature (see Adams and Lamont, 2003; Asgarian, 2012; Gloet and Terziovski, 2004; Andrieva and Kianto, 2011; Deng et al., 2008; Smith et al.,2005) the second hypothesis is formulated:

H2 – There is a positive impact of Knowledge Management on Organizaional Innovation

Improved productivity raises a company's competitiveness (Muellbauer, 1991). Deployment of new technologies in various organizational business and production processes leverages its productivity (Powell, 2004). Knowledge is a crucial element in this context. Knowledge related to required technologies, their implementations and continuous use must be effectively managed to achieve the desired result. In knowledge-based industries, knowledge is also the primary production input that relies on knowledge identification, aggregation, utilization, and dissemination (Grant, 1996). In the operational value chain of a firm, each primary and supporting activity from inbound logistics to services and infrastructure development to procurement is thoroughly entwined with knowledge. These activities in unison build the competitiveness capacity of the firm (Porter, 1990). Based on this and prior literature review (see Autio et al., 2000; Zaim, Tatoglu and Zaim, 2007; Karaszewski, 2008; Lee and Sukoco, 2007; Lee and Lee, 2007; Chuang, 2004) the third hypothesis was devised:

H3 – Organizational Knowledge Management positively influences on Organizational Competitiveness

How innovation in recent years has become a priority in the firm's quest for competitiveness is exemplified in Porter's works. In his Five Forces Analysis and Value Chain analysis frameworks, innovation received rather a peripheral attention (Porter, 1990). At a later stage, his cluster concept and Diamond framework, on the other hand, evince innovation as a vital element in creating sustained competitiveness (Huggins and Izushi, 2011). In an innovation-driven economy, innovation is considered as a primary source of competitiveness (Jaffe and Trajtenberg, 2002). Adoption of new activities, procedures and routines in streamlining and enhancing business processes and use of new technology to achieve this increase firm's competitiveness (Goel and Rich, 1997). If a company can develop knowledge-based competitiveness by churning out rapid innovation, rivals face extreme difficulties in displacing it from its competitive position (Carneiro, 2000). Based on these arguments, and prior literature (see Vilmaz et al., 2005; Barringer and Bluedorn, 1999; Hornsby et al., 2002; Lopez-Nicolas and Merono-Cerdan, 2011; Wang and Lin, 2013) the following hypothesis is crafted:

H4 – Innovation makes positive effects on Organizational Competitiveness

Firms need to work on its market expansion to ensure strong competitive position. Market growth can stem from new products, improved products, new markets and improved customer satisfaction (Slater, Mohr and Sengupta, 1995). These are often outcomes of firms' innovation efforts. Identifying knowledge necessary for the chosen innovation process, its aggregation, recombination, and application are the activities that engender expected innovation (Scarbrough, 2003; Plessis, 2007). Effective management of these knowledge activities impacts on the company's competitiveness by shortening the time needed for the innovation process, enhancing companies' innovation capabilities and propounding new ideas. In this context, innovation plays a mediating role in KM's beneficial influence on competitiveness (see Andreeva, and Kianto, 2011). Moreover, as a management tool, KM's use in innovation process by itself can be a source of competitiveness (Davenport, 1988). The final hypothesis ensues from these arguments and following prior literature (Lopez-Nicolas and Merono-Cerdan, 2011; Lee, Lee and Kang, 2005; Darroch, 2005; Adams and Lamont, 2003).

H5 – Organizational Knowledge Management affects positively on Organizational Competitiveness through Innovation

1.16. MEASURES

The survey questionnaire constructed for this study is composed of 44 questions. All questions are formerly validated and carefully chosen from previous literature.

1.17. RESEARCH LIMITATION

The primary limitation of this study is that it does not consider the feedback effects. A longitudinal research to investigate the dynamic aspects based on this construct would, probably, produce a more convincing result.

Secondly, although data collected from 178 firms is a satisfactory level for this type of research, a larger sample pool would generate a more robust outcome.

Thirdly, while we have considered the impact of organizational knowledge management that includes the KM effectiveness and semantic KMS on the innovation and competitiveness of the firm, some researchers have focused on other factors such as organizational learning, market orientation, etc. Conducting a deeper analysis of those assumptions along with Semantic KMS is also necessary but not a part of this study.

1.18. THESIS STRUCTURE

The thesis follows the prevailing structure recommended for research and comprised of four elements: a) Background theory, b) Focal theory, c) Data theory and d) Novel contribution (Philips and Pugh, 1994).

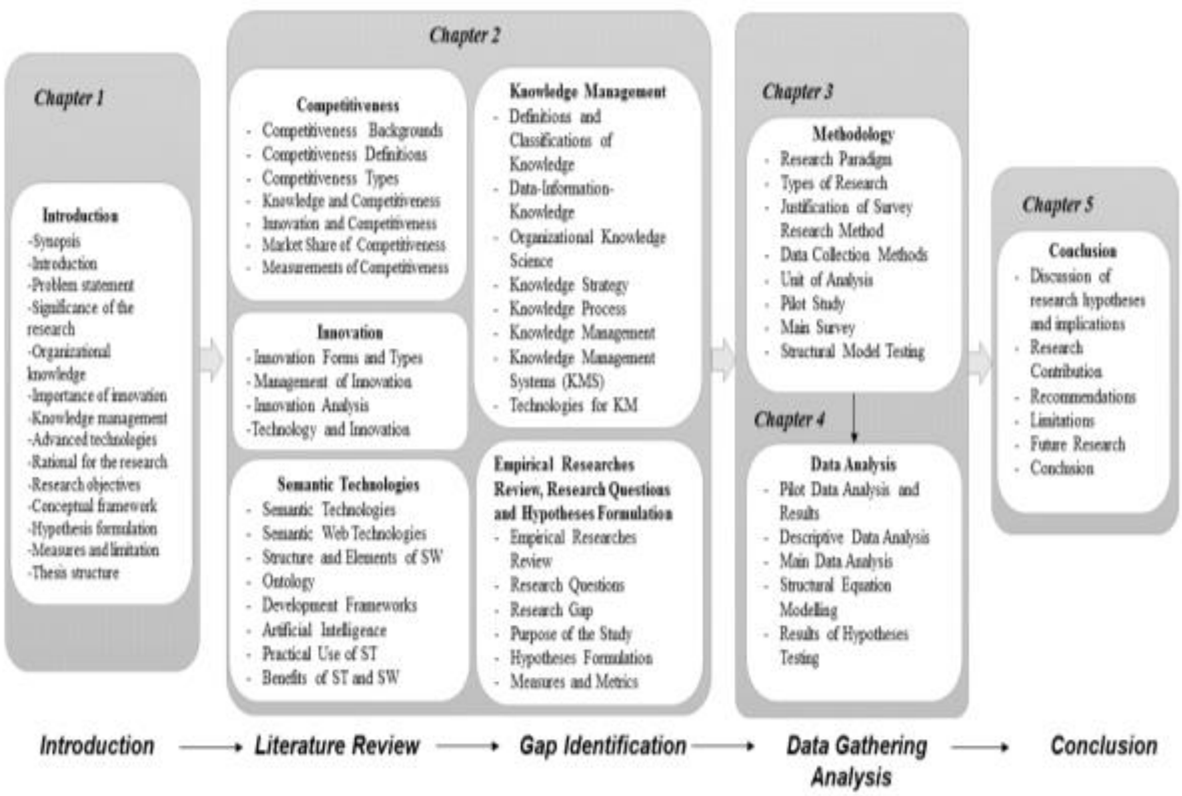


Figure 2: Thesis structure

Chapter one. The introductory chapter describes the research problem, the purpose of the research, goals and objectives and sets practical and academic context and includes a summary of the work.

Chapter two. Presents a comprehensive literature review of the fundamental concepts of the thesis: knowledge, knowledge management, knowledge management systems, semantic technology, organizational innovation and organizational competitiveness. It also covers gaps found in the literature and establishes the ground for the conceptual model. It elaborates the critical issues, notions and limitations stemmed from the research problems, presents the conceptual framework along with related constructs, variables, and formulates the hypotheses.

Chapter Three. Outlines the data collection methodology. Addresses the research design and explains the data analysis processes and procedures. It describes the questionnaire and approach used in its development. The chapter also illustrates the measurements scale and method of its construction.

Chapter Four. Reveals the study findings. It presents the results of hypotheses testing and validation.

Chapter Five. Conducts analysis, synthesis, and integration of the findings linking with research questions and hypotheses. It also summarizes implications of the research findings for current literature and practitioners.

1.19.CONCLUSION

This thesis is set to discover how semantic technology as an example of advanced technologies brings benefits to a knowledge management system. The findings of this research should help firms to assess the viability of the deployment of a KMS with semantic technology. As the use of KM as a valued management tool started to diminish, the outcome of this research is expected to help both the scholars and practitioners to determine the value KM creates from an objective point of view. The next chapter contains a literature review of the concepts relevant to this research.

2 CHAPTER TWO. LITERATURE REVIEW

2.1. INTRODUCTION

For theory building to supplying theoretical underpinning literature review is an essential module of a thesis. It is also necessary for delineating researcher's approach and understanding of the stated problem (Webster and Watson, 2002). The goal of this review is to provide a comprehensive analysis of the relevant aspects of the research topic, and outline phenomena, their relationships, connected theories and variables (Randolph, 2009). It follows the formal method for discovering, analyzing and evaluating prior works written and executed by scholars of the pertaining fields (Fink, 2009).

The review covers related to the thesis following subjects: competitiveness, innovation, knowledge, knowledge management, knowledge management system, organizational strategic readiness and semantic technology.

2.2. COMPETITIVENESS

In this section, we review competitiveness – a critical factor in understanding a firm's status vis-a-vis other market players. In this study competitiveness is the prism through which firms' performance gets analyzed. Here, we start with the origin of the concept then explain what the firm-level competitiveness is and determine the working definition of the concept and its sources.

The review also encompasses relations of competitiveness with knowledge, innovation, and technology. It ends with a brief description of the measurement of competitiveness and a conclusion.

2.2.1. Competitiveness Background

Competitiveness is one of the major topics and areas of studies in the business management and economics (Chaudhury and Ray, 1997). Competition provides the necessary conditions of spurring creativity and innovativeness in firms, oblige them to develop unique products and services and allow them to take advantage of imperfect market offers. Competitiveness in the increasingly globalized world is a leading indicator for understanding the position of a firm, industry or a country that they hold in comparison to peers (Maskell and Malmberg, 1999).

Competitiveness is studied on various levels such as individual, product, firm, industry, regions, nations, regional trading blocks and even global (Porter, 1990; Omae, 1995; Lawson, 1999). Although it is usually examined at a single level, the concept is closely connected and highly intertwined across multiple levels. While it is a major factor in the economics, competitiveness has started to garner rightful attention only in the last couple of decades. In a larger context, competitiveness includes elements of economic concepts that preoccupy policymakers and economists while trying to understand the issues of prosperity and wealth creation (Porter, 2011).

The changes in the proportional value of the productivity factors in current knowledge economy compel to assess competitiveness from a new perspective. These changes are characterized by the increased importance of intangibles, globalized trade policies, borderless connectivity, pressure from new entrants and radical innovations (Stopford, Strange and Hanley, 1991). The changing environment of competition due to technological advancement, diffusion of innovation and globalization compel organizations to find new and innovative strategic approaches to attain competitive advantage.

2.2.2. Firm-level Competitiveness

While national competitiveness always receives more attention, in international markets, it is not the nations, but the firms compete (Porter, 1998). The concept of competitiveness at the enterprise level is reflected through the firm's ability to develop, manufacture and market a product profitably which satisfies the need of the target market audience concerning the product's economic value (D'Cruz, 1992). Several assumptions are vital for defining the concept of competitiveness. These include 1) the existence of a firm hinges on the demand for its products or services 2) the aim of a company is to make profit continuously and satisfy the expectations of the stakeholders 3) competition spurs when multiple firms aspire to meet the demand of the same customer base (Feurer and Chaharbaghi, 1994).

Company's Competitivenss is the outcome of the interconnection of several dimensions. These are competitive performance, competitive process, and competitive potential (Buckley, Pass and Prescott, 1992). Competitive potential means resources and capabilities the firm own that can produce superior products and services. Competitive process refers to managerial activities and procedures that are related to market competition. Competitive performance is the market position of the company compared to the rivals.

2.2.3. Definitions of Competitiveness

Competitiveness like many other concepts of social sciences does not have any specific, clear and widely accepted definition due to its multi-dimensional and multi-level nature. Its definition also drastically varies depending on its focus level. For example, at the national level, OECD (1992) defines competitiveness as to the degree under free market a country can produce products and services in the face of foreign competition and at the same time maintain or even enhance domestic real income. For firm-level competitiveness, there exist many definitions. Some of them are listed here:

- Competitiveness is the ability of an industrial sector or a firm to produce and sell goods which are more attractive thanks to their superior quality, better price and other differentiating factors in comparison to products with similar attributes offered by competitors (Flejterski, 1984).

- Continuous production and sale of goods or services which are better in quality and cheaper in cost in comparison to local and international rivals are competitiveness (Buckley et al., 1988).

- Competitiveness refers to a firm's market share of the products or services it offers (Ajitabh and Momaya, 2004).

This research defines organizational competitiveness as the ability of an organization to develop and market innovative goods or services superior to the ones available in the market, either based on their attractive price or non-price factors such as product quality, brand image, and marketing capabilities (Feurer and Chaharbaghi, 1994). If a company wants to become competitive, it must garner enough market demand by boosting the perceived value of their goods or services by customers (D'Cruz, 1992).

According to Porter (1990) productivity growth best explains organizational competitiveness. The better the productivity of a firm, the more chances are there that it will become competitive. Organizations often adopt a business strategy with the goal of ascending from present competitive level to a superior one. The company achieves this goal when it learns how to use its resources efficiently by building capabilities and core competencies and gain competitive advantage (Grant, 2008).

The firm's market share and its competitive advantage are directly related to its ability to produce and sell products with greater efficiency (Grant, 1991). In a free market economy, if some non-market instruments such as state monopoly are not there to artificially support the company, its failure to compete in the marketplace will first cause a loss of market share for its products. If this persists long enough, the firm eventually will be forced to close its doors. Because of this, competitiveness is an indicator of firm's performance of utmost importance (Mulatu, 2016). As cost-based competitive advantage is often short-lived, in the long run, firm's capability to continuously develop and market innovative products or services is one of the key success factors for its competitiveness (Appelbaum, 2000). Four components are instrumental in the shaping of organizational competitiveness. These are the organization, its competitors, its customers and its environment (Rosenau, 2003). To compete the firm must have a product or service that has sufficient market demand. In a free market, the demand instigates the emergence of competitors. Companies combat for market shares by making their offerings more lucrative than their competitors (Feurer and Chaharbaghi, 1994). The strategy to gain competitive advantage involves differentiating the offerings, having a lower price for the similar product or both (Porter, 1990). While competing in the market, the goal of the organization is still to make an adequate amount of profit. Firms need to deliver better customer satisfaction and greater value than their competitors to develop a sustainable competitive advantage in today's globalized markets. Firms won't be able to achieve these objectives without working on continuous innovation, creating better efficiency in the operational processes, staying cost-effective and becoming a learning organization (Senge, 1990; Johnson, 1992; Hammer and Champy, 1993). The capabilities that a firm need to harness to attain these attributes are dynamic capabilities, adaptability, agility, flexibility, and speed (Ulrich and Lake, 1990; Barney, 2001).

2.2.4. Sources of Firm-Level Competitiveness

At the firm level, price, quality, and reputation are recognized attributes of competitiveness (Hitt, Ireland and Hoskisson, 2012). Other important factors that also explain an organization's competitive advantage include growth trajectory, available resources, organizational culture, management and leadership, unique processes, market approach, business strategy, productivity and innovation (Hitt, Keats and DeMarie, 1998). Strategies directed to the firm's market position, global operation, resource allocation, capability development are the necessary approach businesses need to incorporate to gain competitiveness (see, Bartlett and Ghoshal, 1989; Prahalad and Hamel, 1990). Delivered cost, product characteristics, and user's perceptions are also fundamental in developing competitiveness against rivals (Day and Wensley, 1988). Product cost, quality, the speed of delivery and brand image are characteristics that can be compared with rivals to figure out a firm's competitive position vis-à-vis competitors (Menon, Chowdhury and Lukas, 2002). A company's competitiveness builds upon its resources, core competencies, customer base, policies including governmental and industrial, technology, innovation capabilities, positioning, strategic plan, culture, and reputation (Teece, Pisano and Shuen, 1997; Dwyer and Kim, 2003; Prahalad and Hamel, 2006). Each of these elements needs closer attention in the quest of a firm for gaining competitiveness.

Competition is also a never-ending spiral process for organizations. If an organization successfully implemented a strategy that propelled it to achieve a new level of competitiveness, rivals will also work on acquiring these advantages and some will eventually succeed in their efforts forcing the original company to reevaluate and increase its strength.

2.2.5. Strategic Approaches to the Competitiveness

Literature often stresses on the competitive advantage while discussing competitiveness. The development of competitive advantage strategy is aimed at value-added activities about one of the following strategic approaches: cost, differentiation or focus (Porter, 1990). Competitive advantage refers to the superior market position a company. This unique position can be rooted in either better customer value of products or lower cost of production, and in the successful diffusion of the product that allows the firm to gain and retain market share and stay profitable (Day and Wensley, 1988). Competitive advantage also often means having the edge over competitors thanks to superior resources or competencies that elevate the company to a stronger market position. According to Day and Wensley (1988), these two notions in combination provide a better picture of the concept. They also argued that better resources and skills of the firm facilitate it to gain positional advantages. Better customer value or lower cost results in superior performance outcomes that include market share and profitability exemplify positional advantages of a firm.

Companies can embark upon one or both strategic approaches to competitiveness: Resource-led approach and innovation-led approach (Carayannis and Wang, 2012). The priorities and challenges for the firms those focus on resources, and those put more emphasis on innovation are very different.

2.2.6. Resource-led Competitiveness

From the resource-led perspective, competitiveness means that the firm has the resources and capabilities required for sustaining financial growth in the market where there are other players with equivalent but differentiating resources and capabilities (Fagerberg et al., 2003). Resources are physical, human and organizational assets and attributes that are required for a firm and enable it to develop and implement strategies that improve its performance (Wernerfelt, 1984). They are the input into the production process and work as an enabler in various other processes of the company value chain. Resource-based view (RBV) posits that there are external forces that have an impact on the firm's goal setting, strategy development and managerial decisions that set priorities for certain activities. However, within the enterprise, it is the availability of the resources and capabilities of exploiting them efficiently more often determine the performance of a firm (Penrose, 1959; Wernerfelt, 1984; Grant, 1991; Peteraf, 1993).

2.2.7. Knowledge-based View of the Firm and Firm's Competitiveness

Organization's innovation capabilities ensue from its ability to use knowledge in developing new products, services, processes and business models or improve on existing ones. Capacity to recognize opportunities for growth in the market before the competitors stems from accumulated knowledge within the organization and acquired knowledge from external sources, and management's ability to exploit this unique resource prudently. A learning organization with technological competitiveness can exploit the available market opportunity better than the rivals (Teece et al., 1997).

Competitiveness can receive a significant boost through improved productivity and innovation if knowledge related activities such as knowledge discovery, integration, storing and sharing are well-managed in the company (Nonaka and Takeuchi, 1995). While trying to improve access to knowledge and exchange of knowledge, companies must recognize that knowledge needed for innovation and learning process is not a zero-sum game. Organizations can work together and jointly take advantage of the opportunities and be competitive in the market using various differentiating factors.

2.2.8. Porter's Five Forces Analysis

The resources and capabilities available to a firm is limited and don't allow businesses to pursue every opportunity that emerges in front of it.

The purpose of a company's strategy is to set goals and develop plans for achieving these goals by balanced use of its resources and capabilities. However, firms competitive position stands not just on the direct rivals' position, the structure and idiosyncrasies of the industry also have a considerable influence on it. Porter (1990) developed a conceptual framework that encompasses the industrial forces instrumental in shaping competitive position of the firm, which are competitors, the threat from new entrants, product substitution, suppliers bargaining power and bargaining power of buyers.

The five forces framework assists a firm to assess its unique position in the market and grasp how it must differentiate itself to improve its competitiveness, figure 3.

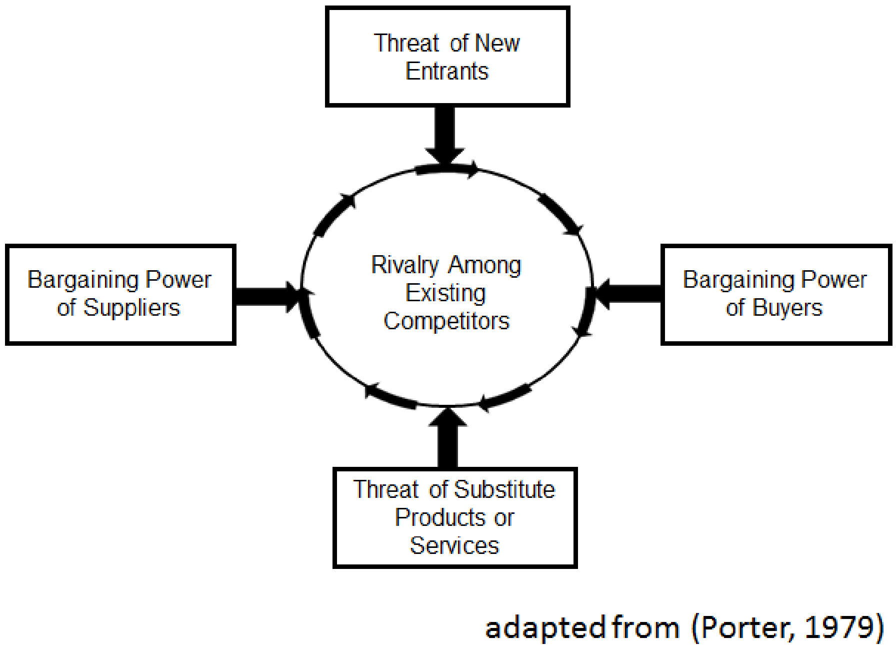


Figure 3: Porter's five forces analysis

2.2.9. Innovation and Competitiveness

Competitiveness of a business involves developing growth strategies that create superior products and services in comparison to rivals (Ulrich, 1993). Innovation is the linchpin of this strategy (Wolfe, 1994).

Non-price factors in globalized world influence more on the competitiveness of products due to the increased complexity, segmentation and niche focus of the products (Subramaniam and Venkatraman, 1999). Product quality, it's novelty, knowledge embedded in the product and technological superiority are some of the key attributes that make the products offering successful in a commercial competition (Murray and Chao, 2005). Because of this, the quest for better competitive position forces the firms to produce more innovative products (Clark and Fujimoto, 1991).

As mentioned before, competitiveness is a complex economic concept that includes many static and dynamic factors. Among them, product quality, its novelty, Intellectual Property (IP), knowledge-based and high-tech components of the products that embody the locally created differentiated capabilities are considered as exceptionally critical (Tidd, Pavitt and Bessant, 2005). The positive enhancement of these factors rests on innovation activities of the organizations and their effectiveness. Healthy competition between firms in free market stimulates innovation that causes improvement of the quality of products, reduction of costs and demand growth. Competitiveness ensues from innovation generated by the enterprise. Innovation not only instigates companies to compete for larger market shares, but it also fuels technological advancement and economic growth (Clark and Guy, 1998).

2.2.10. Market Share and Competitiveness

The ultimate objective of the competitiveness strategy of a company is to win market share and sustain it. From market augmentation strategy perspective, globalization and market diversification can bolster competitiveness (Brown, Green and Lauder, 2001). However, to be successful in their venture companies should improve their capabilities in learning, innovating and developing unique competencies that the new changing environment demands (Teece et al., 1997). Required skills include the ability to integrate new knowledge found in the new environment and translate it into opportunities (Argote and Ingram, 2000) and the strength to adapt to a new environment with sufficient degree of flexibility (Michie and Sheehan, 2005). Other capabilities involve the aptitude to innovate in a response to the new market demand (Narayanan, 2000) and the capacity to create an organizational culture conducive to fostering these competencies (Zwell, 2000).

Locally developed differentiating capabilities can assist a company to penetrate a new market, acquire meaningful market position and sustain growth (Trent and Monczka, 2002). Innovation and learning processes create these capabilities. Companies connected through a value chain should consider learning, exploiting success opportunities, enhancing skills and increasing their competitiveness together when trying to open a new market.

2.2.11. ICT and Competitiveness

ICT also plays a crucial role in developing competitiveness (Guerrieri and Meliciani, 2005) through innovation, improved productivity and process automation. One area, where ICT is making a profound impact is knowledge integration, access, creation, and distribution (Hendriks, 1999). Knowledge from disparate fields that were entirely separate a few years ago is converging in a phenomenal speed. This knowledge fusion (Kodama, 1992) is creating new areas, new products, and new markets. Moreover, the Internet has created a level-playing turf where cooperation between innovators from geographical disperse areas have become easy fostering the development of new knowledge, innovative ideas, and radical innovations. Technology such as knowledge management is pulling in workers from distinct organizational divisions to a single platform assisting cross-pollination of ideas (Rastogi, 2000). The knowledge that was in separate silos of a company thanks to KM getting integrated increasingly creating a holistic base for nurturing innovation (Swan et al., 1999).

2.2.12. Measurement of Competitiveness

Competitiveness has different meaning and understanding depending on which level the analysis is taking place. In this work, the unit of analysis is a firm. The firm-level analysis occurs in a very different context in comparison to industry and country levels. At country-level for example, the focus of competitiveness is on the prosperity of the nation (Reich, 2010). At the firm level, the concern is about the performance of the organization, its ability to produce a sustainable competitive advantage, the effectiveness of business processes, and the lasting effect of these factors on the firm (Ajitabh and Momaya, 2004). Having competitiveness for a company means to own a strong market position. Achieving it requires the company to offer products with substantial value to customers for a prolonged period. The value creation for customers ensures market share acquisition and augmentation, and higher profitability for a sustainable period (Porter, 1985).

Buckley, Pass, and Prescott (1988) developed a category of measurement from qualitative and quantitative perspectives. Many consider that the measure of a firm's competitiveness must include both quantitative such as costs, prices, and profitability and qualitative indicators such as quality and other non-price factors (Dwyer and Kim, 2003). Some performance indicators that are nonfinancial and used in measuring competitiveness include market share (Li, 2000), enhancement of market share (Tracey et al., 1999), sale performance (Anderson and Sohal, 1999), sales growth (Sharma and Fisher, 1997; Lau, 2002), productivity (Ross, 2002) and overall competitiveness (Anderson and Sohal, 1999; Lau, 2002). Competitiveness hinges on both price and non-price factors. Fagerberg's (1988) framework for international competitiveness includes various other indicators as well as price. While some scholars prefer a single factor of market share or profit as the criterion for determining the competitiveness of a firm (Tersine and Hummingbird, 1995) many consider that one indicator can produce a skewed result due to the temporal dependence of the indicators. Profit, for example, for one certain year won't demonstrate overall picture of the competitiveness of a company (Pettigrew and Whipp, 1991). Other scholars analyze both market share and profitability as key indicators for figuring out a firm's market position in comparison to rivals (Day and Wensley, 1988). However, addressing an issue as broad as competitiveness entails that the analysis is done from different perspectives using several indicators such as market share, customer satisfaction, and profitability for capturing a better understanding of a firm's competitive position (Bharadwaj et al. 1993; Morgan and Strong, 2003).

2.2.13. Conclusion

The technological growth, borderless marketplaces, ubiquitous access to knowledge have created an intense need for understanding, analyzing and evaluating competitiveness as a critical concept. This literature review while touched solely some central notions that act as a knowledge foundation for delving into the thesis topic, it still contextually analyzed various aspects of competitiveness that are important in getting a grasp of the concept.

In line with the theme of the thesis, here the focus was on the firm-level competitiveness. As the review revealed, the notion of competitiveness is yet to be defined in a coherent manner that would be acceptable to academics and practitioners alike (Mulatu, 2016). The inconsistency in the various definitions provided here manifests the problem.

The strategic approaches outlined here are not a widely-accepted model. While competitiveness is salient enough to be incorporated into any corporate strategy, there is hardly any model available that can make an integration of strategy to competitiveness smoother (Ambastha and Momaya, 2004).

2.3. INNOVATION

In today's globalized and dynamic marketplace, the need for innovation has drastically intensified (Harborne and Johne, 2003). From management to workers, culture to infrastructure and processes to products, innovation touches every corner of a firm's ecosystem. It enables refining processes, creating products and services and winning market segments. Its invaluable role effects on productivity and gaining a competitive edge (Crespi and Zuniga, 2012). Innovation is a vital growth factor thanks to its positive impact on firm's performance (Cottam et al., 2001). Because of its importance, interest in innovation, its processes and outcomes, its determinants and enablers and questions such as how to effectively manage it to extract maximum benefit are being studied thoroughly (see, for example, Dewar and Dutton, 1986; Zirger and Maidique, 1990; Hurley and Hult, 1998).

A core component of innovation is knowledge (Leonard-Barton, 1995). A prerequisite of Innovation is to have right knowledge at the right time. In present digital economy, which is very different from previous stages of economic development, acceleration of knowledge growth in every industry is very high. In this new environment overwhelmed with information deluge, many organizations struggle to discover needed knowledge, assimilate it to their knowledge base, and provide access to it so that knowledge can be applied in innovation initiatives immediately. Most businesses recognize the problem and believe it is necessary to strengthen their knowledge activities such as identifying, capturing and managing knowledge resource to achieve innovation success (McNaughton, 2002; Pyka, 2002; Adams and Lamont, 2003; Shani et al., 2003).

Technology plays an integral role in harnessing the power of knowledge and its incorporation to firm's innovation quest. Companies are increasingly adopting knowledge management systems or various modules of it for improving their knowledge related activities. Thus, the link between innovation, knowledge, and technology is quite evident (see, for example, Carneiro, 2000; Du Plessis, 2007; Lin, Che and Ting, 2012).

In this chapter, a literature review of innovation – a vital element of organizational survival – and its complex and intertwined relationship with knowledge and technology is presented.

2.3.1. Defining Innovation

Ever since Schumpeter (1934) introduced the concept of innovation as the catalyst of change in the economy, it has been widely studied in many disciplines. With the faster technological advancement and extreme competition, lately, it has evolved even more into a subject of intense interest for individuals, corporations, and governments. Because of the wide diversity of the group that is involved in the study of innovation the perception of what constitutes innovation also differs significantly. Innovation is associated with the introduction or a new combination of the essential factors of production into the production system (Chen et al., 2004). It encapsulates the technical, physical and knowledge-based activities that are central to the formation of product development routines (Cardinal et al., 2001). From the knowledge perspective, innovation is considered as the development of new knowledge or exploitation of existing knowledge dictated by market pull or technology push (Dougherty, 1992). It is also viewed as a knowledge process aimed at creating new knowledge geared towards the development of commercially viable solutions (Afuah, 1998). Extending the knowledge perspective of innovation but focusing on the market, Afuah (1998) concludes new knowledge manifested in the distribution process, advertisement, and product quality improvement in various dimensions thanks to customers input can be referred as market innovation. Gopalakrishnan and Damanpour

(1994) suggest that it is both a process of the creation and an introduction of a new idea, method, and device.

Over the years, innovation has been scrutinized through a myriad of theoretical perspectives in efforts to define, clarify and perceive it. It had been regarded as a serendipitous (Porter and Stern, 2001) as well as a rational and purposeful phenomenon (Nelson and Winter, 1982). It is a process wherein knowledge is captured, shared, and aggregated with the further objective of creating new knowledge, which gets embedded into products and services (Harkema, 2003). Stressing on change, Drucker (2014) asserted innovation is a change that builds a new performance dimension. On the other hand, claims have been made that defining innovation by change alone lessens the value of the concept making it narrower and it is necessary to differentiate innovation with the notion of organizational change very clearly (King and Anderson, 2002). However, there is no doubt that innovation entails change. Based on firm's goal, strategy, structure, resources, capabilities and intention firms select the type of innovation it wants to focus on (Ettlie and Reza, 1992) and change is an integral part of this quest.

Schumpeter (1934) introducing the concept of innovation weighted heavily on the novelty factor. He penned innovation is the debut of a new product, a new production method, a penetration into a new market, finding a new sourcing option and creating a new enterprise. Later the idea has been broadened and elaborated with the concept that it does not have to be an entirely new thing, it can be new to the unit which is implementing it (King and Anderson, 2002). It can even be an imitation if it is new to the adopting firm (Van de Ven, 1986). In many organizations, the relative newness of innovation in the processes and outcomes has overshadowed the notion of complete newness (West, 2002). Others have treated invention as the primary cause of innovation.

Invention while is not an innovation it is still an important factor behind many innovations (Amabile, 1983). Generating new and useful ideas in any field is an innovation (Amabile et al., 1966) however it must be actionable and successful in the market (Twiss, 1992, Amabile, 1998). Without distribution of the product or service and their adoption by users, economic value creation from it will not be possible. From this angle, innovation is also studied and distinguished as diffusion and adoption (Kimberly and Evanisko, 1981).

From competitiveness perspective, it is defined as a source of competitive advantage in shifting economic conditions, expanding the market, creating global rivalry and quickening technological obsolescence (Dess and Picken, 2000; Tushman and O'Reilly, 1996). It facilitates companies to gain and sustain competitiveness (Banbury and Mitchell, 1995; Bates and Flynn, 1995). Innovation is also a mode of creating value for customers (Slater, 1997) and shareholders (Kelm, Narayanan and Pinches, 1995). Some scholars believe that innovation can be perceived better by its following characteristics (King and West, 1987; West and Farr, 1990):

- Innovation is tangible. It can be an organizational product, process or procedure.

- An idea is a mere beginning of the innovation and cannot be an innovation by itself.

- Innovation ought to be new to the unit that introduces it. However, for the individual or group who is submitting it, innovation does not have to be necessarily new.

- Innovation should be premeditated and cannot be unintentional.

Some of these criteria, mentioned here, differ from the notion evinced by others. For example, is idea should be considered as innovation? Some scholars believe that it should be and define innovation as tangible items, idea, and practice which is considered as new by adopting unit (Zaltman, Duncan, and Holbek, 1973; Dewar and Dutton, 1986). Daft (1978) maintained that technical innovation is an idea for developing a new product, service or process.

While there are different understandings about how exactly innovation should be defined, in its saliency for organizational growth scholars are unanimous. Considering its importance for firms, some researchers prompted to declare that innovation is the lifeblood of a company's survival and expansion (Zahra and Covin, 1994).

The working definition of innovation for this thesis relies on Damanpour's (1991) original concept, "Innovation is a creation and implementation or adoption of a new or modified process, product, service, or strategy which produces social or economic value." In this work, the focus is on the firm-level innovation. Because of this, the words innovation and "organizational innovation" are used interchangeably here.

2.3.2. Innovation Spectrum

These definitions of innovation illustrate that there are two distinct standpoints of innovation: innovation being a process and innovation being an outcome (Van de Ven, 1986; West and Farr, 1990).

Innovation as a process is a process of generating new problem-solving ideas (Dosi, 1982; Kanter, 1984), a diversified learning process (Rosenberg, 1982), a process of interaction between stakeholders (Kline and Rosenberg, 1986), and a knowledge transformation process from tacit to explicit and vice versa (Patel and Pavitt, 1994). When innovation is perceived as a process, it facilitates observing, studying and analyzing the constituent parts of the innovation (Greve and Taylor, 2000).

Literature provides many innovation process models. For example, innovation process is regarded as a concatenation of three phases: emergence, growth, and maturity (Howard and Guile, 1992). A series of stages: invention, development, realization, and distribution (Maidique, 1980) and from application angle as development, design, and use (Niosi, 1999). A generic approach separates innovation process in three distinct steps: Idea generation, development, and commercialization (Kamal, 2006). From innovator's perspective on a need to create the process of innovation covers three phases which are generation, acceptance, and implementation (Aiken and Hage, 1971). Baregheh at al. (2009) offered more granular stages that include creation, generation, implementation, development, and adoption.

Innovation consists of a complex process and its outcome. According to Freeman (1982), innovation is a process which transmits and receives impulses, and connects new technical ideas to the markets. It is a learning process which brings into play knowledge, skills, competencies, know-how, capacities, and abilities (Beckman and Barry, 2007).

As a process, it starts with the generation of new ideas, continues with the development of the new product, process or service and completes with the phase of an implementation of the outcome. Innovation processes had also been described as discovery and creation (Dosi, 1988), production and emergence (Gupta et al., 2007), development, solving and implementation (Myers and Marquis, 1969) or introduction and application (West and Farr, 1990). Although the process seems linear, it is a phenomenon characterized by convergence and divergence from various departments, stakeholders, and management of an organization (e.g., Van der Van et al., 2007). At every step of this process, it engages foundational knowledge base, knowledge acquisition, and aggregation along with clear strategic vision (Xu et al., 2010).

The objective of the innovation outcome is to introduce new products or services to the market and make an economic gain. If the innovation's outcome is a new or improved process, the goal is to increase productivity or reduce cost by optimization of the business routines, processes, and procedures (Greve and Taylor, 2000). Whatever is the outcome of the innovation initiative, organizational learning and knowledge management act as valuable tools in the process (Crossan et al., 1999).

Increased complexity of the innovation and market demand for faster implementation force companies to seek knowledge from external sources by hiring new talents and through knowledge partnerships that include mergers and acquisitions, alliances and outsourcing (Powell et al., 1996). Better knowledge flow, knowledge sharing, and transfer within various departments of the organization and with numerous external agents create opportunities of new knowledge generation and recombination which is the precursor to innovation (Inkpen, 1996; Birkinshaw et al., 2008). Moreover, innovation is also a tool for entrepreneurs to create and exploit new opportunities that derive from market and technology knowledge combining with the entrepreneurial vision (Drucker, 2014).

2.3.3. Innovation Forms

Innovation is categorized under various forms. One typology includes seven forms, which are a product, process, organizational, management, production, commercial/marketing, and service innovation (Trott, 2005). However, it seems some of the aspects in this list are redundant and can be organized under one type. For example, production and marketing are both process innovation. Organizational and management could be either strategy or process innovation depending on the innovation context. Todd et al. (2005) offered a slightly different model that includes product, process, position, which is market focus shift and paradigm, which is firms' operational change. Again, both change of market focus and operational changes could be considered as business model innovations which can very well fall into the category of strategy innovation (Johnston and Bate, 2013). Four areas of the firm where innovation takes place. These are products, processes, services, and strategies. Forms of innovation can be designated along these spaces (Utterback and Abernathy, 1975; Nijssen et al., 2006; Pisano, 1997).

Product Innovation. Product innovation is the most likely form of innovation because of the clear visibility of the changes that are adopted. Especially, it is valid for the consumer products area. Product innovation covers the novelty of the product itself, improvement of its performance dimensions and its design and aesthetics.

The need for product innovation has lately intensified due to the following challenges that companies are facing: continuous pressure for cost reduction, shortening of the product lifecycle, increased competition, globalization of markets and supply chain, faster commoditization of products and increased product complexities (Brown, 2005). Success in developing new products entails in-depth knowledge of technology trends, market audience, a method of distribution and customers' applications (Urban and von Hippel, 1988).

New product development is directly responsible for the market success of firms in technology sectors (Maidique and Zirger, 1984). It is also recognized as an engine of company's renewal (Dougherty, 1992) and its market position (Floyd and Lane, 2000). As new product development modifies the resource configuration of the firm, it can be seen as a dynamic capability (Eisenhardt and Martin, 2000). Moreover, organizations often compete in the marketplace focusing on new product development (Brown and Eisenhardt, 1995). Firms need to remember that if the new product innovation originates from its core competence, the product has a better chance of gaining market success (Danneels, 2002).

Service innovation. While it is not always that evident, services are the major contributory portion of the economy in the developed world and a significant part in developing economies. Services are a set of knowledge, skills, capacities, and competence that are provided to a customer as solutions to problems in the form of processes, performances, and contracts (Gadrey et al., 1995; Vargo and Lusch, 2004). Innovations that bring novelty and refinement to these services are called service innovation. New business models, the proliferation of online services and diversifying relationship with customers are attributes that impact service innovation more than any other (Snyder et al., 2016). Although services comprise better part of the economy, studies aimed at service innovation, and its effects are still scant (Aas and Pedersen, 2010).

Process innovation. A series of activities or operations that transform an input to an outcome is called a process innovation. Process innovation is often referred to streamlining or improving a process to reduce costs (Bonanno and Haworth, 1998). An organization is full of processes such as product development to after-sales service and from performance management to resource allocation. Process innovation obligates to step back from the process itself and focus on the objective of the process (Davenport, 2013). Process innovation can be both incremental and revolutionary. It may involve from reducing steps, introducing new steps or even eliminating the process entirely, and reintroducing of a new process.

However, compared with product innovation it is still a less researched phenomenon (Clark and Stoddard, 1996; Reichstein and Salter, 2006). Both product and process innovation are attributed for bringing positive impact on the firm's performance (Prajogo and Ahmed, 2007). The economic and market impact of product innovation is visible as it causes revenue growth and profit generation and it also contributes to the market shift. A process innovation, on the other hand, does not have any direct impact on the market, unless it is a market-related process. Its contribution to the firm's performance exemplifies through improvements of various product dimensions, cost reduction, time-saving, and faster investment turnover (Baer and Frese, 2003; He and Wong, 2004; Edquist et al., 2001).

There are two types of process innovation: technological process innovation and organizational process innovation (Edquist et al., 2001). Process innovation is targeted to either cost reduction or refinement and improvement of processes such as a production process (Wheelwright and Clark, 1992). Process innovation often indicates an implementation of new technology such as capital machinery, processing machines, robotics, and ICT to improve a process or build capabilities and skills. New skills and capabilities are developed by learning to do things differently (Reichstein and Salter (2006).

The infusion of innovation within the production process is referred as technological process innovation which has three phases: discovery, development, and deployment (Hollen, Van Den Bosh and Volberda, 2013). At the discovery phase, new technology knowledge gets created from the combination of external knowledge with existing knowledge or when a new way of using existing technology knowledge is found. Development stage takes place when the discovered knowledge is utilized to build up scales for commercial production, and a trial is conducted. At the final phase of the deployment, the actual production using the new technological process gets initiated (Lee et al., 2008; Hollen, Van Den Bosh and Volberda, 2013). Organizational process innovation refers to the optimization, refinement and introduction of new ways of conducting corporate activities (Hervas-Oliver, Sempere-Ripoll and Boronat-Moll, 2014).

Strategy innovation. With the continuous transformation of the business environment, the need for strategy innovation becomes increasingly urgent for an enterprise.

Strategy innovation helps to identify new sources of opportunities. It aids new entrants to infiltrate the market despite resource constraint and for incumbents to stay competitive (Hamel, 1998). Strategy innovation is an expedient of new value creation for customers and opportunity exploitation for the organization. Business model innovation can be deemed as a type of strategy innovation (Teece, 2010). Two methods of creating strategy innovation are: applying existing strategies that work in other industries but still not adopted in the given industry and improving on the current strategy (Choi and Valikangas, 2001). The result of the adoption of a new strategy is the creation of a new future by deviating from the predictable path (Johnston and Bate, 2013).

Business model innovation is increasingly becoming a pressing issue in the era of rapid technological shift and globalization. In a 2006 study done by IBM, the majority the of the participants accentuated on the importance of business model innovation for their continuous growth. The study also found that more successful companies overwhelmingly implement business model innovation (Pohle and Chapman, 2006). Although, innovation in business models is gaining much attention lately, according to Chesbrough (2010) it's quite difficult to develop and implement due to various reasons. Among them, cultural change, structural and organizational process change, leadership and path dependence are some critical impediments. However, strategy innovation is deeply related to other forms of innovation. Firm's business model, for example, evolves and it embraces new strategic options thanks to the development of new products and services (Schoonhoven, Eisenhardt and Lyman, 1990).

2.3.4. Innovation Value Chain

While numerous models that divide the innovation process into various stages are available, as stated above, Hansen and Birkinshaw's (2007) proposed value chain framework with a slight modification covers from the beginning to the end of the entire sequence and expresses the steps precisely.

It includes weakly interconnected three different stages of the innovation process: Front-end innovation, Conversion, and Diffusion. Fuzzy Front-end or Front-end of innovation is the initial stage of the innovation process (Koen et al., 2001). It involves the step when a decision to take an innovation initiative is operationalized to the idea portfolio completion. This stage is engaged in opportunity identification, analysis, and selection (Khurana and Rosenthal, 1998).

Koen et al. (2001) to systematize the front-end process described five mutually interconnected steps involved in it. It includes 1) Opportunity identification, 2) Opportunity analysis, 3) Idea generation, 4) Idea selection 5) Concept and technology development. There are three ways to generate ideas in this framework. In-house – idea development within a unit, Cross-pollination – collaborative idea generation among multiple units and external – acquisition of ideas from external sources (Hansen and Birkinshaw, 2007). Once ideas are garnered, they must go through an extensive analysis. Especially, if the ideas are harvested by an idea generation system automatically from different sources including the Web, organizational knowledge repository, and through crowd-sourcing. Taking into the account the significance of this step a modified version will have following six elements: Opportunity Identification, Opportunity Analysis, Idea Generation, Idea Analysis, Idea Selection and Idea Portfolio Development.

Factors that are valuable at the idea generation level include identifying the domain of interest, problems of interest, adjacent areas of interest, sources of interest, idea capturing tools, a method of idea selection and the development of a portfolio of ideas and its management (e.g., Wooten and Ulrich, 2014). The quantity of the idea developed at the idea generation level makes a difference on the implementation of ideas. The more ideas are generated, the more chances of some of these ideas to come to fruition. However, quantity should not adulterate the quality threshold set for the submitting ideas (Clegg et al., 2002). Screening eliminates the ideas that have faint chances of success and might incur high costs (Desouza et al., 2009). The ideas that have been selected go through the refinement process to qualify for portfolio acceptance. The screening criteria should include the evaluation of ideas through the lens of both present business model and future possibilities.

When ideas are selected as concepts to work on, they end up in the innovation portfolio. Innovation Portfolio contains information such as the origin of an idea, an idea generation-related event, matured concepts that are accepted for R&D and their status. Innovation portfolio is the link between idea generation and product development. Innovation portfolio is very different than a project portfolio management (Mathews, 2010). Like project and investment portfolios, Innovation Management portfolio is also a tool for risk mitigation (Bard et al., 1999) but it is more necessary for bringing clarity in the process of perfecting concepts. Moreover, it is adaptive and exploratory in nature, unlike project management which is sequential and organized (Mathews, 2010).

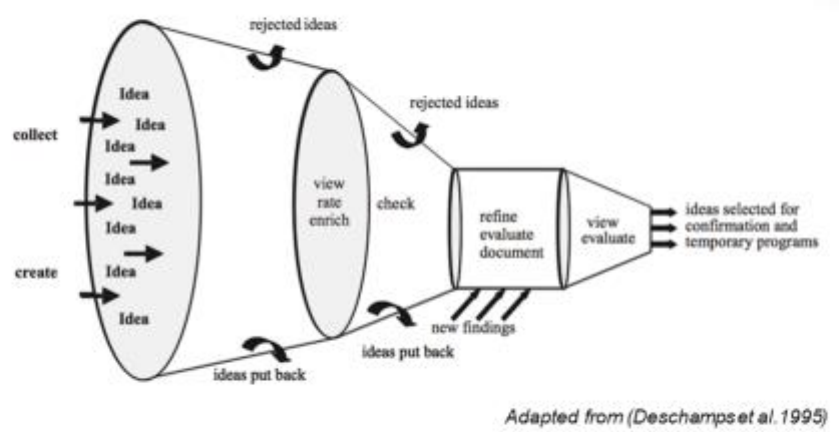


Figure 4: Idea funnel

Idea Management System (IMS) is used for product, process and service innovation widely (Warner, 2002; Das and Puri, 2003), figure 4. Recently, collaborative idea development has become popular, and many enterprises are using it quite successfully (Brugger, 2010; Raffel, 2010; Jager and Jager, 2011). The IMS's growing popularity is propped by its handling capacity of an essential element of the innovation process (Fenn and LeHong, 2011). IMS works better if the domain is narrow and the idea submission request is precise (Imaginatik, 2009).

Once a concept is identified as a viable innovation project, the conversion stage starts. The conversion stage in a new product development includes linear, iterative and simultaneous steps of the design of the product, the creation of the product, prototype making, and commercial production (Adams et al., 2006). Takeuchi and Nonaka (1995) propose that R&D and production divisions should work closely and share knowledge from the initiation of an innovation project. That way, it will speed up the entire innovation process. Innovation projects are risky, the ideas that fuel them are often opaque in the beginning, and figuring out what might be the real outcome is difficult. The use of Knowledge Management tools is imperative if the firm wants to lessen the uncertainty surrounding an innovation project (Plessis, 2007).

A company's R&D strategy gets defined by its corporate goals. The approach to R&D differs significantly depending on whether the organization emphasizes on increasing market share, opening new markets, compete with a rival on a product level or creating a disruptive new product (Lowe, 1995). A firm's innovation capital forms from its capability of developing creative ideas, R&D competence, producing new technology, products, and services that satisfy a market need (Chen, Zhu, and Yuan Xie, 2004).

Knowledge is the main force behind any R&D achievement. R&D capabilities evolve along with the access to new knowledge, combination and recombination of new knowledge with the prior knowledge base. A presence of "strong knowledge" (Nelson, 1982) propels the technological advancement faster. Lack of capabilities bolstered by knowledge will forestall any possible innovation success even if a high market demand exists. The efforts will be futile without knowledge (Mowery and Rosenberg, 1979). Nelson (1982) compares R&D activities with a search. According to him, strong knowledge and the connection with externalities are necessary attributes for having a better ability to perform R&D search. Stronger knowledge not only works as an enabler for better R&D outcome, but it also reduces the cost of any R&D product (Nelson, 1982). R&D intensity of the firm shows its technological opportunity capturing capabilities and readiness of withstanding external threats (Philips, 1966).

The purpose of the diffusion phase is to gain economic value from the innovation (Kanter, 1988; Strebel, 1987). It is a well-recognized stage of the innovation process. A firm is a profit-making entity; it's every innovation endeavor must be commercialized. Diffusion of innovation is the commercialization of products or services by making a connection with the prospective audience through various conduits. There are five groups within the target audience. These are innovators, early adopters, early majority, late majority, and laggards. Much of the diffusion success depend on how innovators and early adopters are communicated, figure 5 (Rogers, 2010; Tarde, 1903).

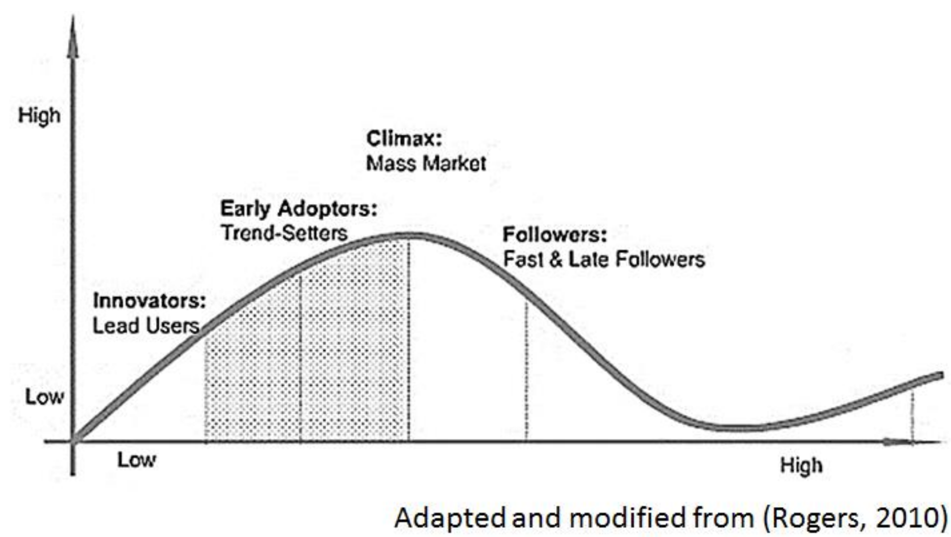


Figure 5: Innovation impact over time

The diffusion curve demonstrates the progressing acceptance of an innovative product or service. First, the acceptance moderately grows till it reaches a tipping point. Once it crosses the point, the growth rate rises at a quicker pace. After touching its height, the acceptance level finally starts to taper off (Abrahamsson, 1991). Developing competitiveness from innovation does not occur just from the new product or service. No doubt, ideation, R&D and new product development are critical stages, but the most important stage is still commercialization of the product. Innovation brings real value to the firm only when it uses the innovation to improve productivity or earn revenues.

Every proactive company should consider deploying advanced technology based innovation management system in today's competitive market so that it can manage and harness the innovation process, its domain knowledge complexity, information load, heterogeneity of information format and disperse location of required information.

2.3.4. Strategic Options of Innovation

Innovation strategy is an integral part of organization's business strategy (Hamel, 2000). Innovation strategy sets the goals and objectives of innovation, facilitates creating a plan of action to achieve those goals, and developing innovation competencies (Hurley and Hult, 1998).

An organization is a system with its various components and subsystems. For the firm to function, all the parts need to work according to their expected roles. For optimal outcome, not just these components need to perform seamlessly but also must work in congruence with other segments symbiotically. The higher this congruency between various components the better the efficiency and effectiveness of the organization as a cohesive system (Tushman, Anderson, and Reilly 1997).

Innovation as an organizational subsystem is composed of various components of its own. Often in firms, the R&D department doesn't have any direct relationship with departments such as shipment and delivery unless they specifically work on a same project. As company resources and capabilities are limited innovation strategy obliges that these resources are used productively (Grant, 1991). Unfortunately, finding a traction in different divisions are often difficult due to organization's deeply rooted culture, individual idiosyncrasies and lack of knowledge of possible common areas of interest. The innovation strategy should bring far-flanged sections of the company on a common platform, develop needed innovation capability and execute a well thought-out tactical plan to achieve a fruitful result from the cross-pollination of ideas and resources. After all, firms do know that effective implementation of innovation strategy facilitates performance improvement and allow curving out a bigger market share (Han et al., 1998).

Innovation strategy is a set of policies, decisions and action plan that indicate how the firm is planning to reach its innovation goals using available resources and capabilities. Steps need to determine an innovation strategy includes analyzing competitive landscape, set strategic objectives, formulate a strategic plan, implementation of the plan, assess progress and overall control (Grant, 2016). There are various internal and external factors of the organization that has impact on the innovation capabilities of the company (Bate and Robert, 2003). Strategies help to sort out what should be the firm's action, policies and mechanism of interaction with these factors (Grant, 1991). In a large company with multiple divisions, the strategy choice, their mix and evolutionary path of strategy practice and knowledge growth may vary division to division (Perrow, 1986; Scheepers et al.,2004).

Exploitation and Exploration. An organization performs two sets of activities: exploration and exploitation to achieve its innovation objectives (March, 1991). The strategy choice of these activities, which one should be the primary focus and which one secondary, and the engagement ratio between them concern all firms. Exploration is associated with environmental scanning in search of new knowledge, technology, market demand, relationships and ideas for enhancing company's innovation capabilities and resources. Exploration strategy often takes longer to produce beneficial outcomes (Benner and Tushman, 2003).

Exploitation, on the other hand, is identified with the activities related to the refinement of existing knowledge and capabilities. With better visibility, this strategy is characterized by a greater certainty, clear control and limited change resulting in more immediate benefits (Amason, Shrader and Tompson, 2006). Firms need to engage in both exploitation, to create value from existing resources and exploration, to stay competitive and connected with the external environment (March, 1991). As a firm's resources and capabilities are limited, it must act judiciously and make a concerted effort to come to the right choice and appropriate strategy balance to maximize benefits from innovation which is a challenging task to do for many reasons. Since exploitation is clearer and produces more immediate results, firms incline to emphasize more on this strategy. Businesses develop routines, processes, and procedures from the long-term and continuous engagement in exploitation. These structural factors are hard to change and refocusing on exploration, even when the firm understands that a strategy change is crucial for the survival of the enterprise, is tough. Companies must remember without exploration in time of radical market shift, they are susceptible to failure (O'Reilly and Tushman, 2013).

March (1991) also noted that because of their raison d'être, features, and modus operandi are different there is a special conflicting concomitant tension present between them. Moreover, there also exist recursive and co-evolutionary link (Subramaniam and Youndt, 2005). Hence, various balancing acts are necessary for gaining value from these strategies. That's why March (1991) suggested that firms need to build both capabilities as its long-term innovation strategy putting concurrent stress on both exploration and exploitation.

Innovation is uncertain, complex and chaotic (Reinganum, 1983; Kline and Rosenberg, 1986). It also needs an intricate network of a vast number of stakeholders. Some are directly involved in the process of innovation and others have infrequent input in it. The innovation ecosystem consists of a diverse array of interconnected organizational features and functions covering its structure, management, culture, routines, processes, procedures, and planning. Moreover, the selection of the domain of the innovation, the types of opportunities the firm decides to focus on, the ideas that might graduate to the concept level, and the resources required for the entire innovation process are complex questions. We can add to that other matters such as how the development of prototypes and production will take place and how the company plans to commercialize the innovations. These are complex questions that demand quick, optimal and consistent answers. Without a holistic, systematic and implementable innovation strategy in the evolving marketplace with changing customer preferences, continuous advent of new technologies and emergence of new rivals, it would be hard for a firm to gain and retain competitive advantage (Lengnick-Hall, 1992).

Huge growth of knowledge in any domain in present-day makes constant augmentation of organizational knowledge necessary for it to stay innovative (Boekema et al.,2000). The size of a company does not matter; even the large corporations are bound to rely on external knowledge to satisfy their innovation need. Although it is proven that more distant knowledge can produce better innovation, most firms tend to focus on their subject field and market scope (Miller, Fern and Cardinal, 2007). Enterprises need to emphasize the importance of knowledge aggregation from exogenous sources in their innovation strategy and focus more on exploration to change this behavior (Kabir, 2016).

2.3.5. Determinants of Innovation

Damanpour (1991) identified some factors that influence on organizational innovation capabilities. These include specialization, functional differentiation, professionalism, managerial attitude toward change, managerial tenure and technical knowledge resources, administrative intensity, slack resources, external communications, internal communications, and vertical differentiation. According to Dewar and Dutton (1986) distribution of knowledge, its extent, heterogeneity and access to an extensive level of knowledge from external sources are factors of innovation success. Having in-depth knowledge of the subject matter internally within the organization and an access to a vast amount of new knowledge are preeminent requisite for radical innovation to take place. However, for incremental innovation, knowledge depth is not a crucial determinant, but access to external knowledge is still essential. One set of success and failure determinants of innovation listed by Mayers and Marquis (1969) includes an in-depth knowledge of user needs, superior marketing capabilities, efficient product development capabilities, assimilation and use of external knowledge with internal knowledge and management leadership.

Knowledge is a significant determinant of innovation. Firms accumulate technical, market and organizational process knowledge and utilize it as a strategic resource which combined with human creativity and technological readiness craft the foundation of innovation proliferation (Nonaka and Takeuchi, 1995). Sources of innovation span cross-pollination of knowledge from disparate disciplines, new connections and networks made, knowledge absorbed from socialization and recombination of existing knowledge with knowledge gained from external sources (Hippel, 2007).

2.3.6. Types of Innovation

As an integral part of firm's strategic innovation choice, what kind of innovation is its core focus, what resources would be allocated to it and how the innovation competence would be developed emerges from the precise understanding of various types of innovation and their characteristics (Ettlie et al., 1984). Factors that contribute to the innovation success varies depending on the kind of innovation implemented. Because of this, it is impossible to examine innovation as one single unit (Damanpour and Evan, 1984).

Categorization in any domain facilitates reducing complexity and understanding phenomena better. It also enables clarifying the comprising entities of a subject and relationship between them sufficiently and systematizes the differentiating factors (Rosch, 2005). The ability to separate a domain object from another allows grasping if any action is needed, what kind of action required. What inputs are necessary for performing the actions. And How we need to carry out this work.

In innovation field, each type of innovation has a different impact on the organization, its structure, its strategy, its potential, and performance. Because of this, innovation has been routinely analyzed and differentiated based on various categories. Depending on the focus area within organizational system, the intensity of innovation efforts, its granularity, and collaborative level, innovation is typified as radical and incremental (Freeman, 1974, Dewar and Dutton, 1986; Nord and Tucker, 1987), continuous and discontinuous (Tushman and Anderson, 1986), sustaining and disruptive (Christensen, 1997), open and closed (Chesbrough, 2003), administrative and technical or technological (Daft, 1978; Kimberly and Evanisko, 1981; Damanpour, 1987) and modular or architectural (Henderson and Clark, 1990).

2.3.6.1.Open Innovation

In present environment where specialization has granulated to the extent that often the practitioners lack time to make themselves familiar with new knowledge created even in adjacent to their disciplines, collaboration is the way to go in innovation. Moreover, diversity has proven to be a prerequisite for many types of innovation. Collaboration with external partners help improving business performance, sustain revenue growth and streamline and speed up innovation processes (Chesbrough, 2003). Chesbrough (2003) defines open innovation as, "A paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market as the firms look to advance their technology."

Adoption of open innovation practices and policies facilitates expediting R&D processes by bringing outside-of-the-box ideas and diversity resulting lower expenditure, better design and higher outcome (Chesbrough, 2003; Laursen and Salter, 2006; Lichtenthaler, 2009).

In the closed innovation model, the entire process from ideation to development to implementation takes place within the perimeter of the company. Even the knowledge resource is mostly developed internally and relies heavily on the business talents. It used to be the dominant model of innovation in the last century (Chesbrough and Vanhaverbeke, 2011).

With better communication thanks to the Internet and ICT, information flow within the organization and outside of it became more fluid, which turned out to be one of the main reasons for the sudden surge in the popularity of the open innovation concept. The notion of open innovation comprises of various preexisting management theories and suits well for present networked and collaborative innovation context (Huizingh, 2011). Within open innovation, there are two distinct types present. When knowledge from external sources is used internally to develop innovation this kind of innovation is called inbound, and when knowledge generated by the firm is exported and applied by another company in its innovation initiative, it is outbound (Chesbrough, 2003).

Presently, crowdsourcing, award-based open challenges, and collaboration through the global community of practices made developing products, generating ideas and tapping into talents a norm for many innovative firms. At the same time, companies found a new way to commercialize their under-utilized IP through licenses and joint ventures. But the very process of implementing open innovation also requires some much-needed homework for firms to do. Among them, adoption of new business models, development of needed capabilities, allocation of substantial resources, the creation of strategical and tactical plans that will support knowledge acquisition and integration from external sources seem to be crucial (Chesbrough, 2006, Lichtenthaler and Lichtenthaler, 2009). The idea behind the open innovation model is to adopt a strategy to make a concerted effort in finding and leveraging external knowledge sources and partners to bolster internal growth. Typically, from ideation to commercialization any stage can profit from external collaboration and communication.

At the front-end of innovation openness to new ideas is a required attribute. Innovation is a recombination of internal and external information, technology, know-how, skills, perspectives, understanding, and motivations. The broader the exposure to new knowledge the better the chance of occurring a new combination. That is why companies with open culture are more prone to be innovative.

Seventy-five percent of CEOs from various industries concede that external collaboration is vital to their innovation endeavors (Rowell, 2006) It shows a fundamental shift is taking place in the present economy where firms started to realize that incorporating open, networked and collaborative innovation models makes good business sense (Tapscott and Williams, 2006).

Closed innovation, according to the definition of Chesbrough (2003), is when a firm executes the entire innovation value chain of ideation, development, and commercialization including financing, marketing, servicing and supporting on its own. However, there is hardly any firm in the present day that can perform all the necessary activities required for innovation or carry all of them out on their own (Huizingh, 2011).

Open innovation starts with applying at the beginning addition of an extra layer on the existing innovation processes and practices (Chesbrough and Crowther, 2006). The integration of the concept of open innovation hence takes place gradually.

2.3.6.2.Stage-Gate Method

Many firms today use Stage-Gate methods and techniques to streamline their innovation processes and reduce chaotic vicissitude that often follows a new product development (NPD) process. Stage-Gate contributes to the substantial reduction of a project's lifespan and improves various steps of the innovation process. It is a combination of both conceptual and operational methods of initiating ideas and bringing it out to the market. The system comprising a series of cross-functional stages is based on the best practices culled from successful companies' NPD processes. It's an effective method of diminishing uncertainties and mitigating risks (Cooper, 1993).

An organization's resources and capabilities are limited. To satisfy its knowledge requirement, it still must spend resources on the discovery, assimilation, and storage of knowledge from external sources and development internally. Stage-Gate adopts strategies and structures to reduce uncertainty, mitigate risk and optimize resource use (Daft and Lengel, 1984). If deployed diligently, the Stage-Gate is proven to be a powerful method which can accelerate and invigorate a company's innovation endeavors (Grönlund, Sjödin and Frishammar, 2010).

2.3.7. Management of Innovation

Innovation is chaotic and full of uncertainty (Mansfield and Wegner, 1975), it is a search for unknown based on limited known variables (Teece, 1996). The uncertainty emanates from unpredictable changes due to natural causes, lack of communication between stakeholders and effects of the environmental components.

In these conditions, there is no guarantee of success in it. Most innovation endeavors fail (Ram, 1989). Because of this, it is imperative to manage innovation activities skillfully and improve the success ratio (Tidd, Bessant and Pavitt, 2005). Multiple factors have influence on the process of managing innovation projects a firm. Damanpour (1991) listed four factors, which are innovation type, innovation stage, innovation scope and organizational type. Tidd et al. (2005), however, contended that industry dynamics and the organizational context are important aspects that deserve attention as well.

Critical success factors for innovation encompass four areas: firm related, product related, project related and market-related factors (Van der Panne, Van Beers and Kleinknecht, 2003). The hindering factors that drastically reduce the chance of innovation to take place include lack of trust in innovation (Amabile, 1996), lack of skilled workers, both success and failure fear (Alencar and Bruno-Faria, 1997; Van de Ven et al., 1999), individual resistance and sabotage (Alencar and Bruno-Faria, 1997; Hadjimanolis, 2003) and lack of resources (Levine, 1980). Other failure factors include the fear of new thinking, lack of tolerance for radical ideas, short-term focus, innovation for the sake of innovation, and organizational politics (Cozijnsen, Vrakking and van IJzerloo, 2000; Van der Panne, Van Beers and Kleinknecht, 2003; Maidique and Zirger, 1984).

For innovation to succeed, firms ought to implement proper organizational routines, processes, and system and scan the environment continuously for possible factors that might impact on the innovation negatively (Tidd, Bessant and Pavitt, 2005).

2.3.8. Human Factors in Innovation

Factors like technology, tools, and R&D profoundly influence on the innovation success (Leblanc et al., 1997). However, human factors such as employee knowledge, teamwork, cross-pollination, corporate culture, leadership all are also important determinants of successful innovation (Zien and Buckler, 1997). Creating a culture supportive of innovation, having the right employees, good team spirit, motivated workers and other human-related factors comprise the required ingredients for successful innovation context within an organization (Dougherty, 1992). Top management's support and leadership are considered as two of the key success factors for innovation (Smith and Tushman, 2005). Innovation processes are complex, often fuzzy, erratic and unpredictable. Such environment requires extraordinary resources, system, relationship, flexibility and responsibility necessitating decisive leadership for promoting fertile innovation context. Apart from the ability to use technology for knowledge exploration, an innovative company also must have champions – boundary spanners, those who are consistently seeking knowledge outside of their domain and beyond their usual knowledge need (Davenport, Prusak and Wilson, 2003). Knowledge workers within the process of extracting, gathering, creating, sharing, using, do devise ideas often as a collaborative effort that works as a precursor to firm's innovation (Amar, 2002).

As far as the role of people in the innovation success is concerned studies have identified the requirement of an innovation champion, a boundary spanner – a key person who pushes the innovation cause (Chakrabarti, 1974). When the structure of the organization is informal and less bureaucratic, employees are more innovative which results in better innovation success (Shepherd, 1967; Sapolsky, 1967 and Becker and Whisler, 1967).

A healthy innovative corporate culture calls for the introduction of several HR related practices. They include empowerment and involvement. Innovation is a risky business. Most innovations don't graduate to the diffusion level. If people do not have some degree of autonomy in their experiments, if they are not a part of the key innovation-related decisions, they won't be able to work with full motivation (Amabile and Grykiewicz, 1989; Barney and Griffin, 1992).

2.3.9. Technology and Innovation

Knowledge, technology, and people are the essential components of innovation. Innovation hardly can be imagined without technology input. In Technology-push based innovation obviously, technology is the primary subject of innovation but even in market-pull technology plays a substantial role (Roberts, 1988).

Technology can be a production input, production tool, the innovation itself and an enabler of innovation. In any advanced technology-based innovation, the core components are also technology centered. For example, the modern knowledge management system is built using various information technology-based modules and programs. These modules are also developed grounded on other technology and knowledge components.

In many types of process innovation, technology facilitates improving and streamlining the processes that result in productivity enhancement. Industrial progress is characterized by new technology implementation in the different spheres of the economy including factory production processes. Schmookler (1966) noted that both product technology and production technologies are vital for understanding innovation from an economic growth perspective.

Increasing automation and introduction of robotics are innovations that are bringing productivity improvement by lowering production cycle, optimizing material use, reducing human intervention and manufacturing superior new products (Hirukawa, 2015, June). In innovation management, from idea generation to prototype building, and product development to commercialization at every level, various systems and tools based on advanced technologies are increasingly getting used for faster, better and cheaper outcome of innovation.

For example, many idea generation tools from knowledge management system perspective are now employed in the innovation processes (Cebon and Newton, 1999). Idea management in a sense is an effort to systemize and supply a structural framework to the idea sourcing, generating, collecting and assessing the process. It also includes various tools for ideas or suggestions harvesting, assessing ideas and selecting ideas. The goal of this management instrument is to develop and introduce ideas for solving one or multiple problems. The management of ideation process should be considered as a highly valuable system within the innovation value chain management because of its profound impact on the development and diffusion of innovation.

Innovation management systems also cover each of the stages from idea portfolio to dissemination of the product. There're numerous tools and programs to support even most subtle, implicit and complex processes of innovation that include, for example, the entire chain of R&D.

Technology tends to evolve based on path dependency (Arthur, 1989) which means not necessarily the best technology will become the dominant preference. An inferior technology with faster diffusion has a better chance of becoming the dominant design. When a specific technology becomes the dominant design (Utterback and Abernathy, 1975), it starts to get additional momentum (Hughes, 1987) raising its chance for even further growth. Technology also has ripple effects. A radical innovation in one area facilitates emerging new products and services in the adjacent areas as well.

Technology as an innovative product is one of the main propellers of economic growth in a knowledge economy (Machlup, 1962). There are more disruptive and radical innovations taking place with advances in the technology and almost in every industry. These innovations are instrumental to the growth of knowledge economy and transfer of industrial economies to the knowledge economy. They are also bringing dramatic changes into our everyday life.

Schumpeter (1942) argued that innovation stemmed from recombination creates a new array of opportunities and sets a foundation for further sprawling of the new combination and technological advancement. This continuous process enhances the economy, shifts markets and in its turn open more new possibilities, technology change, and innovation capabilities. We are observing this spiral effect of technology innovation at an unprecedented scale in today's economy and society.

Firms often are not ready to embrace new technologies at an early stage for fear of not knowing how sustainable the technology would be. Conversely, they also understand that failure to integrate advanced technologies might result in the loss of their competitiveness. Innovation is one area where technology plays a key role. The dichotomy of technology acceptance that worries firms can be addressed by developing better absorptive capacity, continuous environmental scanning for relevant knowledge, strategic clarity, technology readiness, and visionary leadership.

2.3.10. Conclusion

Innovation has become more complicated due to changing customer needs, enormous competitive pressures and rapid technological changes (Cavusgil et al., 2003). Globalization and advances in technologies have made innovation a key component of firm's survival. Innovation is a tool that helps companies to exploit opportunities that market and technology changes and environmental tensions produce.

In the present economy, no firm can afford to stay in a comfort zone. A business with rigid structures and bureaucratic approach to innovation are vulnerable to unpredicted market shift which may even cause its demise. Because of this, firms should strive to become innovative. Innovative companies are agile; their goals are aligned with future market expectations and technological advancement. Transforming a company's business strategy, deep-rooted culture, innovation approach and managerial functions and making them to a contemporary technologies, methods and innovation strategy that will propel the company to more competitive level is a painstaking and complex task. However, among other things, knowledge assimilation and utilization and use of advanced technology in the management of the innovation life cycle are crucial for firms and can help the business to become and stay innovative. Corporations pushing for innovation success must figure out what knowledge they require, how to discover, acquire, manage and use it effectively (Adams and Lamont, 2003, Cardinal et al., 2001 and McNaughton, 2002; Pyka 2002, Shani et al., 2003). Moreover, the innovation activities also generate new knowledge. The entire innovation ecosystem morphs and reinvents itself continuously if its knowledge base keeps on growing, its absorptive capacity deepens and assimilation of knowledge from external source percolates and diffuses across the ecosystem building new capabilities. These skills can influence on firm's innovation efforts and create the foundation for innovation-led competitiveness.

In this section, a literature review of innovation, its relationship with knowledge and technology are delineated. Innovation is a vast and complex subject. While efforts have been made to cover most important issues of innovation pertaining this thesis, from a larger context of innovation, it just scratches the surface of this discipline which is immensely valuable for any organization's success.

2.4. SEMANTIC TECHNOLOGY

Semantics is the branch of linguistics and AI that studies the relationships between linguistics symbols such as words, phrases and sentences and their meanings (Shtern, 1976). In AI and semantic technology, the broader question about semantics is how a formal representation model can capture, maintain and deliver knowledge so that machines can always interpret it correctly, autonomously, and operate on it to make intelligent decisions. This general objective introduces such questions as what tools, apps, services, and frameworks are required to sustain such model? In this section, a review of the state-of-the-art of some of the most critical concepts, tools, and techniques involved in the building of a semantic knowledge management system is presented.

In recent years, there has been a tremendous proliferation of inventions that are changing the shape of the technological landscape. Some of these advances in technology is not as visible as mobile devices or cloud systems but still exerting a profound influence on many spheres of the organizational realm.

Since the introduction of the Internet and with the explosion of new knowledge, massive technology revolution has been taking place in every area of the economy. For companies, in this economy of the digital age, new technologies generate opportunities that help to gain competitive advantage. Mere adoption of a new technology because of rapid technological change is not enough to become competitive, important is to learn and apply how to achieve better productivity and innovation, find better solutions to existing problems and improve decision-making process through the practical use of the technology.

Companies are still learning how to become a knowledge-driven one. The sudden flare-up of big data has just exacerbated the situation. KMS are implementing new analytical tools to extract knowledge from the continuous inflow of massive amount of data and use it in the decision-making process at all levels of the company where it can bring a positive outcome. Without embracing the advanced technologies such as semantic technology which enables knowledge to be globally accessible and handling knowledge processes smoother, this will become a daunting task (see, Davies, Fensel and Van Harmelen, 2003).

As machines and users produce a massive amount of data, finding the needed contextual information within the heterogeneous and unstructured content is becoming downright impossible using the present composition of content production, dissemination and display through the Internet. Semantic technology brings structure and meaning to data that mitigates the problem of this information overload to a substantial extent (Berners-Lee, Hendler, and Lassila, 2001).

Companies that are knowledge-driven and open to experiment with new tools and technologies are more capable of identifying and exploiting market and technology disruption and achieve competitiveness (Leonard-Barton, 1995). ST and AI-based tools and programs help to do things differently making the process of recognition and implementation of directional and strategic changes easier.

2.4.1. Introduction

Companies are facing unprecedented upheaval in the way workers produce, consume, use, maintain and share knowledge. This deep change is taking place because of the enormous amount of information that is getting generated by company workers, software applications, automated processes and the smart products. Most this information flows through interconnected and Web-based systems. The external sources such as books, periodicals, journals, blogs, reports, white papers, articles, etc. those which are routinely getting published on the Internet are also an invaluable resource of knowledge. The efficient and effective use of the inflow of this colossal amount of information will be crucial for companies to stay competitive (Boisot, 1998). Organizations will need to reevaluate their business strategies, redesign their knowledge activities, train their knowledge workers accordingly and go beyond traditional knowledge management systems if they want to exploit these opportunities.

Very few companies today are taking advantage of the valuable information that is emerging continuously on the Internet (Choo, 2002). Discovering necessary knowledge from the ocean of information on the vast array of the Internet's sprawl relying on individual worker's efforts is not a great strategy for a company because by doing so it risks losing huge potential opportunities.

Seamless aggregation of worthy and valuable information for the organization to the company knowledge repositories and linking them to critical concepts and documents with proper accessibility are vital for exploiting knowledge located outside of the firm.

Traditionally, companies expect workers to find from external sources the relevant and missing information that they require for their jobs at hand. This approach, while worked before, in the highly competitive and technology-saturated landscape, where success might hinge on crucial knowledge at the right time, does not fit any longer. Companies need to step up and find a better way of tapping into the new and enormous amount of knowledge located outside of the organization and more so for the one residing in the other departments and branches of the firm. Moreover, A critical problem that the companies face due to constant attrition and retirement of workers is that time and time again they are forced to reinvent the wheels (Ghahfarokhi and Zakaria, 2009). A holistic repository of a comprehensive network of knowledge as envisioned in Semantic KMS eliminates this issue once for all resulting in a significant gain in productivity (see, Ferraram, Nikolov, and Scharffe, 2013).

Access to full range of information relevant to any problem contributes to better decision-making. At present many companies are not utilizing the extensive additional knowledge that is readily available but located outside of the manager's current reach and as a result, some critical opportunities are getting overlooked.

In the pre-computer era, in the organizational context, the knowledge that resides in employees' mind, documents, journals, books, and other printed materials were the primary source of knowledge where paper documents were one of the most important information media. Once created, documents were filed together, categorized and stored in archives for future reference.

Hence, libraries and archives used to be the primary repositories of knowledge. The loss of knowledge due to lost documents, improper filing, attrition and retirement of workers was acknowledged as unavoidable reality.

Things started to improve substantially with the introduction of computers. Storage capacities allowed data and information to be stored in databases and network system facilitated access to stored documents at the organizational level. As a result, creation, use, and sharing of information and documents have improved, and their lifecycle increased substantially, albeit at rather localized level. Finding the right document was still a tedious task as documents were often categorized inconsistently and search methods were rudimentary.

The Internet has changed that dramatically. From the early 90's thanks to the emergence of the Web, a sudden explosion of data, information, and content started to take place. The advancement in ICT, progress in the Internet backbone infrastructure, and cheaper access to the computer devices enhanced personal reach to the information flow at the global level. Organizations of all types commenced to produce a massive amount of information and share the information to a larger audience which was not possible before. Thanks to the simple hyperlinks, documents and their references got linked now, and Web-based search engines enabled to discover those documents quickly.

Meanwhile, the information explosion continued in ever-increasing speed. The problem is no longer of having not enough information, but how to precisely discover and identify the right information that is required at the right time. As Lewis (1996) lamented long before the present super deluge of data, information quantity is growing at an exponential rate, but the ability to process and extract required knowledge from it is not growing as fast. Semantic Web or Web 3.0

is envisioned as the solution to the problems of the data deluge, finding knowledge by using natural language queries and having interconnected links of data seamlessly with the help of ontology and graphs (Berners-Lee, Hendler, and Lassila, 2001).

2.4.2. Semantic Technology

Semantic Technology (ST) - a loosely connected diverse group of tools, techniques, methods, and algorithms which are used for adhering meanings to data and extracting semantics embedded in data (see, Fürber, 2016). Data in this context can be anything ranging from signals to documents and from texts to images and videos. The underlying idea is to enrich data making them meaningful for humans at the same time interpretable by machines with the help of supportive tools.

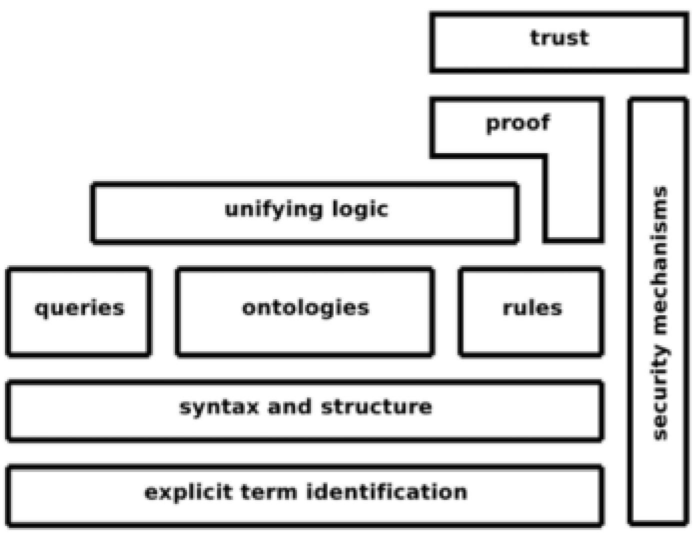
Some of these technologies are available ever since efforts to create artificial intelligence programs have started and include machine learning and data mining, expert systems, categorization and tagging, semantic search and query. The present domain of ST includes Semantic Web technology, which is a foundational tool in ST projects.

Many of the relevant problems of information organization, archiving, displaying and finding can be addressed with the help of semantic technology. ST provides the necessary tools, concepts, and methods for sharing and reusing content across the Internet. These technologies facilitate finding, interacting and decision-making by the web agents – software programs – based on rules, logic and an inference mechanism about the information with sufficient given context. Context is provided in various formats and describes annotation properties and other attributes of the information (see, Meroño-Peñuela et al., 2014; Toma, 2014, May; Toma, Simperl, and Hench, 2009, June).

2.4.3. Semantic Web Technologies

The Semantic Web is a structural model and an extension of the existing Web that provides semantic annotations to content making discovering, processing and aggregating information by software tools easier and efficient (Barners-Lee et al., 1999, 2001).

The idea of the Semantic Web derived from several real-life problems. They include a better way of simplification and clarification of surrounding realities with abstract expressions, ability to capture and share knowledge anytime and to empower machines with reasoning ability using accessible knowledge (Hitzler et al., 2010), figure 6.



Adapted from (Passin, 2004, pp. 141-169)

Figure 6: Semantic web Layer Cake

Semantic technology along with Semantic Web uses some of the notions and applications, i.e., intelligent agents, ontologies, which have originated from Artificial Intelligence. The concept of Semantic Web characterizes a method where data adhere meanings representation thanks to ontology and other aspects of Semantic Web, which allow machines to tackle well-defined problems without any human intervention. The positive thing about the Semantic Web is that it is an extension of the existing Web. Although an entire business ecosystem can be built based on Semantic Web, it can easily be integrated with the existent Web and Web-based systems (Gábor and Szabó, 2013). This interoperability of Semantic Web is another reason why Semantic Web is an ideal tool for the development of many critical business applications and systems including knowledge management systems (Adrian et al., 2012).

Any entity on the Web embodies the potential problem of the word sense disambiguation. Most entities on the Web mean different things based on the context and user perspective. Humans recognize and understand the meaning of entity hinging on its context, a priori knowledge about the entity and embedded nuances it carries. For machines to recognize an entity in its correct meaning, it must understand somehow the context. Semantic modeling and ontology deliver the information required for the machine to grasp an entity correctly (Davies, Fensel, and Van Harmelen, (Eds.), 2003).

2.4.4. Structure of the Semantic Web

The Resource Description Framework (RDF) is the semantic foundation for common data abstraction and syntax for the Internet. The RDF Vocabulary Description language (RDFS) and the Web Ontology Language (OWL) both offer a common data modeling language for data on the Web. The SPARQL Query Language and Protocol gives a standard way of data interaction on the

Internet. A Uniform Resource Identifier (URI) is a set of characters used for identification of a physical or abstract resource. It provides a globally unique name to an entity. XML is a markup language for defining documents with structured data and provides syntax to RDF language (Hitzler et al., 2010).

KMS and ST have some common problems to deal with although the context might be different (Antoniou and Van Harmelen, 2004):

- Annotating information with semantics
- Verifying data quality, finding and capturing knowledge from it
- Delivering answers to queries made using natural language
- Filtering and controlling information access.

KMS tools employ ST in knowledge search and discovery, in resolving big data related issues, building ontology-based knowledge repositories, interpreting data for business decision-making, and in the use of natural language among others (Feigenbaum et al., 2007; Haschke et al., 2010).

2.4.5. Elements of Semantic Web

2.4.5.1.Semantic annotation.

Annotation means appending notes, attributes, tags, names, descriptions, comments, and explanations, etc. to data, text, content, document, files, drawing and other types of content.

Semantic annotation is the process of adhering semantic metadata to resources so that they can be comprehended and processed by machines. Semantic annotation eliminates or reduces gaps between the ambiguity of a concept in natural language with its ontological representation in a formal language (Nagarajan, 2006). Developing and applying semantic metadata for managing information and processes are the key features of the Semantic Web. It powers the ability of a machine to understand the underlying data. Semantic metadata conceptualizes the document and its relationship with other documents as well as annotates entities within the document such as information about a person or a firm. Ontology-referred semantic annotation makes the resource interoperable on the Semantic Web. In Semantic KMS repository, all audio, video, textual and data resources are semantically annotated, making them entities of a larger Semantic Web and interpretable by software agents. There are multiple open source tools available to provide semantic annotations to entities. Some traditional tools include KIM (Popov et al., 2003), SHOE (Uren et al., 2006), and Annotea (Kahan et al., 2002).

2.4.5.2.XML and HTML5.

XML stands for eXtensible Markup Language. Tags are used customarily in XML to annotate, categorize and structure underlined content. It facilitates storing, sharing and exchanging data throughout the Internet in a flexible format making information both machine and human readable. It allows creating own markup as needed for the data, information, and documents. Unlike HTML, where tags are predefined carrying instructions how content should be demonstrated on the Web, XML supports the creation of own tags to formalize an XML document. The syntax of the XML follows a predefined set of rules for encoding content. HTML 5 has brought some flexibilities to the HTML markup language by introducing some tags that enrich encapsulated content with semantics to a certain extent (Patel-Schneider and Siméon, 2002, May).

2.4.5.3.Linked Data.

Information on the Web is heterogeneous, often unstructured and fuzzy. These issues create a significant impediment in data integration, assimilation, and discovery.

The existing document-based Web allows performing a search using keywords and finding relevant documents. However, search using natural language on HTML pages often do not produce the best possible discovery. Linked data is a transitional mechanism from document-based Web to a Web of interlinked data that builds a groundwork for the later full switch to the Semantic Web (Bizer, Heath, and Berners-Lee, 2009). This concept, which is becoming increasingly popular, is used to make linked data as open access. It is commonly known as Linked Open Data (LOD) (Yu, 2011). Linked Data means semantically linked machine-readable data, and Open Data is defined as data which is not constrained by any restriction such as copyright or patent, freely available and reusable.

Direct implementation of SW years ago was often complicated, time-consuming, and cumbersome. Considering seemingly slower adoption of SW due to these factors, Tim Berners-Lee et al., (2006) proposed a set of best practice rules in the use of LD which are:

1. Use URIs to name the entities as opposed to any application-specific identifier such as UUIDs, database key, etc.

2. Use HTTP URL so that the entities can be accessed, referred, interpreted or verified.

3. Use RDF, OWL, and ontologies such as Dublin Core, FOAF, SKOS, etc. to model the data.

4. While publishing data on the Web, use the URL for each entity which makes the discovery of related information easier. This 4th rule is crucial as it delivers the context for the data.

LOD is an excellent method for making the data residing in organizational repositories interoperable and accessible on the Web. Many government organizations and public and private companies are making their data published on the Web using LOD so that others can take advantage of their content.

2.4.5.4. RDF and RDFS Schema

2.4.5.4.1. RDF. Resource Defined Framework (RDF) is the pillar of Semantic Web.

It is a standard model for data interchange and knowledge representation. RDF is a convenient method of creating metadata about web pages and expressing real-world objects. Unlike HTML or XML, which are used for correct display of documents. The purpose of RDF is to process and recombine information embedded in the documents (Hitzler et al., 2009). It provides a coherent way of describing and searching the Internet for a text and graphics content to multimedia files.

RDF is a framework for illustrating resources that allow viewing, linking and handling entities on the Web. When used in different Web resources, it ensures apps to have interoperability among those resources. Websites can deploy graph model of RDF to provide with access to their data semantically. The RDF shareable data model is the foundation based on which other semantic functionalities such as querying, embedding, and reasoning take place. Whenever data requires being interoperable and extensible, RDF should be the preferable choice. The Semantic Web is based on distributed data, and RDF is the language that provides this ability. RDF not only uses many of the functionalities of the Web but also enhances the Web infrastructure capabilities by buttressing it with data distributiveness.

Originally developed for Web resources metadata representation, use of RDF expanded to cover generic data modeling for data management and reasoning (Patel-Schneider and Siméon, 2002, May). In RDF data is defined in a directed relationship graph, which is represented by triples – subject, predicate, and object. The predicate describes the relationship – the property - between two things giving a meaning to the statement. Triples are easy to visualize as a directed graph. Two triples referring to the same information can be easily merged by forming a combined graph. This way, by combining graphs an extensive structure of a graph can be generated. The graph model, which is a decentralized data representation model, supports compilation of graphs from diverse information sources. The similarity between two nodes of two graphs is identified by the URIs. URI embodies a global identifier for a specific resource on the Web. The most common use of a URI is a Unifrom Resource Locator (URL). The use of URI and RDF in combination provides the distributive power to data (Antoniou and Van Harmelen, 2004).

The database which is used as the repository of triples is called a triple store or RDF store. A query language is needed to access the store. SPARQL is the RDF query language. Being a query language, it has some similarities with query languages such as XQUERY and SQL. It provides a straightforward and precise method of expressing inference rules.

RDF has a powerful, expressive ability suffice for modeling contextual information. However, it cannot specify to which class a property belongs.

2.4.5.4.2. RDFS.

RDFS is the schema language and semantic extension to RDF. It allows expressing resource types, resource relationships, and attribute types by defining an ontological vocabulary (Wood et al., 2014). RDFS uses the same kind of triples as RDF and enhances its capacity by adding a set of specific resources.

RDFS describes meaning via inference mechanism and the use of specified resources in a certain way. It supplies information required for an agent to interpret RDF triples correctly. RDFS provides precisely defined semantics such as the relation between subclasses. A triple can be described using different RDFS vocabulary for various purposes if needed. With the help of RDFS, it is possible to create hierarchies of classes and properties. In other words, RDF is domain neutral, and the RDF schema is needed to meet the needs of a particular domain. To bring reasoning ability to the knowledge representation and extend the modeling capabilities OWL which is based on description logic is used.

2.4.5.5.OWL.

RDF and RDFS support the representation of some ontological knowledge. However, for delivering actual semantics to the entities a much more expressive language than RDF and RDFS are needed. OWL is designed as the standard ontology language for constructing, publishing and sharing Semantic Web ontologies.

For proper use, ontology languages should have the following properties expressiveness, well-defined syntax, powerful reasoning support and formal semantics. OWL fulfills these criteria. OWL ontology consists of three categories of things: classes, individuals, and properties (Matentzoglu, Bail, and Parsia, 2013, October).

Ontology language that supports the descriptive logical reasoning that concurrently embodies sufficient expressiveness and at the same time easy to implement is hard to achieve. Two different sublanguages of OWL were designed to circumvent this problem (Staab and Studer, 2013). OWL Lite is a language layer which is an augmentation of RDFS. It is easy to learn and implement but restricted in expressiveness. OWL DL, DL is the abbreviation of Description Logic, another subset that provides strict logical reasoning. The drawback of this subset is it does not own full conformability with RDF. Because of this RDF documents sometimes should be modified to convert to an OWL DL document.

OWL FUL, the complete OWL language, supports all RDF documents, while OWL DL or Lite can use only modified versions that conform with their constraints. OWL is backward compatible (Staab and Studer, 2013). It means OWL Lite is a subset of OWL DL, and OWL DL is a subset of the OWL. Being exemplified in RDF graph OWL, in its majority of the construct, uses RDF instances and description. OWL is a potent tool for aggregating data as entities linked in diverse places can be correctly identified thanks to OWL's ability to represent ontological information. OWL 2 is the next serialization of OWL or OWL 1 with new functionalities, profiles, and syntax. It is entirely backward compatible with OWL and subsequently with OWL's subsets. In SKMS, because of its superior semantic expressiveness capability OWL 2 along with SWRL

(Semantic Web Rule Language) is increasingly becoming a popular choice (Carroll, Herman, and Patel-Schneider, 2015).

OWL1 became a W3C standard in early 2004 with its variants of OWL Lite, OWL DL, and OWL Full. Since then several improvements have been recommended to reduce OWL's limitation. OWL 2 enhanced capabilities of the OWL with some valuable functionalities that include increased property expressiveness, extended support of data-types, easy meta-modeling, broader annotation capabilities, syntactic sugar for easier programming of commonly used patterns, and ability to define keys (Staab and Studer, 2013). However, it kept language features, design decisions, and use cases of OWL 1. Like OWL 1, OWL 2 also has several dialects that are useful in specific cases: OWL 2 EL - ideal for the large size of properties and classes, OWL 2 QL - perfect for a big volume of instance data, and OWL 2 RL supports scalability of reasoning without abandoning expressiveness capability.

2.4.5.6. RIF.

Sometimes it is necessary to convert existing rules to be used in another semantic system. Rule Interchange Format (RIF) is suitable for this purpose. RIF constitutes of several dialects and can be deployed based on a situation. Although, RIF is developed for rule interchange, being a standard rule language it also can be used to build rules even when no conversion is necessary. RIF uses XML syntax and as such machine-readable (Kifer and Boley, 2013).

2.4.5.7. SWRL.

Not all relations are possible to express with OWL 2 constructs. SWRL rules extend OWL with descriptive logic rules and facilitate enhancing OWL's expressiveness ability for an ontology. SWRL allows inclusion of new rules of inference and axioms to the ontology. These new rules are designed to infer new knowledge from an OWL knowledge base. SWRL is a great tool that helps integrating rule systems to an ontology and enhance its capability substantially.

For performing reasoning on SWRL rules external engine such as JESS (Java Expert System Shell) Rule Engine or Pellet are used. SWRL rules are for creating new knowledge and do not support modification of existing knowledge. SWRL rules are implication rules composed of the antecedent, consequent pair (O'Connor et al., 2005).

2.4.5.8. SPARQL.

SPARQL is the standard query language for querying RDF store. It performs a query by matching graph patterns. A triple is the most granular level graph pattern. A result is inferred when an exact match to a graph pattern is found. Like in any SQL, SPARQL uses similar query structure of SELECT - FROM - WHERE. SPARQL is not capable of making any modification of RDF graphs. It incorporates four types of queries: Select, Describe, Ask, and Construct. Each type of queries serves a task. For example, select query much like in an SQL query returns one or multiple triples as a result (DuCharme, 2013).

2.4.6. Advantages of Semantic Web

2.4.6.1.Data, Application Independence.

In the present web-based system, the data representation and applications are interlinked in a manner that there is a limit to what extent one or another could be modified and still work together. Semantic technology allows the data, and the application being entirely independent.

Any application can collaborate with any data source if it uses the model. It gives application to be developed in its own course and the data to be portable (Segaran, Evans, and Taylor, 2009). The advantage of the data portability is it makes data easily reusable and maximizes data connectivity. The semantic structure of data also minimizes or eliminates redundancy and enables network effects.

The web is predominantly made from HTML documents. Due to its structure, a computer can only understand the layout and presentation of the HTML page, but most of the content is visually reproduced on a monitor for humans to absorb information in natural language from there. The machine does not have enough information about the content for it to process the data automatically. Moreover, HTML only links one document or part of the document to another. Any implicit relationship between the documents must be placed within the document in codes that has to be deciphered by programs. Although this works remarkably well for finding and sharing information, it does not make the relationship anyway understandable for the machines. Resource Description Framework (RDF) resolves this issue by making the relationship between two resources more meaningful. Still, there is a challenge. The relationship between two resources would be denoted by a Uniform Resource Identifier (URI), but this URI must be context sensitive to avoid contextual ambiguity (Segaran, Evans, and Taylor, 2009). Ontologies resolve this and some other complexities.

2.4.7. Ontology

Ontology is a branch of metaphysics in philosophy, which studies the real world and abstract entities and how they are linked (Lowe, 2007). Ontology in philosophical term defines as the study of things that exist. Things in ontology are divided into two categories: abstract and concrete (Effingham, 2013). Concrete things are tangible objects as well as concepts that are bound by temporal and spatial constraints such as a name of a place or an event. Abstract are conceptual things such as propositions, properties or facts. In knowledge representation, ontology supports semantic tools to model entities and their relationships making automated reasoning by machines possible. The entity is referred to an object that exists by itself. Its existence can be physical or just abstract (Chen,1976).

An ontology is a set of descriptions through knowledge representation of the worldview of a domain. Gruber (1992) came up with the most accepted definition of ontology in computer science which is "An ontology is an explicit specification of a conceptualization." Ontologies are populated with instances or individuals. Instances refer to a specific name of a generic entity (Maedche, 2012). For example, Toronto is an instance of the concept "City."

Ontologies are fundamental components of the semantic technology. Natural language is full of ambiguous words. A single word in various contexts might mean different things. For programs to identify similar terms from two separate databases, they need to have a mechanism that specifies the domain of the context which in turn defines the terms and their properties. The collection of information that resolves this issue is called ontology. Ontologies with metadata are essential tools to systematize and supply constructive descriptions of diverse arrays of content. A typical ontology is a document that consists of taxonomy and related inference rules. Semantic KMS uses ontologies as a key structural layer and foundational concept for its knowledge base (Guarino, 1998).

Ontologies are essential elements for specifying and attaching semantics to data in the Semantic Web. Ontologies define the concepts and links between them within a knowledge domain. The advantage of ontologies is they are modular and expandable. Ontology models of two or multiple domains can be merged to create a larger ontology. Ontology architecture consists of four layers: Meta Layers, Language Layer, Ontology Layer and Instance layer (Lee et al., 2009).

There is a plethora of ontologies dedicated to various domains available both commercially and as open source. Ontology can be selected from existing one or createed from scratch depending on the requirement. Advantages and disadvantages both escort these strategies. To adopt an existing large ontology for a purpose often it is necessary to cull through numerous categories and properties and select a small section of it. A new ontology tailored to an individual need has the advantage of having the exact model of the domain. However, building an ontology from scratch is a tedious and costly work. That's why if an ontology comes with reasoning and query tools and consists the required domain, it might be preferable to adopt it.

The structure of an ontology for Semantic Web can be viewed as a graph with following elements: a set of concepts, a set of relationships between the concepts and a set of instances of a specific concept. Depending on their reach, boundary, and purpose, ontologies are categorized as upper-level, domain ontologies and App and task-based ontologies. An upper ontology is a larger and general model of the world. It encompasses multiple domains, usable for multiple purposes and supports various apps for solving an array of tasks. Domain ontology is dedicated to representing one single domain. Application and task ontologies are oriented to support glossaries of tasks or applications (Guarino, 1998).

Web ontology languages fulfill three basic requirements (Jasper and Uschold, 1999; Allemang and Hendler, 2011):

1) It can describe important concepts of a domain.
2) It can describe key relationships between the concepts where they are hierarchical or user-defined.
3) It can set rules of what can be expressed by imposing constraints.

The number one advantage of ontologies is that it creates a universal environment of interconnected knowledge representation model. At present, disparate disciplines use completely different concepts in representing their domain knowledge. Each field applies a unique conceptual model to represent knowledge of the field that best suits the practitioners. For example, the knowledge representation and classification in architecture do not have anything in common say with botany. However, there is always overlapping knowledge how disparate the disciplines are from a scientific perspective. Gaudi's use of nature in his architectural masterpieces is one of the examples. Because of differences in knowledge representation in various fields inter-disciplinary communications at machine level is rather difficult. Semantic Web, thanks to ontology matching, makes this complex problem a lot simpler (Staab and Studer, 2013).

2.4.8. Metadata

Data to be used in a meaningful way, it is necessary to know about how the data is structured and what it represents. While this information might be sufficient for acting upon the data, for practical and unambiguous application of the data in Semantic Web, contextual information about it and its place in the real world is also necessary. Metadata or data about data is a term used for describing a resource or entity for data aggregation and discovery (Arms, 2000). Any physical or abstract object has three features: content, context, and structures. Metadata construct can reflect all the three features of an object and may contain hints or answers to the questions such as who, why, when, where, what and how. As an example, HTML meta tags are used for discovering a Web page easier. Metadata construct may also include the characteristics of the object, its properties, functionalities and relationships with other objects (Baca, 2008).

Semantic metadata enriches the data with information such as rules and relationships. It embodies domain related and contextual information that allows the data to be interpreted in a meaningful way. Ontology-based metadata can provide sufficient information about the data for machines to process it without human intervention. Data enriched with ontology-based semantic metadata gains properties like interoperability, relationship, and links with other data. It allows machines to perform reasoning over the data (see, Uren et al., 2006; Stumme, Hotho, and Berendt, 2006).

2.4.9. Semantic Interoperability

Interoperability is the age-old problem of standardization. To use information extracted from diverse sources and make them actionable there must be a way to aggregate them cohesively.

Semantic interoperability means an unambiguous exchange of data between two knowledge representation mechanisms. The goal of semantic interoperability is to achieve neutrality of software and hardware platforms with the help of a protocol layer and common interfaces that will facilitate interoperability of diverse information representations (Moschoglou, 2013).

2.4.10. Dublin Core Metadata Terms.

Dublin Core Metadata Terms are one of the first controlled vocabularies that are used for content metadata creation to achieve maximum interoperability and reusability of metadata.

Dublin Core consists of a set of simple metadata elements for interdisciplinary resource discovery and extraction (Dublin Core Metadata Initiative, 2012). It gets used in the description and queries of a myriad of knowledge resources on the Web. The metadata elements include three groups assigned to the corresponding scope. These are elements relevant to the content of the resource, factors regarding intellectual property resources and items connected to resource instantiation (Weibel et al., 1998).

2.4.11. Development Frameworks

For ontology and ontology application building, editing and maintenance many development tools are available. Some are listed here. Apache Jena is an open source Java-based framework for the development of a Semantic application that includes an OWL API which supports the integration of external reasoners. Sesame is a framework for processing RDF and RDFS data. Both use RDF store like a database. The advantage of Sesame is it supports PHP and

Python along with Java. Protégé is by far the most popular development tool for ontologies (Staab and Studer, 2013).

Jena, the OWL API, and Sesame and Protégé. Among these four frameworks, according to the SEAL's evaluation, Sesame is the best tool for working with large-scale ontologies (Wrigley, García-Castro, and Nixon, 2012, April).

2.4.12. Artificial Intelligence

The goal of AI field from its very beginning was to develop thinking machines commensurable or superior to the human level of general intelligence. Although, research is ongoing in artificial general intelligence, or strong AI, most present AI researchers are more concerned about solving task-specific and domain-based problems, which is called narrow AI (Russell et al., 2003; O'Regan, 2016).

Artificial Intelligence can be defined as a field which studies and is involved in developing and using algorithms and methods emulating human behavior, perspectives, and intelligence to solve complex problems (Nilsson, 2014).

At the beginning of the AI research, the primary emphasis was on General Problem Solving (GPS) using reasoning as search method. The process GPS used is called Mean Ends Analysis. The idea behind this process is to sort out what requires accomplishing and figure out a method to do it. Unfortunately, the system worked only in solving some problems but was not capable of solving any general problem contrary to the initial expectation (O'Regan, 2016).

The first Expert System developed by Feigenbaum (1965) for chemical analysis moved the primary focus of AI from computer algorithms towards knowledge representation. The foundation of the ST research can be attributed to Ross Quillian's work on Semantic Network for Knowledge Representation. In early 1970s, AI emphasis squarely was in knowledge representation and natural language understanding.

Minsky (1974) introduced frame system theory a critical approach in knowledge representation. The concept of Knowledge Engineering (KE) and Expert Systems originated by Feigenbaum in 1977 remained as the area of interest for the AI scholars in much of the 1980s. Machine Learning, which at that time was represented by the neural network, in the 80s, was still a rather peripheral domain of AI. In next decade that has dramatically changed.

Thanks to the new computational capabilities and a large amount of accumulated data, machine learning and knowledge discovery from data or data mining in the 1990s became the preeminent AI domain of exploration. The catalyst for the sudden rise of the machine learning was the introduction of back propagation in neural networks (Domingos, 2015; O'Regan, 2016).

Knowledge and problem solving using knowledge-based reasoning is one essential part of AI. The other significant part which is called computational AI that uses various statistical and machine learning techniques on training data and solve complex AI problems. Both approaches of AI are necessary elements in ST.

2.4.12.1. Machine Learning.

Machine learning is a branch of AI that uses various statistical and computational algorithms for solving problems that require some level of intelligence to learn from and adapt to a contextual environment. It is the study of algorithms, tools, and techniques where computer programs continuously ameliorate their capacities autonomously by learning from experience (Carbonell, Michalski, and Mitchell, 1983).

The first real theory of machine learning was the concept of perceptron invented by Rosenblatt in 1950s. It was a simplistic learning model based on how neutrons work (Domingos, 2015). From 1990s various machine learning and statistical methods are increasingly getting used in the everyday computational analysis. Today, from search engines to recommendation systems, and automated driving cars to stock market analysis the use of machine learning is ubiquitous. In knowledge management systems, there're multiple areas where machine learning algorithms are applied (Marsland, 2015).

Machine Learning banks on data. The more data is available, the better for the algorithms. Enterprises are producing and accumulating an enormous amount of data these days. Because of this explosion of data, machine learning systems are proliferating in every sphere of our life. Machine Learning differs from programming in a way that instead of finding the answer to a question, it figures out how does an answer is derived. The domain of machine learning includes a wide array of subsystems such as predictive analytics, pattern recognition, data mining, statistical modeling, knowledge discovery, data analytics, adaptive systems, and others (Marsland, 2015). If any of the organizational business and knowledge processes is involved in producing or using extensive data, machine learning algorithms in one way or another can be used to drive efficiency, create innovative solutions, and optimize the processes.

2.4.12.2. Agents.

The concept of the agent denotes a tool for analyzing systems (Russel et al., 2003). Agent is a term refers to a diverse body of programs and tools. Synonyms of the word agent include knowledge-bot, softbot, taskbot, personal assistant, userbot, even a robot. An agent is a software program that works in its environment and changes it to accomplish its assigned tasks.

In Semantic KMS software agents play a significant role (Hendler, 2001). For example, working within the respective environment, agents extract the semantic data, perform reasoning, execute necessary transactions and deliver the required information. Agents are applications meant to accomplish tasks on behalf of users and other programs. Since in the Semantic Web content is represented in machine-readable format, the agents can extract, comprehend and execute any given task without human intervention. Intelligent agents perform their mission based on the knowledge that allows them to adapt even when the environment has changed, or parameters for the goal have modified. They can learn from external stimulants, cumulative experience, interacting with other agents and change in the surrounding environment.

Present intelligent agents such as Web crawler are created to discover and extract needed information from the known, and possible sources and aggregate identified information to the knowledge repository using metadata crosswalks and interoperable ontology. The crawler agents are equipped with machine learning algorithms and can monitor and detect new data, find patterns and correlation between the knowledge domain of the firm and extract only the relevant content.

These programs are more efficient in pinpointing patterns, correlate and align a network of knowledge than the previous generation and information obtained by them often become an great source of innovation.

In multi-agent systems, a set of agents works for achieving individual goals. Each agent is responsible for performing a single action or achieving an objective. While single-handedly none of them can solve the problem, in combination, they work for achieving their set goal. Agents in the system communicate and collaborate and even compete with each other to accomplish their jobs. If we look at Semantic KMS as a holistic but evolving system, some agents perform specific tasks for the common goal of allowing the enterprise to manage knowledge activities.

2.4.12.3. Natural Language Processing.

It's a set of computational methods and algorithms that perform processing and analyzing of human language (Paris, Swartout, and Mann, (Eds.), 2013). Most documents in the organizational repository and communications are unstructured and not directly processable by machines. Some tools and programs are highly efficient in retrieving text from a document, parse it, index the words, assign semantics to the entities and aggregate to the repository. However, solving the problem of sentence ambiguity is more complex that is yet to get resolved fully. While for a native speaker to determine the subtle nuances and semantics behind a sentence might be easy thanks to relevant tacit knowledge acquired from years of experience and use, things are a lot trickier for a machine.

Semantic technology along with machine learning algorithms are presently powering systems to process queries made in natural language, translate languages and cluster documents in repositories (Gollapudi, 2016). While Siri, Cortana, OK Google and Watson demonstrate a high degree of achievement in NLP (Hauswald et al., 2015, March), works are still in progress to bolster this type of AI systems in acquiring common sense knowledge and reasoning, denotative and connotative semantics (Cambria and Hussain, 2012) and reusable contextual knowledge base.

2.4.13.4. Data Mining.

Data mining is a process to extract valuable insights from data. This process includes sub-processes like collecting data, cleaning, editing, preprocessing and conducting analytics (Larose, 2014). The ubiquitous presence of the Internet, the proliferation of mobile devices and Internet of Things, cheaper storage and cloud services, numerous and expanding sensor data are producing an overwhelming amount of data. It has become necessary to discover and extract insights and knowledge from these data that can help achieve specific business strategic and computational goals.

Data mining techniques are around since the early 1960s. But with the advent of advanced machine learning algorithm, technological prowess and the emergence of Big data, the importance of data mining to extract actionable information became crucial (Wu et al., 2014). Data mining incorporates two objectives: prediction and description.

Usually, raw data are heterogeneous and unstructured in format and requires conversion so that machines can process them automatically. The preprocessing of the data to prepare for analysis is most time-consuming part of the entire process as it rests on the original format of the raw data and what type of analysis planned to perform.

In Semantic KMS, various data mining approaches are involved such as text mining of the Web documents to convert them to RDF and aggregating to the knowledge base or mining semantic data for solving knowledge related problems (Rettinger et al., 2012).

Data mining is a critical step in the process of knowledge discovery within KMS. The goal of the data mining is to discover patterns, insights, and knowledge that are previously unexplored or undiscovered but valuable for the organization using machine learning and statistical techniques (Dunham, 2002). A unique role in KMS plays text mining - a subfield of data mining which uses AI tools and techniques such as NLP, information retrieval, and data visualization.

2.4.13.5. Text Mining. Mining text and integrating them to the ontology-based repository is an invaluable way to discover new associative knowledge (Aggarwal and Zhai, 2012).

For example, in most scientific fields researchers possess comprehensive knowledge of small subfields and oblivious about the discoveries made in other disciplines and even fields within their discipline. The ability of the Semantic KMS to associate disparate data and provide access to them can have a significant impact on discoveries and innovative solutions to many current and impending problems.

2.4.12.6. Knowledge discovery and extraction.

Knowledge discovery aims at finding new, interesting and insightful information from raw data without human intervention. Knowledge discovery is a process of extracting valuable, implicit, new and usable information from large amount of data (Fayad et al., 1996).

These data could be structured, unstructured or semi-structured but difficult to work using conventional methods due to their sheer amount, heterogeneity, and complexity. Various data mining, machine learning, and data analysis techniques are used for discovering knowledge depending on the type of data and required analysis. Ontologies play an integral role in the Knowledge Extraction (KE) module by delivering the underlying meanings to the extracted information from the document. At the same time, ontologies of a semantic repository can take advantage of the KE for filtering, enhancing, populating and enriching annotations of entities (Davies, Fensel, and Van Harmelen, (Eds.), 2003).

2.4.12.7. Knowledge Representation.

While trying to develop general problem-solving methods such as finding proofs of theories and doing a global search, researchers encountered the problem of computational limitation. They realized that a knowledge base pertaining an issue at hand that machine can understand and utilize is necessary for efficiently solving this problem (Domingue, Fensel, and Hendler, (Eds.), 2011).

Knowledge engineering which consists of knowledge acquisition and knowledge representation is a field grew up from the need to create methodologies and techniques for supporting the representation of human knowledge that computers can understand (Guarino, 1995).

In Artificial Intelligence, knowledge representation is defined by a set of data and a group of inference rules which are applied for performing automated reasoning on the data by software agents (Brachman, Levesque, and Reiter, 1992). Knowledge representation portrays and describes real-world information in a manner so that programs can use them for solving complex tasks. Automated reasoning using inference engines are a vital component in knowledge representation as they allow deriving to knowledge through logical interpretation, support knowledge claim and draw conclusions. In semantic technology, knowledge Representation Framework (Sowa, (Ed.), 2014) consists of three layers. The XML layer is the instances, The OWL ontology layer, and SWRL inference rule layer. Instances are XML documents within domain ontology, the real-world domain-specific ontology in OWL, SWRL is the rule markup language for developing inference rules.

Knowledge representation at its core is a metaset – knowledge of information about an entity – its properties reflect its relation to the other entities of the same ontology and what types of reasoning can be executed using this knowledge.

Questions, which are important in the formalization of any knowledge representation framework, address problems of data that ST resolves such as incompatibility of systems and formats (Van Harmelen, Lifschitz, and Porter, (Eds.), 2008):

- Lack of conformity between systems
- Difficulty in transferring data of different origin
- Heterogeneity of Data and their format
- Diverse types of data repository and their structure
- Problems of synonymy, polysemy, and homonyms

2.4.12.8. Knowledge Based Systems.

KBS in AI is meant to deliver reasoning based intelligent decisions in a particular domain.

KBS are computer systems that are developed to emulate human intelligence by acquiring and using domain knowledge (WIIG, 1994). In early 1970's first KB systems were adopted in domains where formal knowledge was crucial for solving problems and only some human experts possessed that knowledge. Knowledge acquired from diverse sources are processed to build representation models which are well structured. There are various methods, rules, frames, techniques, and programs are applied to discover, acquire and represent knowledge in KBS (Studer, Benjamins, and Fensel, 1998).

The biggest issue the old KBS confronted was the problem of knowledge acquisition. Knowledge acquisition in pre-Internet era was a difficult job. The knowledge base was developed from pieces of information about conditions (Guarino and Giaretta,1995). The primary source of this knowledge which was converted into a rule-based expert system was the domain experts (Buchanan and Shortliffe, (Eds.), 1984). While at that time, it seemed to be a viable model for creating a system that can substitute an expert in specific areas, in retrospective, such expert systems were doomed to fail for some obvious reasons. It is impossible for even for an expert to articulate everything that the person knows about a domain. Michael Polanyi's (1962) famous adage "We know more than we can say" which reflects the problem of transferring tacit knowledge and flawlessly codifying it fits in here. With continuous discoveries and augmentation of the knowledge base, a static knowledge repository becomes obsolete quickly. Information extraction and codification are time-consuming and expensive processes. Especially, in the era when most of the processes were manual. The expert systems of that time also failed to grasp the problems of uncertainty and vagueness which have been tackled better later by applying probabilistic, fuzzy and evidential reasoning (Kruse, Schwecke, and Heinsohn, 2012).

Below we review some of the key areas where semantic technology is actively used to harness knowledge, information explosion, and bring efficiency by streamlining various knowledge-related processes.

2.4.13. Publishing and Semantic Technology

The world of content production and dissemination is changing. Equipped with smartphones and handheld devices and the ubiquitous access to the Internet, users today expect to receive the information when it is needed immediately and automatically. Publishers in this new realm must ponder what innovative methods they can use to take advantage of the powerful smart devices and wearable technologies that consumers possess and how to deliver content to their fingertips. Along with this, they also should consider the ever-growing number of content, increasing complexities of any domain, the rising intricacies of the questions and problems a discipline covers, and the issues inherent to big data due to the explosive growth of information.

There exist many programs based on semantic technology that are already writing content that 's hard to distinguish from a human contributor. One tool is helping the creation, for example, of sports news in lightning speed and disseminating to the consumers who are passionate about receiving updated news instantaneously.

Information connectivity is crucial for keeping a customer engrossed and engaged with a constant flow of relevant information based on the person's interest. Publishers are compelled to meet audience's interest and counter the ever-changing content demand by delivering interconnected content in user-friendly and efficient manner. ST aids in enhancing content with metadata and semantic annotation with interoperability so that machines and programs can process them without human intervention. Using ST, a complete content ecosystem surrounding a piece of information can be created and augmented through linked data that connect multiple types of structured, unstructured data, and various formats of multimedia data. This rich environment can contain comprehensive seamlessly linked information about people, places, events, news, and knowledge capable of satisfying the requirements of most complex systems and discerning users' need (Hyvönen et al., 2004). It not only enriches content with interconnected relevant and validated information but also delivers personalized content tailored to the taste of a reader.

2.4.14. Life Science and Semantic Technology

Some research projects spanning healthcare, life science, biotechnology and clinical research areas are actively using ST (see, Neumann, 2005). For decades, researchers are working in their domains continuously producing an immense amount of valuable data. Due to the use of various legacy programs and computers, these data are very heterogeneous. The increased understanding that data can deliver better value if they conform with data from other relevant sources, these industries are looking for a way to federate data which requires formalizing and structuring of data. Semantic tools equipped with semantic annotation and domain ontology bring the necessary conformity to data so that they can be used across multiple platforms and domains. One such tool is, for example, Bio2RDF, an RDF data formalization system and repository that build mashups of bioinformatics data (Nolin et al., 2010).

2.4.15. Internet of Things

Internet of things (IoT) is transforming the way we interact with everyday devices and many components. Electronically connected physical objects supported by the communication protocol, sensors and embedded software allow these objects to exchange data as needed with the external environment. Each thing or object receives its unique identifier. This Internet-based network of objects is called the Internet of Things (IoT).

IoT connected objects produce pervasive and ubiquitous data depending on the requirement while interacting with the surrounding environment. A part of this data is used in decision-making, taking actions and monitoring changes. Some of these data are also capable of generating insights and new ideas. However, the data deluge – the problem inherent in any Big data identified as volume, velocity, and variety – creates a major impediment and requires an approach that is capable of extracting, accessing and processing information and knowledge from the data (Gudivada, Baeza-Yates, and Raghavan, 2015). The problems exacerbate with the nature of some of these objects which have limited memory, generate heterogeneous types of data and work simultaneously making the processing of data immediate (Atzori, Iera and Morabito, 2010).

Semantic technology is increasing getting used in the formalization and conceptualization of the abstract representation of the data so that machines and programs can interpret them. ST facilitates linking of data with other data of the domain as well as other ontologies. Interoperability – seamless crosswalk of data within multiple ontologies – supports the use of same data in various IoT resources, information systems, and applications, which is a key advantage of ST (Selvage et al., 2006). The nature of IoT calls for autonomous interconnection, communication, and data exchange of diverse types of objects and devices. Semantic technology thanks to their ontology-based approach, semantic annotation capability, linked data, semantic web services, and various machine learning techniques is becoming the technology of choice for supporting object identification, monitoring, and connection of "things" as well as for information representation, discovery, aggregation, storage, transfer, and dissemination.

2.4.16. Benefits of Semantic Technology

Semantic technology using SW framework standard along with AI tools provide a mechanism to give knowledge a machine-readable formal representation. These technologies are superior to traditional technological architecture presently applied in many ways (Dolog and Nejdl, 2003, May; Davies, Fensel and Van Harmelen, (Eds.). 2003; Antoniou and Van Harmelen, 2004; Shadbolt, Berners-Lee and Hall, 2006; Maedche, 2012).

- First, thanks to the cohesiveness and standards the use of semantic technology ensures that all users and software agents will interpret data in a uniformed method.
- Second, ontology matching and merging provide an advantage of enhancing organizational domain when required.
- Third, the organizational ontology is reusable for other purposes.
- Fourth, all entities become interoperable and reusable thanks to their URI format.
- Fifth, thanks to the comprehensive semantic repository and triple stores, knowledge workers receive unprecedented access to new knowledge.
- Sixth, partners and suppliers that use semantic technology in building their KMS are also relieved from ontology mapping and interoperability of the documents of the organization.

- Seventh, by making a host of publicly valuable documents through the Semantic Web, organizations can contribute to knowledge growth and social responsibility.
- Eighth, reasoners can find documents with inconsistency and explanations can be added to those documents bringing clarity to places where it was lacking.
- Finally, lightweight-ontology-based access policies can modify the policies when needed more easily than a conventional system.

2.4.17. Conclusion

The above discussion shows that semantic technology is a unique set of frameworks, tools, and techniques that can enhance any ICT-based platform such as knowledge management system significantly. Each process of organizational knowledge activities can get a boost in efficiency from the deployment of a semantic knowledge management system. For example, use of ontology and triple store fundamentally changes the structure of a knowledge repository. The interconnected entities, reduction of ambiguity and ability to extract relevant knowledge from diverse data format and media facilitate access to all pertinent documents and content just in time as needed. It alone can bring enormous benefits to any firm. Studies show that most knowledge workers spend a substantial amount of their working hours on reinventing the wheels (Dalkir and Liebowitz, 2011). The new KMS supported by semantic technology eliminates this costly and unwanted practice. The benefit of such KMS has not been constrained alone in streamlining knowledge processes, the main areas of organizations in attaining competitive advantages such as innovation process and management of innovation-related knowledge also receive fundamental positive shift as the later sections of this thesis reveal.

While the domain of semantic technology is vast and complex, in this section, we have reviewed some of the key concepts and elements that are utilized in the development of a robust semantic KMS. In the next section, we will consider an architectural framework of a semantic knowledge management system and a literature review of the impact of such systems on organizational performance.

2.5. KNOWLEDGE MANAGEMENT

2.5.1. Introduction

Knowledge has surpassed land, capital, and labor, which were the primary production factors in prior economic stages and became the main one in the knowledge economy (see, Powell and Snellman, 2004; Acs, de Groot and Nijkamp, 2013). It is also an end-product with significant market share now (Teece, 2010) and a critical component in gaining and sustaining competitiveness (Vaiman and Vance, 2010). In the complex, shifting, and ever-sophisticating market achieving superior performance requires making rapid, timely, assessed and precise decisions. Knowledge is an essential element in this process as well.

Knowledge has always been a constituent of production, now that it has become the dominant factor in many industries and the primary driver of economic growth (Boisot,2002), firm's sustainability, growth, and even survival depend on it (Salojarvi, Furu and Sveiby, 2005). Many companies realize that without having access to the vital knowledge at the right time, without faster absorption, sharing, utilization and continuous creation of new knowledge, staying competitive would be a daunting task. In this new paradigm, firms must take in the account that they need a whole new strategy in respect to knowledge as knowledge has a unique property of becoming obsolete quickly (Dierickx and Cool, 1989).

A firm with dynamic capabilities of implementing new technologies, capturing knowledge from external sources and assimilating that knowledge with existing knowledge can develop new applications, products, and knowledge (Kogut and Zander, 1992). Having a clear understanding of the knowledge integration process and how the knowledge flow through various organizational divisions take place is vital for any effort of streamlining and improving knowledge processes and benefit from it (Grant, 1996).

Capturing, learning, integrating and sharing knowledge occur in any organization at different levels of a firm. Important is to consciously and actively pursue these processes so that the company becomes capable of generating creative, task-related, strategic, technology and market-oriented combinations and recombination resulting development of innovative products, services, processes, and strategies (Birkinshaw et al., 2008).

The rise of the knowledge economy compels firms to reassess the value of their knowledge assets, understand the importance of knowledge in their business strategies, and realize the impact of new knowledge on their innovation efforts. This new role of knowledge and the need for the practical use of it makes managing knowledge related activities a critical issue of the firm. Knowledge management supports operational processes, facilitates informed decision-making, brings accessibility to knowledge in the innovation process (Dalkir and Leibowitz, 2011; fuller, 2012; Hislop, 2013; Holsapple, 2013). The goal of the knowledge management is to identify, capture, aggregate, analyze, assimilate, exploit and share knowledge from external and internal sources and build firm's knowledge assets and use them effectively (Wiig, 2012). KM not just improves firm's knowledge assets, but also helps to create new knowledge and capabilities that have possibilities of becoming core competencies of a company (Leonard-Barton, 1995).

2.5.2. Knowledge

Despite the long and evolving history of the study of knowledge as an epistemological concept, it has started to gain further traction in recent decades as the study of knowledge theory from organizational perspective brought new ideas and had instigated a further debate in this intricate, multifaceted and ambiguous substance. Until the 20th century, the subject of knowledge has been studied mostly by philosophers in epistemology and considered as propositional and personal (Dancy, 1985). With the advent of technology era, the growth of knowledge economy and realization of organizations that knowledge is a vital resource in their quest for the competitive advantage the field of knowledge study has augmented considerably and now covers organizational, economic and social spheres along with the previous focal point of personal knowledge.

In organizational knowledge science, there had been numerous attempts to provide a universal definition of knowledge. However, none of them had been accepted widely by the research community. This predicament in bestowing a comprehensive definition to knowledge can be attributed to the dynamic and highly subjective nature of knowledge. Some of the definitions stated below show the wide differences in the understanding of the perception of knowledge.

2.5.3. Knowledge Definition

Hassell (2007) argued that organizational knowledge science is set on a shaky epistemological ground, that is why it is facing difficulty in defining the concept of knowledge. The problem transpires from the fact that knowledge such as "know-how," which is of immense importance in organizational knowledge science are not of a concern in epistemology. Epistemology focuses on Propositional knowledge and covers all fields of study where truth is knowable or even possibly unknowable from the perspective of the nature, source, and extent of knowledge (Klein, 1998b), and unlike organizational science utterly indifferent to the economic value of knowledge. In organizational science, on the contrary, it is considered as a factor generated by economic agents through a rational optimizing behavior (Langlois, 2001). Moreover, epistemology's emphasis is on the generation of knowledge by an individual, and personal knowledge. Organizational science is preoccupied with the capture, collection, creation, utilization, and sharing of knowledge in a collective context (Aarons, Linger, and Burstein, 2006).

In the organizational context, knowledge is defined as "a fluid mix of framed experiences, values, contextual information, and expert insight that proves a framework for evaluating and incorporating new experiences and information. It originates and is applied in the mind of the knowers. It often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices and norms (Davenport and Prusak, 1998, p. 5)." In a stark contrast from the epistemological view of "Justified True Belief (Klein, 1998b)," this definition assumes that knowledge is a tool, a system, a mechanism and a product that is used for perceiving the environment and engaging in practical activities. However, this seemingly elaborate and all-encompassing definition still has room for criticism.

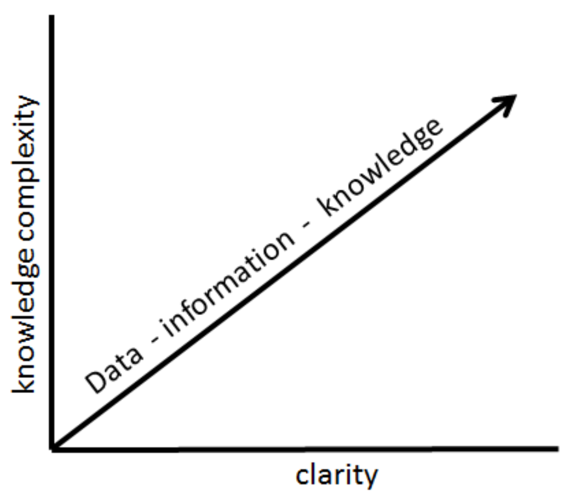
Butler (2006) pointed out that although this definition seems to cover a wide context and can claim to be nearer to a universal definition, a closer inspection shows obvious cracks in its foundation. According to his social constructivist perspective, knowledge cannot be ingrained in files, databases, and repositories or any of the organizational silos because knowledge cannot be separated from knowers and objectified. In his opinion, the aspects of knowledge that needed to be considered are 1) socially and experientially constructed knowledge is a phenomenon of concurrent existence in the society and an individual. 2) its nature is contextually and content-wise particular to a group and the members of the group, those who hold the mental representation of it. On the other spectrum, positivists also contend and disagree with the idea that "knowledge originates and applied in the minds of knowers (Davenport and Prusak, 1998, page 5)." According to this view, knowledge can exist independent of human mind, and it can be applied without the intervention of the originator of knowledge (Kabir and Carayannis, 2013).

Definition linking knowledge with information found widespread popularity in KM literature as well. Some examples include: knowledge consists of relevant and actionable information founded at least partially on experience (Leonard Barton and Sensiper, 1998). It is related to humans and gets created from information flow based on the knower's commitment and beliefs (Nonaka and Takeuchi, 1955). It is verified, assessed and codified information (Earl, 1994).

2.5.4. Data - Information - Knowledge

In the KM context, a conventional conceptualization in defining the elements representing content depicts the relation between data, information, and knowledge as a hierarchical continuum (Stenmark, 2002; Meadow and Yuan, 1997; Rowley, 2007). In this understanding, data is the crude form and basic foundational building block of information, information is data with semantics, and knowledge embodies information with experience, insights, expertise that is used in the decision-making process (Zins, 2007a). Knowledge in this sequence is the final product based on data and information as inputs (Rowley, 2007). There are two different approaches to defining knowledge in this manner. The first one is the hierarchic structure of data, information and knowledge (DIK) which has been accepted as the de facto model in the information technology literature (Rowley, 2007) and the second one is the knowing process

that converts information to knowledge (Shin et al., 2005), figure 7.



adapted and modified from (Hey, 2004)

Figure 7: Knowledge hierarchy

The hierarchy can also be viewed as a top-down structure. Knowledge is a prerequisite for perceiving, interpreting and converting both data and information. It means an inverted hierarchy of knowledge — information — data also makes a perfect sense (Tuomi, 1999).

The clarification and conceptualization of what data, information, and knowledge are, their relative concatenation and useful contextual application of their hierarchy is an ongoing process and still a topic of further debate. The most contentious of them is still knowledge.

Not too long ago, knowledge was considered as personal and embodied in human, but now we accept the fact that knowledge dwells in multiple places of a firm (Levitt and March, 1988; Starbuck, 1992; Walsh and Ungson, 1991; Argote and Ingram,2000). For example, Walsh and Ungson (1991) denoted that five knowledge repositories exist in an organization: a) workers and stakeholders, b) roles and organizational structures, c) organizational routines d) culture of the organization and e) the physical structure of the business (via, Argote and Ingram, 2000). This is an example of the dynamic understanding of knowledge and how the perception of knowledge evolves. Of course, some scholars vehemently oppose this stand and claim that knowledge is and will always be inherently personal (Cook and Brown, 1999).

Lacking any universal definition of knowledge, scholars are circumventing this issue by successfully developing a working definition of knowledge suitable for the task at hand and relevant to their distinct subject matter. In this thesis, the same approach is taken.

The definition that suits the purpose of this thesis describes knowledge as contextual, validated, relevant and actionable information (Earl, 2004; Liao, 2003; Soliman and Youssef, 2003; Wainwright, 2001; Kabir and Carayannis, 2003). It can be embodied within individuals, groups, networks, and firms and it can also reside in systems, products, processes, structures and other organizational silos (Cepeda-Carrión, 2006).

2.5.5. Knowledge Classification

The importance of knowledge as a vital resource in gaining and sustaining competitive advantage of an organization is a relatively new phenomenon. Organizations are still struggling to figure out the actual effects of knowledge, which type of knowledge is most critical for an organization's growth, where this knowledge is located and how to extract, assimilate and use this knowledge. Without a clearer understanding of the categories of knowledge, this task becomes difficult to comprehend and execute.

In their seminal work "Knowledge Creating Company" with the introduction of the concept of tacit and explicit knowledge borrowed from Polanyi (1962, 2015) and their importance in firm's knowledge management quests, Nonaka and Takeuchi (1995) started a salient discourse about knowledge typology. Since then, it has been a topic of much debate among the scholars and practitioners of knowledge management.

Polanyi's concept and classification of tacit and explicit knowing as described and explained in his two omnibuses of articles: Personal Knowledge (1962) and Tacit Dimension (1966) act as the theoretical foundation for many later scholarly works related to knowledge management. His concept of knowledge postulates that logical and empirical approach solely is incapable of producing genuine knowledge as rules, and empirical analyses alone can't explain scientific discoveries, knowing by nature is personal, and explicit and tacit knowings are inherently intertwined (Sveiby, 1997; Wirtanen, 2000).

According to Polanyi's (1962) classification, there exist two fundamentally different types of knowledge. Explicit knowledge is the knowledge that is explicable and can be expressed using language and other symbols, and tacit knowledge, which is difficult or impossible to communicate. Most important and personal knowledge is tacit. Nonverbal and pre-verbal knowledge, which is overlying and superimposed on explicit, is tacit knowledge. It also includes somatic skills. In the learning process and acquiring skills, tacit knowledge is critical and fundamental. However, he also suggested that in any knowledge the degree of tacit and explicit varies (Polanyi, 1962).

2.5.6. Tacit Knowledge

Innovation and development of core capabilities both require the use of in-depth knowledge that human talents possess. To share, transfer and utilize this knowledge efficiently some of this tacit knowledge must be codified or externalized (Nonaka and Takeuchi, 1995; Ambrosini and Bowman, 2001).

Founding on the philosophical discourse of Polanyi (1962), Nonaka (1995) advanced the concept of tacit knowledge and postulated its importance for knowledge creation in modern enterprises. Tacit knowledge is embodied, intimate and subjective. It exemplifies in cognitive abilities, physical experience and perception, somatic skills, mental aptitude and sense-making. It is inherently difficult to delineate, interpret and formalize (Saviotti, 1998; Leonard and Sensiper, 1998) and it is hard to codify and transfer due to its fuzzy nature (Polanyi, 1962; Reed and DeFilippi, 1990).

Along with the rising interest in the organizational management, the concept and saliency of tacit knowledge in the enterprise realm have been studied for several decades. Many scholars within this period have contributed to the present understanding of this subject matter, its availability, viability, application and sphere of influence (see, for example, Nelson and Winter, 1982; Winter, 1987; Kogut and Zander, 1992; Grant, 1996).

Collins (2010) has proposed three types of tacit knowledge to bring better clarification to the concept: relational tacit knowledge, somatic tacit knowledge and collective tacit knowledge. According to him collective tacit knowledge due to its context dependence is entirely ineffable and inexplicable. The other two types of tacit knowledge are partially or wholly possible to codify.

Technology obviously plays a significant role in the increasing need of tacit knowledge and the ability to explicate it. Many types of knowledge which had been considered in the recent literature as tacit has become fully explicable thanks to the advances in technologies (Kabir, 2012).

This discourse shows that knowledge is a complex, subjective and shifting concept. Particularly, the tacit part of it. What is perceived as tacit today might not stay tacit in the future. The goal of knowledge management is to identify, bring clarity, provide access and help the creation of both the tacit and explicit types of knowledge and produce economic value from the available knowledge.

2.5.7. Organization and Knowledge

2.5.7.1.Resource-based view of the firm.

Strategy management research is duly concerned about the factors behind the performance difference between the firms (Grant, 1991). The Resource-Based View (RBV) address this strategic question by offering a theory. It suggests that resources with some unique characteristics owned by the firm are the foundation of a company's better performance compared to its competitors (see Penrose, 1980; Grant, 1991, Wernerfelt, 1984; Barney, 1991; Teece, Pisano and Shuen, 1997).

As products and services originate from available to organization resources which ultimately explain its performance, resources should be major focus elements in understanding firm's capabilities of creating superior competitiveness (Wernerfelt, 1984). The growth and direction of a business are dictated by resources it owns and knowledge, skills, and competence that it has developed over time (Penrose, 1959). RBV thus postulates that "organizational resources that are valuable, rare, difficult to imitate and non-substitutable can yield sustained competitive advantage" (Meyer, 1991). Unique Knowledge possessed by an organization is one of the resources that fit in this category. Hence managing knowledge is of utmost importance for a firm's survival in the present economy (Nelson and Winter, 1982; Kogut and Zander, 1992; Zander and Kogut, 1995). Moreover, knowledge is undoubtedly one of the most salient of these resources. Delivering sustainable value from the use of knowledge requires efficient management of a complex set of activities that organization controls.

2.5.7.2.Knowledge-based View of the Firm.

Knowledge-based view (KBV) of the firm, which is an offshoot of RBV, claims that a company's ability to capture, integrate, assimilate, combine, create, diffuse and maintain knowledge explains its market position and success (Conner and Prahalad, 1996; Kogut and Zander, 1993). Organizations rely on knowledge resources for growth which demands a strategic focus on aspects such as the development of competencies, organizational learning, and management of tacit and explicit knowledge (Curado and Bontis, 2006).

Arrow (1962) denoted that R&D is primarily engaged in the creation of information (read knowledge), and any invention is risky because information as an output can never be predetermined from its input. Competitiveness level of an enterprise builds upon the knowledge resource it owns and skills, capabilities, and competencies that it has developed in successfully leveraging this resource. Thus, managing organizational knowledge flow and knowledge activities are imperative for any firm (e.g., Lee and Choi, 2003; Gold, Segar and Malhotra, 2001).

2.5.8. Knowledge Strategy

The key areas that a business needs to explore while formulating any strategy are the competitive landscape, company value proposition, resources and capabilities, long and short-term goals, and core competencies (Grant, 2016). The question that the strategy tries to answer is how the firm can gain and sustain competitive advantage (Porter, 1980). A segment of this broader strategy coverage is knowledge strategy that demands a clear understanding of knowledge need to compete at existing and future market, and knowledge gap — the missing knowledge crucial for success. Recognizing and identifying knowledge that is required but missing actuates from goals that firm is trying to achieve through its knowledge strategy (Kim, Yu and Lee, 2003; Zack, 2009). The focus of the knowledge strategy and the type of approach the firm selects mostly contingent on it.

2.5.8.1. Successful knowledge use.

A knowledge strategy must recognize and create access to knowledge and human resources needed for the strategy to work successfully (Hansen, Nohria and Tierney, 1999).

As a progressively ever-larger share of these resources are located outside of the firm, knowing where exactly these resources reside and how to tap into those resources are critical. Discovering and Integrating these resources and eventually incorporating them via collaboration, distribution and production have an impact on the creation of real value from knowledge use (Hagel, Brown and Davidson, 2010). Because the required knowledge is also increasingly becoming esoteric, profound and complex, without having a rich knowledge base, high absorptive capacity, and strong motivation organizations will not be able to take advantage of knowledge, even if access to it is readily available (Cohen and Levinthal, 1990; Zahra and George, 2002). The complex set of skills, expertise, and technologies compulsory for this should be continuously nurtured and upgraded since once lost these attributes might be difficult to cultivate again. These problems compel firms to ponder about what should be its current strategy pertaining knowledge. Should it focus on the codification of knowledge from diverse sources and provide access to this explicit knowledge to the employees? Or it should emphasize on tacit knowledge available within the firm and exploit this knowledge more efficiently for achieving the set goals (Hansen et al., 1999; Xie, 2009; Kumar and Ganesh, 2011).

2.5.8.2. Knowledge Audit.

Before opting for acquiring specific knowledge strategy companies must assess their knowledge resource by performing a knowledge audit. The audit should disclose the firm's actual knowledge base of both explicit and tacit types, knowledge created by the company, knowledge obtained from external sources, users of specefic knowledge, the usage frequency of specific knowledge, knowledge need for each task, routine, process, and activity. It also shows where and in which form the knowledge is stored. The analysis of this audit will determine whether critical knowledge for achieving company objectives and conducting the activities necessary for that are available to the firm. It also must recognize the sources of necessary missing knowledge and find barriers in knowledge integration from internal and external sources.

The firm should cover all key areas to map its knowledge and determine if there is any gap between what knowledge already exists within the company and what knowledge it needs. These areas include market knowledge, human capital knowledge, knowledge of the business structure and intellectual properties (Brooking, 1999). Apart from categorizing and prioritizing available knowledge, the audit should identify the alignment of knowledge base with organizations knowledge goals. An accurate knowledge audit will produce a clear and measurable assessment of tacit and explicit knowledge available in the organization (Hylton, 2002). Armed with this information a company can evaluate its strategy requirement, methods, and processes that the firm needs to focus on to achieve its set objectives.

If clear knowledge gaps are identified, the firm should take the exploration approach of acquiring the needed knowledge from various sources, assimilate with existing knowledge and if necessary create new knowledge (Zack, 1991). Exploration is one of the two knowledge related strategies in the implementation of innovation (March, 1991). If knowledge audit showed that the firm possesses knowledge that can be refined, improved or recreated and conceive an innovation, it opts for the exploitation strategy (March, 1991; Toni, Nonino and Pivetta, 2011).

2.5.8.3. Codification and Personalization.

Hansen et al. (1999) identified two approaches pertaining knowledge strategy: codification and personalization. Codification refers to the transformation of knowledge such as the tacit knowledge to a format which will allow to transfer and share knowledge. The goals of this approach are the following: 1) to transfer all available and valuable information, except the one of highly sensitive nature, in codified form, store in accessible repositories for further use and dissemination. 2) to work closely with the experts to retrieve expert knowledge and codify, and 3) to use technologies to augment and create new knowledge. The advantage of this strategy exemplifies in the reduction of reinventing the wheel syndrome and that it allows freeing experts' time for more productive activities. The organization can also streamline business processes and free up resources when access to knowledge becomes easier. The other benefit of codification is that it permits knowledge chunking where modules of knowledge can be combined and recombined for new knowledge creation (Cohendet and Steinmueller, 2000).

However, overdependence on readily available knowledge may have detrimental effects as well. It can develop among the workers a tendency of using available knowledge as opposed to creating new. A lack of timely update of knowledge may ensue lost opportunties and lack of personal focus may increase attrition.

Personalization strategy values tacit knowledge more (Hansen at al., 1999). Organizations adopting this approach emphasize importance on the critical role human capital plays (Moitra and Kumar, 2007). This strategy deems that tacit knowledge that workers embody should be transferred with the help of socialization, i.e., person to person meetings, brain-storming, mentoring and apprenticeship (Lave and Wenger, 1991). Companies that adhere to this strategy is focused on human resources where how to hire and retain talents is the key issue. The information system in use is targeted to deliver a social platform like communities of practice, where people can communicate and socialize online as an extension to offline contacts and provide information about who knows what. The biggest drawback of this strategy is a sudden loss of critical talents can be devastating for the organization.

Personalization approach, according to Hansen et al. (1999) is unavoidable if the firm caters individual customers with tailored knowledge products or services based on tacit knowledge of a person or a group. Codification strategy, they concluded should be the preferable choice if the company deals in generic knowledge products and services, with standardized business processes and procedures which can be modified by the needs of the customer. They advanced the idea that whatever the primary strategy the ratio between the two approaches should be 80% to 20%. Some evidence supported this conjecture (e.g., Haesli and Boxall, 2005), but others have determined that if even it might work in the consulting companies, in other industries this ratio will not sustain (e.g., Jashimuddin, 2005). Even such ratio can hurt sectors such as pharmaceutical (Koenig, 2004). Mukherji (2005) proposed that companies in industries such as software industry will be better off if they try to keep a balance between the two approaches.

Application of codification strategy compels the company to make the technology-oriented cultural shift, to adopt new processes, routines, and procedures, and to allocate substantial capital. It can be initially painstaking but once deployed this strategy can bring significant benefits. For example, once the knowledge of an expert is codified, it will stay in the repository for others to access and use. The loss of knowledge due to retirement or attrition will diminish, and importantly, the firm will gain a clearer awareness of existing in the organization knowledge.

Even in recent years, the biggest stumbling block of codification strategy was the necessity of converting all types of data to structured format to integrate to knowledge base and repositories. The use of semantic technology eliminates or reduces problems such as information overload, data reuse (Apostolou et al., 2007), unstructured data (Schulz and Jobe, 2001), and critical knowledge loss (Jasimuddin et al., 2005). These technologies have the capability of interconnecting heterogeneous data format from diverse sources.

Whatever the strategy a company selects, KM can play a crucial role in its success (Lee and Choi, 2002; Lopez-Nicolas and Merono-Cerdan, 2011). Because of this, KM needed to be a vital component of a firm's knowledge strategy and aligned with its business strategy. Only then KM will be powerful enough to improve the company's business performance (Hansen et al., 1999; Smith, 2004; Halawi et al., 2006). The KM strategy must have a holistic approach, where it covers the entire organization from operation to marketing and from production to sales. The stakeholders such as workers of various divisions and the management should be aware of the KM practices implemented in the company.

2.5.9. Strategic Readiness of a Firm

Strategic readiness is the concept that can be defined as companies' extent of preparedness in carrying out a strategy. It includes reading and understanding environmental signals, ability to set and modify goals following the new signals, possessing of necessary or have the capacity to acquire resources and capabilities relatively quickly, and an organizational culture supportive of systematic change (Redding and Catalanello, 1994; Koh et al., 2006).

Strategic potential of a firm and its capabilities to implement a strategy are grounded on various organizational resources (Grant, 1991). Among them, more valuable are intangible assets rather than the tangibles. While the capital requirement for a strategy and the process of evaluating the need of the investment are not difficult to figure out, with intangibles, it is trickier. Besides, technology or knowledge is incapable of generating economic value without supportive elements. Human resources, skills, and competence of workers play an essential role in working with the technology and knowledge assets for extracting real benefits (Kaplan and Norton, 2004). With any new strategy that the firm is planning to implement it needs to consider these aspects. To apply any strategy, three types of intangible assets are necessary (Norton and Kaplan, 2004):

- Human Capital – Talent, skills, and knowledge of the workers
- Information Capital – Knowledge repositories, databases, ICT infrastructure
- Organization Capital – Culture, leadership, people's alignment with goals, ability to share knowledge.

The availability of these resources, how they are applied, and how prepared the company is in embracing new assets in a way prove the firm's capability of deploying and managing other assets including technologies such as a KMS.

2.5.8.1. Human capital. An organization's human capital composes of the workers' knowledge, competence and skills, and internal and external relationships (Edvinsson and Malone, 1997). Buyers, suppliers, partners and company advisers are also a part of the organization's human capital. Workers' skills and experience are formed from years of engagement with the company, training and education received, and knowledge they have accumulated (Sveiby, 2007; Pinto, 2013).

The human capital of a company is a source of innovation and competitiveness (Ling, 2013) and one of the fundamental elements of organizational intellectual capital (Edvinsson and Sullivan, 1996). Stewart and Ruckdeschel (1998) defined intellectual capital as a combination of intellectual elements that include knowledge, information, intellectual properties and experience that are applied to generate wealth.

Human capital is essentially an intangible asset that is a source of a firm's better competitive position. A knowledge worker's skills, learning ability, knowledge base and creativeness contribute to the knowledge resource of the organization.

The social capital of the worker which is the person's relationships with other members of the company, links that the individual has developed with external counterparts, and the ability to exploit these relationships are also constituent parts of firms' human capital (Nahapiet and Ghoshal, 1998).

Knowledge management plays an important role here, as it is utilized for retaining valuable knowledge possessed by workers obviating the loss of knowledge due to employee attrition.

2.5.8.2. Organizational Capital. From the resource-based perspective, Barney (1991) proposed a typology of assets which are physical capital, human capital and organizational capital (Wright, McMahan, and McWilliams, 1994). Skandia's classification (Edvinsson, 1997) however, first divides firm's total capital to financial capital and intellectual capital. Where intellectual capital is comprised of organizational capital, social capital, and human capital. Organizational capital is also considered as one of the two parts of structural capital, where the other segment is the relational capital.

Organizational capital is the resources and assets of the firm that support company operations. These resources include such elements as the culture, norms, routines, and procedures

(Bontis, 1999; Fernandez et al., 2000). It is also referred to the intangibles that stay in the organization when at the end of the day workers go home (Skandia, 1994; Youndt et al., 2004) and as such located in the structured and formalized rules of a firm (Subramanium and Youndt, 2005).

However, for this thesis the following constituent elements of Organizational Capital suggested by Kaplan and Norton (2004) are deemed valuable: company culture, leadership, and alignment of people with goals and teamwork.

Culture. Organizational culture refers to common memes of the organization that includes vision, norms, assumptions, values, symbols, rituals, beliefs, habits and attitudes of the employees and management (Hofstede, 1984; Schein, 1985). Culture embodied within the employees of the company significantly influences the effectiveness and efficiency of various organizational business processes and ultimately impacts on the financial performance of the corporation (Peters and Waterman, and Jones, 1982). Culture can be a precious economic asset for an organization, and it makes a positive impact on various aspects of organizational processes if managed effectively. It can also contribute to a company's performance. However, culture, if not addressed properly, may play a deleterious role in the implementation of any new initiative that includes new technologies including KMS (e.g., Martinko et al., 1996; Armenakis and Bedeian,1999; Wanberg and Banas, 2000; Wilkinson, 2003).

Leadership. Firm's leadership often oversees and steers the strategy formulation process. It is the leader's vision that ascribes a purpose to the organization (Selznick, 1957) and develops shared goals that members of the team strive to achieve (Collins and Porras, 1997). It's the leader's job to formalize and assign structure to the company so that it can perform optimally by the set vision. This vision is also central to any strategic decision the organization pursues (Mintzberg, Ahlstrand and Lapel, 1998). According to the "upper echelons" theory, the formulation of strategy and any strategic decision taken by the firm predominantly originate from the top executives' values, understanding, bias and personal experiences (Hambrick and Mason, 1984).

A forward-thinking strategic approach that shows genuine interest from the leadership allows motivating employees and creating economic value. Consequently, strategic leadership aims to envision and adopt a culture of strategic readiness to change and embrace new approaches when necessary to achieve success (Hitt, Ireland and Hoskisson, 2009). Three critical aspects that leadership should be concerned about pertaining strategy readiness are customer focus, supportive of teamwork and open communication (Kaplan and Norton, 2004).

Alignment. Organizations are holistic systems (Maula, 2006). From the system thinking perspective, a system performs at its best and produces a valid result when all its components are aligned optimally (Bertalanffy, 1950). For a firm to be aligned to achieve corporate goals, management's clear vision, mission and strategy directives must be cascaded down to all employees. Employees after internalizing the information should develop their individual and group objectives in line with the organization's strategy creating a common and shared vision (Kaplan and Norton, 2004).

Teamwork. Like the components of a system, various units of an organization work as self-reliant subsystems. A culture of openness and knowledge sharing within the groups and across the board is crucial for successful implementation of any strategy (see, Damodaran and Olphert, 2000). Strategic readiness requires that teams have a high level of trust, synergy, and culture of knowledge sharing (Armenakis, Harris and Mossholder, 1993). Studies show that knowledge hoarding as a power game is one of the biggest hurdles in successful implementation of any new initiatives (Szulanski, 1996).

2.5.8.3. Information Capital. Firm's information or knowledge resources that can be utilized in the economic value creation processes are referred as its information capital (see, Chase, 1997). Information capital includes knowledge repositories, applications and the portfolio of knowledge assets (Marr, and Adams, 2004). A KMS, for example, is an information capital of a firm. It provides a firm a category of capabilities that are used for leveraging company knowledge assets effectively and develop a unique kind of competency. KMS as an information capital asset can have a transformational consequence on the firm by providing a platform for the creation and recombination of knowledge from diverse sources. However, to gain substantial benefits from a KMS, the company must develop skills and competencies in the effective use of it.

Strategic readiness heavily influences on a firm's innovation adoption (Tornatzky and Klein, 1982; Chwelos et al., 2001; Zhu and Kraemer, 2005; Kim and Garrison, 2010) and innovation capabilities. If a company is not sufficiently prepared strategically and practically, any KM initiative pursued by it can fail (Kang et al., 2008).

2.5.10. Why Knowledge Management

Organizations espouse knowledge management for various reasons. These include streamlining business processes by practical use of knowledge available to the business on different levels, ameliorating decision-making by having access to necessary knowledge at the right time, efficient use of knowledge available to the workers, managing change in the ever-evolving market by assimilating external knowledge quicker. It also covers areas such as developing knowledge repository for valuable knowledge before it gets lost due to attrition or retirement of knowledge workers. And include building communities of practice for employees so that they can communicate, transfer and share knowledge adequately and become more innovative thanks to better access to knowledge and efficient use of it in, for example, new product development (Du Plessis, 2005).

KM can deliver such diverse benefits as competitive advantage, financial performance improvement, Customer satisfaction improvement, market augmentation, business process streamlining. Other benefits may comprise of innovation process improvement: ideation to new product development and R&D to innovation diffusion (Davenport, and beers Long, 1998; Alavi and Leidner, 1999; Edvardsson and Durst, 2013). Since its emergence, KM has been viewed as a benefactor in various organizational issues including as a mechanism and conduit of problem-solving. Massingham (2013) identified seven problems that KM should be directed to resolve:

New employees: New hires go through a substantial learning curve where access to required knowledge is indispensable. For developing necessary skills that their jobs demand, a KM-supported apprenticeship program should be an essential part of the process of learning for them.

Younger employees: A KM supported mentoring, and apprenticeship can be advantageous for fostering a culture of growth.

The gap in corporate capability: Companies must implement a strategically aligned program to eliminate or reduce the gap and pursue capacity building activities. Here also KM can work as a support mechanism.

The slow pace of task completion: Access to knowledge, support from experts, management coordination and monitoring are necessary to improve in this area where KM should work as a platform.

Unused work results: It is a common problem that arises from unclearly set objectives and opacity in understanding the job by a worker. KM tools can be a supporting means to reduce this kind of challenges.

Resource cuts: KM tools can be used to optimize and refine processes and eliminate redundancy.

Low productivity: Ineffective resource use and low quality of the production processes are two main reasons of low productivity. Bringing efficiency in resource utilization, refinement of the production processes and product tool upgrades are some of the factors that contribute to resolving this issue.

2.5.11. Knowledge Process

Knowledge flow within an organization transpires through certain knowledge related activities (see, Sher and Lee, 2004). These activities within knowledge management are called knowledge processes (Wiig, 1995; Alavi and Leidner, 2001; Hoffman et al., 2005). As a vital resource and key component in organization's innovation and competitiveness knowledge needs to be acquired, shared, stored and utilized in an uninterrupted and continuous process. The goal of KM processes is to facilitate the management and employees of the company to create new knowledge, boost research and development, invent new products, services, and processes, develop new strategies and business models. KM processes are aimied at solving problems, helping to execute tasks efficiently, and supporting activities like learning, creative thinking, and decision-making (Borghoff and Pareschi, 1998).

There are four stages of the knowledge flow of a firm: identifying knowledge, aggregating it to a repository, disseminating and using knowledge. Knowing how these steps work is vital for KM success of a company along with supporting, measuring and managing knowledge flow processes (Demarest, 1997).

Since Knowledge Management processes are a linear continuation, there is no commonly accepted precise boundary between one process from another. One method of categorizing it is to divide the processes between the ones used for enhancing firm's knowledge capital from the others, which are concerned with knowledge application (Grant, 2016). In general terms, these are knowledge generation and knowledge application (Spender, 1992) or knowledge exploration and knowledge exploitation (March, 1991).

Grant (2016) mentioned a typology of knowledge consisting of knowledge generation or exploration: creation and acquisition, and knowledge application or exploitation: integration, sharing, replication, storage and organization, measurement and identification.

There are several incongruities in this classification such as knowledge identification is a required component and prerequisite for knowledge acquisition, knowledge replication could also be considered as a part of knowledge generation, and finally, knowledge must be integrated first so tht it can be exploited.

These differences show that organizational knowledge processes are fluid enough to be overlapped within a classification (figure 8 below).

CITED FROM	DESCRIPTION OF PROCESSES						
DeLong, 1997	capture			transfer		use	
Leonard-Barton, 1995	acquisition				integration	experimentation	collaboration
Teece,1998	assembly	creation		transfer	integration	use	exploitation
Skyrme and Amidon, 1996; Spender, 1996)		creation		transfer		use	
Wiig, 1995		creation	manifestation	transfer		use	
Gold et al., 2001; Lee et al., 2011	acquisition		conversion		application		
Skyrme and Amidon, 1998	assembly	creation		transfer	integration		exploitation
King et al., 2008	acquisition	creation	refinement	transfer		utilization	sharing
Holzner et al., 1979	consciousness		extension	transformation		implementation	protection
Pentland, 1995	construction		organization	distribution		application	storage
Nissen et al, 2000		create	organize	distribute		apply	evolve
Nonaka et al, 1995		creation	access	dissemination		application	
Demarest, 1997	construction		embodiment	dissemination		use	
Daal et al, 1998		creation	draw-up	dissemination		apply	evaluate
Davenport, et al., 1998		create		transfer		asset management	
Liebowitz., 1999	identify,capture		store	share		apply	sell

Developed for this study

Figure 8: KM processes

Other scholars have regarded knowledge processes from a more simplistic perspective such as a set of components that comprises 1) creation, manifestation, use, and transfer (Wiig, 1995). 2) acquisition, conversion, application and protection (Gold and Malhotra, 2001; Lee et al., 2011). 3) create, transfer, assemble, integrate and exploit (Teece, 1998). 4) acquire, collaborate, integrate and experiment (Leonard-Burton, 1998). 5) create, transfer and use (Skyrme and Amidon, 1998). And from KM system perspective, create, organize, formalize, distribute, apply and evolve (Nissen, Kamel and Sengupta, 2000). Each of these processes may consist of multiple sub-processes which also varies from one typology to another. Heisig's (2009) research, however, showed that the most reviewed in literature KM processes are acquisition, codification, application, creation, storage, and sharing.

There are also more elaborate conceptualizations of the KM processes which tried to encompass several other peripheral aspects of knowledge management activities: Choi and Lee (2002) viewed KM processes as initiating, generating, modeling, storing, distributing and transferring, using, and retrospecting. From a little different perspective, Demarest (1997) suggested that KM activities include underpinning, observation, instrumentation and optimization and these are consecutive processes.

All these classifications by and large refer to similar processes but differ mainly due to diverse types of conceptualization (Andreeva and Kianto, 2011). In this thesis, the typology used consists of Knowledge Acquisition, which is knowledge searching, finding and integrating from external sources, Knowledge Accumulation, which is codifying, organizing and storage, Knowledge Application, which is use and creation, and Knowledge Dissemination, which is sharing and transferring. The reason for selecting this classification is it corresponds with processes deployable in a KM system with a clear framework.

2.5.11.1. Knowledge Acquisition (Search, Find and Integrate).

Firms own a combination of knowledge resources and skills (Kogut and Zander, 1996). One of the main explanations of a company's sustained competitiveness is its superior capability of acquiring, creating and sharing knowledge (Ghoshal and Moran, 1996).

Knowledge acquisition is the knowledge related activities of searching and finding knowledge from external sources and integrating it into organization's current knowledge base for further use in knowledge creation (Holsapple and Singh, 2001). It is a vital process of firm's learning that augments knowledge base and its boundary by adding knowledge from a rapidly changing external environment (Nonaka, 1994). Acquisition of new knowledge is essential for developing a strategic plan and making strategic decisions based on an adequate level of knowledge. Strategic decisions grounded on a sufficient and fair amount of knowledge facilitate companies to stay competitive and improve their performance (Chen, 2004). Knowledge from external sources are the cradles for firms to discover new opportunities and successfully exploit them (Penrose, 1959). The growth of a technology firm often sprouts from knowledge acquired from partners and other sources combined with firm's knowledge (McDougall, Shane and Oviatt, 1994). While in the present quickly shifting market environment all businesses desperately need access to external knowledge, for technology companies, it is more crucial because a continuous renewal of knowledge is critical for their survival (Autio, Sapienza and Almeida, 2000). With rapid technological advancement, it is impossible for any firm to develop all necessary knowledge in-house. In this case, acquiring critical knowledge before rivals is imperative because it facilitates the company to gain competitive advantage (Chen and Lin, 2004; Zahra and George, 2002). Consequently, the ability to acquire knowledge from exogenous source effectively is a competence that can enhance firm's productivity and performance (Deng, Doll and Cao, 2008; Chang and Lee, 2008).

Moreover, organizations should pursue externally sourced knowledge actively as the more knowledge absorbed from external sources, the better the chances of knowledge recombination and generation (Cohen and Levinthal, 1989) resulting in higher growth in creativity and innovation. Firms can develop capabilities that induce recognition of new possibilities and capture of new business opportunities thanks to the aggressive acquisition of external knowledge which in turn leads to better innovation (Zhou and Uhlaner, 2009; Deng, Doll and Cao, 2008; Chang and Lee, 2008). Knowledge acquisition, however, brings more value for the companies that have in-depth knowledge of the relevant subject matter in the form of supported knowledge in R&D, market development and innovation (Lee and Zhou, 2012).

Merger and acquisition, joint ventures, consultants, suppliers and customers, employee training and hiring used to be the traditional sources of knowledge (DeNisi, Hitt, and Jackson, 2003). Now thanks to the Internet, ICT, and KMS, bigger focus is also given to experts' tacit knowledge, documents, the Web, multimedia content, big data, and partners those who possess knowledge requiring codification. Knowledge acquisition from the KMS perspective is a goal-oriented process which includes the sub-processes of knowledge searching, discovery, and integration. Knowledge search is a sub-process that is used when a piece of information is actively sought for with the further intention of acquiring it if the information is deemed valuable (Huber, 1991; Wilkesmann, Wilkesmann and Virgillito, 2009). Knowledge search presupposes scanning the environment for a specific knowledge that the organization at present lacks (Rosenkopf and Almeida, 2003; Rosenkopf and Nerkar, 2001).

Knowledge search. Knowledge search is a prerequisite for learning. Knowledge is sought either for immediate use or accumulated for later use. An efficient search system that has access to the extensive amount of information from all potential sources of required knowledge and user-friendly enough for an intuitive query is capable of lessening one of the biggest problems of a firm, which is dynamic knowledge creation (Nonaka, Krogh and Voelpel, 2006). From an organizational perspective, knowledge search differs in two dimensions: scope and depth. The search depth refers to the ability to find and reuse the existing knowledge of the firm. The search scope means the range of knowledge domains that the company explores to find new knowledge (Katila and Ahuja, 2002). Both dimensions are crucial for firm's innovation quest.

An important derivative of a search process is that it demonstrates how the employees are interacting with the KMS and how effective is this interaction (Collinson and Wilson, 2006). The search process is different when applied to an external source from an internal source. Semantic KMS where sources are integrated for allowing maximum exposure to both external and internal sources simplify the search process.

Semantic search engine goes further than a query for certain keywords. It has the capability of processing natural language, and it grasps the relationship and meanings of the terms. It also has the capacity of perceiving domain specificity of a term.

The goal of the semantic search is for machines to own human-level understanding of a question and to deliver the query result also at the level of human experts or even better (Sudeepthi, Anuradha and Babu, 2012).

Knowledge Identification. Knowledge Identification is one of the processes within knowledge acquisition (Quintas, Lfrere and Jones, 1997; Snowden, 1998; Heisig, 2009). Finding the right knowledge often requires conducting an active search process. Before that, however, the searcher must have the cognizance of the particular knowledge need. Several important factors of successfully finding and identifying knowledge are 1) a clear understanding of the object of the search, 2) where this knowledge might be located, and 3) what process is necessary to use for finding the desired information. The searcher also needs to possess adequate prior knowledge base to recognize the value of knowledge retrieved from the various types of queries conducted and identify the one best fits. Scanning of the possible external resources is necessary if knowledge is unavailable in the local knowledge-base. The semantic KMS is built with the objective in mind to encompass all possible sources of domain knowledge relevant to the firm and help the user to identify associated to the query information if even the right information is unavailable.

Knowledge Integration. In the process of doing business and solving various problems, the available knowledge within the organization is not always enough.

The firm needs to search, identify and add different knowledge from external sources to its knowledge base continuously for improving efficiency in knowledge use, creation, and recombination (Alavi and Leidner, 2001; Magnier-Watanabe and Senoo, 2008). The integration of new knowledge to previously available knowledge is imperative for building a robust knowledge base. For the integration of acquired knowledge from an external source, it needs to get formalized, structured, organized and then only merged to the prior knowledge. Occasionally, it is necessary to mold the existing knowledge structure so that new knowledge can be accommodated. The knowledge integration process is involved in acquisition and assimilation of both explicit and tacit knowledge (Zack, 1999). Depending on the knowledge strategy of the organization, it can be proactive in the acquisition of knowledge by searching and obtaining knowledge that has intrinsic value, but no immediate need or it can acquire knowledge as it is required. Knowledge integration to semantic repositories differs from the conventional method of adding information to databases is in Semantic repositories content can reside in any format.

2.5.11.2. Knowledge accumulation (codify, organize and store).

Active accumulation of knowledge is necessary for a firm to gain value from managing knowledge flow and knowledge activities (Gates, 1999). The collection of knowledge available to employees is a resource that can be fundamental to a company's core capabilities.

Without a well-endowed knowledge collection in a firm, it is hard for employees to perform their business activities efficiently (O'Dell and Grayson, 1998) since knowledge is increasingly becoming the primary resource for the production and processes (Toffler, 1990). Most companies now encourage their employees to contribute to the knowledge collection process that enhances the capabilities of the firm's knowledge repository and augments domain knowledge. Moreover, it is now commonly accepted that extensive knowledge resource and intellectual properties are a source of competitive advantage of a firm (Leonard-Barton, 1995).

The process of knowledge accumulation is vital to the creation of a robust knowledge resource for the company (Hanley and Dawson, 2000). Accumulation of knowledge also creates externalities that may play a significant role in creativity and innovation activities of the firm (Krugman and Obstfeld, 2000). Continuous accumulation of technical, operational and domain knowledge, and providing access to them with the means of advanced technologies create a strong ground of innovation activities (Foray, 1998). The accumulated knowledge also works as a determinant of innovation success as knowledge aggregated from external sources also boosts the chances of identifying technology opportunities for an organization (Teece, 2007). For knowledge accumulation to become a potent resource, the process must be structured and systematized (Davenport and Pruzak, 1998) After all, the economic value derives not from knowledge accumulation but its practical use and creation (Zack, 2002). A semantic KMS provides necessary elements for structuring the knowledge accumulation process far superior to a conventional method.

Knowledge codification. The objective of codification is to transform acquired knowledge to a viable format so that it can be added to the repository.

Codification is necessary for the externalization of experts' knowledge and knowledge that is in a multimedia format such a video and audio that needed to be converted to textual format. Presently, AI agents bolstered with machine learning, NLP and semantic technology can execute this in realtime. The codified knowledge later gets integrated to knowledge repositories. One of the most vital elements of a KMS is its codification tool (Ruggles, 1997).

Knowledge organization. Once knowledge is integrated and codified, it must be organized or formalized and assimilated with the existing knowledge base.

In a traditional database-based repository, this means categorization of the data and aggregation to the database. However, it is a complex process that gets complicated by a myriad of available data format, the intended use of the data and how it should be categorized for its practical later use. The reduction of uncertainty and complexity related to knowledge content is handled by the organization process which is the formalization of knowledge content by its format, structure, and type (Arms, 2000). Semantic technology, however, eliminates the need for such hard formalization of knowledge.

Knowledge storage. Obviously, one of the primary storage of knowledge, especially the tacit type of knowledge, is the human mind. A database-based repository is highly formalized and structured and most commonly used knowledge bin in organizations presently.

In a conventional KMS, human intervention in the formalization of knowledge content is desirable and necessary. The attempt of process automation of knowledge content aggregation is often only partially become successful in traditional KMS. It is hard to accommodate a piece of information if it is unstructured and not escorted with metadata. Considering the explosion of unstructured and semi-structured data in organizations and at the Web level, maintaining a correctly categorized and well-organized repository is increasingly becoming more difficult despite the availability of many tools. Ontology-based semantic repositories are meant to resolve this issue and specially fit for managing unstructured and semi-structured knowledge content (De Vergara, Villagrá, and Berrocal, 2002).

2.5.11.3. Knowledge application (use and creation).

Knowledge application takes place when organizations use and create knowledge. From production perspective, knowledge application refers to the process of creating value by adding, embedding and incorporating knowledge into a firm's production process, product, and service (Wiig, 1997).

Knowledge use. From the innovation standpoint, it is the utilization of knowledge from opportunity identification to commercialization (Song, Van Der Bij, and Weggeman, 2005). As innovation is also regarded as a combination and recombination of acquired knowledge with existing knowledge, knowledge is applied at every node of innovation lifecycle (Schoonhoven, Eisenhardt, and Lyman, 1990). Often the leading resource of R&D, for example, is new and base knowledge. The aim of innovation in this respect is to create new knowledge by applying available knowledge.

Knowledge is also continuously implemented in the streamlining and refinement of operational processes (Becerra-Fernandez, and Sabherwal, 2014). In the supply chain, from the selection of a supplier to shipping and handling, each stage requires an application of new knowledge to refine the processes and stay competitive. Knowledge application also means its use in decision-making and problem-solving. Well-informed managerial decisions reduce costly mistakes. In changing market conditions, it is essential to acquire and apply new found knowledge for improved decision-making. Dallier et al. (2007) emphasized knowledge application and growth considering them the critical outcomes of knowledge processes of a knowledge management initiative.

Knowledge creation. Knowledge creation means to generate knowledge as ideas, solutions, innovation, enhancement, recombination and as a complete new knowledge (Nonaka, 1994; Von Krogh, 1998; Von Krogh, Ichijo and Nonaka, 2000; Smith, Collins and Clark, 2005). New knowledge is embodied in improved or new product, process, service and business strategy (Popadiuk and Choo, 2006; Esterhuizen, Schutte, and Du Toit, 2012).

Knowledge creation does not occur from a blank slate. Existing knowledge base, absorptive capacity, and knowledge acquired and assimilated are vital for knowledge creation (Smith, Collins and Clark, 2005). While any employee, process, and system can produce, knowledge workers are the most prolific generator of knowledge (Chen and Edgington, 2005). Superior knowledge creation capability of the organization can evolve into its core competence (Leonard-Barton, 1995).

Proper management of knowledge is necessary to create true competitive advantage. Argote and Ingram (2000) denoted that knowledge transfer and knowledge creation are required processes for an organization's competitive advantage. Organization's knowledge creation capability stands on how effective it is in acquiring knowledge from external resources, the learning ability of the employees, technology use, absorptive capacity, and workers' motivation and organizational culture.

In KM one of the most popular models of knowledge creation is SECI model of knowledge conversion process, figure 9. This model includes four different methods of knowledge conversion:

- *Socialization* – knowledge-transfer by social interactions. The outcome of this is tacit to tacit knowledge conversion,
- *Externalization* – transfer of human embodied knowledge to explicit via codification,
- *Combination* – knowledge conversion and mixing of explicit with explicit,
- *Internalization* – knowledge extraction and adoption through the process of learning (Nonaka, Toyama, and Konno, 2000).

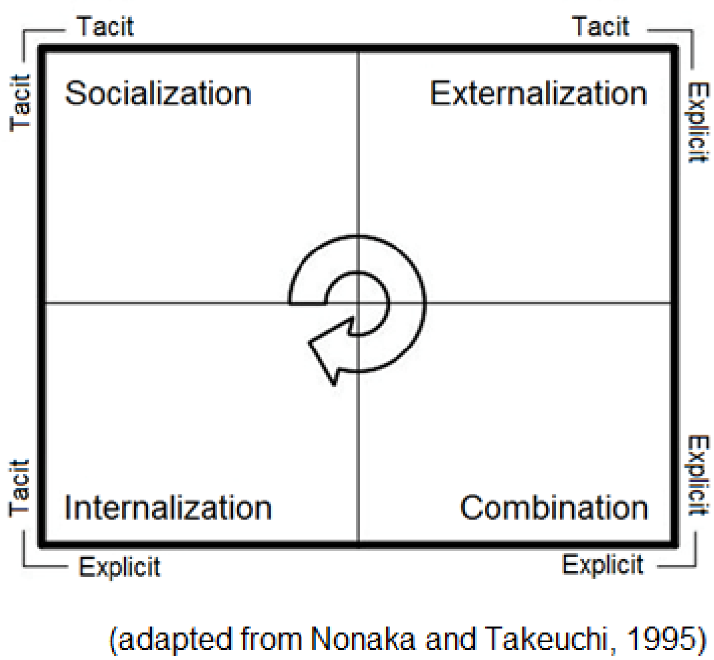


Figure 9: SECI model of Knowledge process

KMS is an enabler of knowledge creation by facilitating tools for knowledge access, sharing and content producing (Bukowitz and Williams, 1999).

2.5.11.4. Knowledge dissemination.

It refers to the mechanisms and routines related to the diffusion of knowledge within an organization (Van der Bij, Song and Weggeman, M. (2003).

Since knowledge is embodied in different individuals and different silos of the organization, firms need robust knowledge diffusion mechanisms to leverage on knowledge possessed by employees and provide them with tools to access required knowledge (Melymuka, 2000). Effective dissemination facilitates employees to improve their knowledge, hone their skills and produce creative ideas (Mahnke et al., 2005). Dissemination of knowledge induces collective learning and brings symbiotic knowledge creation (Nonaka and Takeuchi, 1995; Nonaka and Konno, 1998). The improved knowledge dissemination assists and widens knowledge exposure which helps workers to advance their productivity and firm's performance (Darroch, 2005). The newly embedded knowledge in the refinement of the processes also creates a ground for better competitiveness (Grant, 1996).

Knowledge sharing. Effective sharing of knowledge is linked to faster market response (Sher and Lee, 2004), organizational learning capabilities (Lin, 2007), organizational change (Vaccaro et al., 2010) and innovation (Taminiau et al., 2009). Knowledge sharing as a critical research area evolved from technology transfer, innovation, and strategic management.

Knowledge sharing in broader context relies on what is the relationship between the source of knowledge and the recipient (Hansen, 1999). It also bases on factors such as the location of knowledge and its form (Zander, 1991; Szulanski, 1996), recipient's intention, readiness (Yeung et al., 1999) and absorptive capacity. The source's knowledge sharing capability (Davenport and

Prusak, 1998), and the environment where knowledge sharing is taking place (Rousseau, 1985) are also important.

While organizing and adopting a knowledge sharing mechanism, from the management viewpoint several details needed to be acknowledged. These are what type of knowledge are planning to be shared, in which form and where this knowledge is located. What method, system, and technology would be necessary to enable sharing of this knowledge and how the parties are motivated to take actions that facilitate knowledge sharing.

Knowledge sharing does not directly impact on the improvement of organizational performance. However, performance does magnify thanks to knowledge sharing as an intermediary conduit influencing a decision-making, problem-solving, and innovation.

Knowledge sharing is a knowledge-related activity where to make knowledge reusable and available to others a conscious effort of knowledge transfer takes place (Lee and Al-Hawamdeh, 2002). Bordia et al., (2004) indicate that knowledge sharing is a corporate citizenship behavior. For firms to function properly, it is necessary that employees share knowledge without expectation of any reward.

In a corporate domain, knowledge is often practiced as a bargaining chip in a power struggle, and in the manipulation of interpersonal relationship (Inkpen, and Beamish, 1997). People often hoard valuable knowledge and accept knowledge from others reluctantly (Davenport, 1997). This knowledge hoarding often works as an impediment to knowledge application, creation, and innovation. The willingness of the employees to share knowledge and access to the important channel to do this efficiently within a team and across divisions are imperative in generating new ideas and facilitating innovation (Wang and Wang, 2012). How people are motivated (Osterloh and Frey, 2000) to share their knowledge with other stakeholders are conditioned by the culture embedded in the firm. A culture conducive to supporting knowledge sharing is attributed to factors such as level of trust (Levin and Cross, 2004), ownership of knowledge, learning intention (Baker and Sinkula, 1999) shared objectives, and fairness in dealing with knowledge sharing.

Knowledge transfer. Knowledge sharing and transfer improve firm's innovativeness, competitiveness and financial performance (Argote and Ingram, 2000), facilitate and strengthen group dynamic and bolster work satisfaction. Knowledge transfer sometimes refers to the inter-unit knowledge movement rather than among individual (Szulanski, Cappetta, and Jensen, 2004).

For actual transfer of knowledge to take place available knowledge should be considered by the recipient as meaningful, accurate, valid and innovative. Levin and Cross (2004) argued that these indicators adequately reflect organization's knowledge transfer effectiveness.

2.5.12. Knowledge Management (KM)

An organization's growth depends squarely on its ability to use knowledge effectively (Salojarvi, Furu and Sveiby, 2005). The need for growth makes managing organizational knowledge flow and activities related to it imperative (Davenport, De Long and Beers, 1998).

KM is a management tool which was introduced in the early 1990s to improve productivity and effectively utilize company knowledge resource and generate economic value (Kabir, 2014). Two factors made the proliferation of knowledge management possible. First, the advancement of technology that created the necessary technological base for information management. Second, and more importantly, the understanding at social and corporate levels that knowledge is becoming the key factor in economic growth replacing other resources. Knowledge management finds its roots in various fields that include information technology, HR management, total quality management, organizational science, and cognitive science (Prusak, 2001; Dalkir, 2005). Since the concept differs significantly based on the focus area, its definition, and conceptual understanding also vary accordingly. The technological impact on knowledge management is indubitably profound. The advent of the Internet gave broad access to information, new tools and applications made knowledge creation easier and knowledge dissemination simpler. Cheap storage allowed exponential growth of knowledge and technology use created the breeding ground for innovation at corporate level improving company performance (Junnarkar and Brown, 1997).

The emergence of KM transpired due to following reasons. Managing organizational knowledge related processes within the firm's business operations were increasingly becoming essential for improving productivity, innovation and strategic growth initiatives in the 1990s. New computational tools and technologies that surfaced at that period indicated the possibility of their application in taming in the complex issues pertaining firm's knowledge activities. Consulting companies started to take advantage of this new opportunity which resulted in the creation of the domain "Knowledge Management" (Wiig, 1997; Prusak, 2001; Alavi and Leidner, 2001; Ives, Torrey and Gordon, 1997; Barclay and Murray, 1997).

Consultants initiated the domain of KM and added the word management to it for a reason. From their perspective, KM is not meant to manage knowledge per se, but activities related to it. After all, all business-related issues represent certain processes requiring control and management such as marketing management, sales management, innovation management and strategy management (Alvesson and Kärreman, 2001; Prusak, 2001).

KM is engaged in implementing knowledge-related company strategies, policies, methods, and techniques to acquire a competitive edge from knowledge. KM does it by streamlining, optimizing, and enhancing processes and practices of knowledge flow in innovation, operation and collaboration (Wiig, 2000; Alavi and Leidner, 1999; Davenport, De Long, and Beers, 1998). KM addresses the matters related to knowledge assets and creating value from them (Felin and Hesterly, 2007; Rastogi, 2002). It is a systematic framework that helps to improve organizational knowledge flow through the processes of capturing, assessing, selecting, filtering, using and sharing both tacit and explicit knowledge (Wiig, 1997).

A firm concerned about developing skills and competencies for the use of its intellectual properties and other knowledge resources should deploy KM. KM helps the company to build solid knowledge assets, strengthen capabilities of knowledge generation and application to achieve set objectives. It enables individual knowledge workers to improve their knowledge base, efficiently share their knowledge, enhance their contribution to collaborative projects and creating new knowledge for the organization (Guns and Välikangas, 1998). Apart from improving system-wide knowledge flow, KM is also an important exercise in gaining access to individual skills and knowledge that are deeply embedded in a person and make it available to others so that they can use it in their decision-making processes benefiting the organization (Dalkir and Liebowitz, 2011).

KM is also a vital tool in harnessing the collective knowledge of the firm and leveraging knowledge for building a foundation of the company's success. As a multidimensional framework, it encompasses structure, culture, business processes, people and knowledge resource (Goh, 2005;

Vera and Crossan, 2003; Gooijer, 2000). It is a conscious effort of a firm supported by systematic practices that scan, discover, filter, maintain, structure, create and transfer knowledge that enhances productivity, innovation capabilities and results in improved competitiveness (Bergeron, 2003). KM is an optimization and improvement process that includes organizational learning, knowledge creation and knowledge distribution (Argote, 2012).

KM sets a proper foundation for company-wide intelligent decision-making on a continuous and sustainable way (Courtney, 2001). It exposes the company to various other possibilities and new opportunities in solving issues and reveals new ways of handling them in gaining optimized outcome. KM improves a company's problem-solving capabilities (Andreu and Sieber, 1999), efficient use of its IP, develop talents, improve learning abilities and significantly enhance the chances of gaining access to new market opportunities (Quintas et al., 1997).

KM addresses the issues about knowledge capture, use and distribution (Davenport,1994). The goal of the KM application is searching, finding, capturing, assessing, assimilating, extracting and distributing knowledge vital for organization's success (e.g., Leonard-Barton, 1995; Inkpen and Dinur, 1998; Alavi and Leidner, 2001; Lee and Choi, 2003). Data and information are key ingredients in these processes and include Web-based and company's internal structured and unstructured content, databases, files, documents, apps, and agents from the explicit perspective. From the tacit perspective, they include skills, yet-to-capture personal knowledge, collective norms, cultures, memes, heuristics and esoteric expert knowledge (Duhon, 1998). KM supports improved knowledge use thanks to better communication, collaboration, access to learning, and distribution of knowledge assets (McInerney, 2002). KM is a set of processes, techniques, and procedures that maximize benefits from company knowledge assets (Teece, 2000). It facilitates the company to make intelligent decisions based on comprehensive access to contextual knowledge that ensures improved chances of success (Wiig, 1997).

2.5.12.1. Definitions of KM.

Definitions of Knowledge management abound in the literature (Liebowitz, 1999 but none of them are specific, common, and widely accepted (Schultze and Stabell, 2004). KM, according to Beckman (1999), is aimed at creating new capabilities, bolstering productivity, ameliorating performance, adding to customer value creation, and enhancing strategic growth through systematizing knowledge asset and workers' expertise. It is recognized as an umbrella term (Coleman, 1999) for wide varieties of activities related to organizational knowledge flow.

According to Bergeron (2003), KM is a calculated and methodical strategy for business optimization which identifies, acquires, organizes, secures, aggregates and disseminates critical for business information for improving workers' competencies and firm competitiveness.

Davenport and Prusak (1998) defined KM as the processes, practices, and modes for obtaining, sharing, and transferring knowledge within a firm or from stakeholders located outside of the firm.

Newman and Conrad's (2000) determined KM as "a discipline that seeks to improve the performance of individuals and organizations by maintaining and leveraging the present and future value of knowledge assets. Knowledge management systems encompass both human and automated activities and their associated artifacts."

Schultze and Leidner (2002) considered KM as "the generation, representation, storage, transfer, transformation, application, embedding, and protecting of organizational knowledge."

Massey et al., (2001) concluded KM is about "helping people share and put knowledge into action by creating access, context, infrastructure, and simultaneously reducing learning cycles."

Based on Teece's (2000) earlier work, our working definition of KM is as follows: KM is a managerial activity involving knowledge-related processes, procedures, and techniques used for creating value from organizational knowledge assets.

2.5.12.2. KM goals.

Generating economic value by leveraging knowledge resources is the primary aim of an organization for deploying KM (Nickols, 2000). The factors that motivate the management of a firm to implement KM include avoiding reinventing the wheel, improving knowledge creation process, mitigating risks, accelerating innovation cycle and reducing loss of knowledge due to attrition (Dalkir and Liebowitz, 2011).

Over the years, the KM goals companies pursue have been formalized and are comprised of one or more of the following (see, for example, Rubenstein-Montano et al., 2001; Richter et al., 2013; Maier and Remus, 2002):

1) Improve methods, processes, creativity and knowledge base for innovation, innovative products and services, marketing and business strategies.
2) Enhance efficiency in operational processes such as improving supply chain and reducing the cost of various procedures.

3) Improve decision-making and problem-solving capabilities by delivering, sharing and allocating access to just-in-time knowledge to individuals and community.
4) Improve competitiveness by identifying, acquiring, mixing and using knowledge from external and internal sources.
5) Enhance productivity of knowledge workers by accumulating, sharing and transferring knowledge.

2.5.12.3. KM success factors.

The success of KM originates from the clarity of four components: business strategy, content, context, and technology (Martin and Casadesus, 1999) that mean to have clear answers to the followings (Wong, 2005; Hasanali, 2002; Davenport, De Long, and Beers,1998; Akhavan, Jafari and Fathian, 2006):

First, the objectives of the KM – What is the goal of the company's knowledge management project? An important element is that this goal must be aligned with company's business strategy.

Second, what type of knowledge is the focus? Depending on the kind of knowledge, an entirely different set of tools, processes, and methodologies would be required.

Third, where the use, maintenance, and creation of knowledge will take place? A divisional KM project varies significantly from a corporate-wide initiative.

Fourth, how and using what mechanism and technology this goal will be achieved? Selection of frameworks, tools, and methodologies will rely on the position taken in the first three strategic questions.

In literature, various factors have been proposed as enablers of KM success such as knowledge quality (Kulkarni, Ravindran and Freeze, 2006), supportive organizational culture

(Beckman, 1999), required technological resources and infrastructure (Jennex and Olfman, 2006), and supportive management (Jennex and Olfman, 2006). Other factors include strong leadership (Davenport, 1996), employee empowerment (Liebowitz and Beckman, 1998), a proper KM strategy (Jennex and Olfman, 2006), community trust (Ford, 2004), and a learning organization (Starbuck, 1997). An earlier work identifies seven key success factors (Skyrme and Amidon, 1997): an apparent connection to the needs of the business, distinct vision, mission and framework, strong knowledge leadership, a culture conducive to knowledge sharing and flow, a learning culture, KMS infrastructure quality, and well-determined knowledge processes. Others conclude the following five factors could have a positive influence on the success of KM initiatives: competitiveness, focus on the customer, good employee relations and their development, innovation and lower cost (Skyrme and Amidon, 1997).

2.5.13. Knowledge Management System (KMS)

Knowledge Management System (KMS) is an ICT based platform that supports KM activities by integrating functionalities which are required for smooth handling of knowledge for a division or an entire organization (Lee and Hong, 2002; Havens and Knapp, 1999). With KMS knowledge workers receive access to a set of integrated services that improve their ability to conduct knowledge-intensive business processes substantially (Alavi and Leidner, 2001).

KMS is a generic term for ICT-based knowledge activities and support tools (Hendriks, 2001). No boundary constrains what tools and programs constitute a holistic KMS. KM systems are a result of an evolutionary process which is continuing till today. The precursors to the present understanding of KMS are executive information systems, decision support system, and expert systems (Firestone and McElroy, 2003).

The possible effects of KMS on the companies have been studied thoroughly from various perspectives starting from the late 1990s (see, Alavi and Leidner, 2001; Wiig, 1997; Meso and Smith, 2000). Firm's sustainable competitive advantage does not just occur from the exploitation of a single resource; it is always an amalgamation of different resources with distinctive capabilities that create the desired outcome (Prahalad and Hamel, 1990; Galunic and Rodan, 1999). Although KMS plays a vital role in knowledge creation and capacity building that in turn help to construct core competencies of a firm, it requires working with other resources and capabilities to become truly beneficial (Adams and Lamont, 2003). Teece et al. (1997) argued that the firm's ability to use its technological, organizational and managerial processes efficiently at the time of faster technology changes, is instrumental to its future success. KM tools are essential in the organizational processes related to new knowledge creation and innovation. Since these tools and systems are so quintessential to the overall success of the innovation-oriented firms, companies' need to monitor, analyze, evaluate and implement technologies that can make a significant improvement of these instruments (Adams and Lamont, 2003; Du Plessis, 2007; Week, 2000).

A review of KM systems in literature found various tools which have been used in KM activities. These include artificial intelligence, competency management systems, search and retrieval systems, decision support systems, digital repositories, group support systems, data mining tools, intelligent agents, data warehousing, virtual collaboration tools, knowledge maps, knowledge portals, knowledge-based systems and learning support systems (Nevo and Chan, 2007). These tools can work as a stand-alone application or act in combination with others. However, tools for knowledge capture and creation capabilities are most critical among them (Maier and Remus, 2002).

2.5.13.1. Definition of KMS.

KPMG (1999) defined KM systems as 'the web of processes, behaviors, and tools which enable the organization to develop and apply knowledge to its business processes.' A portion of knowledge management does not require technology involvement; however present knowledge management is difficult to imagine without ICT use.

KMS is a dynamic, complex and systemic composition of various facets that include technology, firm's learning capabilities, Intellectual and knowledge resource, knowledge processes and strategic aspects (Becerra-Fernandez et al., 2004). It is also viewed as a four-level system that includes at the first level ICT, at the second level applications and agents, on the third level knowledge employees and human interaction, and at the final level organizational strategic objectives, routines, practices, and procedures.

Adoption of a KMS is a long-term undertaking. Its success comes from its continued use and refinement. Implementation of any ICT-based system and continuity in its utilization hinges on many factors. One of them, for example, is prior experience (Taylor and Todd, 1995; Karahanna et al., 1999).

Based on Alavi and Leidner (2001), we develop our working definition of KMS as Knowledge Management Systems (KMS) are ICT-based infrastructure aimed at organizing and facilitating knowledge-related activities.

Difference Between KMS and Information Management System. The characteristics of KMS and requirements to it are very different from an Information Management Systems (IMS) even though KMS mostly bases on ICT like IMS. The divergence mainly stems from the objectives and purpose of the technology employed in each case.

While most IMS works with structured data, the central domain of KMS is unstructured and semi-structured content, which is estimated as almost 80% of the organizational information volume (Lindvall, Rus, and Sinha, 2003; Ferrucci and Lally, 2004). One of the fundamental puzzles that KMS is deemed to resolve is how to deliver knowledge at the direct touchpoint promptly to apply in solving a pressing problem (Schwartz, Divitini and Brasethvic, 2000).

2.5.13.2. KMS value analysis.

The implementation of KM tools in a firm is a complex process that requires extensive value analysis (Duffy, 2001). Selection of KM tools is one of the aspects of broader company knowledge strategy.

The value analysis often includes knowledge audit, knowledge map, technology requirement, stake holders' requirement and cost-benefit analysis (Teece, 1998; Chen and Chen, 2006). KM is a continuous process of recurring knowledge activities and needs strategic management of these processes. The KM strategy must cover the development of policies related to knowledge flow processes, implementation of those policies, actively monitoring the effectiveness of the policies and their implementation mechanisms, and assess the real benefits they produce (Demarest, 1997). As tacit and explicit knowledge have very different representations, approaches to policies, practices, routines and procedures for each of them need to be well thought out and balanced by the strategic need of the firm. In strategy building the emphasis should be on all critical components of KM including people, culture, technology, information and knowledge flow, and knowledge activities.

Firms deploy ICT for productivity improvement, streamlining processes and work practices, and better use of resources which allows firms to become nimbler, agile and competitive (Bresnahan, Brynjolfsson and Hitt, 2002).

Whenever a new module of an ICT is deployed it brings technology knowledge from external sources and facilitates the firm to improve its communication capabilities, knowledge flow, innovation capabilities and generate new knowledge (Brynjolfsson and Hitt, 2000; Kogut and Zander, 1993; Nelson and Winter, 1982).

While many of KMS software are possible to develop in-house most firms are motivated to invest in outsourced systems freeing internal resources for more valuable objectives focused on product refinement, operational improvement, new market development, marketing, and sales. Also, important to note that KM enabling software is programmed for converting information contextually, assigning meanings and attributes for further use as knowledge and as such differs from conventional information technology systems (Tuzovsky and Yampolsky, 2003). Moreover, investment in KM-related ICT helps to access knowledge from external sources, streamlines internal knowledge processes and build new operational competencies and skills. Firms with higher competencies in operational, technical and managerial skills tend to be more innovation prone and more competitive. Additionally, technology implementation brings a positive organizational shift to the firm thanks to new methods and processes that get deployed along with the new technology forcing the firm to adopt changes in various business processes and procedures (Henderson and Clark, 1990).

ICT is the underlying technology backbone of the KMS and enabler to KM processes. The technology choice for KMS should base on a tripartite analysis of what knowledge is needed, who needs this knowledge and how this knowledge should be communicated to the stakeholders. Firms also need to consider the context, culture, educational level, absorptive capacity along with the business objectives, resource need, and available capabilities while taking a decision on wheather and how to deploy a KMS. Understanding these issues will simplify the process of technology selection. For example, many of the knowledge-related matters that small enterprises require can be fully supported by various simple and easy-to-use Web-based platforms. Moreover, often these solutions are offered for a fraction of the cost in comparison to individually tailored systems (Mitev, 1994; Giraldo, 2005; O'Sullivan, 2005).

The range of knowledge processes that KMS covers is extensive. The obvious reason for the deployment of KMS is maximizing the automation of knowledge flow related processes or sub-processes. In most cases, still people play the primary role in decision-making, and technology typically works as a supportive element. However, the trend is shifting rapidly. With the advent of increasingly sophisticated artificial intelligence programs, many of the organizational knowledge processes and activities will be soon fully automated (Nissen, 2006; Nissen, Kamel, and Sengupta, 2000; Sambamurthy and Subramani, 2005). Prior discussion has showed that how many types of knowledge, which were recognized as ineffable before, with the present technological advancement have become quite explicable (Kabir, 2012).

2.5.13.3. Tacit Knowledge conversion.

One of the main focuses of the KM is the tacit dimension of knowledge which includes somatic skills, know-how, experience, insight, and heuristic rules among others (Bouthillier and Shearer, 2002; Sinotte, 2004; Bouthillier and Shearer, 2005).

The technology for managing various tacit types of knowledge is quite broad, and methods of codification and making them transferable are also wide.

The KMS consists of multiple modules. Not all modules suite universally for every single division of a firm. A careful selection process aligned with the company's knowledge strategy is essential to maximize benefits from a KMS. Management armed with a broad, long-term strategic goal and allocated resources must take a decisive role in this. For example, some key modules such as decision support system, business process management tailored to the division, business analytics, knowledge integration modules, knowledge repository systems are used across the board and support primarily explicit knowledge-related activities. All these systems, to some extent, also handle certain tasks related to tacit knowledge. However, direct contributors to the management of tacit knowledge are tools that bolster, capture, integrate and improve knowledge sharing processes through meetings, mentoring, training, interviewing, communities of practices, simulations, guided experiments and other types of socialization that enable knowledge transfer and sharing. Multimedia tools to capture these moments and converting them to searchable format and integrating them to knowledge repositories should be an integral part of a KMS aimed at tacit knowledge managing. Semantic KMS bolstered with AI agents, and machine learning techniques is fully capable of supporting these actions (Hunter, Falkovych, and Little, 2004; Miltiadis et al., 2005).

2.5.13.4. KMS Architecture.

Many of the organizational KM processes are supported by the ICT based KMS infrastructure. As KMS is not a unified and fixed platform, various KM tools are combined to create it based on specific requirements of a firm.

These tools include but not limited to systems and apps such as decision support systems, business analytics, document repository and management systems, various learning tools, search engines, and different communication and collaboration tools.

KMS tools are referred as technologies that enhance and enable knowledge identification, integration, codification, and distribution (Ruggles, 1997). There exists various categorization of KMS tools described in the literature. One framework, for example, shows four categories of tools some of which overlap with each other and include information management tools, knowledge portal and charting, groupware tools and AI tools.

1. The classification of KM tools according to Laudon and Laudon (1999) comprises four groups:
   a. Knowledge sharing enabling tools: such as groupware, intranets, and Website.
   b. Knowledge distribution enabling tools: such as database, document management systems, and content publishing.
   c. Knowledge capture and codification tools: such as expert systems, search engines, neural networks, intelligent agents for knowledge creation.
   d. Enabling tools: such as CAD, investment workstations, and Office apps.

The group of tools proposed by various papers might differ, but most include the following set of tools (Tyndale, 2002; Gallupe, 1998): intranets, portals, content and document management systems, information retrieval systems, databases and repositories, electronic publishing systems, groupware and workflow systems.

Other tools and programs comprise of push technologies, intelligent software agents, help desk apps, customer relationship management, data dump and warehousing, data mining apps, business process management, knowledge Creation apps, business analytics and decision support system. These tools incorporate many of Web technologies which cover (Benbya, 2008; Tredennik, 2006): wikis, forums, blogs, podcasts, peer to peer, social tagging, and social networking.

In Semantic KMS, technologies such as fuzzy modelling, different uses of ontologies and AI-based agents, probabilistic models, machine learning technologies are increasingly gaining ground for improving the capabilities of KMS tools (Herschel and Jones, 2005; Uren et al., 2006; Davis, Lytras and Sheth, 2007; Grundspenkis, 2007; Abecker and Van Elst, 2009). These capabilities are necessitated by the demand for deeper and closer integration of many knowledge processes with business process automation systems including Customer Resource Management (CRM), Enterprise Resource Planning (ERP), and Supply Chain Management (SCM), figure 10.

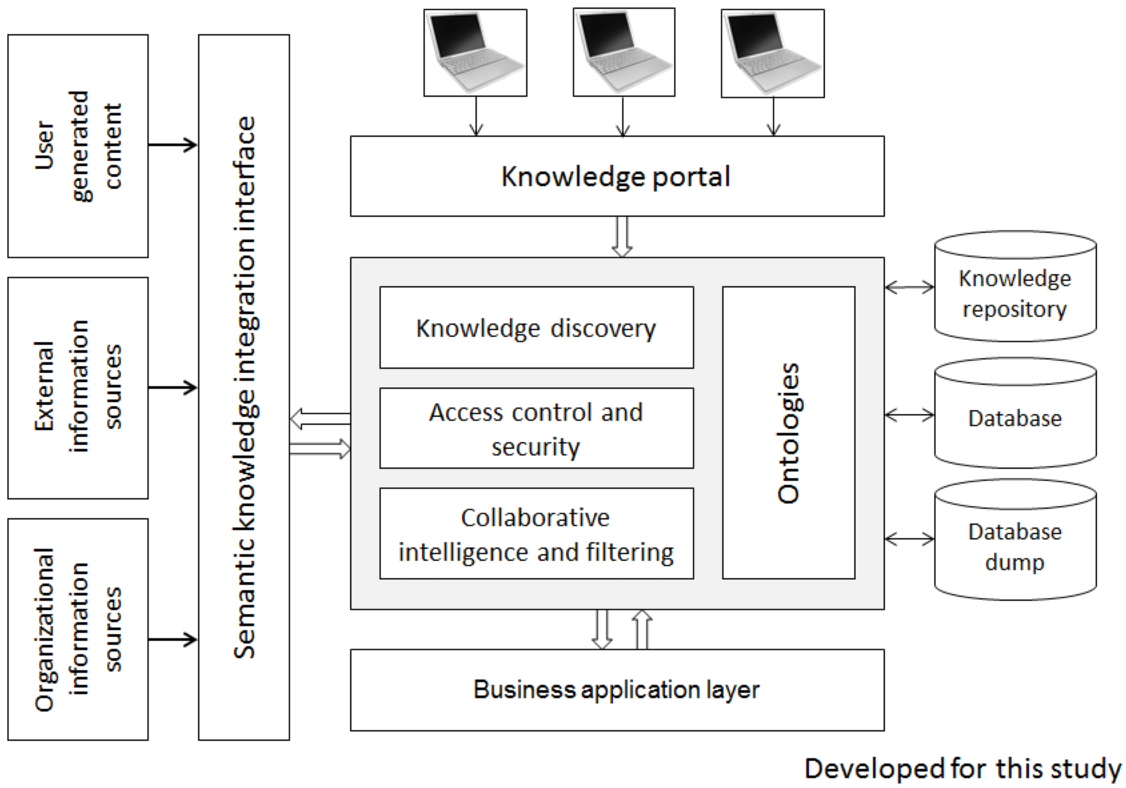


Figure 10: Semantic knowledge management system architecture

Other factors arise from the need for leveraging cloud technology, the need for harnessing Big data analytics for real-time business intelligence, and the need for developing ability to deal with 3D technologies and their environment. Also, important factors are mobile technology integration, knowledge protection and security and seamless integration of knowledge repositories within the firm's silos and external sources (Maass and Kowatsch, 2012).

However, all these KMS tools, by and large, are meant to support the following KM activities (Ruggles and Holtshouse, 1999):

1) Access, identify, extract and aggregate knowledge from external sources (Integration interface)

2) Analyze, synthesize and apply knowledge in decision making and innovation (Knowledge discovery, Knowledge portal, Business applications)
3) Organize knowledge in documents, databases and repositories (Ontologies, Databases, Knowledge repository)
4) Transfer and share knowledge within internal departments and with external sources (Collaborative intelligence, Knowledge portal)
5) Development and Creation of Knowledge (Business applications, Knowledge portal)
6) Protect knowledge from unauthorized access (Access control and security)
7) Measure and map knowledge assets (Knowledge discovery, Collaborative intelligence and filtering)
8) Apprise effects of knowledge management (Business applications)
9) Maintenance of the tools and systems (Access control, Business applictions).

2.5.13.5. Benefits of KMS.

KMS helps to prevent loss of knowledge transpired due to retiring employees, attrition, misplacement of documents and wrong categorization. It also facilitates streamlining and harmonizing organizational knowledge related routines, processes, and procurers, capturing experiences and specific know-how related to projects, customers, products. Moreover, it aids in marketing by depiction and transformation in the form of case studies, best practices, lesson learned and aggregating them in an easily-accessible repository (Heijst et al., 1988). It mines valuable data and converts into reusable information, helps employees stay connected through the community of practices, makes finding relevant information easier and holistically links various data.

KMS simplifies processing knowledge and the mechanism of formalizing and organizing knowledge repositories which in turn provides better access and use. It offers a platform for handling explicit knowledge, extracting knowledge from unstructured sources, and codifying tacit knowledge. It also delivers methods and mechanism for managing activities related to knowledge possessed by employees but not yet codified (Wu and Wang, 2006).

The users of a KM system are mainly concerned about the following attributes: easier implementation and integration of the system, scalability, and modularity of parts, the capability of manipulating various formats, multilevel access control, security of knowledge, and more natural knowledge search and retrieval mechanism (Nevo and Chan, 2007).

Firms by deploying KMS achieve enormous advantages that include 1) better use of knowledge already available in organizational silos. 2) Formalized business processes and workflows. 3) Improved use of human talents and potentials. 4)Reduced decision-making time. 5) Expedite innovation process and 6) Faster customer response.

2.5.14. Organizational Knowledge Domain

According to Liebowitz (2007), there are five factors, the need for which compel organizations to adopt KM. These are adaptability/agility, creativity, a repository of knowledge, organizational internal effectiveness, and organizational external effectiveness.

The demand for KM exploitation and use is broad and includes areas such as access to new knowledge, knowledge reuse, company knowledge audit and mapping, improved innovation life cycle, better innovation processes and practices, and enhanced competitiveness and higher productivity.

Companies undertake projects in the following knowledge domains to achieve these gains (see, Hothouse, 1999):

1) Collecting and sharing best practice, after action reviews and past experiences

2) Adding and embedding knowledge in existing products, services, and processes

3) Developing new knowledge products and services

4) Capturing, assimilating and using knowledge for the innovation process

5) Sourcing and using knowledge for streaming and refining various business processes

6) Creating repository of experts' profiles

7) Building knowledge base through expert systems

8) Using machine learning algorithms, data analysis tools, business analytics and decision-making systems for better decision-making and business optimization

9) Improvement of the use of knowledge resource and intellectual capital

10) Developing a community of practice for harnessing employee knowledge

11) Developing platforms for the customer, supplier, and other stakeholders' relationship management.

As KMS tools are selected by the need of the firm, the kind of knowledge and its domains where the use of KMS will be most beneficial are important factors of concern (Swan and Scarborough, 2001). Alavi and Leidner (1999) suggested a list of domains that can benefit from KMS which include marketing and sales, human resources, customer service, operational processes, competitors, suppliers, customers, and partners. KMS can wholly or partly support all knowledge domains and cover the entire spectrum of organizational knowledge flow. It combines technology, external environment, and internal operations – from supply chain to services – to bring economic value from corporate knowledge assets.

2.5.15. Knowledge Management System Factors

KMS is a complex system that covers many knowledge-related activities and processes of a firm. The improved capability of a KMS thanks to the implementation of semantic technology produce superior results in many areas of knowledge management. A selected few of these regions where Semantic KMS causes immense impact are outlined below.

2.5.15.1. Knowledge integration.

Organization's internal and external processes create a massive amount of data each day. While part of these data is just noise, a significant portion of it is valuable information that can generate substantial impact on the company's competitiveness. Organizations are also in need to integrate knowledge from external resources. The complex and varied representation of content in numerous formats, unstructured data, and legacy data make the process of knowledge integration rather difficult.

To gain competitive advantage from knowledge use and knowledge creation having high efficiency in knowledge integration is essential (Zack, 1999). However, companies are still facing the problem of information integration due to the heterogeneity of data format, unstructured and semi-structured data, an overwhelming amount of data that businesses produce, diversity of knowledge silos and lack of interoperability among various knowledge repositories. Knowledge integration is a crucial element in knowledge management as the inability of the system to integrate vital knowledge for a reasonable cost, and enough simplicity has been one of the causes of many KM failures (Alavi and Tiwana, 2002; Chua and Lam; 2005). Semantic knowledge representation of all accessible data that a company possesses using ontologies and entities is a powerful approach to resolving these issues (Warren, Davies and Simperl, 2011). Annotated data using ontology also allow intelligent agents to perceive data better and discover and identify data for required purposes. Moreover, it makes knowledge reuse simpler and efficient (Badr et al., 2010).

2.5.15.2. Knowledge quality.

In KMS knowledge is considered as information and an object. Like any information management system, the quality of knowledge in KMS is a crucial factor (Law, 2008). Knowledge quality from this perspective can have three different dimensions: intrinsic, contextual and representative (Wang and Strong, 1996). Intrinsic quality is inner knowledge properties independent of users, location, format or usability (Levitin and Redman, 1998) These values remain the same whether knowledge is in a KMS or any other silos and include accuracy, consistency, and freshness (Nelson, Todd and Wixom, 2005).

The second dimension is contextual. The quality level of knowledge in a system depends on how users view it. For a user, the quality of knowledge accessible through a system is understood as the degree of perceived helpfulness of the knowledge obtained in accomplishing a task and solving a problem. In this context, how users value knowledge extracted from the system in a decision-making process is also critical. Knowledge quality refers to not just the accuracy of information, the quality aspect also contains relevance, completeness and perceived overall value (Nelson, Todd and Wixom, 2005).

The third dimension is in which format knowledge is delivered by the system to the user. How effective this format of knowledge representation is for the user to capture, interpret, understand and use (Wang and Strong, 1996).

Factors that are fundamental to consider in knowledge quality include relevancy, accuracy, format, freshness, and timeliness (Nelson, Todd and Wixom, 2005; Seddon, 1997; Kim et al., 2009). The properties of semantic technology embedded in the Semantic KMS facilitate organizing, monitoring, discovering and updating information in a manner so that knowledge in the repositories are consistent with the high level of knowledge quality users need and demand (Joo and Lee, 2009).

2.5.15.3. Convenience of use.

Convenience of use is one important parameter for successful implementation and continuous usage of any system. The success of any system hinged on the satisfaction of users who work with it. Convenience of use is often referred to as ease of use as well (Lai, 2009).

In the information system success model developed by DeLone and McLean (1992), system use was one of the variables. They argued that the utilization of the system measured by usage pattern, dependency, times accessed, time used and use frequency demonstrate if the system is applied for its intended objective and if all the functionalities are utilized (DeLone and McLean, 2003). Further to arguments of Seddon (1997), this researcher contends that convenience of use is a critical element and contributes to the actual behavior of a user in exploiting a system and as such should be considered as an important factor (Jackson, Chow and Leitch, 1997).

Semantic KMS eliminates many of the inherent hindrances of traditional KMS use. Firstly, it supports cloud computing which allows access to the system from anywhere with any device. Second, semantic personalization and recommendation solution that supports Semantic KMS provides an interface completely personalized for the user improving user experience and ease of use significantly. And thirdly, the advanced user interface simplifies access to all or most necessary knowledge to the user.

2.5.15.4. Knowledge search.

Knowledge search in a conventional KMS faces a difficult challenge of retrieving most relevant information if the query keywords don't match exactly. These search engines are lexical based and assess the relevance of documents to search query and rank them using various probabilistic and statistical methods. Despite significant improvement, these search engines, however, still not always produce accurate and satisfactory search results (Mustafa, Khan and Latif, 2008).

The semantic search takes into the consideration the underlying meaning and context of the query term which produces a far superior result than keywords based search. Semantic search has the capability of disambiguation of words based on context and discerns synonym, polysemy, homonym, hyponym, and idioms. As the query through semantic search looks for the underlying semantics of the entity, it can differentiate when a glass, for example, means the non-crystalline transparent substance or when it is a container for liquid made from this substance. It can also figure out from the context that Trump, president of the United States, and Donald Trump are a single entity, but Trump tower is something different. It can identify complex terms with underlying meanings such as "lower house," which means the House of Commons in the UK.

The semantic search engine is the tool for intelligent knowledge retrieval on the Semantic KMS. Semantic search is the combination of natural language processing and semantic computing. A semantic query delivers exact information as opposed to the entire document in navigational search engines.

As it is founded on concept-based entities and their relations, it makes the tool to perceive the searcher's intention easier. The superiority over the conventional search exemplifies in the engine's ability to find serendipitous knowledge connections and esoteric but critical knowledge.

Semantic search resolves key issues that the organizations are facing today. One example is the big data. Firms are producing, accumulating and storing a large amount of data in diverse formats. Data semantically integrated through domain ontologies help to retrieve knowledge from the dark pool of data, which is rather a challenging task for a conventional search engine.

2.5.14.5. Serendipity and Arbitrage. In two knowledge scopes where the use of Semantic KMS can make profound impacts are knowledge serendipity and knowledge arbitrage (Carayannis, 2008, Hamel, 2002, Leonard-Barton, 1999).

Knowledge Serendipity. To find insights from knowledge, it is often necessary to look beyond the obvious. The term serendipitous knowledge refers to finding insights thanks to a chance encounter or an aha moment.

Serendipity is often referred as a chance encounter (Barney, 1986, Carayannis and Juneau, 2003), happy accident (Ferguson, 1999), unexpected surprise (Tolson, 2004) or unexpected discovery (Roberts, 1989). It is the unintentional benefit that knowledge spillover effect produces within the organization, groups and a discipline (Carayannis, 2008). It had been acknowledged as a source of invention (Campanario, 1996) and a precursor to many scientific innovations (Tolson, 2004). According to De Rond (2005), serendipity is also a capability. It is the ability to see pattern and connection that are not apparent. Serendipity can also be viewed as the capacity of discovering and assimilating knowledge beyond the obvious and reap benefits from it (Carayannis, 2008).

Semantic KMS can capture a massive amount of information from various organizational silos and the Web. It then Integrates all the information collected to the existing knowledge base interconnecting diverse entities. Thanks to this ability of Semantic KMS, knowledge workers inevitably get exposed to new links between entities that they were not aware of before and may discover new insights unexpectedly. Moreover, if provided with an intelligent agent, the system itself can draw unexpected conclusions and discoveries from available knowledge. One example of this capability is IBM Watson's, an AI-based platform that uses semantic technology, discovery of six proteins that modify p53, an essential protein, associated with various categories of cancer. It is a remarkable achievement in life science, as this finding is contributing to the improvement of existing treatments and drugs significantly (Chen et al., 2016).

Knowledge Arbitrage. It is a concept that refers to discovering a new application for a product or service which was not the original intention of the user (Hamel, 2002). Knowledge Arbitrage is defined as a capability of introducing knowledge gained from one field in another unrelated domain (Carayannis, 2007; Carayannis, Provance and Givens, 2011).

Hughes and Warhead (2010) in the context of open innovation called for strategy shift in uncertain conditions and stress more on the deliberate search of knowledge arbitrage. Knowledge arbitrage recognizes the possibility of combining both exogenous and endogenous knowledge within the firm and externally in finding new opportunities.

A Semantic KMS can provide visualization of various linked entities in the form of a graph. These links may expose patterns that are not identified previously. If access is furnished across the board within the organization, this connected network of information may facilitate discovering knowledge that can be used in unassociated to originally intended areas. Thanks to the recommender system embedded in the Semantic KMS, firms can deliberately search for arbitrage possibility of esoteric knowledge that they possess. For instance, Yeo et al. (2013) provided an example of knowledge arbitrage, where using collaborative filtering recommender solution, a firm found that its proprietary knowledge of LCD can be utilized in the Solar cell field.

Efficient use of the Semantic KMS for this purpose will contribute to the cross-pollination of knowledge within diverse sectors regularly if a comprehensive amount of knowledge is made available to all workers of the company. This use of existing knowledge in unrelated areas may furnish better value, creating a new impetus for gaining an unexpected competitive advantage. It is one of the reasons for this study to include serendipity and arbitrage as these elements can be significant contributory factors in gaining competitive advantage (Mintzberg, 1979; Hart; 1992; Hamel, 1996). Moreover, they were never researched empirically in the context of KM before.

2.5.16. Knowledge Management and Firms' Performance

Many investigations were conducted in the field of KM, its various aspects and their effects on firm's performance. Several of them are illustrated here:

The fact that Information Technology (IT) improves a company's KM capability is a well-researched and established claim (Alavi and Leidner, 2001; Gold et al., 2001; Schulze and Leidner, 2002). Eisenhardt and Santos (2002) found that KM capability impacts on a company's competitiveness and financial performance positively. Tanriverdi (2005) combining these two relationships verified whether IT did have any influence on a firm's performance mediating through KM capability and discovered a significant positive correlation. His research also investigated the linkage between firm's IT relatedness to KM capability and found a decisive connection.

The concept of knowledge relatedness used in the study comes from the resource-based view of multi-business firms (Farjoun, 1994). In this study, Tanriverdi (2005) integrated knowledge processes within the factor of knowledge capability. Knowledge process is represented by the features of knowledge creation, transfer, integration, and leverage.

Lee and Choi (2003) studied the relationship between KM enablers, KM processes with organizational creativity as a mediator and found their positive correlation with organizational performance. Their findings imply that the status of KM processes in a firm can show where the company stands regarding organizational creativity.

Andreeva and Kianto (2012) explored KM practices from the perspective of human resources management and ICT management and found that these two types of practices are strongly correlated and have tremendous positive impact on both competitiveness and economic performance of a firm. Their findings also show that HRM practices have a mediating effect on ICT practices' influence on financial performance. Zhou and Uhlaner (2009) by surveying 400 Dutch SME concluded that SME relied more on external sources for knowledge and new technologies. Knowledge acquired from external sources is instrumental for this type of companies to identify new opportunities and develop new or improved products and processes.

López-Nicolás and Meroño-Cerdán (2011) constructed their view of KM strategies based on Hansen's et al., (1999) codification and personalization. They investigated the influence of KM strategies on organizational innovation and performance. Their findings illustrate that the type of strategy organization deploy has no significant statistical difference in the benefits and performance of the firm in using KM.

Lee, Gon Kim and Kim (2012) developed a KM performance framework from a holistic perspective which included KM infrastructure and knowledge process capabilities and proved their positive effects on firm's performance. They noted that their findings might work as a guideline for KM practitioners in the implementation of a proper KM strategy taking into consideration cultural, structural, management and ICT factors.

Yu, Kim and Kim (2007) have conducted a study that found KM drivers which include KM system quality, learning orientation, Reward, and KM team activities are correlated with KM performance. KM performance in this context operationalized through Knowledge Quality and Knowledge Satisfaction.

While examining the positivity of the relationship between KM practices and organizational performance in biotechnology and telecommunication industries of Spain, Marques and Simon (2006) created a new theoretical model for KM practices. This framework was never tested before and included knowledge process orientation, organizational learning capacity, understanding of the organization as a global system, innovative culture, individual approach and competence development. According to the authors, this new typology of KM practices would improve measuring the influence of intangible assets on firm's performance. Following review covers various emerical studies pertaining KM and firms' performance (Table 1).

Table 1: The Literature Review of Empirical Researches of KM, KMS and Firm's Performance

Literature	Research Variables (Independent)	Research Variables (Dependent)	Method	Key Findings
Wang and Lin (2013)	KM orientation	Administrative and technological innovation and organizational performance	Survey	Knowledge sharing, absorption and receptivity influence innovation and firm's performance

Adams and Lamont (2003) *Table1, continued*	KMS effectiveness, Organizational learning-based resources and capabilities, Capital resource	Innovation and Competitiveness	Survey	No research was performed
Asgarian (2012)	KM capacity	Innovation	Survey	KM capacity has positive impact on innovation. However, knowledge application makes little effect on administrative innovation.
Choi, Poon & Davis (2006)	KM Strategy: KM focus (Tacit, Explicit), KM Source (External and Internal Orientation)	Organizational performance	Survey of 131 Korean listed companies	Adoption of any of the strategy is beneficial. Both strategies together are better than any single one.
Mazdeh & Hesamamiri (2014)	KM Reliability	Financial, Process and Internal performance	Survey	KM reliability improves organizational performance
Han and Wang (2012)	KM capabilities KMS	Organizational performance	Survey	KM capabilities improve organizational performance, KM effectiveness leads to more effective KM processes. The effect of KMS on KM capabilities and organizational performance is indirect.
Massa and Testa (2009)	KM processes	Innovation and Marketing	Case studies: Semi-structured Interviews	KM effectiveness depends on knowledge domain and intention. KMS should always focus on both tacit and explicit dimensions.
Nonaka and Takeuchi (1995)	Knowledge conversion model: Socialization, Internalization, Externalization, Combination	New knowledge creation, Innovation	Case studies	Knowledge conversion enables knowledge creation, which in turn facilitates innovation
Zaim, Tatoglu and Zaim (2007)	KM processes, KM infrastructure	Organizational performance	Case study	KM infrastructure – context and background could be more important than application aspect of KM
Lee and Choi (2002)	Knowledge creation process, KM strategy	Organizational performance	Survey	Confirmed that human focused strategy opts for socialization with little emphasize on codification.
Choi and Lee (2003)	KM styles, KM methods	Corporate performance	Survey	Both tacit and explicit knowledge are important in capitalizing on corporate knowledge

Gloet and Terziovski (2004)	KM practices (IT focus, HRM focus)	Innovation performance	Survey	Significant and positive link exists between KM practices and innovation
Marque´s & Simo´n (2006) *Table1, continued*	KM practices	Organizational performance	Survey of Spanish biotech and telecom companies	Strong and positive link identified between the adoption of KM practices and organizational performance
	Acquisition, Dissemination, Responsiveness	Innovativeness and Financial outcome	Survey of New Zealand based companies	Knowledge management capabilities lead to better innovation. Firms with KM capabilities are better in incremental innovation rather than new-to-the-world.
Tanriverdi (2005) *Table1, continued*	Firm's IT relatedness and KM capabilities	Financial outcome – ROA and Tobin's Q	Surveys and secondary Data	IT relatedness is linked positively with KM capability. KM capability contributes to market-based and accounting-based company performance, IT relatedness indirectly effects market-based and accounting-based organizational performance via the mediation of KM capability.
Zack, McKeen & Singh (2009)	KM practices	Organizational performance and Financial performance	Survey	KM practices are positively linked with Financial Performance directly and through the mediation of organizational performance
Al-Hakim, & Hassan (2012)	Critical success factors of KM	Innovation and Firm's performance	Survey	There is a significant direct link between CSF and organizational performance and indirectly linked through innovation
Vaccaro, Parente & Veloso (2010)	Reliance on KMT	Speed to Market, New product performance, Financial performance	Survey	Relations between reliance on KMT and speed to Market, new product performance and financial performance are positive. An indirect link between reliance on KMT and financial performance through new product performance also exists. However, no indirect link detected between reliance on KMT and financial performance via speed to Market.
Andrieva and Kianto (2011)	Knowledge Processes	Innovation	Survey	Positive relationship exists between knowledge processes and innovation

Darroch and McNaughton (2003)	KM orientation	Innovation, Financial performance	Survey	Knowledge management orientation plays positive role in Innovation and facilitate better financial performance
Chuang (2004) *Table1, continued*	KM resources – technical, human, cultural, and structural	Competitiveness	Survey	There is a strong association between social KM resource and competitive advantage. KM capability has positive link with competitive advantage.
Gold, Malhotra and Segars (2001)	Knowledge infrastructure and Process capabilities	Organizational effectiveness	Survey	Both knowledge infrastructure and knowledge process capabilities have positive impact on the organizational effectiveness
Zhou and Uhlaner (2009)	External knowledge acquisition and Internal knowledge sharing	Innovation orientation	Survey	New possibilities and new business opportunities that organizations can create thanks to aggressive acquisition of external knowledge drive better innovation
Chang and Lee (2008)	Knowledge accumulation Capability, Culture, External environment	Administrative and technical innovations	Survey	The link is positive but the mediating factors of culture and external environment are crucial as well.
Deng, Doll & Cao (2008)	Absorptive capacity	IT use for problem solving/decision support, Innovation, Productivity	Survey	Absorptive capacity facilitates IT-enabled problem solving that helps generating innovative ideas and enhance productivity
Liu, Chen & Tsai (2004)	KM capability	Competitiveness	Survey	Better KM capability results more competitiveness
Ho (2009)	KM practices	Organizational performance, Financial performance	Survey	KM practices are associated with organizational performance. Organizational performance is linked to financial performance. KM practices have impact on financial performance via organizational performance.
Moffett et al. (2003)	External and internal factors	Organizational KM implementation, development and maintenance	Survey	Organizational climate and internal technical climate have biggest impact on KM
Khalifa, Lam & Lee (2001)	Strategy, Technology Fit, Culture and Leadership	KM structure Adequacy, KM effectiveness	Survey	This study found a strong relationship between KM structure adequacy and KM effectiveness. Strategy, they found, has a crucial impact on the KM structure adequacy.

Table1, continued

Kulkarni, Ravindran and Freeze (2007)	Knowledge content quality, KM systems quality, Perceived usefulness, user satisfaction, Measures of organizational support	Knowledge use	Survey	Organizational factors such as leadership, commitment and supervisor and coworker support for reinforcing KM initiatives are as important as the KM enabling IT
Alavi, Kayworth Leidner (2001)	Cultural values	KM practices	Case study	The use of technologies relies on the cultural values of the individuals impacting what features will get priority. As a result, what would be the outcome.
Karaszewski (2008)	Knowledge management	International competitiveness	Survey	KM impacts on international competitiveness positively
Brachos, Kostopoulos, Soderquist & Prastacos (2007)	Organizational context	Knowledge transfer effectiveness, Organizational performance	Survey, Interview	Organizational context effects positively on knowledge transfer and knowledge transfer has a positive link with effectiveness organizational performance
Smith, Collins and Clark (2005)	Existing and Accessible knowledge	Knowledge creation capability, Innovation	Survey, Interview and Secondary data	Existing and accessible knowledge has a positive impact directly on Innovation and through knowledge creation capability. Knowledge creation capability has strong link to innovation.
Lee, Lee and Kang (2005)	Knowledge flow processes	Financial performance: Stock price and Price to earnings ratio	Survey	The proposed knowledge management performance index is capable of measuring quality of organizational knowledge
Zheng, Yang & McLean (2009)	Organizational structure, Culture & Strategy	Knowledge management effectiveness, Organizational effectiveness	Survey	Knowledge management, organization culture, structure, and strategy are highly linked to organizational effectiveness.
Liao & Chuang (2006)	KM resources	KM process capability, Innovation, Firm performance	Survey	KM resources have positive effect on KM process capability KMPC has strong impact on innovation. Innovation is favorably linked to firm performance.

Table1, continued

Mills and Smith (2011)	Knowledge infrastructure and Process capabilities	Organizational effectiveness	Survey	Knowledge infrastructure and knowledge process capabilities both are positively linked to organizationalpPerformance. However, technology infrastructure and knowledge conversion have feeble connection with organizational performance
Lopez-Nicolas and Merono-Cerdan (2011)	KM strategy	Innovation and Firm's performance	Survey	Strategic KM improves organizational performance and innovation
Lee and Lee (2007)	KM capabilities Processes	Organizational performance	Survey	Companies need to pay special attention to their capabilities before implementing KM initiatives. There is a strong correlation between companies' KM and their financial performance.
Bierly and Chakrabarti (1996)	Company typology by KM, KM strategy	Return on sales and Return on assets	Interviews	Innovators and explorers are more profitable
Kalling (2003)	Knowledge development and Knowledge utilization	Knowledge capitalization	Case studies, Grounded theory	Not all knowledge is utilized and not all knowledge utilized improves firm's performance. The link between knowledge and performance can be observed through mediating variables such as productivity.
Rabhi, 2011	KM system generated internal data	Customer satisfaction, time to market ability, R&D cost reduction and Knowledge accumulation capability.	Longitudinal analysis	Data generated internally from indicators embedded in the KM system is a powerful tool for examining KM system performance
Islam, Low and Hasan, 2011	KM practices: knowledge acquisition, conversion, application, protection	Organizational effectiveness	Survey	Selected KM practices have significant impact on organizational effectiveness

These examples demonstrate that the result of the implementation of any new technology to bolster and improve KM activities, KM capability and KM practices can be investigated by its impact on firm's various performances.

2.5.17. KM Measurement Metrics

Performance measurement is defined as the process of quantifying the effectiveness and efficiency of a given action (Neely et al., 1995). It is necessary for a firm in taking calculated decision and relates to following areas: 1) Clarifying investment effectiveness, 2) Assessing present status, 3) Developing strategy alignment, 4) Predicting future possibilities, 5) Evaluate the effect of a new practice, 6) Gaining knowledge about an experience. Performance measurement allows a company to manage its business practices proactively rather than based on old data.

Developing a performance measuring method includes following steps:

- Determining Key Performance Indicators (KPI) for all characteristics of the practice involved;
- Defining the benchmarks for KPIs of each component of the practice;
- Developing methodology that clarifies what type of data is necessary to collect, from where this data would be collected, how the data would be collected, stored, analyzed, interpreted and shared;
- Ensuring that tools and technology for executing the measures and data processing are available.

Performance measurement requires data. The data related to any action can be subjective or objective (White, 1996). Objective data are based on observable and quantifiable facts. Metrics to measure phenomenon using objective data are easier to develop using benchmarks and established measurement methods.

Subjective data, on the other hand, originate from human perceptions, individual interpretation, and judgments. Setting metrics and measurement methods for any action using subjective data are challenging, and the selected benchmarks are highly dependent on observer's perception, prior success, and adaptability.

Performance measurement assists a company in achieving its strategic goals. Firms that deploy financial and non-financial performance measurement systems in their quest in improving their performance produce a superior result than the competitors who don't pursue it (Van Der Stede, Chow, and Lin, 2006). Two ways performances are measured in the firms: financial performance (such as return on investment and purchase to earnings), and productivity improvement.

Non-financial performance measurement systems are inherently complex due to subjective approach that requires in developing and implementing such systems. Due to the subjective nature, these systems are susceptive to flawed benchmarking and imperfect implementation and call for extra caution.

Businesses have long felt the need for developing methods of measuring performance to assess a company's standing about various business practices. Many of the processes involved in those practices do not have a direct and clear impact on company financial performance. Over the years, several methods under the name of performance management have been created. The most applied among them is the Balanced Scorecard (Kaplan and Norton, 1992).

Various studies show that performance management based on financial data alone does not produce a satisfactory result. Especially, in the knowledge era where intangible assets are increasingly becoming more salient than the tangible resources. The problem, however, is how do we quantify the impacts of factors such as process improvement, quality of product enhancement, better customer service, and others when these factors have an only indirect connection with financial outcomes (Maskell, 1991; Jagdev et al., 1997; Ghalayini et al., 1997; Kaplan and Cooper, 1998; Hussain, 2013).

Implementation of a KMS in the organization is still a difficult task (Kim et al., 2003) and there is no guarantee that the KM initiative will improve organizational performance (Leidner, 2000; Garud and Kumaraswamy, 2005). That's why once implemented it is necessary to conduct a performance analysis.

Evaluation of KM performance facilitates acquiring a better understanding of the effect of the KM initiative, implementation of KMS and the value they create. It allows management to see how successful the effort is, extract and utilize KM best practices, and determine the actual value of company knowledge and IP. This information also contributes to the refinement of firm's strategy aimed at the improvement of its top and bottom lines (Malhotra, 2005).

Inherent intangible attributes of knowledge assets make developing and applying financial metrics on them difficult (Ahn and Chang 2002, January). Nevertheless, the firms need to know how to evaluate the effectiveness and performance of the KM activities and practices (Wikramasinghe, 2002).

Although it is not possible to measure the KM Effectiveness directly by traditional financial measures such as return on assets or return on equity some efforts were still made. One notable example is the Knowledge Management Performance Index (KMPI) developed by Lee et al.

(2005) that included stock price performance of a firm and its price to earnings ratio and R&D expenditure. There are two apparent problems with this metric. First, the metric will work only for listed companies keeping most firms at bay and second, the R&D expenditure is better considered as innovation parameter and should be deemed as a mediator rather than direct organizational performance outcome.

The criticism of financial performance based management style that does not accommodate knowledge as one of the most valuable assets has been well documented (Kaplan, 1983; Meyer and Gupta, 1994). Efforts have been made to develop performance measurement frameworks which are more encompassing and inclusive of intangible assets (Keegan et al., 1989; Brown, 1996; Epstein and Manzoni, 1997). Even in the widely accepted and familiar "Balanced Scorecard" (Kaplan and Norton, 1992), one of the four perspectives of which is learning and growth does not include any measures of knowledge dimension (Marr, 2004).

In 1990s several efforts have been made to create performance metrics that explicitly encapsulate knowledge assets measurement. The most prominent of them are Skandia Navigator (Edvinsson and Malone, 1997), IC-Index (Roos et al., 1997), IC Audit Model (Brooking, 1996), Intangible Asset Monitor (Sveiby, 1997) and economic values of knowledge (Teece, 1998). Skandia's "Navigator" model, for example, provided a thorough roadmap for measuring intellectual capital of an organization (Marr, 2004).

One possible performance measure of KM is to determine to what extent it improved the efficiency and effectiveness of the firm (Detert, Schroeder and Mauriel, 2000). Since there is a limited possibility of direct measurement of KM's contribution to company's performance, there have several other indirect metrics emerged and were applied over the years which can ascertain the KM effectiveness using various tried and tested criteria. The degree of improvement in the effectiveness and efficiencies of various processes and procedures is one of these measures (Detert, Schroeder and Mauriel, 2000; Ostroff and Schmitt, 1993). One proposed type of metrics used in this method calls for measuring KM impact on innovation capabilities such as new product and process development, the effectiveness of R&D investment, customer satisfaction, market growth, improved collaboration, better decision-making, higher productivity and several others (Anantatmula, 2005). Some other possible performance indicators of KM are knowledge quality (Huang et al., 1999), knowledge sharing (Bock and Kim, 2002), and end-user satisfaction with KM implementation (Becerra-Fernandez and Sabherwal, 2014).

Organizations are a complex ecosystem with a myriad of system-wide processes and procedures. While most of them in one way or another intersect with knowledge flow, the connection of KM with many of them are not so apparent. In some other cases, the attributes that affect the performance of the process are rather difficult to segregate and measure the KM influence alone (Bharadwaj, 2000). Because of this, preferences are often given to the indicators that directly imply the influence of the KM or the linkage between an indicator and KM is easy to follow.

However, while the goal of KM is the improvement of organizational performance, such linkage is still obscure and difficult to be empirically validated due to the substantial number of exogenous factors (Bharadwaj, 2000). Therefore, recent studies suggest more direct indicators of KM performance such as knowledge quality (Huang et al., 1999), level of knowledge sharing (Bock and Kim, 2002), and end-user satisfaction with KM implementation (Becerra-Fernandez and Sabherwal, 2014). These indicators can be considered as immediate outcomes of KM and more direct measures of KM performance. To measure KM performance researchers have used many indicators that include KM strategy, KM methods, KM processes, KM practices, Km infrastructure, strategic readiness among others and their impact on innovation, competitiveness, customer satisfaction, knowledge share and organizational creativity. In measuring the effectiveness and efficiency of Semantic KMS and KM Effectiveness, this thesis also adopts a similar approach.

2.5.18. Discussions and Conclusion

This research has started from the observation of several growing trends in the corporate world. In the knowledge economy, knowledge has become the primary factor of production. It has also become the central element of increasingly more end products and services. This new status of knowledge is forcing companies to pay urgent attention to knowledge and knowledge-related activities. Knowledge from the standpoint of RBV of the firm is a resource of utmost importance for businesses in their quest in developing core competencies.

Firms apply knowledge management tools and practices to harness the power of knowledge. Knowledge management system has emerged as a supportive ICT-based technology to handle knowledge management processes. With the explosive growth of knowledge and proliferation of advanced technologies, it becomes clear that new strategic approach is needed to create an optimal ecosystem within the realm of organization's knowledge use for gaining and sustaining competitive advantage from such a vital resource as knowledge. The researcher having practical experience in working with knowledge management has realized that existing KMS and KM practices in the companies are incapable of overcoming the rising demand from increasingly sophisticated knowledge related processes. An apparent solution to the problems existing KMS is facing is to upgrade the system with latest technologies so that it can tackle the volume and heterogeneity of data and information as a conduit of knowledge and the speed of knowledge growth. But the question is how do we figure out what contemporary technology suits best for a KMS overhaul.

Semantic technology, as the review and examples show, has all the necessary underlying capabilities that are required for handling the growing knowledge demand of the firms. The researcher tried and tested several Semantic technology-supported KM tools and become convinced the viability of deploying ST in every node of a KMS. However, the review of existing literature showed that comprehensive research on the effect of such KMS on the organizational KM endeavors is scant.

From the review, we also spotted that the ways of measuring the effect of technology on an organizational process or when they are not directly linked to financial aspects is not obvious. The question also arises how we can measure the impact of a practice or process on the firm's performance which is not directly related to financial outcome. Researchers in KM field like many other similar organizational management areas apply an indirect method to do this.

Innovation is one aspect which is built upon the factors like knowledge base, access to appropriate knowledge, proper and efficient handling of knowledge activities. In short, KM has a profound and observable impact on innovation. Innovation, in turn, as numerous studies from varieties of areas within organizational realm convincingly prove, has a close link to firms' performance such as competitiveness.

Once from the literature this concatenated relationship between KM, innovation, and competitiveness was established, we started working on developing a model, which has four components with causal relationships, namely: ICT to KMS, KMS with KM, KM to Innovation, and Innovation to Competitiveness. We found several similar models in KM literature that could work as a foundation for our model. This section of literature review corresponds to the components of the model we have developed for this study. The discussion follows the bottom up linear relationships of competitiveness, innovation, knowledge management, and knowledge management system. However, we decided to review Semantic technology before KM and KMS to provide the right context from technology perspective so that the reader can relate nuances of ST with KM and KMS.

Limitation of chapter two sections.

While we made efforts to cover key concepts and understandings of the six crucial elements of the model, namely: competitiveness, innovation, knowledge, knowledge management, knowledge management system, and semantic technology by no means these analyses are exhaustive. Each of these areas is well researched with a myriad of ways of interpreting various concepts. We tried to keep the review comprehensive and focused on our final objectives as per the adopted model.

Contribution. The present literature review contributes to the conceptualization and understanding of concepts relevant to the research question in the following manner:

1. Key concepts and theories vital to this study were investigated, analyzed and working definitions were offered.

2. An in-depth analysis of the current state-of-the-art in empirical research linking KM and organizational performance was conducted.
3. Two fundamental mechanisms how Semantic KMS and KM influence on organizational performance: innovation and competitiveness have been investigated thoroughly.
4. A clear explanation of why these mechanisms are preferred ways of measuring the indirect links were examined and justified.
5. Each of these mechanisms demands precise measurement for each construct. These latent variables of the constructs were identified.

Based on these findings from the literature review the theoretical model was finalized, constructs were developed and methodology of the empirical test that demonstrates the quantitative proof of the impact of Semantic KMS on firms' performance was proposed.

2.6.RESEARCH GAP, RESEARCH QUESTIONS AND HYPOTHESES FORMULATION

2.6.1. Introduction

This section depicts the nexus between literature review of the previous segments with the present study. Here we identify the gaps in the literature, develop research questions and formulate the hypotheses.

2.6.2. Research Gap

Empirical studies so far have convincingly shown that there is a positive correlation between different aspects of KM and companies' various performance outcomes. These aspects include innovation, competitiveness, customer satisfaction, operational excellence and financial results (see, Adams and Lamont, 2003; Asgarian, 2012; Han and Wang, 2012; Lee and Choi, 2002; Marques and Simon, 2006; Chuang, 2004). Numerous studies have demonstrated that KMS has a positive effect on innovation and organizational performance (Lopez-Nicolas and Merono-Cerdan, 2011; Basadur and Gelade, 2006; Adams and Lamont, 2003).

However, we located noticeable gaps in the studies found in the existing literature.

First, the occurrence frequency of the keywords "Semantic Web" in Knowledge Management literature has increased significantly in the last decade and by 2012 ranked 13 among the most popular keywords. It proves the increasing demand for this advanced technology in KMS (Qiu and Lv, 2014). However, there only a few pieces of research were done in the area of the influence of Semantic KMS on knowledge management (see, Joo and Lee, 2009; Samsuddin, Miah, and McGrath, 2013). Moreover, these investigations are done in one single country, and with a small number of samples. This situation calls for conducting further empirical research encompassing a broader geographical area and a more versatile group of samples.

Second, the KM aspects that have an impact on the organizational outcome commonly selected in the studies are as follows:

- KM practices (Darroch and McNaughton, 2002),
- KM processes (Lee and Choi, 2003),
- KM capabilities (Han and Wang, 2012),
- KM enablers (Ho, 2009; Mills and Smith, 2011),
- KM infrastructure (Gold, Malhotra and Segars, 2001),
- KM strategy (Zheng, Yang and McLean, 2010),

- KM resources (Tan and Wong, 2015),
- KM factors (Moffett and McAdam, 2003),
- Organizational culture (Chang and Lee, 2008) and various combinations of these factors.

However, none of the combinations in the studies have features from the perspective of the KM Effectiveness that include KM processes and strategic readiness. After all, an organization that is open to new and radical changes like adopting semantic technology should naturally have a continuous strategic preparedness to innovative ideas embedded in its culture and structure.

Third, there is also a significant research gap found about the adoption of Semantic KMS in the organization.

Some empirical analyses were done in the use of semantic technology in KM, but very few have statistically ascertained the importance of Semantic KMS (see, Chen et al., 2007; Davies et al., 2003; D'Aquin et al., 2005; Joo and Lee, 2009; Rathore et al., 2016). Samsuddin, Miah, and McGrath's (2013) study is one of the rare examples. It used interview method to determine the need for improving KM using semantic technology in universities. More studies are undoubtedly necessary for companies to understand the advantage of ST when they plan to upgrade their KMS or prepare to deploy KMS for the first time.

2.6.3. Purpose of the Study

What are the general goals of the study?

To further our understanding of how and through which mechanisms semantic technology-based knowledge management system impacts on firm performance.

The aim of this research study is to receive answers to the following questions:

1) What impacts semantic knowledge management technologies have on the effectiveness of the organizational knowledge management.
2) Whether organizational knowledge management influences organizational innovation and competitiveness.
3) Whether there is a positive correlation between innovation and competitiveness
4) Whether organizational knowledge management has a positive impact on competitiveness via innovation.

2.6.4. Research Questions

To achieve the research goal as stated we have come up with two research questions.

1. Does semantic knowledge management system influence organizational performance?

Semantic KMS is a relatively new concept. It has its idiosyncrasy that differs from other ICT based systems and studies are still scant. However, the literature review shows that knowledge management system does have a positive effect on organizational knowledge management. The literature review also confirms that this link is empirically grounded. Based on this supposition, this study needed to develop theoretical foundation necessary to investigate our first question which will fill the void of lack of evidence on the issue of whether there is a link between semantic

KMS and organizational performance. The investigation will include identifying the variables that embody the possible connection, develop a methodology and perform the test.

2. If it does, how and through which mechanisms this influence takes place?

There is enough theoretical support available in the literature that suggests that KM does have a positive impact on firms' innovation and competitiveness. The researcher plans to use similar mechanisms to ascertain the linkage between Semantic KMS and company performance. The research must build a model that connects the causal association between Semantic KMS, KM and firms' specific performance to execute it.

Grounded on the review of previous empirical studies in the area of KM, this research creates the following model to investigate the first and second research questions.

2.6.5. Operationalization of Variables

Table 2: Operationalization of Variables

Variables	**Operationalization**	**Types of measure**
Semantic KMS	Convenience of use, Knowledge search, Knowledge integration, Knowledge quality, Serendipity and Arbitrage	Subjective

KM Effectiveness	**KM Processes:** Acquisition, Application, Accumulation, Dissemination **Strategic Readiness:** Human Capital, Organizational Capital, Information Capital	Subjective
Organizational KM	Semantic KMS, KM Effectiveness	Subjective
Innovation	Completely new product, New product to the firm, Addition of new products to existing line, Improve products line, Product change for cost reduction, Product differentiation	Subjective
Competitiveness	Profitability, Growth, Success, Market share increase	Subjective

2.6.6. Proposed Theoretical Model

The conceptual model, defining the hypotheses and the relationships between the independent and dependent variables, were developed based on prior literature and theoretical considerations. The model also exemplifies the methodology that governs the process of determining the level of relationships between Semantic KMS, KM, innovation and competitiveness. As found in the literature, one key aspect of these associations is the mediating role of innovation between KM Effectiveness and competitiveness. While the previous studies have determined an existence of a definite link between KM and firm performance mediating through innovation, this research is the first which is investigating innovation's mediating role in the context of KM Effectiveness and competitiveness.

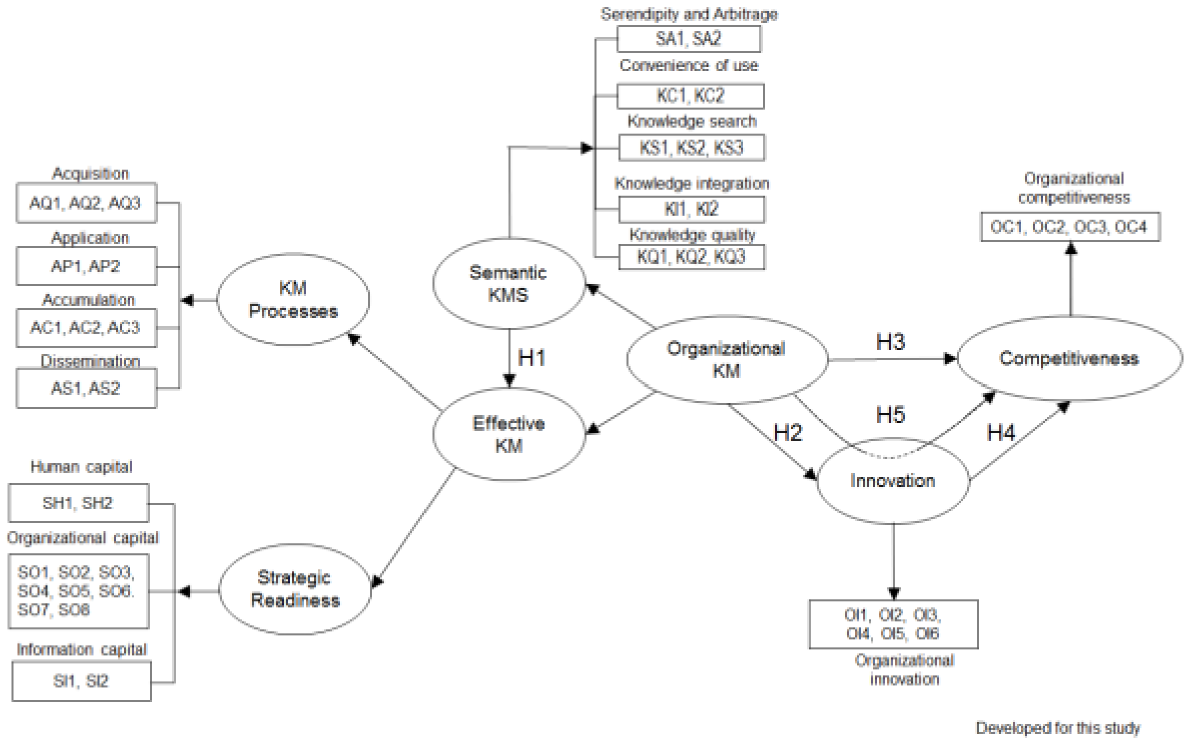


Figure 11: Proposed theoretical model of the research

Figure 11 depicts a summary of the research components.

2.6.7. Hypotheses Formulation

2.6.7.1.Hypothesis one. Semantic KMS and KM Effectiveness.

Semantic KMS. Semantic KMS is a KMS where semantic technology is the underlying technical, architectural and software support which facilitates the improvement of organizational knowledge processes, KM activities, and knowledge flow. Semantic technology was particularly applicable in KMS for managing knowledge activities. If deployed correctly they can aid in reducing possible failure aspects of KMS which emerge due to the incongruence between KM goals and corporate strategies (Heisig, 2009).

Cayzer (2004) proposed a decentralized KMS based on semantic technology that would be capable of capturing, integrating, annotating, indexing and performing queries of the information from a community of practice. The system, thanks to ST, expected to overcome the challenges such as complexity of use, extraction, and capture of the information from various silos and in heterogeneous formats, adoption of changes and automatic inference of knowledge. The proposed system emphasized on semantic blogging as a key feature.

Joo and Lee (2009) did research pertaining limitations of conventional KMS and how SW can overcome the issues related to system quality and knowledge quality and improve user satisfaction. Their finding confirms the challenges that traditional KMS face in factors such as ease of use, difficulties of finding information and the integration of heterogeneous knowledge. Knowledge quality, according to this study, also suffers due to trustworthiness and comprehensiveness of knowledge. Many of these issues, they argued, can be eliminated or mitigated using Semantic Web. We concur with their findings and add that various other features of ST that Semantic Web does not include can improve existing KMS even more.

Zhou, Ding and Finn (2010) empirically analyzed the growth of Semantic Web in the KM from social network perspective focusing on a single Semantic Web standard element FOAF — friends of a friend. Their analysis shows a clear trend of evolutionary growth of Semantic Web community.

Davies et al., (2005) proposed a model of Semantic KMS and argued that the weaknesses of the conventional KMS could be significantly reduced in the following areas using semantic technology: search and extraction of the information, maintenance, and automated document generation.

Ribino et al., (2009) developed a prototype of a Semantic KMS that included ontology-based repositories, expert system, decision support system, semantic search and extraction modules. The system is targeted at ICT companies for managing project management-related knowledge growth.

Ale et al., (2014) addressing the issues of information overload and lack of context in tacit-explicit information conversion offered a conceptual model of Semantic KMS. The system is designed to observe essential requirements identified by them. It combines network and repository models and creates a platform that supports social and technological issues of KM. The model was tested experimentally as a case study of a company from the tourism industry.

Tiwana and Ramesh (2001) outlined one of the first frameworks for semantic knowledge management. This KMS was meant to achieve the following objectives: knowledge discovery, new knowledge creation, knowledge aggregation and packaging, knowledge application, and Knowledge reuse and revalidation.

Joo (2011) studied factors that influence organizational adoption of Semantic Web and its diffusion using grounded theory. Five factors were identified. Demand-pull, which includes the need for improved search, retrieval, and integration services. Technology push — a host of attributes effect on this such as technology maturity, technology promise, and government support.

Organizational competence developed through users' training and better communication, and absorptive capacity from both users and the vendors. According to the study, over-expectation works as a negative factor impacting semantic technology adoption. Deployment also hinges on determinants such as the scale of the ontology, visible effect of the technology use and investment need.

Dessì et al., (2015) offered a framework of collaborative knowledge management for biomedical communities. This architecture addressed the issues of 1) How to extract relevant information just-in-time from large and physically distributed semantic resources. 2) As content structure, format, and annotations differ in diverse resources of interest, how to search for all these resources despite the heterogeneity of data and other constraints 3) How to address users' perspectives and context in sharing and managing knowledge.

Cheng, Lu and Sheu (2008) offered a model of a knowledge management system developed particularly for financial research. The ontology-based semantic system can handle all necessary knowledge flow processes for financial research and includes a financial security rating agent which is based on data mining and statistical methods.

Garcio-Crespa et al. (2010) conducted empirical research on the use of semantic digital libraries. A digital library is content repository like the concept of knowledge repository in KMS. It was aimed at finding if the use of their semantic digital platform improves user experience, faceted search experience, performance, keyword search and faceted search. The study supported the hypothesis that the implementation of their semantic digital library was a success.

Samsuddin, Miah, and McGrath (2013) pointed out the need for universities to improve knowledge management in the context of oral history in education domain. They have developed a framework for KMS enhancement using semantic technology based on the interviews conducted as a part of an empirical study. These interviews allowed them to recognize and identify the limitations of the conventional knowledge management systems. From an extensive review of the literature, they extracted ways how semantic technology can improve each perceived limitation and issue in a KMS.

Rathore et al. (2016) did an exploratory research to clarify what role KM plays in the development and lifecycle process management in biopharmaceutical industry based on data from 356 publications and 17 large biopharma companies. The study discovered crucial gaps in the KM tools presently used which according to them can be eliminated by using semantic technology based KM system unique to biopharma industry.

A 2016 technology trend monitoring study for identifying and monitoring key technology trend did a case study analysis of semantic technology. The study encompassed diverse sources including scientific articles, patents, media, foresight projects, conferences, European Commission projects, dissertations, SlideShare presentations and the Web. Within the semantic technology domain, the study identified a list of five strong trends. These are Linked Open Data (LOD), social semantic web, mobile semantic, semantic digital libraries and semantic-based apps. Semantic apps and tools cover a wide area such as semantic e-commerce, e-government, e-learning, and e-health. The study confirms within the ICT sector; semantic technology remains a primary domain with five trends mentioned above (Ena et al., 2016).

Semantic KMS is presently used in various areas from generic KMS platform such as collaborative KMS (Chao, Zhang and Xing, 2012), content management tool (Kalender and Dang, 2012) management of business process knowledge (Gabor et al., 2014) to industry-specific ones. These industries are as diverse as tourism (Mouhim et al., 2010), supply chain management (Huang and Lin, 2009), musical information (Nguyen, Arch-int and Arch-int, 2015), humanitarian assistance (Clark and Cassani, 2014), laminated composites (Premkumar, Wileden, and Grosse, 2014), and product lifecycle management (Liao et al., 2014) to name a few. However, in industries where deployment of Semantic KMS are most prominent include bioscience, finance, software, e-government and business processes.

The quality of the KMS, its ease of use and many other factors influence on the effectiveness of a KM. Some examples include, first, lack of automated validation process of documents' addition to the knowledge repository. As a result, it gets easily cluttered with imprecise, irrelevant and unreliable information. Second, the inability of the KMS of delivering unstructured valuable information as a search result. Third, lack of availability of updated information in the repository. Fourth, failure of the KMS to produce most relevant information along with secondary, adjacent but valuable information for a query. These are serious negetive issues that hinder the proliferation of the use of KMS. Clearly, to eliminate or mitigate these problems it is imperative to improve all facets of the KMS.

It is technology that has enabled the advent of KM (Hendriks, 2001). Each stage of improvement in KM's capability has been instigated and supported by advances in technology. Semantic technology has brought game-changing enhancement to the core areas of the KMS (Grobelnik and Mladenic, 2008). As KMS is the underlying technological tool intertwined with

KM activities, any significant functional improvements of KMS should also exert a positive influence on KM. Kulkarni et al. (2003) asserted that IT impact on KM effectiveness is high which means KMS plays a central role in the effectiveness of knowledge use.

As the goal is to determine the level of improvement ST as an ICT causes, we decided to apply measures used previously for this purpose and added two crucial components serendipity and arbitrage. We elaborated our arguments how Semantic KMS can elicit these and the items used for this purpose in the previous chapter.

KM Effectiveness. Despite numerous efforts, organizations are still having a problem with the issue of identifying clear metrics for evaluating the effectiveness of a KM initiative (Khalifa, Lam and Lee, 2001). KM effectiveness does not automatically appear from the availability of a comprehensive KM structure (Khalifa, Lam and Lee, 2001).

The importance of adequate strategy, human factors, and culture in the success of KM implementation and its effectiveness of use have been emphasized in several research works (e.g., Pentland,1995; Zack, 1999; Alavi and Leidner, 1999).

Khalifa, Lam and Lee (2001) have developed a model which included strategy, technology fit, culture and leadership as the factors of KM adequacy that in turn influences on the KM effectiveness. Their study, for example, found a strong relationship between KM structure adequacy and KM effectiveness. Strategy, they determined, has a crucial impact on the KM structure fitness.

The evaluation of the KM effectiveness is essential as various studies found that it has a substantial impact on a firm's KM capability. Wen (2009) argued that KM effectiveness is directly related to KM capability which affects on firms' effectiveness. While analyzing KM effectiveness, he emphasized primarily on the effectiveness of knowledge integration, knowledge quality and the outcome of knowledge use. Andrew et al. (2001) claimed that Knowledge process capability, on the other hand, directly responsible for main areas of firm's effectiveness. Knowledge process in this context according to them comprises of knowledge acquisition, conversion, application, and protection. KM capability, as Liu et al. (2004) found, is also associated closely with a company's competitiveness.

The KM effectiveness is based on numerous attributes. It is impossible to incorporate all indicators of this phenomenon in one single study. The concept of KM effectiveness might start, for example, from the successful implementation of KM. According to Anantatmula (2007) the following are some important KM implementation effectiveness attributes: improved communication, enhanced collaboration (Sveiby and Simons, 2002), improved employee skills (Marr et al., 2003), better decision-making, higher productivity and supportive leadership. In any KM initiative, leadership, culture, technology, and measurement are acknowledged as success factors that influence on KM effectiveness as well (Asoh et al., 2002). In this research, our goal is to incorporate two elements considered critical for KM effectiveness which are KM processes and Strategic readiness. KM processes selected for this study as stated earlier cover the entire gamut of knowledge related activities that can be conducted through a KMS. The strategic readiness comprising human, organizational and information technology capitals are crucial for the effective implementation and use of any KM initiative. Based on these arguments and prior literature (see Davies, Lytras and Sheth, 2007; Joo and Lee, 2009; Lee et al., 2005; Lin and Huang, 2009;

Kalender and Dang, 2012; Joo, 2011; Kumar, 2012; Chao, Zhang and Xing, 2012; Rathore et al., 2016) we developed our first hypothesis.

H1 Semantic Technology-based Knowledge Management System (Semantic KMS) is positively related to the Effectiveness of Organizational Knowledge Management (KM Effectiveness).

2.6.7.2. Hypothesis two. Organizational KM and Innovation.

Organizational KM constitutes of two elements KMS and KM. For this study, as explained earlier, the variables used here are Semantic KMS and KM Effectiveness. The rationale behind this is as follows:

1. KM is intertwined with KMS as KMS has instigated the use of KM in the firms.
2. Our study focus is a type of KMS which is KMS built using semantic technology.
3. As clarified earlier, KM effectiveness is broadly determined by the kind of KMS used.
4. Firm's knowledge management capability should not be judged by the mere presence of KM but its effective use.

Innovation. Knowledge is the primary constituent of innovation. Innovation occurs because of the recombination of knowledge (Galunic and Rodan, 1997). In each stage of the innovation process knowledge plays a prominent role (Scarbrough, 2003). At ideation level, which is the first phase of the innovation process, a prior knowledge base of the domain and knowledge extracted from multiple sources create the foundation for generating a new idea. At Research and Development (R&D) level, knowledge aggregation and knowledge use are significant activities.

On diffusion level market knowledge, customer knowledge and knowledge of competition are necessary. For streamlining the processes with a systematic methodology and maneuvering of knowledge activities required for the innovation process, KM as the underpinning tool is used. Efficient management of these activities elevates firm's innovation capabilities.

Adams and Lemont (2003) in a paper proposed to inquire how KMS effectiveness influences on firm's innovation practices and how innovation competencies are linked to sustainable competitive advantage. They believed that in both the cases the relationship should be positive.

Darroch (2005) observed that KM effectiveness fosters better resource use and help to build new capabilities. These capabilities translate into the improved utilization of resources contributing to better innovation outcome and strengthening financial performance. Having knowledge resource, according to her findings, is not enough. Essential is to figure out how this knowledge is managed and used. Her study, grounding on the data collected from 1743 firms with over fifty employees, confirmed that effective management of knowledge processes positively impact on firm's innovation.

Gloet and Terziovski (2004) showed that KM is a facilitator in improving innovation performance of a firm. To maximize the potential of KM and reap benefits concerning innovation performance focus should be given to both IT and human resources.

Zhou and Uhlaner's (2009) investigation confirmed the importance of KM in integrating knowledge from external sources influence on small and medium-sized enterprises' innovativeness. Chang and Lee (2008) researched the question if knowledge accumulation capability affects firm's innovation. Knowledge accumulation capability in their study comprises of knowledge selection. obtainment, establishment, expansion, and storage. These variables are quite like the KM processes as we deliberate in this thesis. Their study indicates that there exists a substantial positive link between these two.

Smith, Collins and Clark (2005) conducted a field study covering knowledge workers and company executives of technology firms. The relationships they tested were between knowledge stock, knowledge creation capability, and innovation. They found a linear association between them. Considering one of the fundamental reasons why companies implement KM is knowledge creation, it is safe to say that their finding indirectly confirms a positive relation between KM and innovation.

Liao and Chuang (2006) observed that KM effectiveness is grounded on two aspects: KM resources and KM process capability. They discovered that KM resources consisting of structural, cultural and human resources have a high degree of influence on the KM process capability of a firm. Moreover, KM process capability contributes profoundly to companies' innovation magnitude and speed.

Urgal et al. (2013) examined the data of 9432 enterprises of a community innovation survey and found that knowledge resources are positively associated with firms' innovation performance. These resources enhance innovation capability of a company which in turn also improve innovation performance of the business. Shani et al. (2003) noted that with increasing amount of knowledge, designing and managing new product development is becoming an ever-complex task. Implementation of KM and proper KM strategy can tackle this issue and improve firms' innovation capability. According to Cavusgil (2003), KM can be instrumental in addressing innovation complexity. The knowledge that gets produced thanks to the innovation process and knowledge resource that is a necessary precursor to R&D, both these types of knowledge should be managed with the help of KM. Effective knowledge use, Cavusgil (2003) maintained, makes a company innovative and more successful in comparison to peers.

In a shifting market environment, the ability of a firm to integrate knowledge swiftly and efficiently from external sources which often work as a vital resource for innovation is imperative for innovation success (Chen et al., 2004). KM as a platform and collaboration tool facilitates codifying and sharing tacit knowledge of a cross-divisional team of the company. It instigates cross-pollination of ideas that may evolve into new knowledge source for innovation and improve the organization's innovation capacity (Cardinal et al., 2001).

Inkinen (2016) reviewed empirical studies done on KM practices and firm performance. The article shows that numerous empirical studies validated the idea that KM practices are indeed a key driver of innovation.

However, not all studies demonstrated a clear and deep association between KM and innovation. For example, in an investigation conducted by Mageswari et al. (2015) on the impact of KM on innovation noticed only a partial influence. This discrepancy relays the postulation that more research is inevitable in this direction. Based on these examples and arguments we formulated our second hypothesis.

H2 There is a positive impact of Organizational Knowledge Management on Organizational Innovation.

2.6.7.3. Hypothesis three. Organizational KM and Competitiveness.

KM and Competitiveness. Improved productivity raises a company's competitiveness (Muellbauer, 1991). Deployment of new technologies in various organizational business and production processes leverages its productivity (Powell, 2004). Knowledge is a crucial element in this context. Knowledge related to required technologies, their implementation and continuous use must be effectively managed to achieve the desired result. In knowledge-based industries, knowledge is also the primary production input that relies on knowledge identification, aggregation, utilization, and dissemination (Grant, 1996). In the operational value chain of a firm, each primary and supporting activity from inbound logistics to services and infrastructure development to procurement is thoroughly entwined with knowledge. These activities in unison build the competitiveness capacity of the firm (Porter, 1990).

From strategic readiness perspective, Wang et al. (2014) investigated the effects of structural, relational and intellectual capitals on firms' performance in the context of knowledge sharing. They found a strong relationship between organizational capitals and its performance. They also noted that knowledge sharing increase intellectual capital of a company significantly which contributes to firms' financial and operational performance.

Employee competencies improve over time through learning. Learning requires access to knowledge where knowledge sharing is an important attribute. Better employee competencies as Hsu (2008) observed are beneficial to firm's performance. KM is a valuable tool for providing employees the required knowledge just in time.

Theriou et al. (2011) tested the association between KM effectiveness and firm performance. Data used in the study was collected from Greek manufacturing and construction companies. They found that KM effectiveness is a key predictor of business performance. Both determinants of firm performance: market share, and profitability, used in the model construct, show a noteworthy positive relationship with KM Effectiveness.

Kaveh et al. (2015) examined if there is any significant link between knowledge management and firms' competitiveness from the data collected from packaging industry and confirmed a close relationship between them. Knowledge sharing, a vital KM process, as Wang and Wang (2012) found, directly contributes to organizational performance.

Gholami et al. (2013) surveyed 282 SME in Iran to test the possible impact of KM on organizational performance. Their findings confirm that there is a meaningful statistical effect of KM on firms' performance. The organizational performance in their research included attributes such as financial performance, innovation, staff performance, work relationships and customer satisfaction.

Andreeva and Kianto, (2012) observed that although ICT is essential in managing knowledge related activities and there is certainly a link between ICT such as KMS and organizational performance empirical studies in this area are still rare. They investigated the contributory relationship of ICT practices in KM with company competitiveness and established statistically significant relationships.

Based on this and prior literature review (see Autio et al., 2000; Zaim, Tatoglu and Zaim, 2007; Karaszewski, 2008; Lee and Sukoco, 2007; Lee and Lee, 2007; Chuang, 2004) the third hypothesis was formulated as:

H3 Organizational Knowledge Management positively influences on Organizational Competitiveness.

2.6.7.4. Hypothesis four. Innovation and Competitiveness.

Many studies proved the undeniable linkage between innovation and firm performance (see Yilmaz et al., 2005; Barringer and Bluedorn, 1999; Hornsby et al.2002). Organization's capacity to innovate whether it is radical or incremental, administrative or technological, process innovation (see Olson and Schwab, 2000) or product innovation (see Han et al., 1998), strategy innovation or business model innovation, the effects on firm's performance is proven to be positive one (Damanpur et al., 1989; Deshpande et al., 1993; McGrath et al., 1996; Han et al., 1998; Du and Farley, 2001, Wu et al., 2003; Adams and Lamont, 2003; Gloet and Terziovski, 2004; Lee and Sukoco, 2007; Lopez-Nicolas and Merono-Cerdan, 2011).

Wang and Lin (2013) analyzed KM orientation and its impact on innovation and firm's performance. They also found knowledge sharing, knowledge absorption, and knowledge receptivity have an influence on innovation and that innovation impacts company's performance positively.

Most of these studies, however, focus on company's performance, but a significant portion of the factors also considered competitiveness as firm's central performance indicator (Roper, 1997; Gunday at al., 2011). For example, according to Martin-de Castro et al. (2013), technological innovation is an antecedent to firms' competitiveness. Adams and Lamont (2003) verified KM system's effectiveness along with KM aspects on innovation and innovation's link to competitiveness and located a positive relationship.

How innovation in recent years has become a priority in the company's quest for competitiveness is exemplified in Porter's works. In his Five Forces Analysis and Value Chain analysis frameworks, innovation received rather a peripheral attention (Porter, 1990). At a later stage, his cluster concept and diamond framework, on the other hand, evince innovation as a vital element in creating sustained competitiveness (Huggins and Izushi, 2011). In innovation-driven economy, innovation is considered as a primary source of competitiveness (Jaffe and Trajtenberg, 2002). In a recent research in the context of e-business Soto-Acosta et at al. (2016) confirmed a positive impact of innovation on firm's performance which comprises financial performance and customer satisfaction.

Adoption of new activities, procedures and routines in streamlining and enhancing business processes and use of new technology to achieve this increase firm's competitiveness (Goel and Rich, 1997). If a company can develop knowledge-based competitiveness by churning out rapid innovation, rivals face extreme difficulties in displacing it from its competitive position (Carneiro, 2000).

Based on these arguments, and prior literature (see Yilmaz et al., 2005; Barringer and Bluedorn, 1999; Hornsby et al., 2002; Lopez-Nicolas and Merono-Cerdan, 2011; Wang and Lin, 2013) the following hypothesis is crafted:

H4 Innovation makes positive effects on Organizational Competitiveness.

2.6.7.5. Hypothesis five. Relationship between Organizational KM and Firm's Competitiveness via Innovation.

Firms need to work on its market expansion to ensure strong competitive position. In the early days of KM implementation, researchers were convinced that KM brings direct financial benefits to firms by facilitating cost-cutting and income generation (Davenport et al., 1988). However, now the prevailing view is any financial benefit derived from KM is tangential and by indirect effects through various organizational processes (Gold et al., 2001; Lee and Choi, 2003; Gloet and Terziovski, 2004; Zaim et al., 2007; Chang and Lee, 2008; Zhou and Uhlaner, 2009); Andreeva and Kianto, 2011; Urgal et al., 2013). Innovation is one the mechanisms that several studies found can demonstrate KM's effect, and presently gets widely selected in the investigation of KM's growing impact (e.g., Zhou and Uhlaner, 2009; Chang and Lee, 2008; Smith et al., 2005; Liao and Chuang, 2006).

Lopez-Nicolas and Merono-Cerdan (2011) verified how KM strategy from the perspective of codification and personalization impact on innovation and consequently on organizational performance directly and mediated through innovation. KM, as the research discovered, is a valuable tool for firms to transform into an effective, efficient and innovative company.

Vaccaro et al. (2010) concluded that KM's indirect contribution to company's financial performance via innovation is highly positive. Innovation in that study is characterized by new product development and improved products.

Wang and Wang (2012) surveyed 226 managers of 89 technology companies to test the theory that there exist positive links between knowledge sharing, innovation, and organizational performance. They found that both explicit and tacit knowledge sharing influence positively on innovation quality and its speed and organizational performance receives benefits from knowledge sharing indirectly through innovation.

Alegre et al. (2011) checked whether implementation and use of KM practices contribute to firm's innovation performance based on the data collected from French biotechnology SME firms. The results reveal strong support for this assumption. They also found that KM dynamic capabilities work as a positive mediating factor between KM practices and innovativeness.

Daud and Yusoff (2011) tested empirically and found that KM affects positively on organizational performance mediating through intellectual capital. Similarly, Urbancova (2013) investigated and found that firms can gain competitive advantage from knowledge through innovation. An empirical examination to ascertain KM capabilities' contribution to firm performance found both direct and indirect positive links (Cohen and Olsen, 2015).

Market growth can originate new products, improved products, new markets and improved customer satisfaction (Slater, Mohr and Sengupta, 1995). These are often outcomes of firms' innovation efforts. Identifying knowledge necessary for the chosen innovation process, its aggregation, recombination, and application is the activities that engender expected innovation (Scarbrough, 2003; DuPlessis, 2007). Effective management of these knowledge activities impacts on the company's competitiveness by shortening the time needed for the innovation process, enhancing corporate innovation capabilities and propounding new ideas. In this context, innovation plays a mediating role in KM's beneficial influence on competitiveness (see Andreeva, and Kianto, 2011). Moreover, as a management tool, KM's use in innovation process by itself can be a source of competitiveness (Davenport, 1988).

The final hypothesis ensues from these arguments and following prior literature (Lopez-Nicolas and Merono-Cerdan, 2011; Lee, Lee and Kang, 2005; Darroch, 2005; Adams and Lamont, 2003).

H5 Organizational Knowledge Management effects positively on Organizational Competitiveness through Innovation.

2.6.8. Measures

The survey questionnaire constructed for this study is composed of 44 questions. All questions are formerly validated and carefully selected from previous literature. Tables reflecting the measures are illustrated in the next chapter.

The variables for innovation are selected from Darroch (2005) and Lopez-Nicolas and Merono-Cerdan (2011).

Strategic readiness factor from KM Effectiveness is operationalized based on Kaplan and Norton (2004) and KM process variables are selected from Gold et al. (2001), Zack et al. (2009) and Kulkarni, Ravindran and Freeze (2007).

Competitiveness factor is structured based on Dahspande et al. (2003), Drew, (1997), Lopez-Nicolas and Merono-Cerdan, (2011), Lee and Choi (2003) and Andreeva and Kianto (2011). The impact of Semantic KMS on KM Effectiveness was operationalized based on Delone and McLean's (1992) success model and Grant (2008). The variables are selected from Joo and Lee (2009).

2.6.9. Conclusion

This section is based on the analysis of the previous researches and literature. It developed and delineated the research questions and hypotheses. In the next chapter, the philosophical view of the researcher, adopted paradigm, method of data collection and data analysis are elaborated.

3. CHAPTER THREE. METHODOLOGY

3.1.INTRODUCTION

This section describes the research method and the design of the research project. It reviews various research approaches, and their advantages and limitations. As research problems and objectives dictate what should be the research methodology this review is necessary for clarifying which approach the researcher is embracing and why (Mouton, 1998).

Before a researcher starts collecting data and commence to analyze the data a proper research structure or design is needed. A research design is the logical steps and structure that facilitate minimizing ambiguity while answering the research questions based on collected data and their analysis. The use of research design entails the selection of a suitable research method for obtaining the goals and objectives outlined by the researcher. The selection of the method requires having a clear idea about what evidence is essential to answer convincingly the set research questions.

This chapter covers three areas. It reviews the philosophical views and research paradigms that are relevant to this research. It develops a research design in agreement with the paradigm adopted for this research. It depicts the research method, data gathering, and analysis methods.

3.2. RESEARCH PARADIGM

A paradigm is referred to a holistic system of thinking (Neuman, 2011). Chalmer (1982, p. 90) describes a paradigm as "made up of the general theoretical assumptions and laws, and techniques for their application that the members of a particular scientific community adopt." The characteristics of a paradigm according to him include:

- Accepted laws and assumptions of the discipline;
- These generalized laws can be tested in various situation within the discipline;
- There exist technique and tools that are used to test the laws in the real world;
- Some prescribed methods are available to handle researches in the discipline.

A paradigm is also defined as a set of theories, principles, assumptions, concepts, values, practices, procedures and routines that create the foundation for specific thought pattern in any discipline. It exemplifies values, understanding, the way of thinking, traditional approach, models, accepted theories, methodologies and concepts of a field (Mouton, 1996; Creswell, 2007; Babbie, 2010). In science, a paradigm is a holistic framework of a philosophy of science, how and using which tools the learning, understanding, and research are transpired in the discipline. Kuhn (1962) in his book "The Structure of Scientific Revolutions" illustrated what construes paradigm in science. In any scientific field, there exist a set of laws, beliefs or assumptions that ensue from past scientific successes of that area and work as its theoretical foundation. Practitioners of the field share their knowledge and base their research to a large extent on same models, standards, and practice rooted in this foundation, which conjointly called a paradigm. The paradigm assists practitioners to seek out new research areas, identify scope, ask questions, and investigate the issues using accepted methods.

However, the concept of paradigm and what it's constituted of are still a contentious subject (Livesey, 2011) and even Kuhn admitted that his use of the word was not very consistent. It is, however, generally understood as a worldview, a holistic belief system within a field, and a guiding framework for conducting research and practices within the discipline.

The worldview (Guba, 1990; Creswell, 2014) related to ontology — what exactly is knowledge for the research, epistemology — what is the process of knowing, axiology — what values are rooted in it, and methodology — what methods are applied in the research process are present in any study, although in most analyses they are implicit (Crotty, 1998; Neuman, 2000; Creswell, 1994). These assumptions are shaped over the course of time from the factors such as researcher's experience, acquired knowledge, community belonging, educational background, and interaction with others. Sometimes, certain beliefs may also be embedded in the concerning problems that the researcher is investigating. Moreover, scholarly communities usually have a way to tackle and study certain research problems and methods of adding knowledge through the study. These assumptions and ways reflect the researcher's approach in identifying a concerned problem, formulating research questions, adopting an investigating process, applying methods of gathering data and analyzing them. Researchers, as a result, employ quantitative, qualitative and mixed methods based on their worldview or philosophical assumptions (Creswell, 2014). However, it should be noted that a researcher's worldview is not always rigid and might change over time (Schutt, 2011).

Based on epistemological and ontological views there exist various philosophical underlying assumptions or research paradigms. Some of them are pragmatism (Rorty, 1990; Cherryholmes, 1992), social constructivism (Guba, 2000; Crotty, 1998), positivism and post-positivism (Phillips and Burbules, 2000). Here two approaches that are frequently mentioned in literature Positivism, which also includes Post-Positivism, and Constructivism are reviewed (Creswell, 2014).

3.2.1. Positivism and Post-positivism

Positivism relies on the belief that objective reality and facts exist independent of a person's subjective experience or perception (Hesse-Biber and Nagy, 2010). Knowledge is derived from sensory experience from data which can be observed and confirmed through scientific approaches. Positivist knowledge strives to be general, objective, replicable and value-free. Positivism is the philosophical underpinning where quantitative analysis is used as the research method (Kincaid, 2000).

Positivism postulates that theory of science, whether it is natural or social science, should be transformed into observable statements using scientific methods. According to this theory, if it is not an observable fact, it is not real knowledge (Compte, 1975). The use of quantitative data in scientific research in social science owes a great deal to positivism (Kincaid, 2000). Positivism proclaims the idea that a researcher can keep a non-interventionist, entirely neutral, and completely detached position from the studied phenomenon (Morris, 2006).

To claim that a researcher can be positive about the absolute truth of knowledge (Phillips and Burbules, 2000) from the investigation where human behavior plays a significant role is rather questionable. A scintilla of doubt will always exist in the claim of objectivity and preciseness of the foundations when a social phenomenon is the object of the investigation resulting in a fuzziness and probabilistic degree in the claim. Moreover, sensory data while analyzed are processed through concepts which are interpreted by the researcher. When sifted through the researcher's interpretation, the data, and the analyzing process goe through an inevitable transformation that creates a propensity towards a specific outcome (Quine, 1951). This bias undoubtedly affects the objectivity.

Post-positivism is a modified version of positivism and not a stand-alone philosophical approach (Creswell, 2009). Mere measurement cannot ensure understanding; there always exist multiple perspectives of a single reality. The understanding of this reality, according to this view, is relative and never complete. Post-positivism, thanks to this acceptance of various perspectives, allows the use of different research strategies which may include quantitative, qualitative and mixed methods.

Observable data and their measurement to seek knowledge for the external reality are critical for the post-positivistic approach. As such, the problems are studied by investigating causes and their impact on outcomes through experiments. To examine the data efficiently and correctly the problems and the causes are transformed into a testable dataset and analyzed through scientific methods. Based on theories and conjectures, post-positivism is considered as a methodical, observational, experiential and analytical study of phenomena and their relationships (Wildermuth, 1993).

Post-positivistic views assume (Creswell, 2014):

a) Knowledge is anti-foundational. Discovering absolute truth is impossible. The scientific research is always fallible.

b) In research, the claims are first made and through evidence and rational analyses the conjectures are either justified, justified after refinements or abandoned for more warranted claims.
c) The research determines the causal relationships between entities of interest, and search for the truthfulness of concerned statements.
d) Standards of reliability and validaty are observed with scientific rigor to stay objective in inquiring process.

Based on the analysis mentioned above, post-positivism, as opposed to positivism, has been selected as the guiding philosophical approach in this research. This approach also implies while the reality is independent and detached, the researchers cannot stay neutral and isolate themselves from any possible bias in their interpretation. It also makes the rigorous determinism that tags along with all forms of positivism more pliable.

3.2.2. Interpretivist/Constructivism View

Interpretivism observes and interprets a social phenomenon to apprehend it. It is also referred as phenomenological approach and based on the lived experience of human beings. It is a method of understanding how people as social elements make sense of their world through identifying, defining, evaluating, justifying and accepting their everyday actions (Babbie and Mouton, 2008). Reality is perceived by an individual through socially and experientially constructed explanation, interpretation, and comprehension. Social interaction between humans and the reality that it produces play a decisive role in the interpretative method of trying to understand a social phenomenon. Due to its inherent complex nature and ephemeral existence, conducting an objective observation of social phenomena is not possible. Observation and interpretation of the social world and phenomenon that is getting investigated, researchers assay and build their understanding of the subjective reality and provide explanations that develop theories. Knowledge, according to interpretivist view, is constructed by humans' interests and their observation, contemplation, interpretation, and explanation (Blumberg et al., 2011). Knowledge embedded in the mind of a knower and the knower are inseparable. The personal worldview of the investigator impacts on her understanding of herself, others and surroundings as well as the object of investigation. Reality cannot be disconnected from a person's knowledge, and researchers cannot be impartial in finding the truth due to inherent personal values that create a bias.

The existence of reality, according to constructivist or interpretivists, is the reflection of human perception and it is represented and constructed by human thoughts (Flanagan, 1991; Rosenau, 1992). It is virtually a process of learning through acquiring knowledge.

Within the broader umbrella of constructivism, from the perspectives of neo-Vygotsky (Tharp and Gallimore, 19880) and Piaget (Piaget, 1969; Adey and Shayer, 1994) to social constructivism (Rogoff, 1990; Fosnot, 1996) and radical constructivism (von Glasersfeld, 1996) many branches of ideologies exist. However, all these schools share some similar views that include (Crotty, 1998; Fox, 2001; Creswell, 2014):

a) Individuals construct meanings of the reality as per their perceptions;
b) All knowledge is personal or socially constructed;
c) Culture plays an important role in an individual's interpretation of the world through her social and historical perspective;
d) A generic concept and meaning of an entity are socially constructed through the interaction of the individuals with the community.

3.2.3. Rationale for Selecting Post-Positivist View

Within any scientific domain, empirical research in studying a phenomenon applies a certain methodical approach to the questions asked and results expected. Three elements are essential to consider while designing a research methodology: What knowledge claims are made, what inquiry strategies or procedures of research are adopted and what methods of data collection, analysis, and writing are used (Crotty, 1998; Creswell, 1994). Knowledge claim in this context construes what and how the researcher will learn of this research – the paradigms (Martens, 1998; Kuhn, 1951) of the investigation and methodology implemented (Neuman, 2000). In the overwhelming majority of the cases where the impact of knowledge management in an organizational context is studied researchers have opted for empirical research using the quantitative method and post-positivistic approach. This study follows the same path.

3.3. TYPES OF RESEARCH

There exist three types of research studies (Churchill, 1987; Ghauri and Gronhaug, 2002). Choice of any or multiple of them is determined by the purpose of the study as these types are not mutually exclusive.

3.3.1. Exploratory Research

To understand the phenomenon from a different perspective, gain knowledge and insight about the processes occurring and clarifying the essence of the problem exploratory study is used (Saunders, Lewis and Thornhill, 2006; Zikmund, 2003). It is usually conducted before the main study when information is still scant for pursuing a detailed analysis. The exploratory level usually does not produce significant clear answers and used for constructing concepts, formulating and refining hypotheses and selections of variables (Sekaran, 2003).

3.3.2. Descriptive Research

It delineates various attributes of phenomena and the population of the research study and provides a clearer picture of the research context and relationships (Zikmund, 2003; Neuman, 2006).

3.3.3. Explanatory Research

Once the researcher defined the problem clearly and narrowly, the explanatory research is deployed for clarifying the cause-effect relationships between the various variables (Zikmund, 2003; Sekaran, 2003). Using the information garnered from exploratory and descriptive researches at this level the researcher tests, refines, develops or enhances a theory by discovering the reasons behind a phenomenon's existence (Neuman, 2006).

3.4. JUSTIFICATION OF QUANTITATIVE PARADIGM

3.4.1. Quantitative Research

The quantitative approach is defined as a formalized method of conducting research with the well-defined scope and explicit control of the research steps (Mouton and Marais, 1992; Kothari, 2004). It is meant to be objective, methodological, prescribed and a systematic way of investigating a phenomenon (Blessing and Chakrabarti, 2009). In this approach, using proper tools following a strict methodology information about evidence of the studied phenomenon is gathered, converted into numerical data and analyzed with the help of statistical instruments (Polit and Hungler, 1995).

In the social science use for quantitative analysis for answering empirical questions is a long-accepted method. Better software, robust analytical methods, faster computing speed and access to quality data in a larger volume are increasingly making quantitative data analysis a preferable method in the social science even more (Park, 2006).

In Quantitative Research, who and what are the basis of a research problem. An important part of the literature review is the focus on relationships between the previously identified and measured variables. Researchers try their best to stay detached and observe the phenomenon externally while developing hypotheses and testing them empirically (Neuman, 2006). This method of hypothetic-deductive testing includes content analysis, statistics analysis, surveys, experiments and secondary data analysis. To bestow solid empirical underpinning to the conclusion a relatively large sample data is collected and analyzed for validity and reliability.

3.4.2. Qualitative Research

This research type warrants for describing reality as it is in nature. The fundamental set of questions in this research method is what is going on, what the actors are doing and what is the main purpose of what they are doing. The meaning is perceived through the culture and social interaction (Gubrium and Holstein, 1997). The goal is to explore the dynamic processes within a specific social context by asking questions such as "why" and "how" as it is hard to quantify these underlying dynamics in a meaningful way. Moreover, the goal of this approach is to draw a subjective understanding by observing a process (Hesse-Biber and Nagy, 2010).

The research method used in this approach includes but not limited to case studies, ethnography, action research, grounded theory with field research and historical comparative research (Neumann, 2006). The qualitative method uses an inductive approach to developing theory. The aim is to construct knowledge based on diverse subjective views as described by Van Maanen (1983: 9) "to describe, decode, translate and otherwise come to terms with the meaning, not the frequency, of certain more or less naturally occurring phenomena in the social world." Because of its focus, the possibility of contextual immersion, flexibility and open-ended questions in interviews, the data garnered are rich and capable of producing new knowledge and insights related to the studied phenomenon. As a result, qualitative methods generate high validity outcome, albeit reliability and generality in the process get hampered. These methods are suitable for developing new theories and knowledge thanks to the clarity of understanding of the phenomenon they provide.

3.5. UNIT OF ANALYSIS

This research is about relationships between various components of an organization. Hence the unit of analysis is the firm while data is collected from mid to high-level management representatives.

3.6. QUANTITATIVE DATA COLLECTION METHODS

3.6.1. Justification of Survey Research Method

There exist four basic categories in quantitative research techniques: experiments, surveys, observations and secondary data studies (Zikmund, 2003).

Experiments: Two or multiple groups of research participants are selected. Conditions for one group are kept the same while for others they are changed. The researchers monitor and check the groups' data to identify if any changes have occurred. This research technique is called experimental (Neuman, 2006). For determining a cause-effect relationship between the variables experimental technique is most desirable. However, this technique requires that the researcher assumes control of at least one variable, which often in a business context is not possible. Because of this, researchers embrace correlational studies of observational and survey research as their preferable choices.

Observation: it is the method of monitoring and tallying the participants and the variables without receiving any direct responses from the participants (Zikmund, 2003). Structured and unstructured are two methods of observation. The structured method is used for testing hypothesis and unstructured in the theory building process (Manning, 2006). Survey is the most widely used research techniques in quantitative business research (Manning, 2006). The goal is to gather information from a sample pool by asking the participants to answer to a set of questions for later use in analyzing this data and deduce conclusions (Zikmund, 2003).

Secondary data study: it is a research technique where already collected data for a different purpose is used for conducting a new research (Zikmund, 2003).

Survey: This research opted for survey research technique for two main reasons. First, most researches done in this field of studies, as outlined in the literature review of the prior empirical researches, used survey method. Second, it is a fast, efficient and precise way of gathering data and evaluating it from a large sample pool (Zikmund, 2003).

Four types of surveys are there. These are Face-to-face interviews, Telephone interviews, Questionnaire dissemination through postal mail or e-mail and online surveys (Neuman, 2006).

Personal or face-to-face interview: In this approach, the researcher communicates with the respondent being in the close physical proximity (Zikmund, 2003).

Telephone interview: In this method, instead of being present at the same place with the respondent, the researcher makes a phone call to communicate and conduct an interview (Neuman, 2006).

Questionnaire dissemination through postal mail or e-mail: Before the advent of the Internet, a traditional method of distributing questionnaire was postal mail. The researcher mails the questionnaire to the sample population and receives answers though postal mails. The same process can be conducted now through electronic mail.

Online surveys: The researcher communicates with the sample pool through email and requests to complete the survey online on a website designated for this purpose.

Among all these survey methods, the face-to-face method garners maximum responses. However, the presence of the interviewer and her explanations to various possible questions of the responder may result in unexpected bias.

Considering the vast geographical span of the sample population, in the case of this research, the researcher considered the online survey method is the best option. The reasons for this choice also include:

1) It is one of the most cost effective eliminating multicollinearity (Evans and Mathur, 2005),

2) The direct and automated input of the data diminishes chances of administrative errors (Brennan, Rae and Parackal, 1999),

3) It provides the ability to address a large sample population simultaneously (Zikmund, 2003),

4) Online data collection in real-time facilitates fast and efficient real-time analysis of the data (Zikmund, 2003).

3.6.2. Research Design

There are three steps in this research process, which include:

a) Development of the questionnaire;
b) Conducting pilot survey;
c) Conducting the main survey.

3.6.3. The Development of the Questionnaire

The questionnaire design, which is the first of the research design phase, requires the operationalization of measurement variables following the prior literature and the development of the theoretical framework.

3.6.4. Operationalization of Measures

All constructs of the theoretical model are measured using multiple items with six-point Likert scale of 1 (strongly disagree) to 6 (strongly agree). Six point Likert Scale delivers improved granularity resulting easier decision making. It is considered as the optimal and preferable number by many researchers (Preston and Colman, 2000).

Measuring KMS. Knowledge is increasingly becoming the primary factor of production in the knowledge economy. The Economic success of an organization as well as an individual now significantly depends on the capability of learning, knowledge absorbance, knowledge use and knowledge production. Semantic KMS is designed to achieve this.

Following Delone and MCcLean's (1992) success model and variables that were employed by Joo and Lee (2009), we have developed the first eight measurement items. The first variable Convenience of Use has two items. Knowledge Search composes of three items. Knowledge Integration includes two items, and Knowledge Quality consists of one item.

The second group of variables Serendipity and Arbitrage which are operationalized from the work of Carayannis (2011) consists of two items. These twelve items form the factor of Semantic KMS, figure 12.

Measuring KM Effectiveness. KM Effectiveness factor includes the measurement of the performance of KM using KM processes and the strategic readiness. The items for KM processes

Semantic Technologies based KM System (Joo and Lee, 2009)

Since the implementation of Semantic Technologies based KM System

Convenience of use
KC1 KM system response time is faster
KC2 KM system is easier to use

Knowledge search
KS1 It is easier to find the knowledge you need
KS2 Classification is now well organized in the system
KS3 The KM system provides more relevant knowledge as search result

Knowledge Integration
KI1 You have access to more relevant knowledge from disparate information systems and the Web
KI2 More information is converted to an accessible format and stored in the KM system

Knowledge Quality
KQ1 Knowledge provided by the KM system is often adequate for the task at hand
KQ2 Knowledge provided by the KM system is accurate enough
KQ3 Knowledge provided by the KM system is reliable

Serendipity and Arbitrage (Carayannis, 2011)
SA1 You are finding more unexpected and valuable knowledge than before
SA2 Better access to knowledge helped you using available knowledge at least in one new area

Figure 12: Semantic KMS

are operationalized using items developed by (Gold, Malhotra and Segars, 2001) and Smith (2206).

Knowledge Acquisition

AQ1 Your firm regularly captures knowledge from external sources, i.e. competitors, partners, suppliers and outside research

AQ2 In your firm it is a company priority to identify and acquire new knowledge

AQ3 The knowledge management processes in your firm support learning and using lesson learnt from previous experiences, best practices and expert insights, etc.

Knowledge Application

AP1 Your firm is actively engaged in research and development

AP2 Newly acquired knowledge is regularly used in projects and tasks

Knowledge Accumulation

AC1 In your firm collected knowledge is well categorized and organized

AC2 It's a common practice in your firm to document and store new knowledge such as lesson learnt, best practices, expert's insights etc.

AC3 You consider that knowledge (know-how, technical skills, best practices, research works, etc.) is sufficiently codified in your firm

Knowledge Dissemination

The following aspects are common practice in your firm:

AS1 Information sharing using communities of practices, social media, wikis and blogs

AS2 Informal and formal meetings and dialogues to share knowledge
Transfer of knowledge within departments, units and partners

Figure 13:Variables of KM processes

The variables in KM Processes include Knowledge Acquisition, Knowledge Application, Knowledge Accumulation and Knowledge Dissemination and comprised of ten items, figure 13.

KM Strategic Readiness which consists of Human Capital, Organizational Capital, and Information Capital are operationalized based on Kaplan and Norton (2004). Items are selected from Gold, Malhotra and Segars, (2001), Zack et al., (2009) and Kulkarni et al., (2007), and composed of 12 items, figure 14.

KM Strategic Readiness (Kaplan and Norton, 2004; Gold et al., 2001)

Human capital

SH1 Your firm has more employees with higher education than key competitors
SH2 Your firm has more skilled workers than key competitors

Organization Capital

SO1 Your firm frequently forms partnership with others in various areas
SO2 In your firm access to knowledge from coworkers and experts is easy and simple
SO3 KM group in your firm is a recognized source of organizational value creation
SO4 Your firm has adopted a clear knowledge related strategy
SO5 Top management in your company participates in key knowledge management initiatives
SO6 Top management in your company emphasizes the importance of KM to employees
SO7 Employees' opinion and ideas are valued in your firm
SO8 A culture of continuous learning such as training and participation in seminars, trade shows, conferences, etc. exist in the firm

Information Capital

SI1 Information technology infrastructure in your firm is adequate for knowledge management initiatives
SI2 Your firm often invests in new technologies

Figure 14: KM strategic readiness

Measuring Organizational Innovation. In one area where the performance of a KM is quite noticeable is Organizational Innovation. A significant amount of research demonstrates the positive association between KM and firm's innovation (Hage, 1999; Leonard-Barton, 1999). The factor of Organizational Innovation is composed of 6 items which are operationalized from the works of Darroch, (2005), and Lopez-Nicolas and Merono-Certdano (2011), figure 15.

Organizational Innovation (Darroch, 2005; Lopez-Nicolas and Merono-Cerdan 2011)

Since the adoption of first KM initiative in your firm

OI1 Your firm has launched at least one new product or service that is completely new to the world
OI2 Your firm often introduces products and services new to the firm
OI3 Your firm regularly adds more new products and services to the existing line
OI4 Your firm often improves and revises existing products or services
OI5 Your firm frequently changes products or services in order to lower cost
OI6 Your firm regularly repositions products and services to differentiate from existing ones

Figure 15: Organizational Innovation

Measuring Organizational Competitiveness. An organization's competitiveness is its ability to make a product or service that satisfies needs of a targeted population and sell it with enough profits even though other competing products and services are also available in the same market.

Various studies showed that both KM and Innovation have linkage with Organization's Competitiveness (see, Lee, Lee and Kang, 2005; Zaim, Tatoglu and Zaim, 2007; Karaszewski, 2008; Lee and Sukoco, 2007; Lopez-Nicolas and Merono-Cerdan, 2011).

In agreement with several studies found in the literature we have used the scales developed and used by Deshpande et al. (1993), Jaworski and Kohli (1993), Drew (1997), Avlonitis and Gounaris (1999), Va´zquez et al. (2001), Lee and Choi (2003) and recently Andreeva and Chianto (2011). This construct is composed of four items, figure 16.

Organizational Competitiveness (Deshpande et al., 1993; Drew, 1997)

Compared with key competitors, the firm
OC1 is more profitable
OC2 is growing faster
OC3 is more successful
OC4 has bigger market share

Figure 16: Organizational competitiveness

3.6.5. Questionnaire Preparation

The study followed Churchill's methodology of questionnaire development in the measurements that were created for this research (Han and Zhong, 2006). Care has been taken in reducing language ambiguity, bringing clarity and avoiding any possible bias so that data collection can be sufficiently accurate. The questionnaire is also structured in a manner so that it minimizes any potential vagueness. Questions relevant to the same section is categorized together. The first part of the questionnaire set consists of basic information which includes age, gender, position, industry, firm's size, years in business and time knowledge management practice implemented in the enterprise. For simplicity purpose, four types of company position are included. The Industry question constituted of 13 items. Firm's size has three different fields. Years in business is used for better understanding of the maturity of the business. There are three time segments for clarifying experience of the firm in the use of KM which are less than three years, 3 to 7 years and over seven years.

3.7. PILOT STUDY

The pilot study is a necessary element before conducting any main study. There are several reasons for conducting a pilot study. First, to validate the questionnaire construct and if needed to make refinements. A pilot study also demonstrates if a full study is at all viable to pursue. Second, identifies possible subtle impediments in conducting a thorough research. Third, it gives an idea of the possible required sample size for the full study and resources needed to perform it (Van Teijlingen and Hundley, 2002).

3.7.1. Interviews

There were two steps of the pilot study. At the first step, three semi-structured interviews were conducted (Polkinghorne, 2005). The goal was to understand the value of the research, the views of the industry insiders on this type of study, the clarity of the research design and refine the questionnaire if required. The first interviewee was the key executive of one of the top oil companies in the world which was one of the early adopters of semantic technologies in KM. As the interviewee was located in Europe, the interview took place through the email and online chat. His comments and suggestions were valuable contributions to this study. He also completed the survey, went through the questionnaire and made some suggestions in relation to the questionnaire.

The second interviewee was a KM consultant who was involved in the implementation of KM and Semantic tools for KM in one of the largest European aircraft engine manufacturing companies. He also filled up the survey and made some valuable comments pertaining sample selection. This interview was conducted via Skype.

The third interview was with the Chief Knowledge Officer of one of the private KM Institutes of Canada. It was a face-to-face interview. He also filled up the questionnaire and made some valuable comments. Under the suggestions and ideas of the interviewees, some of the wordings of several questions were perfected.

3.7.2. Preliminary Survey

At the second step, 20 randomly selected contacts, those who are professionally associated with KM from the researcher's list of LinkedIn contacts, were pulled out. In randomly selecting the contacts same criteria were applied as later for the main survey that reflects similar composition in both groups (Green and Tull, 1970).

A request to fill out the survey using surveymonkey.com platform was sent out to these 20 people. Ten filled surveys were received. Along with the previous three surveys completed by the interviewees, there was the final tally of 13 responses. As sample size thirteen is considered as an adequate number (Calder, Philips and Tybout, 1981) for a pilot study survey, no further request was sent out.

To check out the validity and reliability of the measurement scales of the questionnaire and assess if any further refinement is necessary item-total correlations and Cronbach Alpha using Pearson's correlation were used.

3.7.3. Validity and Reliability

Validity refers to if the tool measures what it is designed to measure. Internal validity shows if the design of a research study is a good test of the stated hypothesis, and to what extent researchers objectives are aligned with the relevancy and coherence of the results (Royer and Zarlowski, 2001). External validity demonstrates whether the research can be generalized beyond the present context, time and place, and reuse (Cooper, Schindler and Sun, 2003).

Reliability relates to the consistency of measurements each time the measurement tool is applied (Kumar, 2012). "A scale or test is reliable to the extent that repeat measurements made by it under constant conditions will give the same result" (Moser and Kalton (2001: p.353).

3.7.4. Data Analysis

Data must be well-organized so that an efficient analysis can be conducted for high-quality interpretation (Punch, 2009). While there are many tools and programs available for data analysis, for the analysis of this research data Statistical Package for Social Scientists (SPSS) and SPSS AMOS were used.

Cronbach's Alpha is applied for estimating internal consistency reliability linked to scores entailed from a scale. For scales of new studies, the acceptable minimum threshold is considered at 0.7 (Nunnaly and Bernstein, 1994). Most questions of this research were validated and used in prior studies. Questionnaire validity is tested with the help of Pearson Product-Moment Correlation. It measures a linear associative strength of two variables. Coefficient r denotes this strength. Its value is placed between -1 (perfect negative correlation) and 1 (perfect positive correlation). For the positive relationship, 0.1 to 0.3 is regarded as having small, 0.3 to 0.5 is medium, and 0.5 to 1.0 is the strong strength of association. Several assumptions are taken into consideration for the validity of Pearson correlation. These are 1) Data should be of the continuous level. 2) Values of data are independent of each other. 3) There exists a linear relationship and 4) samples are random. As Pearson correlation may provide a spurious relationship in some cases, a factor analysis on the main survey data was later performed to confirm the validity and overcome this issue (Pearson, 1896).

3.8. MAIN SURVEY

Since no anomaly was discovered in the pilot analysis in agreement with the result of the pilot study, the questionnaire was carried out for the main survey.

3.8.1. Survey Sample

The survey is the most common method of data collection for this type of study (Baroudi et al., 1986). In this study, a convenient sampling method is used as in the case of many similar types of research (Templeton, Lewis and Snyder, 2002). The sample population was extracted from LinkedIn contacts of the researcher. One of the main criteria in the selection process was that the person's profession must relate to knowledge management of his or her organization and the company should be in North America or Europe.

The objective of the use of the quantitative method is to gain a broader understanding of the problem and meant to confirm that the data collected is representative of the population. While the sample population was selected from the LinkedIn contacts of the author and seems like a convenience sampling of data collection method (Marshall,1996) these connections were randomly tapped and developed from a large segment of LinkedIn users, those who are somewhat connected to the concept of knowledge management in their respective organizations. This method of data gathering, where the participants are selected because they own specific qualities is referred as purposive sampling (Kothari, 2004). Although an overwhelming majority of professionals of the developed world is presented on the LinkedIn platform, only professionals with interest in building a social network are active users (Baruffaldi, Maio, and Landoni,2017). It might cause selection bias akin to the one rooted in the convenience sampling. However, it is important to note that this is a common factor of concern in any survey-based data collection method (Fowler, 2013).

640 contacts were selected, and an email invitation to participate in the survey on the Qualtrics platform was sent out. Two reminder emails were sent after a week and two weeks. In total 232 responses were received. The survey was carried out in the summer of 2014.

3.8.2. Data Analysis Method

After checking the data collected from the main survey for the accuracy and missing values, descriptive statistical analysis was performed to have a synopsis of the sample. It includes a summary of demographic information of the respondents and some important details about the firms they represent. For all statistical analyses of this study IBM SPSS and AMOS version 20 were used.

Data analysis of this research is executed in four steps. In the first step, Exploratory factor analysis is performed to explore possible factor structure of the given observable variables.

In the second step, a measurement model describing the relations of the latent constructs have been identified, developed and evaluated to clarify if the latent variables measures were consistent and defined correctly.

In the third step, structural equation model was used to test the hypotheses. In the fourth step, Pearson's correlation was applied for testing the first hypothesis using Principle Component Analysis and Cohen's criteria (Cohen, 1988).

3.8.2.1. Exploratory Factor Analysis.

It is a linear statistical modeling method of exploring and identifying probable factor structure of a group of observed variables without using a predefined structure (Suhr, 2006).

It reduces the variables and determines the factor structure of the given variables and define the latent constructs. EFA, however, just describes the relationship and does not infer causal interpretations. It works better with larger sample size. EFA assists in identifying precarious variables more easily than the CFA. Its use in the new data set is desirable before performing SEM, as it prepares the variables for easier structural modeling. When AMOS is used for CFA and structural modeling in EFA factoring method of Maximum Likelihood is applied (Fabrigar and Wegener, 2011).

Data Adequacy for EFA includes KMO statistics where 0.9 is considered as marvelous and less than 0.5 is acknowledged as unacceptable. Bartlett's Test of Sphericity at less than 0.05

confirms the high correlation of the variables and acceptable for running the EFA. Less than 0.4 communality score means the item might have difficulty to load on a factor significantly. In the factor structure exemplified by the pattern matrix, a primary loading should be 0.2 percent higher than cross loadings. For best result of convergent validity for the sample size near 200, as in the case of this study, factor loading greater than 0.4 should be considered as acceptable. If in pattern matrix the variables load in a single factor it means discriminant validity occurred. However, in the case of cross loads, none should surpass 0.2. For reliability test, Cronbach's alpha representing internal consistency should be over 0.7.

3.8.2.2. Measurement Model. Structural Equation Model.

The relationships between one or multiple independent variables and one or multiple dependent variables are often tested using Structural Equation Model (SEM). A researcher develops a theoretical model based on literature and own assumptions where variables are identified, and constructs are formed with the conjecture that they are linked in a particular manner. SEM is a multivariate statistical technique. The use of SEM has been increasingly growing in last two decades and getting closer to the use of ANOVA.

The biggest advantages of using SEM are its capabilities of modeling complex dependency and working with structural relationships of latent variables. SEM suits well for doing path analysis, which allows the estimation of the regressive dependence level and significance of the relationship between two or more variables of a hypothesis. A path diagram is the visual depiction of the links and effects of the independent and dependent variables, which represents the hypotheses to be examined. SEM as a statistical analysis tool not just covers the techniques of the path analysis and path diagram, its strength lies in its ability to handle observable variables of a latent variable. SEM is considered as the right tool for analyzing relationships that are represented in the hypotheses of this study because it covers structural model that demonstrates the links between latent variables, and measurement models reflecting the relationships of the observable variables that constitute each latent variable (Nachtigall et al., 2003). It allows representing a single framework for all the data. Although, looks similar SEM differs significantly from a regression model. In a regression model, independent and dependent variables are distinctly different. In SEM, on the other hand, a dependent variable in one section of the model can act as an independent variable in another part of the model. For mediation analysis, SEM also provides considerable simplification in comparison to standard regression model by allowing mediation hypotheses testing within one single analysis (Gunzler et al., 2013).

The aim of the SEM analysis is to figure out the degree of support sample data provides to the theoretical model. However, apart from those mentioned earlier, reasons for selecting SEM as preferred tool for this study include: first, it facilitates modeling and testing of complex constructs with a plethora of interrelated path dependency and second, it takes in consideration measurement error when analyzing data statistically. As a result, it provides superior degree of statistical estimation.

SEM analysis is executed in two steps (Hair et al., 1995). At the first level, using CFA measurement model is validated by evaluation Goodness-of-fit and tested for identifying evidence of construct validity. Confirmatory factor analysis is a statistical method of testing if the set of variables defines a construct. At the second step, fit statistics for the structural model is calculated, individual parameters estimates are verified, and theoretical relationships of the hypotheses are tested (Hair et al. 1995).

In total, there are six stages within CFA/SEM steps.

CFA	Stage 1: Defining Individual Constructs
	Stage 2: Developing the Overall Measurement Model
	Stage 3: Designing a Study to Produce Empirical Results
	Stage 4: Assessing the Measurement Model Validity
SEM	Stage 5: Specifying the Structural Model
	Stage 6: Assessing Structural Model Validity.

3.8.3. Sample Size

According to Holland et al. (1996), while a sample size of at least 100 participants is recommended for a sophisticated model, a size of 200 is more desirable. This survey fits into these criteria. The estimation procedure is also gets selected based on the sample size. In this research, the Maximum Likelihood estimation method was executed which is considered as a preferable method for the sample size of this study.

3.8.4. Overall Goodness of Fit

In SEM, the fit indices demonstrate if the model is acceptable. Many fit indices stemmed from the Chi-square value. The difference between the observed and predicted covariance matrix is represented by Chi-square. Chi-square is considered as a reasonable fit measure for a model with a sample size of 75 to 200.

Several classes of the goodness of fit indices are available such as absolute fit indices, incremental fit indices and parsimonious fit indices (Hair et al., 1995). Each index has its own limitation and to overcome it several fit indices are recommended to use for any study (Marsh, Balla and Hau, 1996).

3.8.5. Absolute Fit Measures

Absolute fit considers that the best fit for a model is when the fit is zero. The aim of the absolute fit, thus, is to identify the difference of the model from the perfect fit and show which of the proposed model provides the best fit (McDonald and Ho, 2002). Key absolute fit indices are comprised of Chi-square, Goodness-of-fit index (GFI), Root mean square residual (RMSR), Root mean square error of approximation (RMSEA), Standardized root mean residual (SRMR), Expected cross-validation index (ECVI), Actual cross-validation index (CVI), Normed Chi-square and Gamma Hat.

3.8.6. Incremental Fit Measures

This fit measure is like R-square, where the zero value indicates worse to one confirms the best possible model. It evaluates how well the model fits in comparison to an alternative model (Hair et al., 1995). The baseline model usually used is the null or independence model where all variables are uncorrelated but may have variation. Typical incremental fit statistics include Normed fit index (NIF), Tucker Lewis index (TLI), Comparative fit index (CFI), and relative non-centrality index (RNI) (Hu and Bentler, 1999).

3.8.7. Parsimony Fit Indices

Complex model estimation process depends on the sample data. The issue is it produces less rigorous theoretical model with superior fit indices. Parsimony fit indices facilitate overcoming this problem (Mulaik et al., 1989). The commonly applied parsimony fit indices are a Parsimonious goodness-of-fit index (PGEI) and Parsimonious normed fit index (PNFI) (Mulaik et al., 1989).

Since it is unrealistic to add every index in the reporting of fit indices, several key fit indices are considered as important and should be included. The frequently used fit indices consist of CFI, GFI, NFI and the NNFI (McDonald and Ho, 2002). Model Chi-square along with its degree of freedom and related "p" values are one of the most important statistics that must be included in all reports (Kline, 2005). Moreover, Kline (2005) suggested that Chi-square, RMSEA, CFI and SRMR should always be considered. A parsimony fit index such as PNFI should be added to this list as well (Hooper, Coughlan and Mullen, 2008).

3.8.8. Unidimensionality and Construct Validity

Construct Validity refers to construct correctness measured by the assessment (Peter, 1981). It consists of several classes: unidimensionality and reliability, convergence, discriminant and nomological (Campbell and Fiske, 1959).

Convergent validity deals with the degree how aligned various attempts to measure the same component, and discriminant validity refers to the degree of distinction between the measures of different components (Bagozzi and Yi, 1991).

Unidimensionality verifies if all items of a construct measure only that construct. It can be done by factor analysis.

3.9. STRUCTURAL MODEL TESTING

Once the measurement model is validated, the analysis continued with the validity test of the structural model and associated hypothesized relationships. This analysis includes examining the overall fit of the structural model based on the same criteria as the measurement model and testing of each hypothesis of the model.

3.10. ETHICAL CONSIDERATION

In any research involving humans should adhere to certain ethical principles. These principles include:

1. Voluntary participation — participation in the research must be based on free will.
2. Informed consent — participants should be informed about the procedure and potential risks involved if any. They should provide consent to participate.
3. The risk of harm –- in some cases physical or psychological harm might be inflicted because of the participation in the research. Researchers must not place participants in such situations.
4. Confidentiality — the identifying information will not be released to anyone not directly involved in the research.

In this research, all ethical requirements are diligently followed. All data received from the participants are well protected and kept anonymous, private and confidential. All data were analyzed without separating individuals and as an overall data pool.

Each participant received information about the purpose of the study and how the data will be utilized. This research is approved by the ethics committee of Newcastle University.

3.11. CONCLUSION

This chapter described the research design, research paradigm, research population and data collection process and the reason why the quantitative approach to conducting the research was selected. It provided information about how questionnaires were developed and the pilot survey conducted. It also outlined the data analysis method and ethical considerations.

4. CHAPTER FOUR. DATA ANALYSIS

4.1.INTRODUCTION

The research methodology was delineated in the previous chapter which explained the worldview of the researcher, the justification of adopted method and the research process applied for testing the theoretical model and research hypotheses. The data analysis involves two steps: the pilot data analysis and analysis of the data collected through the main survey.

As explained in the previous chapter the pilot survey included ten responses and three extensive interviews with the experts of the field. The interviews were used for content validation and refinement of the questionnaire that were prepared based on prior literature. Pearson's correlation and Cronbach alpha scores were used for assessing validity and reliability of the data analysis of the pilot survey. At the next step, data gathered from the main survey was checked, cleaned and prepared for the data analysis using EFA, CFA, SEM and Pearson's correlation.

The result of these analyses is reported below.

4.2. PILOT DATA ANALYSIS

According to the analysis, the Cronbach alpha for the Convenience of Use is 0.962. For Knowledge Search, it is 0.940. For Knowledge Integration, the reliability score is 0.909, for Knowledge Quality it is 0.918, and for Serendipity and Arbitrage, it is 0.889. The validity score, which is measured by Pearson's correlation, of these constructs, is more than 0.5. Therefore, the Semantic Knowledge Management scale is accepted as valid and reliable.

As for the Knowledge Management Effectiveness, the KM Processes - Knowledge Acquisition has a reliability score of 0.78, for KM Process - Knowledge Application the score is 0.893, for KM Process - Knowledge Accumulation it is 0.847 and for the KM Process - Knowledge Dissemination the reliability score is 0.893.

For Knowledge Acquisition the validity score is also high although the r score is less than 0.5. Since it is still in the acceptable range, there is no need to remove this item.

For the Human Capital, Organizational Capital and Information Capital the reliability scores are 0.932, 0.925 and 0.832 respectively. These scores are high enough in reliability term. Since the validity scores are also more than 0.3, it indicates that the items are calculating the constructs that they were supposed to calculate (Nunnally and Bernstein, 1994).

The same level of reliability and validity is achieved for the Organizational Innovation and Competitiveness with the Cronbach alpha scores of 0.896 and 0.814 respectively.

According to the result of the pilot data analysis, it was assumed that the reliability and validity scores of the items are good and the same questionnaire can be used for the main survey.

4.2.1 Result of the Pilot Study

Construct	Cronbach Alpha	Pearson's Corelation (r)									Sig (2 tailed)								
KM PROCESSES																			
Knowledge Acquisition	0.78		AQ1	AQ2	AQ3							AQ1	AQ2	AQ3					
		AQ1	1	0.867	0.479						AQ1	1	0.001	0.162					
		AQ2	0.867	1	0.205						AQ2	0.001	1	0.569					
		AQ3	0.479	0.206	1						AQ3	0.162	0.569	1					
Knowledge Application	0.893		AP1	AP2								AP1	AP2						
		AP1	1	0.818							AP1	1	0.004						
		AP2	0.818	1							AP2	0.004	1						
Knowledge Accumulation	0.847		AC1	AC2	AC3							AC1	AC2	AC3					
		AC1	1	0.656	0.68						AC1	1	0.04	0.03					
		AC2	0.655	1	0.713						AC2	0.04	1	0.021					
		AC3	0.68	0.713	1						AC3	0.03	0.021	1					
Knowledge Dissemination	0.893		AS1	AS2								AS1	AS2						
		AS1	1	0.813							AS1	1	0.004						
		AS2	0.813	1							AS2	0.004	1						
KM STRATEGIC READINESS																			
Human Capital	0.932		SH1	SH2								SH1	SH2						
		SH1	1	0.873							SH1	1	0.001						
		SH2	0.873	1							SH2	0.001	1						
Organizational Capital	0.925		SO1	SO2	SO3	SO4	SO5	SO6	SO7	SO8		SO1	SO2	SO3	SO4	SO5	SO6	SO7	SO8
		SO1	1	0.383	0.379	0.124	0.1	0.191	0.636	0.511	SO1	1	0.274	0.279	0.733	0.783	0.597	0.048	0.131
		SO2	0.383	1	0.657	0.674	0.799	0.862	0.791	0.745	SO2	0.274	1	0.039	0.033	0.006	0.001	0.006	0.013
		SO3	0.379	0.657	1	0.824	0.791	0.776	0.559	0.253	SO3	0.279	0.039	1	0.003	0.006	0.008	0.093	0.481
		SO4	0.124	0.674	0.824	1	0.868	0.862	0.526	0.475	SO4	0.733	0.033	0.003	1	0.001	0.001	0.118	0.165
		SO5	0.1	0.799	0.791	0.868	1	0.988	0.663	0.399	SO5	0.783	0.006	0.006	0.001	1	0	0.037	0.253
		SO6	0.191	0.862	0.776	0.862	0.988	1	0.723	0.514	SO6	0.597	0.001	0.008	0.001	0	1	0.018	0.129
		SO7	0.636	0.791	0.559	0.526	0.663	0.723	1	0.734	SO7	0.048	0.006	0.093	0.118	0.037	0.018	1	0.016
		SO8	0.511	0.745	0.253	0.475	0.399	0.514	0.734	1	SO8	0.131	0.013	0.481	0.165	0.253	0.129	0.016	1
Information Capital	0.832		SI1	SI2								SI1	SI2						
		SI1	1	0.753							SI1	1	0.012						
		SI2	0.753	1							SI2	0.012	1						
INNOVATION																			
Organizational Innovation	0.896		OI1	OI2	OI3	OI4	OI5	OI6				OI1	OI2	OI3	OI4	OI5	OI6		
		OI1	1	0.79	0.687	0.345	0.703	0.306			OI1	1	0.007	0.028	0.328	0.023	0.39		
		OI2	0.79	1	0.877	0.618	0.853	0.463			OI2	0.007	1	0.001	0.057	0.002	0.177		
		OI3	0.687	0.877	1	0.614	0.906	0.408			OI3	0.028	0.001	1	0.059	0	0.242		
		OI4	0.345	0.618	0.614	1	0.658	0.766			OI4	0.328	0.057	0.059	1	0.039	0.01		
		OI5	0.703	0.853	0.906	0.658	1	0.559			OI5	0.023	0.002	0	0.039	1	0.093		
		OI6	0.306	0.463	0.408	0.766	0.559	1			OI6	0.39	0.177	0.242	0.01	0.093	1		
COMPETITIVENESS																			
Organizational Competitiveness	0.814		OC1	OC2	OC3	OC4						OC1	OC2	OC3	OC4				
		OC1	1	0.582	0.802	0.186					OC1	1	0.078	0.005	0.607				
		OC2	0.582	1	0.832	0.522					OC2	0.078	1	0.003	0.121				
		OC3	0.802	0.832	1	0.398					OC3	0.005	0.003	1	0.255				
		OC4	0.186	0.522	0.398	1					OC4	0.607	0.121	0.256	1				
SEMANTIC KM																			
Convenience of Use	0.962		KC1	KC2								KC1	KC2						
		KC1	1	0.932							KC1	1	0.021						
		KC2	0.932	1							KC2	0.021	1						
Knowledge Search	0.94		KS1	KS2	KS3							KS1	KS2	KS3					
		KS1	1	0.93	0.891						KS1	1	0.022	0.042					
		KS2	0.93	1	0.845						KS2	0.022	1	0.071					
		KS3	0.891	0.845	1						KS3	0.042	0.071	1					
Knowledge Integration	0.909		KI1	KI2								KI1	KI2						
		KI1	1	0.845							KI1	1	0.071						
		KI2	0.845	1							KI2	0.071	1						
Knowledge Quality	0.918		KQ1	KQ2	KQ3							KQ1	KQ2	KQ3					
		KQ1	1	0.739	0.745						KQ1	1	0.154	0.148					
		KQ2	0.739	1	0.963						KQ2	0.154	1	0.008					
		KQ3	0.745	0.963	1						KQ3	0.148	0.008	1					
Serendipity and Arbitrage	0.889		SA1	SA2								SA1	SA2						
		SA1	1	0.809							SA1	1	0.097						
		SA2	0.809	1							SA2	0.097	1						

Figure 17: Result of the pilot study

4.3. DESCRIPTIVE ANALYSIS OF THE MAIN DATA

Gender. 54 responses had substantial missing data as a result those were eliminated from the data set. 178 respondents were retained for the data analysis.

Table 3: Gender

		Frequency	Percent	Valid Percent	Cumulative %
Valid	Male	125	70.2	70.2	70.2
	Female	53	29.8	29.8	100.0
	Total	178	100.0	100.0	

Table 3 shows that out of the 178 remaining respondents, 125 were males, which is 70.2 percent and 53 females, which is 29.28 This shows the dominance of males in KM field.

Age. Table 4 shows that most respondents were over 35 years of age. It implies that KM is still a domain of experienced executives. The drawback of this is they are also slow in adopting advanced technologies.

Table 4: Age

		Frequency	Percent	Valid Percent	Cumulative %
Valid	Less than 25	1	.6	.6	.6
	26 -35	25	14.0	14.0	14.6
	36-45	53	29.8	29.8	44.4
	46-55	58	32.6	32.6	77.0
	56 and over	41	23.0	23.0	100.0
	Total	178	100.0	100.0	

Job Position. Out of 178 valid responses, 55 (30.9%) held the position of executives, 54 (30.3%) managers, 4 (2.2%) assistant managers, 33 (18.5%) consultants and 32 (18%) claimed to hold other positions (Table 5).

Table 5: Job position

		Frequency	Percent	Valid Percent	Cumulative %
Valid	Executive	55	30.9	30.9	30.9
	Manager	54	30.3	30.3	61.2
	Assistant manager	4	2.2	2.2	63.5
	Consultant	33	18.5	18.5	82.0
	Other	32	18.0	18.0	100.0
	Total	178	100.0	100.0	

Industry Data. The Consulting (22.5%), ICT (17.4%), Education (14.0 %), Government (11.8%) and Business Services (6.7%) are the main industries that the respondents represent. This data shows there is no specific dominance of any industry in the use of KM (Table 6).

Table 6: Industry

		Frequency	Percent	Valid Percent	Cumulative %
Valid	ICT	31	17.4	17.4	17.4
	Manufacturing	9	5.1	5.1	22.5
	Construction	3	1.7	1.7	24.2
	Consulting	40	22.5	22.5	46.6
	Retail	1	.6	.6	47.2
	Education	25	14.0	14.0	61.2
	Government	21	11.8	11.8	73.0
	Nonprofit and charities	4	2.2	2.2	75.3
	Financial services	8	4.5	4.5	79.8
	Business Services	12	6.7	6.7	86.5
	Personal Services	2	1.1	1.1	87.6
	Other	22	12.4	12.4	100.0
	Total	178	100.0	100.0	

Company Size. A noticeable fact is most respondents represent either large companies (51%) or small firms (31.5%) (Table 7). This is a concern for this research as small companies are not always in position to invest heavily in expensive advanced technologies.

Table 7: Company size

		Frequency	Percent	Valid Percent	Cumulative %
Valid	Small (50 or less empl)	56	31.5	31.5	31.5
	Medium (51 to 500)	31	17.4	17.4	48.9
	Large (over 500)	91	51.1	51.1	100.0
	Total	178	100.0	100.0	

Years in Business. Overwhelming majority of the companies are fairly mature, 39.9% being over 25 years and 39.3% being within the range of 11 to 15 years old (Table 8).

Table 8: Years in business

		Frequency	Percent	Valid Percent	Cumulative %
Valid	Less than 3	13	7.3	7.3	7.3
	3 to 10	24	13.5	13.5	20.8
	11 to 25	70	39.3	39.3	60.1
	over 25	71	39.9	39.9	100.0
	Total	178	100.0	100.0	

Table 9: Experience with KM

		Frequency	Percent	Valid Percent	Cumulative %
Valid	Less than 3	47	26.4	26.4	26.4
	3 to 7	57	32.0	32.0	58.4
	over 7	74	41.6	41.6	100.0
	Total	178	100.0	100.0	

Respondent Companies Experience with KM. 41.6 percent of the companies have KM deployed over 7 years ago and 32% over 3 years (table 9).

4.4. FINAL DATA ANALYSIS

4.4.1. The Exploratory Factor Analysis (EFA).

Exploratory factor analysis was applied by using the maximum likelihood method to extract factors, and the Promax rotation. EFA was executed on 44 variables linked to Semantic KM, KM Effectiveness, Organizational Innovation and Organizational Competitiveness.

The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) value had been calculated, and it (0.947) indicated that the data was suitable for factor analysis. Considering that Barlett's test of sphericity reached statistical significance (Sig. = 0.000), it can be concluded that the justification of application of factor analysis is confirmed. To achieve discriminant and convergent validity of used constructs, variables with small factor loadings (below 0.3) were excluded from further analysis, as well as those which had major cross-loadings between factors (table 10).

Table 10: Communalities

	Initial	Extraction
AC1	.724	.551
AC2	.784	.655
AC3	.720	.621
SO3	.779	.783
SO4	.739	.746
SO5	.866	.818
SO6	.866	.793
OI1	.552	.486
OI2	.779	.802
OI3	.773	.793
OI4	.582	.556
OC1	.653	.705
OC2	.676	.724
OC3	.694	.721
OC4	.542	.536
KC1	.921	.854
KC2	.908	.850
KS1	.931	.927
KS2	.857	.815
KS3	.938	.940
KI1	.873	.822
KI2	.926	.901
KQ1	.923	.910
KQ2	.921	.904
SA1	.928	.886
SA2	.941	.897

Extraction Method:
Maximum Likelihood.

Using 26 items the existence of 4 factors with representative values above 1 (Guttman-Kaiser criterion) were identified by maximum likelihood method. 76.91% of total variance explained were attained by these 4 factors (table 11).

Table 11:Total variance explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			RSSL.[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	15.718	60.454	60.454	15.363	59.088	59.088	14.456
2	2.242	8.622	69.077	1.795	6.906	65.994	12.422
3	1.841	7.080	76.156	1.695	6.519	72.513	7.506
4	1.247	4.794	80.951	1.144	4.398	76.911	7.886
5	.741	2.848	83.799				
6	.540	2.077	85.876				
7	.457	1.760	87.636				
8	.373	1.434	89.069				
9	.332	1.275	90.345				
10	.317	1.221	91.565				
11	.297	1.141	92.706				
12	.254	.976	93.682				
13	.245	.942	94.624				
14	.207	.797	95.421				
15	.206	.792	96.213				
16	.184	.707	96.920				
17	.150	.579	97.499				
18	.129	.495	97.994				
19	.109	.420	98.414				
20	.096	.369	98.783				
21	.073	.281	99.064				
22	.066	.252	99.316				
23	.053	.205	99.522				
24	.051	.195	99.717				
25	.042	.160	99.877				
26	.032	.123	100.000				

By examining scree plot (figure 18) and taking into the consideration the Cattell (1966) criteria, all the three factors were kept for conducting further analysis.

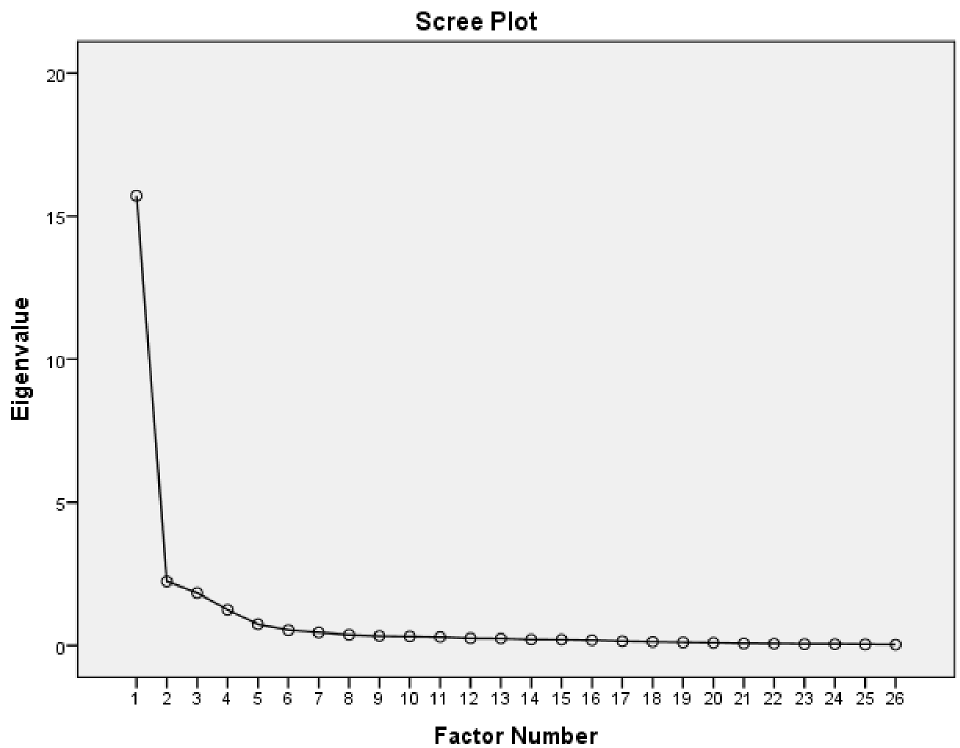


Figure 18: Scree plot

In pattern matrix (table 12), one can observe that the factor structure is quite clean where high loadings in the factors are evidence of convergent and discriminant validity. The second method of examining the availability of discriminant validity entails verification of the factor correlation matrix as shown below. The correlations between the factors cannot be more than 0.7. In this case, between first and second factor there is a correlation of 0.768 which means that there will be discriminant validity issues that were resolved by introducing the second order factor during the confirmatory factor analysis.

Table 12:Pattern matrix

	Factor			
	1	2	3	4
KS2	1.066			
KS1	.996			
KS3	.963			
KI1	.928			
SA2	.821			
SA1	.812			
KI2	.768			
KC2	.758			
KQ1	.741			
KC1	.729			
KQ2	.675			
SO4		.923		
SO5		.888		
SO6		.842		
SO3		.801		
AC2		.719		
AC3		.627		
AC1		.569		
OC1			.876	
OC2			.842	
OC4			.772	
OC3			.761	
OI2				.902
OI3				.902
OI1				.640
OI4				.634

Extraction Method: Maximum Likelihood.

Rotation Method: Promax with Kaiser Normalization. a. Rotation converged in 7 iterations.

Table 13: Factor Correlation Matrix

Factor	1	2	3	4
1	1.000	.768	.586	.563
2	.768	1.000	.423	.538
3	.586	.423	1.000	.399
4	.563	.538	.399	1.000

Extraction Method: Maximum Likelihood.

Rotation Method: Promax with Kaiser Normalization.

Exploratory factor analysis confirmed factor structure (table 13) in which all four factors consist of variables which belong to and follow the previously conducted studies. Name of the first factor is Semantic KM. The name of the second factor is KM Effectiveness. The third factor is the Organizational Competitiveness, and the fourth is Organizational Innovation.

4.4.2. Confirmatory Factor Analysis (CFA)

Confirmatory Factor Analysis was employed to confirm the factor structure found by the Exploratory Factor Analysis. Considering that there is high correlation between first and second factor (above 0.8), the second order factor is introduced in measurement model. Measurement model was formalized in a manner so that each observed variable measures one single dimension, CFA was used to approve the factor structure captured in the Exploratory Factor Analysis stage. The specification of the measurement model took place based on the idea that each observed variable measures one single dimension with error terms adhered to it, but there is no correlation between them or with the latent dimensions.

Measurement model error terms that are neither linked to each other nor with latent dimensions were estimated using the goodness of model fit for explaining the relevance of the correlation between the variables of the dataset. The goodness of model fit is computed for the measurement model to illustrate the strength of the correlation between variables in the dataset (figure 19).

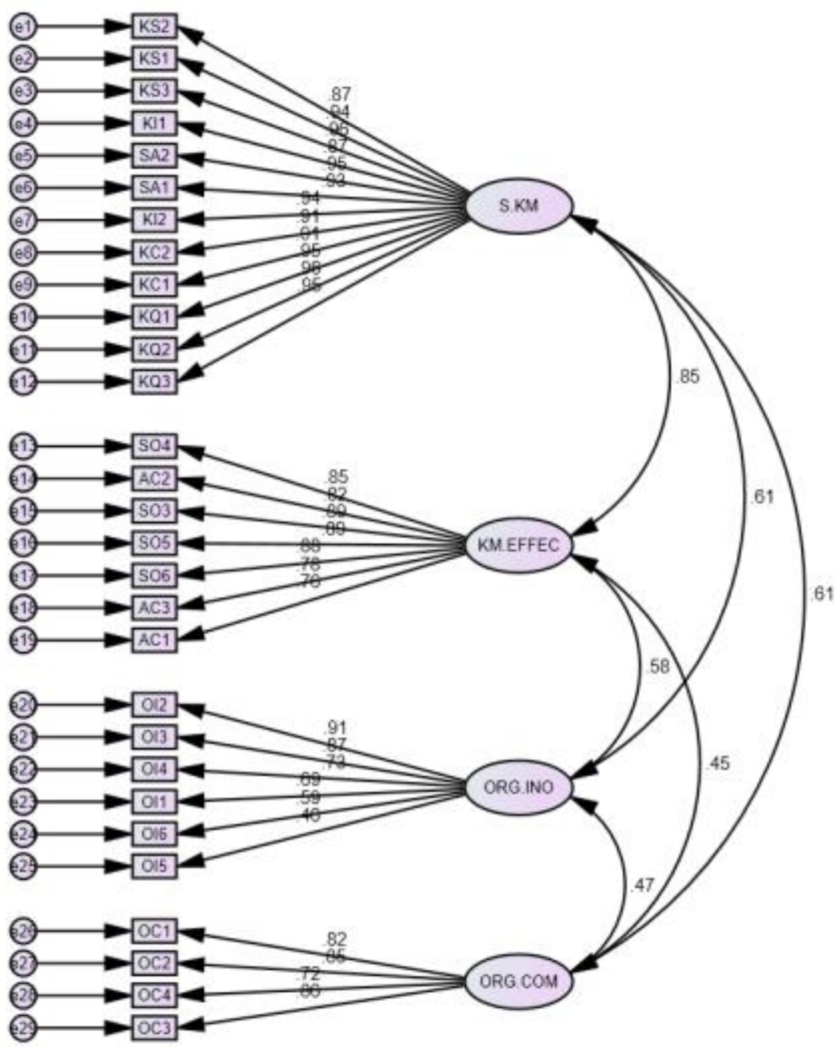


Figure 19: Initial measurement model

Considering that proposed model showed poor model fit, there exist several ways to improve the model (figure 20). In this case, improvement is made by establishing covariance between individual measurement errors and deleting variables which have small factor loadings. After that, the introduction of second order factor is made. Recognizing that discriminant validity issues occur when the test was conducted, the second order factor is introduced on the first and second factor.

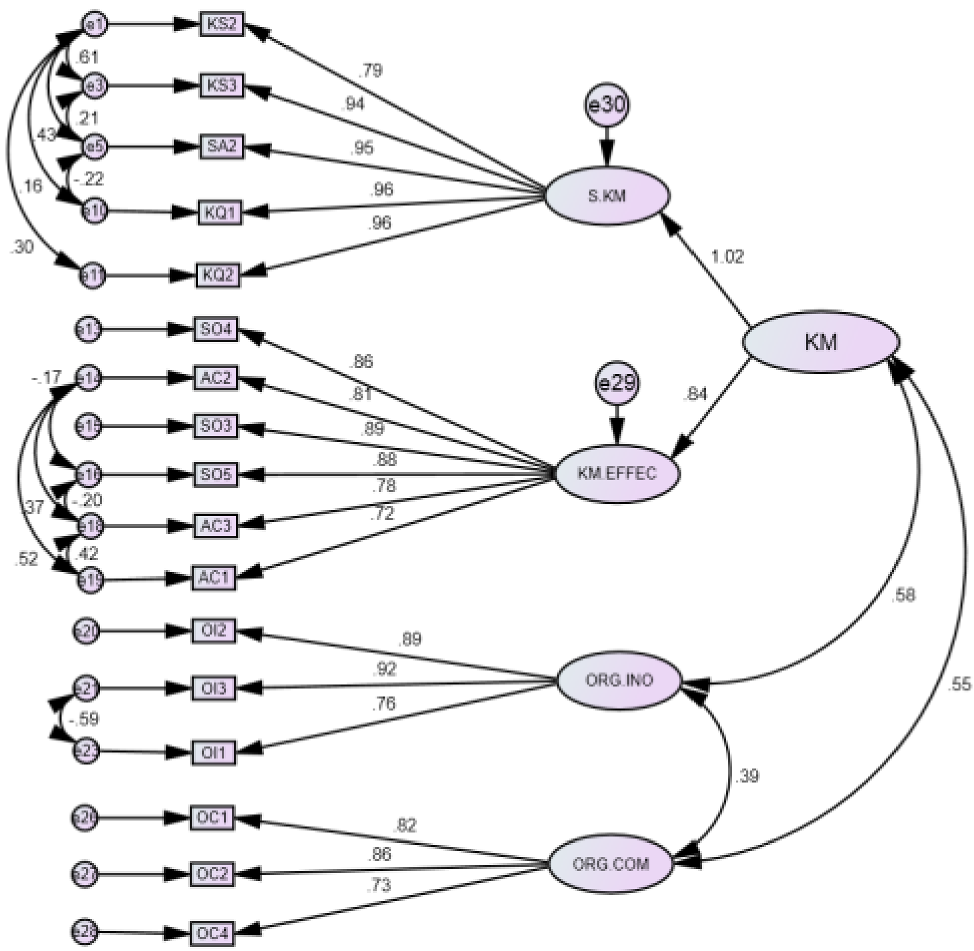


Figure 20: Measurement model with second order factor

Accordingly, the model was calculated and the indicators of goodness of fit were acquired which show that the model attained a good model fit (table 14). That the constructs are vaild and realiable were determined by executing the reliability, discriminant, and convergent validity tests.

Table 14: Fit indices of measurement model

Indicator	Acceptable value*	Initial measurement model	Improved measurement model
CMIN/DF	Below 3	3.288	1.484
RMR	Below .10	.091	.067
GFI	Close to .90 to 1	.668	.913
NFI	Close to .95 to 1	.827	.953
TLI	Close to .95 to 1	.860	.979
CFI	Close to .95 to 1	.872	.984
RMSEA	< .05 = very good > .05 to .08 = good > .08 to .10 = mediocre > .10 = bad fit	.114	.052
PCLOSE		.000	.400

Note: $\chi 2$/df = normed chi-square statistic; GFI = Goodness-of-Fit Index; RMR= Root-Mean-Square Residual; RMSEA = Root Mean Square Error of Approximation; NFI = Normed Fit Index; TLI= Tucker-Lewis Index; CFI = Comparative Fit Index.

****References:*** Hoyle, 2000; Kline, 2005; Thompson, 2005; Hu andBentler, 2010

4.4.3. Convergent and Discriminant Validity

To test constructs' convergent validity, Composite Reliability (CR) and Average Variance Extracted (AVE) were calculated. The measurement model achevied convergent validity which was confirmed by the fact of meeting all three conditions (CR > 0.7; AVE > 0.5; CR > AVE).

A comparison of the values of Average Variance Extracted (AVE), Maximum Shared Variance (MSV), and Shared Average Variance (ASV) was done to test the discriminant validity of the constructs. There are two necessary conditions which must be met (MSV < AVE; ASV < AVE) as well, the one which suggests that square root of the value of the Average Variance Extracted should be more than the value of the correlation between constructs. In this case, all three conditions were met. Based on this, it can be confirmed that there also exists discriminant validity of the constructs. Table 15 shows values of Composite Reliability, Average Variance Extracted, Maximum Shared Variance and Shared Average Variance, and the correlation matrix with the square root of Average Variance Extracted on the main diagonal.

Table 15: Convergent and discriminant validity

	CR	AVE	MSV	ASV	ORG.COM	ORG.INO	KM
ORG.COM	0.846	0.648	0.308	0.228	0.805		
ORG.INO	0.893	0.738	0.331	0.239	0.385	0.859	
KM	0.930	0.870	0.331	0.319	0.555	0.575	0.933

Necessary conditions: CR> 0.7; AVE > 0.5; CR > AVE; MSV < AVE; ASV < AVE

Note: CR - Composite Reliability;

AVE - Average Variance Extracted;

MSV - Maximum Shared Variance;

ASV - Shared Average Variance.

Average Variance Extracted (AVE) was computed based on the equation below:

$$\boxed{\mathrm{AVE} = \frac{\sum_{i=1}^{n} L_i^2}{n}}$$

Composite Reliability (CR) was calculated based on the following equation:

$$\boxed{\frac{\left(\sum^{i} \lambda_i\right)^2}{\left(\sum_{i=1}^{i} \lambda_i\right) + \left(\sum_{i=1}^{i} 1 - \lambda_i^2\right)}}$$

4.5. STRUCTURAL EQUATION MODELLING (SEM)

4.5.1. Specifications of the Proposed Structural Model.

Causal relationships between the dimensions of Organizational KM, Organizational Innovation, and Organizational Competitiveness were tested using structural equations modelling in the statistical software AMOS 20. To create a model in the SEM, factors obtained from the measurement model and tested through Confirmatory Factor Analysis were used. The assumptions of normality, linearity and multicollinearity were not altered as the preliminary analysis demonstrates. The structural model is designed in a way that the construct named "Organizational KM" has a direct and positive impact on "Organizational Innovation" and "Organizational Competitiveness." Further, the model is devised to clarify that "Organizational Innovation" has a direct and positive impact on "Organizational Competitiveness." This model did not include correlation between the measurement errors.

Therefore, it can be assumed that this model obtained indicators of model fit (figure 21) which in turn suggests that the model attained very good fit ($\chi 2$ / df = 1.484; RMR = 0.067; GFI = 0.913; NFI = 0.953; TLI = 0.979, CFI = 0.984, RMSEA = 0.052; P CLOSE = 0.400). Values of fit indicators confirm a good model fit. Based on this analysis a conclusion can be drawn that the model fits the data well (table 16).

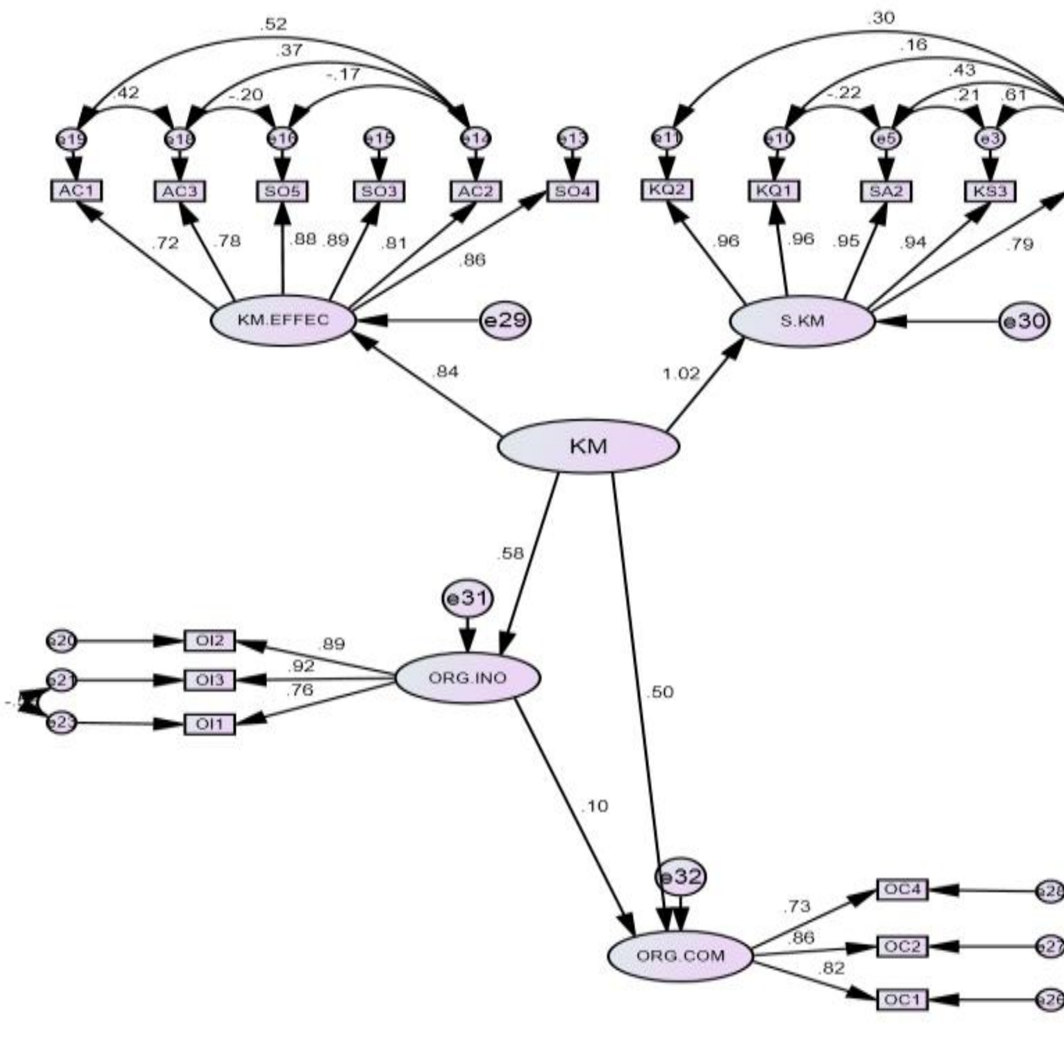


Figure 21:Structural model with second order factor

Table 16: Goodness of model fit (structural model)

Indicator	Acceptable value*	Structural model
CMIN/DF	Below 3	1.484
RMR	Below .10	.067
GFI	Close to .90 to 1	.913
NFI	Close to .95 to 1	.953
TLI	Close to .95 to 1	.979
CFI	Close to .95 to 1	.984
RMSEA	< .05 = very good > .05 to .08 = good > .08 to .10 = mediocre > .10 = bad fit	.052
PCLOSE		.400

Note: $\chi 2$/df = normed chi-square statistic; GFI = Goodness-of-Fit Index; RMR= Root-Mean-Square Residual; RMSEA = Root Mean Square Error of Approximation; NFI = Normed Fit Index; TLI= Tucker-Lewis Index; CFI = Comparative Fit Index.

* ***Source:*** Kline, 2005; Hoyle, 2000; Thompson, 2005; Hu andBentler, 2010

4.5.2. Testing of the Proposed Structural Model.

Testing Hypotheses H2, H3 and H4. The review of the results shown in the table 17, confirms that the construct "Organizational KM" has moderate, direct but statistically significant positive impact ($\beta = 0.575$; $p < 0.01$) on "Organizational Innovation". It also indicates that

"Organizational KM" has a moderate, direct and statistically significant positive impact ($\beta = 0.497$; $p < 0.05$) on "Organizational Competitiveness."

Table 17: Standardized Regression Weights (path coefficients) and statistically significance for direct effects

Dependent		Independent	Regression Weights	S.E.	C.R.	p-value	Standard. Regression Weights	Decision
ORG.INO	<---	ORG.KM	.706	.108	6.506	***	.575	Supported H2
ORG.COM	<---	ORG.INO	.089	.083	1.077	.281	.099	Rejected H4
ORG.COM	<---	ORG.KM	.550	.116	4.721	***	.497	Supported H3

Note: *** - statistical significance p < 0.01

Furthermore, results also claim that "Organizational Innovation" has no statistically significant direct impact ($p > 0.05$) on "Organizational Competitiveness" (table18).

Table 18: Results of direct, indirect and total effect testing

	Dependent		Independent	Estimate	P
Direct effect	ORG.COM	<---	ORG.KM	.550	.014**
Indirect effect (through ORG.INO)	ORG.COM	<---	ORG.KM	.063	.264
Total effect	ORG.COM	<---	ORG.KM	.613	.006*

Notes: *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10

Testing Hypothesis H5. To verify Hypothesis H5, and to conclude if "Organizational KM" has an indirect effect on "Organizational Competitiveness" through "Organizational Innovation," direct, indirect and total effects were calculated. The indirect effect of "Organizational KM" on "Organizational Competitiveness" was tested, where "Organizational Innovation" mediates the relationship between constructs.

The review of the results concludes that there is no mediating effect between "Organizational KM" and "Organizational Competitiveness" through "Organizational Innovation." In accordance with the test results, it can be confirmed that hypothesis H5 is rejected.

Testing of Hypothesis H1. To reduce the number of variables which should be tested via Pearson correlation, variables related to the Semantic KM and KM Effectiveness are subjected to factor analysis using Principal Component Analysis with Promax method of rotation, where the number of obtained component was fixed, considering that the requirement is to have two components (table 19).

The results of PCA indicated that variables are allocated to the components to which they belong in line with previously conducted researches. Those two components explained 66.45% of the variance. The first component was named "Semantic KM" and the second one was called "KM Effectiveness," to run further analysis.

Table 19: Pattern Matrix

	Component	
	1	2
KC2	1.072	
KC1	1.054	
KS2	1.031	
KI2	.993	
KS3	.976	
KS1	.950	
KI1	.921	
KQ2	.903	
SA2	.899	
SA1	.878	
KQ3	.859	
KQ1	.778	
AC3	.602	
SI1	.524	
SO3	.506	.407
SI2	.503	
SO4	.503	.316
AC1	.491	.324
SO6	.481	.400
AC2	.481	.374
AP2		.828
AQ1		.800
AQ2		.796
AP1		.738
SH1		.698
AS2		.628
AQ3		.623
SH2		.551
SO5	.395	.509
SO2	.367	.446

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

a. Rotation converged in 3 iterations.

To investigate if Semantic KM and KM Effectiveness are mutually correlated, the linear correlation between obtained components was tested. This analysis should help in detecting the direction and strength of the linear relationship between the variables. The correlation matrix is based on the Pearson correlation coefficient (see Correlations table 20). Obtained data show that there is a high and positive correlation (r =0.718), which by using Cohen's criteria confirms a strong correlation between components (Cohen, 1988). It means that Semantic KM affects KM Effectiveness. More notably, high degrees of Semantic KM are followed by high degrees of KM Effectiveness and vice versa. Conversely, low degrees of Semantic KM are accompanied by low degrees of KM Effectiveness. According to the calculated coefficient of determination ($d = r^2 \times 100$) compared it was discovered that the variables determined 51.55% of the common variance. As per these results it can be established that the first hypothesis is supported.

Table 20: Correlations

		SEM.KM	EFFECT.KM
SEM.KM	Pearson Correlation	1	.718**
	Sig. (2-tailed)		.000
	Sum of Squares and Cross-products	177.000	127.101
	Covariance	1.000	.718
	N	178	178
EFFECT.KM	Pearson Correlation	.718**	1
	Sig. (2-tailed)	.000	
	Sum of Squares and Cross-products	127.101	177.000
	Covariance	.718	1.000
	N	178	178

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

4.6. RESULTS OF HYPOTHESES TESTING

Table 21: Hypotheses testing result

Hypothesis	Statement	Result
H1	Semantic Technology-based Knowledge Management System is positively related to the effectiveness of the Organizational Knowledge Management	Supported
H2	There is a positive impact of Organizational Knowledge Management on Organizational innovation	Supported
H3	Organizational Knowledge Management positively influences on Organizational Competitiveness	Supported
H4	Innovation makes positive effects on Organizational Competitiveness	Rejected
H5	Organizational Knowledge Management effects positively on Organizational Competitiveness through Innovation	Rejected

In this chapter, data analyses, study results and findings of the pilot survey and main survey were reported. Statistical analysis revealed that three hypotheses were tested positively and two were rejected. In the next chapter, the implications of these findings will be discussed, limitations of this research will be presented and future research scopes will be explored.

5. CHAPTER FIVE. IMPLICATIONS AND CONCLUSIONS

5.1. INTRODUCTION

In accordance with the objectives delineated in chapter one, this study has examined the links between Semantic KMS, KM Effectiveness, Organizational KM, and their impacts on Organizational Innovation and organization's Competitiveness. Hypotheses outlined in a previous chapter were tested by a quantitative research on data collected from 178 samples from a diverse geographic area and industries. Confirmatory Factor Analysis (CFA) and Structural Equation Model (SEM) and Pearson's correlation were applied to test the hypotheses.

The result indicates that Semantic KMS has a positive correlation with the KM Effectiveness. Organizational KM is positively linked to Organizational Innovation and Competitiveness directly. Innovation does not affect Organizational Competitiveness. Moreover, Organizational KM does not impact positively on Organizational Competitiveness mediated through Innovation.

The results and implications of these findings are discussed below followed by conclusions.

5.2. DISCUSSION OF RESEARCH HYPOTHESES AND IMPLICATIONS

5.2.1. Questions

The study started with the research questions of:

Question 1. Does semantic knowledge management system influence organizational performance?

Question 2. If it does, how and through which mechanisms this influence takes place?

Based on these questions five hypotheses were formulated. The data analysis revealed the following results which are discussed below.

5.2.2. Hypotheses

5.2.2.1. H1***: Semantic Technology-based Knowledge Management System is positively related to the effectiveness of the Organizational Knowledge Management.***

Alavi and Leidner (1999) predicted that the use of ICT to support KM initiatives will continue to grow and will receive much attention from both scholars and practitioners. They have, however, noticed that without a proper KM strategy that improves knowledge flows with the help of technology deployment the effect from KM will be relatively little.

Over the years, thanks to technological advances many of the KM processes and activities became intertwined with the utilization of KMS. Alavi and Leidner (1999) proposed several KM areas where ICT can bring substantial positive benefits. With modern technological advances things have changed dramatically and now almost in any area of KM, technology such as semantic technology can play an instrumental role. Gold et al. (2001) avered that technology is one of the crucial elements for the KM Effectiveness in an organization. Choi, Poon, and Davis (2006) maintained that KMS enhances KM processes significantly.

Semantic technology is already supporting and empowering numerous platforms, the Web, and many complex systems. As Davies, Lytras and Sheth (2007) pointed out these technologies have all the necessary capabilities to become underlying technology for KM. The finding of this research that shows a positive relation between Semantic KMS and KM Effectiveness provides support to those previous works and assertions.

Joo's (2011) empirical research found that several factors will ultimately influence the adoption of semantic technology which include potential business value, firm's absorptive capacity, perceived benefits, and apparent benefits. This evidence that Semantic KMS can influence and improve KM effectiveness should work as a reference point for practitioners trying to understand the advantages of such systems better.

The research, however, could not provide any clear indication of how important strategic readiness of a firm, the construct of which is composed of Human Capital, Organizational Capital, and Information Capital, is for KM. Due to poor factor loadings, Human Capital and Information Capital constructs were removed from the measurement model. The data analysis also failed to clarify what level of benefit Semantic KMS brings to the KM processes of Acquisition, Application, and Dissemination as these constructs were also eliminated from the final measurement model.

The analysis, however, did uncover that Knowledge Integration, Knowledge Quality and Knowledge Arbitrage are critical areas where, according to respondents, Semantic KMS brings benefits.

5.2.2.2. H2***: There is a positive impact of Organizational Knowledge Management on Organizational Innovation.***

New knowledge creation and innovation are highly interconnected. KM facilitates knowledge related activities that bolster knowledge creation and embedding it into firm's innovation process (Jang et al., 2002). Innovation is a complex process where knowledge works as a primary resource. Innovation process also creates new knowledge through the development of new products, services and the R&D process. This closely linked environment calls for using KM as a supportive tool for innovation (Cavusgil et al., 2003). Innovation requires integrating knowledge from various silos; KM can be instrumental in enhancing organizational knowledge flow within innovation process as well as discovering and capturing from external sources (Chen, 2004). KM organizes, refines and improves firm's capability of learning and delivers critical knowledge augmenting its innovation potential (Marshall, 1997). KM supports both exploitation and exploration innovation strategies of the company by rendering tools for knowledge acquisition and knowledge sharing (Swan et al.,1999). Nonaka and Takeuchi (1995) claimed that knowledge conversion which requires KM tools assist new knowledge creation and innovation. Asgarian (2012) found that KM capacity has a beneficial influence on firm's innovation. Gloat and Tarziovski's (2004) findings discovered that KM practices are strongly linked to innovation. Similarly, Andrieva and Kianto (2011) determined that KM practices facilitate innovation. The RBV theory forwarded by Penrose (1959), Nelson and Winter (1982) receives empirical backing in this study where it demonstrates that KM can act as a supportive tool in innovation by managing innovation-related knowledge (Darroch, 2005).

This research supports these and other previous findings and ascertains that Organizational KM is positively associated with innovation.

5.2.2.3. H3***: Organizational Knowledge Management positively influences on Organizational Competitiveness.***

Semantic KMS, like any ICT-based system, cannot directly impact on organizational performance. However, in combination with other aspects, it can improve organizational performance (Powell and Dent-Micallef, 1997). As an enabler to various knowledge management activities, through KM, ICT can increase firm's performance (see, Seleim and Khalil, 2007).

Mills and Smith (2011) affirmed that KM infrastructure and knowledge process capabilities are linked positively to organization performance. Lopez-Nicolas and Merono-Cerdan's (2011) empirical research showed that strategic KM enhances both organizational innovation and performance. Lee and Lee (2007) detected that there is a strong relationship between firm's financial performance and KM. The results of a study done by Karaszewski (2008) demonstrated a positive impact of KM on company's international competitiveness. From industry knowledge to market knowledge and product knowledge to technology knowledge, the range of knowledge domain is broad. Firms must improve knowledge processes including knowledge discovery, capture, integration, maintaining, reuse, transfer and sharing to attain competitiveness from the vast and overwhelming knowledge load (Karaszewski, 2008). Semantic KMS bolsters each of these processes with a holistic approach enhancing organization's knowledge resources and knowledge related capabilities. The potential benefits of this ensue improvement of firms' performance.

The results of this research confirm the findings of the previous study outcomes that KM does have a positive influence on Organizational Competitiveness.

5.2.2.4. H4***: Innovation makes positive effects on Organizational Competitiveness.***

Ours's not the first study that could not discover any relationship between Organizational Innovation and Organizational Performance. The specificity of the model and the idiosyncrasy of the respondents can be attributed to this result (Lööf et al.,2001). For example, Svandven and Smith (2000) could not find any linkage between innovation and profitability — one of the characteristics of competitiveness performance.

Rosenbush, Brinkmann and Baush (2011I) acknowledged that innovation is a complex phenomenon where some types of innovation might have positive impacts on firm's performance, but others don't. They provided empirical evidence that implies that newer enterprises benefit from innovation far more than older ones in the context of small and medium-sized companies. Considering that a significant portion of the respondents of this study is from small but mature companies, this research also confirms their findings.

Zaied, Louati and Affes (2015) in their empirical research also could not identify any link between innovation and firm's performance. Darroch's (2005) empirical study also rejected the hypothesis that there is a positive link between innovation and firm's performance. She argued that the possible reason for this anomaly is the specificity of the conceptualization of the constructs.

However, it is to be noted; the consensus is that innovative firms grow faster and are more profitable (Kemp et al., 2003). This study suggests that the components that were the part of competitiveness construct relate to a plethora of other factors than just innovation, and the relationships between innovation and competitiveness within the context of KM need further investigation.

5.2.2.5. H5***: Organizational Knowledge Management effects positively on Organizational Competitiveness through Innovation.***

This research does not support the findings of previous studies such as Liao and Chuang (2006) where they found a relationship between KM and organizational performance mediating through innovation.

We assume that the possible reason could be the sample pool. All respondents of this survey are KM professionals. They have a clear understanding of how KM works in their respective firm, what possible influence it makes on various processes and procedures, and what benefits it provides to related areas. However, it is not a concern of a KM manager to determine how a new product, service or penetration to a new market affect the performance of the company. Possibly due to this reason, this particular data set does not support the hypothesis that Innovation is positively related to Organizational Competitiveness and Organizational KM is positively linked with Competitiveness mediating through Innovation.

5.3. RESEARCH CONTRIBUTION

This study contributes to the existing KM literature by empirically investigating the impact of Semantic KMS, KM effectiveness, and how KM is associated with firm's various outcomes.

A further contribution of this research also includes enhancement of the empirical studies in the better understanding of the knowledge-based view of the firm and the methods of operationalization of similar constructs in knowledge context.

The ICT is a key enabler of KM. However, research in this area is still not as comprehensive as it should have been. Any addition to the growing number of empirical studies in this field facilitates clarifying this complex issue further.

The advent of KM owes significantly to the technological advancement. Because of this, it is necessary to assess the impact on KM when a new and relevant technology appears for many reasons that include 1) to have fast mover's advantage, 2) to improve productivity, and 3) to gain competitiveness. The result and analysis of the impact of semantic technology in this study will assist companies to take an informed decision.

Moreover, the integration of semantic technology with KMS and KM in a unified model is a first research framework that explores their effects on company performances such as innovation and competitiveness on a large geographical and industry scale.

5.3.1. Theoretical Contribution

One of the contributions of this research from the theoretical perspective is its development of a new model that include Semantic KMS and Strategic Readiness. These two constructs in combination have never been tested in any prior literature. Semantic technology is an advancing field in many new areas such as the Internet of Things, Big data and new types of Knowledge Base. All these areas are closely related to knowledge and its management as they produce an enormous amount of data and subsequently information and knowledge. Semantic KMS can play a vital role in these areas along with its role in the improvement of the use of firm's knowledge assets.

Although the significance of semantic technology is growing at a faster speed, previous research of the impact of Semantic KMS was scant. Moreover, a single model that tests the linkage between Semantic KMS, KM effectiveness and Innovation and the impact of KM and innovation on firm's competitiveness has never been applied before.

The research also renews the scholarly discussion of the impact of organizational innovation on the competitiveness from the KM perspective.

The elaborate and comprehensive literature reviews of the related field, particularly, Knowledge, innovation, and semantic technology create a fertile ground and act as a foundation for further research in these areas.

Being one of the first significant studies of Semantic KMS and its impact, the study adds to the growing literature on the use of semantic technology in various industries.

Another contribution of this research is that it merged several critical fields of organizational science in an integrated and holistic model. Semantic technology is a subset of ICT, which not often gets researched along with organizational strategy, innovation, and competitiveness in a single context.

This research has operationalized KM processes through the lens of KM system perspective and differs from many previous works. The study especially fragmented the processes in a manner which is most agreeable from a technology implementation aspect.

For the strategy literature, the study viewed Organizational Competitiveness from a different position. While the relationship between ICT and competitiveness were examined before, none has demonstrated a link between advanced technologies – semantic technology is a prime example of superior and emerging technologies – competitiveness through KM and innovation.

Lastly, SEM is an excellent statistical tool for analyzing complex models in social science and increasingly becoming more popular. The model constructed here and the methodology developed for conducting statistical analysis using SEM can work as a template for both academics and practitioners for handling similar studies.

5.3.2. Contribution to Practitioners

This study has a far-fetched contribution to KM practitioners. As noted by the consulting company Bain, KM as a management tool is losing its importance in recent years. The problem is also exacerbated by the failures of a vast number of KM initiatives (Call, 2005). More research in this area is needed to evaluate present state-of-the-art of KM, its impact, and benefits, its future and technology trend and make both practitioners and academic world aware of the current situation and the real benefits KM may bring.

This study shows that deployment of semantic technology is worthwhile for companies, those who are willing to take advantage of the use of advanced technologies in their KM quest.

The potential value of Semantic KMS is enormous, and it can bring significant benefits thanks to improved abilities of the new KMS in knowledge discovery, aggregation, use, and sharing. The study also demonstrates, for KM to be productive and fruitful, the initiative taken must be optimized and KM processes must be bolstered with KMS.

In present globalized economy, innovation is instrumental in gaining competitiveness of the firm. KM, as the research indicates can have a great impact on a firm's innovation process and outcome. Better knowledge input from external sources, comprehensive access to available to the company knowledge by knowledge workers and other employees and organization-wide capability of knowledge sharing facilitate the company to carry out better R&D and quicker product and service introduction to the market.

5.3.2.1. Recommendations for the managers*:*

1) Many new technologies constantly emerge. It is often difficult to grasp which one will make a lasting difference and which one will become obsolete quicker than expected. This research shows that semantic technology is poised to become a game-changer despite a slow start. Deployment of semantic technology in knowledge management system is an irreversible process, and Semantic KMS can bring serious benefits to an innovative company.

2) As knowledge is increasingly becoming the primary factor of production in the knowledge economy, to stay competitive, it is essential to manage business knowledge assets efficiently. KM is an instrument, which if used correctly, can bring substantial benefits.

3) for the success of an initiative such as the implementation of KM, the company must be strategically ready. Apart from being prepared and knowing emerging ICT, the company must bring its human and organizational capabilities in line for successful implementation of a KM initiative. People, culture, structure, as well as ICT, play a critical role in the success of the initiative.

4) A strategic alignment of the organizational business strategy and KM strategy is necessary for having KM effectiveness. This adjustment is possible to achieve when management can relay company vision, mission, and goals to the employees and workers have a better grasp of what is needed to be done to achieve the set goals.

5.3.2.2. Recommendations for policymakers.

The research validates the importance of advanced technologies and their use in critical areas. At present, humanity is going through an explosive growth of knowledge which it never encountered before thanks to the advent of new technologies. The competitiveness of a firm, industry and even a nation depends on the right technology focus. The life science industry demonstrates that use of semantic technology has been accelerating innovation significantly. Many government institutes are also reaping benefits from the use of semantic technology. This research only demonstrates how semantic technology can bring changes to one area of organizational practice. Nevertheless, in the heightened competitive environment, to gain market advantage, firms and the industries need to evaluate their present strategy, must grasp the importance of these technologies and incorporate these critical technologies in company's knowledge related tools, processes, and practices.

5.4. LIMITATIONS

There are several limitations of this research.

First, as the data was gathered in a one-shot survey, the study did not consider feedback effects. A replication of the study in the future as a longitudinal research and investigation of the dynamic aspects based on the same constructs might produce a more convincing validation.

Second, although data collected from 178 firms is a satisfactory level for this type of research, a larger sample pool would generate a more robust validation. Moreover, the sample pool containing exclusively KM professionals creates certain bias, which should be carefully noted.

Third, important to notice that Semantic KMS has just recently started to receive an adequate level of attention and often companies incorporate one or several semantic tools instead of a holistic Semantic KMS. This study did not take this aspect in consideration.

Fourth, the study investigated the impact of knowledge management comprised of Semantic KMS and KM effectiveness on the innovation and competitiveness of the firm. Some researchers have focused on other factors such as KM capacity (Asgarian, 2012), KM capabilities (Han and Wang, 2012), KM processes (Massa and Testa, 2009), KM styles (Choi and Lee, 2003). Others have emphasized on KM practices (Gloat and Terziovski, 2004), KM orientation (Darroch and McNaughton, 2003) and KM resources (Chuang, 2004) Conducting a deeper analysis of some of those assumptions along with innovation and competitiveness may generate more robust and insightful outcome.

Fifth, dependence on a single respondent in garnering data, while commonly used, is still susceptive to a bias due to a single individual's views. The result could have more reliable if the data were collected from multiple individuals of the same company.

Sixth, the study used only quantitative research approach as prevalent in the overwhelming majority of the similar research, data triangulation using qualitative research might produce a more reliable result.

Seventh, there are no widely accepted variables employed in the constructs of Semantic KMS, KM Effectiveness, Innovation and Competitiveness in empirical research. Another limitation of this study is it might not be comparable with other similar studies that used different variables in representing same constructs.

Finally, SEM is an excellent statistical tool to analyze complex models with latent variables and mediating relationships. Because of this, the use of SEM in this study was appropriate. While the rules for sample size in SEM is still getting examined (Westland, 2010), a general rule of thumb is that the lower boundary for a model like ours should have a sample size of more than 250 (Bentler and Yuan, 1999). Otherwise, it might over-reject a true model (Bentler and Yuan, 1999). That is what might have happened in our case as our sample size was only 178. It could be the reason why we were compelled to exclude some of the items in the final construct. This issue suggests for retesting the model with a larger sample size.

Interpretation and use of this study results call for caution considering these limitations. However, the results of this study can work as a strong foundation for further research. Moreover, many of the assumptions of this study have been validated in prior investigations and can be treated as a reliable source of valuable information in the decision-making process pertaining Semantic KMS, KM effectiveness, innovation, and competitiveness.

5.5. FUTURE RESEARCH

The implementation of Semantic KMS just started to gain ground. This research is one of the first that has investigated the complex relationship of Semantic KMS with various organizational aspects. Multiple promising directions can be extracted from this study for further research where the results of this study can work as a foundation.

This study examined Semantic KMS as a holistic system, but in many cases, companies only deploy certain KM related tools supported by semantic technology. A different research approach might be worthwhile to investigate the impacts of those tools on relevant business processes.

For Semantic KMS, while we have selected some key variables grounding on previous literature, there could be many other variables that might interest future researchers in examining the impact of Semantic KMS. For example, trust can be one of those variables.

This study is one of the first research on Serendipity and Arbitrage from Semantic KMS perspective. Additional research might be needed to understand better how and why these phenomena are critical to apprehend and what possible influence these components may exert to the business aspects such as innovation and firm's performance.

This study focused on two factors: KM processes and strategic readiness in Measuring the KM Effectiveness. This research data cannot validate some of the selected components. Future research can introduce other factors such as KM practices, KM strategy, KM styles and KM orientation. The results of these possible future studies may differ from the outcome of this study or validate it. These studies would be an interesting and valuable contribution to KM theory.

The same research can be performed in a specific country or a single industry context and observe what difference these specificities bring to the research result.

As mentioned earlier, to further verify the validity of this study a future longitudinal research based on the similar constructs could be a good continuation of this work. It is also necessary to better understand the impact of Semantic KMS when the users become more experienced, went through the learning curves and built capabilities based on the new technology. Furthermore, data collected from multiple respondents of the same company would provide more interesting insights.

This research has examined linkages of Semantic KMS, KM Effectiveness, Innovation and Competitiveness using specific constructs. Future research can modify or add new constructs and investigate different associations of the model used in this study.

5.6. CONCLUSION

This study includes the steps of doing a comprehensive review of the relevant literature, developing a theoretical model, building hypotheses, conducting surveys, analyzing data, reporting results and discussing implications. The findings presented in this section is expected to enhance KM literature, aid KM practitioners in assessing the value of Semantic KMS, help academics in theory building, and assist in further research in KM discipline.

Semantic KMS can significantly improve a firm's knowledge use and deliver better performance. Not all companies are taking advantage of this opportunity. Many reasons exist why firms are not more aggressive in the deployment of such an accessible tool for gaining sustainable competitive advantage. First, lack of technical knowledge. As mentioned before, often companies don't have qualified people to monitor and address the rapid advancement of technologies unless the change is relevant to the core production, R&D, and sales activities. Second, within the company value chain spectrum, there always exist pain points which management consider as priorities. Lack of clear evidence that shows tools like semantic technology can make a difference is still scarce. Third, rapid technological advances also make seemingly sophisticated technologies obsolete faster than expected which is one of the prime concerns for many within the company management. Fourth, even though a significant number of studies provided proof of the distinct advantage of knowledge management, it is often not a strategic priority for many businesses due in most cases because of the lack of experts, boundary spanners, and visionary executives. This thesis is aimed at helping organizations in addressing these issues in following ways: It demonstrates how innovation, as one of the primary sources of competitive advantage can receive benefits from semantic KMS. It provides evidence based on data that KM is indeed a source of organizational competitiveness. It gives a clear picture of the advantages that a KMS and knowledge management may have if the KMS is built using semantic technology.

REFERENCES

Aas, T. H., & Pedersen, P. E. (2010). The firm-level effects of service innovation: a literature review. International Journal of Innovation Management, 14(05), 759-794.

Abecker, A., & van Elst, L. (2009). Ontologies for knowledge management. In Handbook on ontologies (pp. 713-734). Springer Berlin Heidelberg.

Abrahamsson, E. (1991). Managerial fads and fashions: The diffusion and rejection of innovations. Academy of management review, 16(3), 586-612.

Adams, G. L., & Lamont, B. T. (2003). Knowledge management systems and developing sustainable competitive advantage. Journal of knowledge management, 7(2), 142-154.

Adams, R., Bessant, J., & Phelps, R. (2006). Innovation management measurement: A review. International Journal of Management Reviews, 8(1), 21-47.

Adey, P., & Shayer, M. (1994). Really raising standards: Cognitive intervention and academic achievement. Routledge.

Afuah, A. (1998). Innovation Management: Strategies, Implementation, and Profits. New York, NY: Oxford University Press, Ch. 2.

Ahn, J. H., & Chang, S. G. (2002, January). Valuation of knowledge: a business performance-oriented methodology. In System Sciences, 2002. HICSS. Proceedings of the 35th Annual Hawaii International Conference on (pp. 2619-2626). IEEE.

Aiken, M., & Hage, J. (1971). The organic organization and innovation. Sociology, 5(1), 63-82.

Ajitabh, A., & Momaya, K. S. (2004). Competitiveness of firms: review of theory, frameworks and models. Singapore management review, 26(1), 45-61.

Akhavan, P., Jafari, M., & Fathian, M. (2006). Critical success factors of knowledge management systems: a multi-case analysis. European business review, 18(2), 97-113.

Alavi, M., & Leidner, D. E. (1999). Knowledge management systems: issues, challenges, and benefits. Communications of the AIS, 1(2es), 1.

Alavi, M., & Leidner, D. E. (2001). Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues. MIS quarterly, 107-136.

Alavi, M., & Tiwana, A. (2002). Knowledge integration in virtual teams: The potential role of KMS. Journal of the American Society for Information Science and Technology, 53(12), 1029-1037.

Alavi, M., Kayworth, T. R., & Leidner, D. E. (2005). An empirical examination of the influence of organizational culture on knowledge management practices. *Journal of management information systems*, *22*(3), 191-224.

Ale, M. A., Toledo, C. M., Chiotti, O., & Galli, M. R. (2014). A conceptual model and technological support for organizational knowledge management. Science of Computer Programming, 95, 73-92.

Alencar, E. M., & Bruno-Faria, M. D. F. (1997). Characteristics of an Organizational Environment Which Stimulate and Inhibit Creativity. Journal of Creative Behavior, 31(4), 271-81.

Al-Hakim, L. A. Y., & Hassan, S. (2012). Critical success factors of knowledge management, innovation and organizational performance: an empirical study of the Iraqi mobile telecommunication sector. *British Journal of Economics, Finance and Management Sciences*, *4*(1), 31-49.

Alvesson, M., & Kärreman, D. (2001). Odd couple: making sense of the curious concept of knowledge management. Journal of management studies, 38(7), 995-1018.

Amabile, T. M. (1983). The social psychology of creativity: A componential conceptualization. Journal of personality and social psychology, 45(2), 357.

Amabile, T. M. (1988). A model of creativity and innovate ion in organizations. Research in organizational behavior, 10(1), 123-167.

Amabile, T. M., Conti, R., Coon, H., Lazenby, J., & Herron, M. (1996). Assessing the work environment for creativity. Academy of management journal, 39(5), 1154-1184.

Amabile, T.M. & Grykiewicz, N.D. (1989). The creative environment scales: Work environment inventory. Creativity Research Journal, 2, 231-253

Amar, A. D. (2002). Managing knowledge workers: Unleashing innovation and productivity. Greenwood Publishing Group.

Amason, A. C., Shrader, R. C., & Tompson, G. H. (2006). Newness and novelty: Relating top management team composition to new venture performance. Journal of Business Venturing, 21(1), 125-148.

Ambastha, A., & Momaya, K. (2004). Competitiveness of firms: review of frameworks and models. Singapore Management Review, 6(1), 45-61

Anantatmula, V. S. (2007). Linking KM effectiveness attributes to organizational performance. Vine, 37(2), 133-149.

Anantatmula, V. S. (2008). Leadership role in making effective use of KM. VINE, 38(4), 445-460.

Anderson, M., & Sohal, A. S. (1999). A study of the relationship between quality management practices and performance in small businesses. International Journal of quality & Reliability management, 16(9), 859-877.

Andreeva, T., & Kianto, A. (2011). Knowledge processes, knowledge-intensity and innovation: a moderated mediation analysis. Journal of Knowledge Management, 15(6), 1016-1034.

Andreeva, T., & Kianto, A. (2012). Does knowledge management really matter? Linking knowledge management practices, competitiveness and economic performance. Journal of Knowledge Management, 16(4), 617-636.

Andreu, R., & Sieber, S. (1999). Knowledge and problem solving: a proposal for a model of individual and collective learning. Working Paper 1/99). Barcelona.

Appelbaum, E. (2000). Manufacturing advantage: Why high-performance work systems pay off. Cornell University Press.

Argote, L. (2012). Organizational learning: Creating, retaining and transferring knowledge. Springer Science & Business Media.

Argote, L., & Ingram, P. (2000). Knowledge transfer: A basis for competitive advantage in firms. Organizational behavior and human decision processes, 82(1), 150-169.

Arms, W. Y. (2000). How effectively can computers be used skilled tasks of professional librarianship? Educação Temática Digital, 2(1).

Arrow, K. (1962). Economic welfare and the allocation of resources for invention. In *The rate and direction of inventive activity: Economic and social factors* (pp. 609-626). Princeton University Press.

Arthur, W. B. (1994). Increasing returns and path dependence in the economy. University of Michigan Press.

Asgarian, N. (2012). Knowledge management capacity and innovation performance. Management Science Letters, 2(8), 2739-2746.

Asoh, D., Belardo, B. and Neilson, R. (2002). Knowledge management: challenges and opportunities for government in the new economy, Conference Proceedings of the 35th Hawaii International Conference on System Science, Big Island, HI, 1-10.

Autio, E., Sapienza, H. J., & Almeida, J. G. (2000). Effects of age at entry, knowledge intensity, and imitability on international growth. Academy of management journal, 43(5), 909-924.

Avlonitis, G. J., & Gounaris, S. P. (1999). Marketing orientation and its determinants: an empirical analysis. European journal of marketing, 33(11/12), 1003-1037.

Baca, M. (Ed.). (2008). *Introduction to metadata*. Getty Publications.

Badr, Y., Chbeir, R., Abraham, A., & Hassanien, A. E. (Eds.). (2010).Emergent web intelligence: Advanced Semantic Technology. Springer Science & Business Media.

Baer, M., & Frese, M. (2003). Innovation is not enough: Climates for initiative and psychological safety, process innovations, and firm performance. Journal of organizational behavior, 24(1), 45-68.

Bagozzi, R. P., Yi, Y., & Phillips, L. W. (1991). Assessing construct validity in organizational research. Administrative science quarterly, 421-458.

Baker, W.E., Sinkula, J.M. (1999). The synergistic effect of market orientation and learning orientation on organizational performance. Journal of the Academy of Marketing Science 27(4), 411–427

Banbury, C. M., & Mitchell, W. (1995). The effect of introducing important incremental innovations on market share and business survival. Strategic Management Journal, 16(S1), 161-182.

Barclay, R. O & Murray, P. C. (1997). What is knowledge management. Knowledge Praxis, 19.

Baregheh, A., Rowley, J., & Sambrook, S. (2009). Towards a multidisciplinary definition of innovation. Management decision, 47(8), 1323-1339.

Barney J.B, Griffin R.W. (1992). The Management of Organisation: Strategy, Structure, Behaviour. Houghton Mifflin Company: Boston, MA

Barney, J.B. (1986). Strategic factor markets: expectations, luck and business strategy. Management Science 32(October): 1231–1241.

Barney, J.B. (1991). Firm resources and sustained competitive advantage. Journal of management, 17(1), 99-120.

Baroudi, J. J., Olson, M. H., & Ives, B. (1986). An empirical study of the impact of user involvement on system usage and information satisfaction. Communications of the ACM, 29(3), 232-238.

Barringer, B. R., & Bluedorn, A. C. (1999). The relationship between corporate entrepreneurship and strategic management. Strategic Management Journal, 20(5), 421-444.

Bartlett, C., & Ghoshal, S. (1989). The transnational corporation. New York.

Baruffaldi, S. H., Di Maio, G., & Landoni, P. (2017). Determinants of PhD holders' use of social networking sites: An analysis based on LinkedIn. Research Policy, 46(4), 740-750.

Basadur, M., & Gelade, G. A. (2006). The role of knowledge management in the innovation process. Creativity and Innovation Management, 15(1), 45-62.

Bate, P., & Robert, G. (2003). Where next for policy evaluation? Insights from researching National Health Service modernisation. Policy & Politics, 31(2), 249-262.

Bates, K. A., & Flynn, E. J. (1995, August). Innovation History and Competitive Advantage: A Resource-Based View Analysis of Manufacturing Technology Innovations. In Academy of Management Proceedings (Vol. 1995, No. 1, pp. 235-239). Academy of Management.

Becerra-Fernandez, I., & Sabherwal, R. (2014). Knowledge management: Systems and processes. Routledge.

Becerra-Fernandez, I., Gonzalez, A., & Sabherwal, R. (2004). Knowledge Management and KM Software Package, 1/e.

Becker, S. W., & Whisler, T. L. (1967). The innovative organization: A selective view of current theory and research. The Journal of Business, 40(4), 462-469.

Beckman, C. M. (2006). The influence of founding team company affiliations on firm behavior. Academy of Management Journal, 49(4), 741-758.

Beckman, S. L., & Barry, M. (2007). Innovation as a learning process: Embedding design thinking. California management review, 50(1), 25-56.

Beckman, T.J. (1999). The current state of knowledge management. In The Knowledge Management Handbook, Liebowitz J (ed.). CRC Press: New York.

Benbya, H. (2008). Knowledge Management: Systems Implementation: Lessons from the Silicon Valley. Chandos Publishing.

Benner, M. J., & Tushman, M. L. (2003). Exploitation, exploration, and process management: The productivity dilemma revisited. Academy of management review, 28(2), 238-256.

Bergeron, B. (2003). Essentials of knowledge management (Vol. 28). John Wiley & Sons.

Bharadwaj, A. S. (2000). A resource-based perspective on information technology capability and firm performance: an empirical investigation. MIS quarterly, 169-196.

Bharadwaj, S. G., Varadarajan, P. R., & Fahy, J. (1993). Sustainable competitive advantage in service industries: a conceptual model and research propositions. The Journal of Marketing, 83-99.

Bierly, P., & Chakrabarti, A. (1996). Generic knowledge strategies in the US pharmaceutical industry. *Strategic management journal*, *17*(S2), 123-135.

Birkinshaw, J., Hamel, G., & Mol, M. J. (2008). Management innovation. Academy of management Review, 33(4), 825-845.

Bizer, C., Heath, T., & Berners-Lee, T. (2009). Linked data-the story so far. *Semantic services, interoperability and web applications: emerging concepts*, 205-227.

Björk, J. (2012). Knowledge domain spanners in ideation. Creativity and innovation management, 21(1), 17-27.

Blessing, L. T., & Chakrabarti, A. (2009). DRM: A Design Reseach Methodology (pp. 13-42). Springer London.

Bock, G. W., & Kim, Y. G. (2001). Breaking the myths of rewards: An exploratory study of attitudes about knowledge sharing. Pacis 2001 proceedings, 78.

Bodenreider, O. (2008). Biomedical ontologies in action: role in knowledge management, data integration and decision support. Yearbook of medical informatics, 67.

Boekema, F., Morgan, K., Bakkers, S., & Rutten, R. (2000). Knowledge, Innovation and Economic Growth. Edward Elgar Publishing.

Bonanno, G., & Haworth, B. (1998). Intensity of competition and the choice between product and process innovation. International Journal of Industrial Organization, 16(4), 495-510.

Bontis, N. (1999). Managing organisational knowledge by diagnosing intellectual capital: framing and advancing the state of the field. *International Journal of technology management*, *18*(5-8), 433-462.

Bordia, P., Irmer, B. E., Garden, M., Phair, K. & Abusah, D. (2004). Knowledge sharing in response to a supportive work environment: evidence from an Australian engineering firm.

Borghoff, U., & Pareschi, R. (1998). Information technology for knowledge management. Berlin, Heidelberg: Springer- Verlag.

Bouthillier, F., & Shearer, K. (2002). Understanding knowledge management and information management: the need for an empirical perspective. Information research, 8(1), 8-1.

Bouthillier, F., & Shearer, K. (2005). Knowledge management and information management: Review of empirical evidence. Introducing information management: An information research reader, 139-150.

Brachos, D., Kostopoulos, K., Eric Soderquist, K., & Prastacos, G. (2007). Knowledge effectiveness, social context and innovation. *Journal of knowledge management*, *11*(5), 31-44.

Brennan, M., Rae, N., & Parackal, M. (1999). Survey-based experimental research via the Web: Some observations. Marketing Bulletin-Department of Marketing Massey University, 10, 83-92.

Bresnahan, T. F., Brynjolfsson, E., & Hitt, L. M. (2002). Pchnology, Organization, and the Demand for Skilled Labor. The new relationship: Human capital in the American corporation, 145.

Brooking, A. (1996). Intellectual capital. Cengage Learning EMEA.

Brown, J. (2005). New Product Development: Profiting from Innovation. Aberdeen Group Business Value Research Series, December, 1-15.

Brown, M.G. (1996), Keeping Score: Using the Right Metrics to Drive World-Class Performance, Quality Resources, New York, NY.

Brown, P., Green, A., & Lauder, H. (2001). High skills: Globalization, competitiveness, and skill formation: globalization, competitiveness, and skill formation. OUP Oxford.

Brown, S. L., & Eisenhardt, K. M. (1995). Product development: Past research, present findings, and future directions. Academy of management review, 20(2), 343-378.

Brugger, J. (2010). Neue Wege im Ideenmanagement: Kollaborative Ideenentwicklung bei der Schweizerischen Post. Ideenmanagement. Zeitschrift fu€r Vorschlagswesen und Verbesserung-sprozesse (Erich Schmidt Verlag), 3: 77–78.

Brynjolfsson, E., & Hitt, L. M. (2000). Beyond computation: Information technology, organizational transformation and business performance. The Journal of Economic Perspectives, 14(4), 23-48.

Buckley, P. J., Pass, C. L., & Prescott, K. (1988). Measures of international competitiveness: A critical survey†. Journal of marketing management, 4(2), 175-200.

Buckley, P. J., Pass, C. L., & Prescott, K. (1992). The internationalization of service firms: a comparison with the manufacturing sector. Scandinavian international business review, 1(1), 39-56.

Bukowitz, W. R., & William Ruth, L. Williams, (1999). The Knowledge Management Field Book. Financial Times Prentice Hall.

Burns, N., & Grove, S. K. (1999). Understanding research.

Calder, B. J., Phillips, L. W., & Tybout, A. M. (1981). Designing research for application. Journal of consumer research, 8(2), 197-207.

Campanario, J.M. (1996). Using citation classics to study the incidence of serendipity in scientific discovery, Scientometrics, 37(1): 3-24

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. Psychological bulletin, 56(2), 81.

Cannon, M. D., and Edmondson, A. C. (2005). Failing to learn and learning to fail (intelligently): How great organizations put failure to work to innovate and improve. Long Range Planning, 38(3), 299-319.

Carayannis, E. G. (2007). Action: The Case of M&A Automation and Valchemy Corporation. Leading and Managing Creators, Inventors, and Innovators: The Art, Science, and Craft of Fostering Creativity, Triggering Invention, and Catalyzing Innovation, 1.

Carayannis, E. G. (2008). Knowledge-driven creative destruction, or leveraging knowledge for competitive advantage Strategic knowledge arbitrage and serendipity as real options drivers triggered by co-opetition, co-evolution and co-specialization. Industry and Higher Education, 22(6), 343-353.

Carayannis, E. G. (2014). Strategic Knowledge Arbitrage and Serendipity (SKARSE™) in Action. Journal of the Knowledge Economy, 5(2), 203-211.

Carayannis, E. G., & Juneau, T. L. (2003). Idea makers and idea brokers in High-Technology Entrepreneurship: Fee vs. equity compensation for intellectual venture capitalists. Greenwood Publishing Group.

Carayannis, E. G., & Wang, V. W. L. (2012). Competitiveness model—a double diamond. Journal of the Knowledge Economy, 3(3), 280-293.

Carayannis, E. G., Provance, M., & Givens, N. (2011). Knowledge arbitrage, serendipity, and acquisition formality: their effects on sustainable entrepreneurial activity in regions. IEEE Transactions on Engineering Management, 58(3), 564–577.

Cardinal, L. B., Alessandri, T. M., & Turner, S. F. (2001). Knowledge codifiability, resources, and science-based innovation. Journal of knowledge management, 5(2), 195-204.

Carneiro, A. (2000). How does knowledge management influence innovation and competitiveness? Journal of knowledge management, 4(2), 87-98.

Cavusgil, S.T., Calantone, R.J. and Zhao, Y. (2003), ''Tacit knowledge transfer and firm innovation capability'', Journal of Business & Industrial Marketing, Vol. 18 No. 1, pp. 6-21.

Cayzer, S. (2004). Semantic blogging and decentralized knowledge management. Communications of the ACM, 47(12), 47-52.

Cebon, P. and Newton, P. (1999). Innovation in firms: towards a framework for indicator development. Melbourne Business School Working Paper 99-9

Chakrabarti, A. K. (1974). The role of champion in product innovation. California management review, 17(2), 58-62.

Chang, S. C., & Lee, M. S. (2008). The linkage between knowledge accumulation capability and organizational innovation. Journal of knowledge management, 12(1), 3-20.

Chao, L., Zhang, Y., & Xing, C. (2012). The Semantic Web-Based Collaborative Knowledge Management. In New Research on Knowledge Management Technology. InTech.

Chaudhuri, S., & Ray, S. (1997). The competitiveness conundrum: literature review and reflections. Economic and Political Weekly, M83-M91.

Chen, A. N., & Edgington, T. M. (2005). Assessing value in organizational knowledge creation: Considerations for knowledge workers. MIS quarterly, 279-309.

Chen, C. J. (2004). The effects of knowledge attribute, alliance characteristics, and absorptive capacity on knowledge transfer performance. R&D Management, 34(3), 311-321.

Chen, C. J., & Lin, B. W. (2004). The effects of environment, knowledge attribute, organizational climate, and firm characteristics on knowledge sourcing decisions. R&D Management, 34(2), 137-146.

Chen, J., Zhu, Z., & Yuan Xie, H. (2004). Measuring intellectual capital: a new model and empirical study. Journal of Intellectual capital, 5(1), 195-212.

Chen, M. Y., & Chen, A. P. (2006). Knowledge management performance evaluation: a decade review from 1995 to 2004. Journal of Information Science, 32(1), 17-38.

Chen, Y., Argentinis, J. E., & Weber, G. (2016). IBM Watson: How Cognitive Computing Can Be Applied to Big Data Challenges in Life Sciences Research. *Clinical Therapeutics*, *38*(4), 688-701.

Cheng, H., Lu, Y. C., & Sheu, C. (2009). An ontology-based business intelligence application in a financial knowledge management system. Expert Systems with Applications, 36(2), 3614-3622.

Cherryholmes, C. H. (1992). Notes on pragmatism and scientific realism. Educational researcher, 21(6), 13-17.

Chesbrough, H. (2003). The logic of open innovation: managing intellectual property. California Management Review, 45(3), 33-58.

Chesbrough, H. (2006). Open innovation: The new imperative for creating and profiting from technology. Harvard Business Press.

Chesbrough, H. (2010). Business model innovation: opportunities and barriers. Long range planning, 43(2), 354-363.

Chesbrough, H., & Crowther, A. K. (2006). Beyond high tech: early adopters of open innovation in other industries. R&D Management, 36(3), 229-236.

Chesbrough, H., & Vanhaverbeke, W. (2011). Open innovation and public policy in Europe.

Chhim, P. P., Somers, T. M., & Chinnam, R. (2017). Knowledge reuse through electronic knowledge repositories: a multi theoretical study. Journal of Knowledge Management, (just-accepted), 00-00.

Choi, B., & Lee, H. (2002). Knowledge management strategy and its link to knowledge creation process. Expert Systems with applications, 23(3), 173-187.

Choi, B., Poon, S. K., & Davis, J. G. (2008). Effects of knowledge management strategy on organizational performance: A complementarity theory-based approach. Omega, 36(2), 235-251.

Choi, D., & Valikangas, L. (2001). Patterns of strategy innovation. European Management Journal, 19(4), 424-429.

Christensen, C. (1997) The Innovator's Dilemma. Harvard Business School Press. Cambridge, MA

Chua, A., & Lam, W. (2005). Why KM projects fail: a multi-case analysis. Journal of knowledge management, 9(3), 6-17.

Chuang, S. H. (2004). A resource-based perspective on knowledge management capability and competitive advantage: an empirical investigation. Expert systems with applications, 27(3), 459-465.

Clark, J., & Guy, K. (1998). Innovation and competitiveness: a review: Practitioners' forum. Technology Analysis & Strategic Management, 10(3), 363-395.

Clark, K. B., & Fujimoto, T. (1991). Product development performance: Strategy, organization, and management in the world auto industry. Harvard Business Press.

Clark, T. H., & Stoddard, D. B. (1996). Interorganizational business process redesign: merging technological and process innovation. Journal of Management Information Systems, 13(2), 9-28.

Clark, T., & Cassani, L. (2014). Semantic Knowledge Management and Linked Data for Humanitarian Assistance. Procedia Engineering, 78, 134-142.

Clarke, R. & McGuinness, T. (1987), The Economics of the Firm, *Basil Blackwell*, Oxford.

Clegg, C., Unsworth, K., Epitropaki, O., & Parker, G. (2002). Implicating trust in the innovation process†. Journal of Occupational and Organizational Psychology, 75(4), 409-422.

Coase, R. H. (1937). The nature of the firm. Economica, 4(16), 386-405.

Cob, C., Abdullah, R., Risidi, H., & Mohd, N. M. (2015). Preliminary study on semantic knowledge management model for collaborative learning. *ARPN J. Eng. Appl. Sci*, *10*(2), 442-450.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale, NJ: Lawrence Earlbaum Associates.

Cohen, W. M., & Levinthal, D. A. (1989). Innovation and learning: the two faces of R & D. The economic journal, 99(397), 569-596.

Coleman, Jr, H. J. (1999). What enables self-organizing behavior in businesses. Emergence, 1(1), 33-48.

Collinson, S., & Wilson, D. C. (2006). Inertia in Japanese organizations: Knowledge management routines and failure to innovate. Organization Studies, 27(9), 1359-1387.

Cook, S. D., & Brown, J. S. (1999). Bridging epistemologies: The generative dance between organizational knowledge and organizational knowing. *Organization science*, *10*(4), 381-400.

Cooke, P., & Leydesdorff, L. (2006). Regional development in the knowledge-based economy: The construction of advantage. *The journal of technology Transfer*, *31*(1), 5-15.

Cooper, D. R., Schindler, P. S., & Sun, J. (2003). Business research methods.

Cottam, A., Ensor, J., & Band, C. (2001). A benchmark study of strategic commitment to innovation. European Journal of Innovation Management, 4(2), 88-94.

Courtney, J. F. (2001). Decision making and knowledge management in inquiring organizations: toward a new decision-making paradigm for DSS. Decision support systems, 31(1), 17-38.

Cozijnsen, A. J., Vrakking, W. J., & van IJzerloo, M. (2000). Success and failure of 50 innovation projects in Dutch companies. European Journal of Innovation Management, 3(3), 150-159.

Crespi, G., & Zuniga, P. (2012). Innovation and productivity: evidence from six Latin American countries. World development, 40(2), 273-290.

Creswell, J. W. (1994). Research design: Qualitative and quantitative approaches. Thousand Oaks, CA: Sage.

Creswell, J. W. (2014). A concise introduction to mixed methods research. Sage Publications.

Crossan, M. M., and Apaydin, M. (2010). A multi-dimensional framework of organizational innovation: A systematic review of the literature. Journal of management studies, 47(6), 1154-1191.

Crossan, M. M., Lane, H. W., & White, R. E. (1999). An organizational learning framework: From intuition to institution. Academy of management review, 24(3), 522-537.

Crotty, M. (1998) The Foundations of Social Research: Meaning and Perspective in the Research Process. Thousand Oaks, CA: SAGE.

Cummings, J. L., & Teng, B. S. (2003). Transferring R&D knowledge: the key factors affecting knowledge transfer success. Journal of Engineering and technology management, 20(1), 39-68.

D'Argembeau, A., & Van der Linden, M. (2004). Phenomenal characteristics associated with projecting oneself back into the past and forward into the future: Influence of valence and temporal distance. *Consciousness and cognition*, *13*(4), 844-858.

Daft, R. L. (1978). A dual-core model of organizational innovation. Academy of management journal, 21(2), 193-210.

Daft, R. L. (1982). Bureaucratic versus nonbureaucratic structure and the process of innovation and change. Research in the Sociology of Organizations, 1, 129-166.

Daft, R. L., & Lengel, R. H. (1986). Organizational information requirements, media richness and structural design. Management science, 32(5), 554-571.

Dalkir, K. (2005). Knowledge Management Converting Theory into Practice.

Dalkir, K., & Liebowitz, J. (2011). Knowledge management in theory and practice. MIT press.

Damanpour, F. (1991). Organizational innovation: A meta-analysis of effects of determinants and moderators. Academy of management journal, 34(3), 555-590.

Damanpour, F., & Evan, W. M. (1984). Organizational innovation and performance: the problem of" organizational lag". Administrative science quarterly, 392-409.

Damanpour, F., Szabat, K. A., & Evan, W. M. (1989). The relationship between types of innovation and organizational performance. Journal of Management studies, 26(6), 587-602.

Danneels, E. (2002). The dynamics of product innovation and firm competences. Strategic management journal, 23(12), 1095-1121.

Darroch, J. (2005). Knowledge management, innovation and firm performance. *Journal of knowledge management*, *9*(3), 101-115.

Darroch, J., & McNaughton, R. (2002). Examining the link between knowledge management practices and types of innovation. Journal of intellectual capital, 3(3), 210-222.

Darroch, J., & McNaughton, R. (2003). Beyond market orientation: Knowledge management and the innovativeness of New Zealand firms. *European journal of Marketing*, *37*(3/4), 572-593.

Das, M., & Puri, R. (2003). Using Innovation Management for Cost Reduction in The automotive Industry.

Davenport, T. H. (1994). Saving IT's Soul: Human-Centered Information Management. Harvard business review, 72(2), 119-31.

Davenport, T. H. (1997). Ten principles of knowledge management and four case studies. Knowledge and process Management, 4(3), 187-208.

Davenport, T. H. (1998). Managing Customer Knowledge: Thin Tank. CIO Magazine, 6, 98.

Davenport, T. H. (2013). Process innovation: reengineering work through information technology. Harvard Business Press.

Davenport, T. H., & Prusak, L. (1998). Working knowledge: How organizations manage what they know. Harvard Business Press.

Davenport, T. H., De Long, D. W., & Beers, M. C. (1998). Successful knowledge management projects. MIT Sloan Management Review, 39(2), 43.

Davenport, T.H., Prusak, L. and Wilson, J. (2003), "Who's bringing you hot ideas (and how are you responding)?", *Harvard Business Review*, Vol. 81 No. 2, 58-64.

Davies, J. F., Grobelnik, M., & Mladenic, D. (Eds.). (2008). Semantic Knowledge Management: Integrating Ontology Management, Knowledge Discovery, and Human Language Technologies. Springer Science & Business Media.

Davies, J., Lytras, M., & Sheth, A. P. (2007). Guest Editors' Introduction: Semantic-Web-Based Knowledge Management. IEEE Internet Computing, 11(5), 14.

Davies, J., Studer, R., Sure, Y., & Warren, P. W. (2005). Next generation knowledge management. BT Technology Journal, 23(3), 175-190.

Day, G. S., & Wensley, R. (1988). Assessing advantage: a framework for diagnosing competitive superiority. The Journal of Marketing, 1-20.

D'Cruz, J. R. (1992). New compacts for Canadian competitiveness. DIANE Publishing.

De Gooijer, J. (2000). Designing a knowledge management performance framework. Journal of Knowledge Management, 4(4), 303-310.

De Rond, M. (2014). The structure of serendipity. *Culture and Organization*,*20*(5), 342-358.

De Tarde, G. (1903). The laws of imitation. H. Holt.

De Vergara, J. L., Villagrá, V. A., & Berrocal, J. (2002, June). Semantic Management: advantages of using an ontology-based management information meta-model. In Proceedings of the HP Openview University Association Ninth Plenary Workshop (HPOVUA'2002), Böblingen, Germany (pp. 11-13).

DeLone, W. H., & McLean, E. R. (1992). Information systems success: The quest for the dependent variable. Information systems research, 3(1), 60-95.

DeLone, W.H., & McLean, E.R. (2003). The DeLone and McLean model of information systems success: A ten-year update. Journal of Management Information Systems, 19(4), 9–30.

Demirsoy, A. (2013). Using Semantic Knowledge Management Systems To Overcome Information Overload Problems In Software Engineering.

Deng, X., Doll, W. J., & Cao, M. (2008). Exploring the absorptive capacity to innovation/productivity link for individual engineers engaged in IT enabled work. Information & Management, 45(2), 75-87.

DeNisi, A. S., Hitt, M. A., & Jackson, S. E. (2003). The knowledge-based approach to sustainable competitive advantage. Managing knowledge for sustained competitive advantage: Designing strategies for effective human resource management, 3-33.

Deschamps, J.P., Nayak, P.R., Little, A.D., 1995. Product Juggernauts: How Companies Mobilize to Generate a Stream of Market Winners. Harvard Business School Press, Boston.

Deshpande, R., Farley, U. & Webster, F. (1993) Corporate culture, customer orientation, and innovativeness in Japanese firms: a quadrad analysis. *Journal of Marketing* 57(1), 23–37.

Desouza, K., Dombrowski, C., Awazu, Y., Baloh, P., Papagari, S., Jha, S., Kim, J. (2009). Crafting Organizational Innovation Processes. Innovation : Management, Policy & Practice. 11(1)

Dess, G.G. & Picken. J.C. (2000). Changing roles: Leadership in the 21st Century. Organizational Dynamics: Winter 2000: 18-34.

Dessì, N., Milia, G., Pascariello, E., & Pes, B. (2016). COWB: A cloud-based framework supporting collaborative knowledge management within biomedical communities. Future Generation Computer Systems, 54, 399-408.

Detert, J. R., Schroeder, R. G., & Mauriel, J. J. (2000). A framework for linking culture and improvement initiatives in organizations. Academy of management Review, 25(4), 850-863.

Dewar, R. D., & Dutton, J. E. (1986). The adoption of radical and incremental innovations: An empirical analysis. Management science, 32(11), 1422-1433.

Domingos, P. (2015). The master algorithm: How the quest for the ultimate learning machine will remake our world. Basic Books.

Dosi, G. (1982). Technological paradigms and technological trajectories: a suggested interpretation of the determinants and directions of technical change. Research policy, 11(3), 147-162.

Dosi, G. (1988). Sources, procedures, and microeconomic effects of innovation. Journal of economic literature, 1120-1171.

Dotsika, F. (2017). Semantification of Organizational Content as a Transformational Technology for SMEs. Journal of Advanced Management Science Vol, 5(1).

Dougherty, D. (1992). Interpretive barriers to successful product innovation in large firms. Organization science, 3(2), 179-202.

Drew, S. A. (1997). From knowledge to action: the impact of benchmarking on organizational performance. *Long range planning*, *30*(3), 427-441.

Drucker, P. (2014). Innovation and entrepreneurship. Routledge.

Du Plessis, M. (2005). Drivers of knowledge management in the corporate environment. International journal of information management, 25(3), 193-202.

Du Plessis, M. (2007). The role of knowledge management in innovation. Journal of knowledge management, 11(4), 20-29.

Du, Y., & Farley, J. U. (2001). Research on technological innovation as seen through the Chinese looking glass. Journal of Enterprising Culture, 9(01), 53-89.

Duhon, B. (1998). It's all in our heads. Inform, 12(8), 8-13.

Duncan, R. (1976.) The ambidextrous organization: Designing dual structures for innovation. *In R. H. Killman, L. R. Pondy, & D. Sleven (Eds.), The management of organization*, 1: 167-188. New York: North Holland.

Dwyer, L., & Kim, C. (2003). Destination competitiveness: determinants and indicators. Current issues in tourism, 6(5), 369-414.

Edquist, C., Hommen, L., & McKelvey, M. D. (2001). Innovation and employment: Process versus product innovation. Edward Elgar Publishing.

Edvardsson, I. R., & Durst, S. (2013). The benefits of knowledge management in small and medium-sized enterprises. Procedia-Social and Behavioral Sciences, 81, 351-354.

Edvinsson, L., & Malone, M. S. (1997). Intellectual Capital: Realizing Your Company's True Value by Finding Its Hidden Brainpower.

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: what are they? Strategic management journal, 21(10-11), 1105-1121.

Ena, O., Mikova, N., Saritas, O., & Sokolova, A. (2016). A methodology for technology trend monitoring: the case of semantic technologies. Scientometrics, 108(3), 1013-1041.

Epstein, M. J., & Manzoni, J. F. (1997). The balanced scorecard and tableau de bord: translating strategy into action. Strategic Finance, 79(2), 28.

Esterhuizen, D., Schutte, C. S., & Du Toit, A. S. A. (2012). Knowledge creation processes as critical enablers for innovation. International Journal of Information Management, 32(4), 354-364.

Ettlie, J. E., & Reza, E. M. (1992). Organizational integration and process innovation. Academy of management journal, 35(4), 795-827.

Ettlie, J. E., Bridges, W. P., & O'keefe, R. D. (1984). Organization strategy and structural differences for radical versus incremental innovation. Management science, 30(6), 682-695.

Evans, J. R., & Mathur, A. (2005). The value of online surveys. *Internet research*, *15*(2), 195-219.

Fabrigar, L. R., & Wegener, D. T. (2011). Exploratory factor analysis. Oxford University Press.

Fagerberg, J. (1988). International competitiveness. The economic journal,98(391), 355-374.

Fagerberg, J., Mowery, D. C., & Nelson, R. R. (2003). Understanding Innovation.

Farjoun, M. (1994). Beyond industry boundaries: Human expertise, diversification and resource-related industry groups. Organization science, 5(2), 185-199.

Felin, T., & Hesterly, W. S. (2007). The knowledge-based view, nested heterogeneity, and new value creation: Philosophical considerations on the locus of knowledge. Academy of Management Review, 32(1), 195-218.

Fenn, J., & LeHong, H. (2011). Hype cycle for emerging technologies, 2011.*Gartner, July*.

Ferguson, A. (1999) The lost land of serendip. Forbes Vol 164(8): 193-4

Ferrucci, D., & Lally, A. (2004). UIMA: an architectural approach to unstructured information processing in the corporate research environment. Natural Language Engineering, 10(3-4), 327-348.

Feurer, R., & Chaharbaghi, K. (1994). Defining competitiveness: a holistic approach. Management Decision, 32(2), 49-58.

Fink, M., & Kraus, S. (Eds.). (2009). The management of small and medium enterprises. Routledge.

Firestone, J. M., & McElroy, M. W. (2003). Key issues in the new knowledge management. Routledge.

Flanagan. O.J., (1991). The science of the mind. MIT Press.

Flejterski S., (1984) Istota i mierzenie konkurencyjności międzynarodowej, Gospodarka Planowa 1984, (9).

Floyd, S. W., & Lane, P. J. (2000). Strategizing throughout the organization: Managing role conflict in strategic renewal. Academy of management review, 25(1), 154-177.

Foray, D. (1998). The economics of knowledge openness: emergence, persistence and change of conventions in the knowledge systems. Trust and economic learning, 162-189.

Foray, D., & Lundvall, B. (1998). The knowledge-based economy: from the economics of knowledge to the learning economy. *The economic impact of knowledge*, 115-121.

Ford, D. P. (2004). Trust and knowledge management: the seeds of success. In Handbook on Knowledge Management 1 (pp. 553-575). Springer Berlin Heidelberg.

Fosnot, C. T. (1996). Teachers construct constructivism: The center for constructivist teaching/teacher preparation project. Constructivism: Theory, perspectives, and practice, 205-216.

Fowler Jr, F. J. (2013). Survey research methods. Sage publications.

Freeman, C. (1982). The economics of industrial innovation. University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship.

Freeman, H. (1974). Computer processing of line-drawing images. ACM Computing Surveys (CSUR), 6(1), 57-97.

Gábor, A., Kő, A., Szabó, Z., & Fehér, P. (2016). Corporate knowledge discovery and organizational learning: the role, importance, and application of semantic business process management—the ProKEX case. In Corporate Knowledge Discovery and Organizational Learning (pp. 1-31). Springer International Publishing.

Gadrey, J., Gallouj, F., & Weinstein, O. (1995). New modes of innovation: how services benefit industry. International journal of service industry management, 6(3), 4-16.

Gallimore, R., & Tharp, R. (1990). Teaching mind in society: Teaching, schooling, and literate discourse. Vygotsky and education: Instructional implications and applications of sociohistorical psychology, 175-205.

Gallupe, B. (2001). Knowledge management systems: surveying the landscape. International Journal of Management Reviews, 3(1), 61-77.

García-Crespo, Á., Rodríguez, A., Mencke, M., Gómez-Berbís, J. M., & Colomo-Palacios, R. (2010). ODDIN: Ontology-driven differential diagnosis based on logical inference and probabilistic refinements. *Expert Systems with Applications*, *37*(3), 2621-2628.

Garud, R., & Kumaraswamy, A. (2005). Vicious and virtuous circles in the management of knowledge: The case of Infosys Technologies. MIS quarterly, 9-33.

Gates, B. (1999). Business @ the Speed of Thought. London: Penguin Books.

Ghalayini, A. M., Noble, J. S., & Crowe, T. J. (1997). An integrated dynamic performance measurement system for improving manufacturing competitiveness. International Journal of production economics, 48(3), 207-225.

Ghauri, P., & Grønhaug, K. (2002). Research Methods in Business Studies . Harlow: Financial Times.

Ghoshal, S., & Moran, P. (1996). Bad for practice: A critique of the transaction cost theory. Academy of management Review, 21(1), 13-47.

Giraldo, J. P. (2005). Relationship between technologies for knowledge management and socialization and performing actions of global organizations. In Proceedings of the Third Annual Conference on Systems Engineering Research CSER.

Gloet, M., & Terziovski, M. (2004). Exploring the relationship between knowledge management practices and innovation performance. *Journal of Manufacturing Technology Management*, *15*(5), 402-409.

Goel, R. K., & Rich, D. P. (1997). On the adoption of new technologies. Applied Economics, 29(4), 513-518.

Goh, A. L. (2005). Harnessing knowledge for innovation: an integrated management framework. Journal of Knowledge management, 9(4), 6-18.

Gold, A. H., Malhotra, A., & Segars, A. H. (2001). Knowledge management: An organizational capabilities perspective. Journal of Management Information System, 18(1), 185–214.

Gopalakrishnan, S., & Damanpour, F. (1994). Patterns of generation and adoption of innovation in organizations: Contingency models of innovation attributes. Journal of Engineering and Technology Management, 11(2), 95-116.

Grant, K. A., & Grant, C. T. (2008). Developing a model of next generation knowledge management. Issues in Informing Science and Information Technology, 5(2), 571-590.

Grant, R. M. (1991). The resource-based theory of competitive advantage: implications for strategy formulation. California management review, 33(3), 114-135.

Grant, R. M. (1996). Toward a knowledge-based theory of the firm. Strategic management journal, 17(S2), 109-122.

Grant, R. M. (2016). Contemporary strategy analysis: Text and cases edition. John Wiley & Sons.

Green, P. E., & Tull, D. S. (1970). Research for marketing decisions.

Greenhalgh, T., Robert, G., Bate, S. P., Kyriakidou, O., Macfarlane, F., & Peacock, R. (2003). A systematic review of the literature on diffusion, dissemination and sustainability of innovations in health service delivery and organisation. How to spread good ideas, 362.

Greve, H. R., & Taylor, A. (2000). Innovations as catalysts for organizational change: Shifts in organizational cognition and search. Administrative Science Quarterly, 45(1), 54-80.

Grönlund, J., Sjödin, D. R., & Frishammar, J. (2010). Open innovation and the stage-gate process: A revised model for new product development. California management review, 52(3), 106-131.

Grundspenkis, J. (2007). Agent based approach for organization and personal knowledge modelling: knowledge management perspective. Journal of Intelligent Manufacturing, 18(4), 451-457.

Guba, E. G. (Ed.). (1990). The paradigm dialog. Sage Publications.

Gubrium, J. F., & Holstein, J. A. (1997). The new language of qualitative method. Oxford University Press on Demand.

Guerrieri, P., & Meliciani, V. (2005). Technology and international competitiveness: the interdependence between manufacturing and producer services. Structural Change and Economic Dynamics, 16(4), 489-502.

Gunday, G., Ulusoy, G., Kilic, K., & Alpkan, L. (2011). Effects of innovation types on firm performance. International Journal of production economics, 133(2), 662-676.

Guns, W. D., & Välikangas, L. (1997). Rethinking knowledge work: creating value through idiosyncratic knowledge. Journal of Knowledge Management, 1(4), 287-293.

Gunzler, D., Chen, T., Wu, P., & Zhang, H. (2013). Introduction to mediation analysis with structural equation modeling. Shanghai archives of psychiatry, 25(6), 390.

Gunzler, D., Chen, T., Wu, P., & Zhang, H. (2013). Introduction to mediation analysis with structural equation modeling. Shanghai archives of psychiatry, 25(6), 390.

Gupta, A. K., Tesluk, P. E., & Taylor, M. S. (2007). Innovation at and across multiple levels of analysis. Organization Science, 18(6), 885-897.

Hadjimanolis, A. (2003). The barriers approach to innovation. The International Handbook on Innovation. Elsevier Science, Oxford.

Hage, J. T. (1999). Organizational innovation and organizational change. Annual review of sociology, 597-622.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). Multivariate data analysis (Vol. 6).

Hair, J.F. Jr, Anderson, R.E., Tatham, R.L. & Black, W.C. (1995) Multivariate Data Analysis with Readings. Prentice Hall International Editions, Englewood Cliffs, NJ.

Hamel G. (2002). Leading the Revolution. Boston: Harvard Business School Press.

Hamel, G. (1996). Strategy as revolution (pp. 69-71). Harvard Business Review.

Hamel, G. (1998). Strategy innovation and the quest for value. MIT Sloan Management Review, 39(2), 7.

Hamel, G. (2002). Leading the revolution: How to thrive in turbulent times by making innovation a way of life. Boston, MA: Harvard Business School Press.

Hamel, G., & Prahalad, C. K. (1990). Corporate imagination and expeditionary marketing. Harvard business review, 69(4), 81-92.

Hammer, M., & Champy, J. (2009). Reengineering the Corporation: Manifesto for Business Revolution, A. Zondervan.

Han, W., & Wang, Y. (2012, May). Knowledge management, knowledge management system, and organizational performance: An empirical study. In *Systems and Informatics (ICSAI), 2012 International Conference on* (pp. 2488-2492). IEEE

Hanley, S., & Dawson, C. (2000). A framework for delivering value with knowledge management: The AMS knowledge centers. Information Strategy: The Executive's Journal, 16(4), 27-36.

Hansen, M. T. (1999). The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits. Administrative science quarterly, 44(1), 82-111.

Hansen, M. T., & Birkinshaw, J. (2007). The innovation value chain. Harvard business review, 85(6), 121.

Hansen, M.T., Nohria, N. & Tierney, T. (1999), What's your strategy for managing knowledge? , Harvard Business Review, 3-4, 106-16.

Harborne, P., & Johne, A. (2003). Creating a project climate for successful product innovation. European Journal of innovation management, 6(2), 118-132.

Harkema, S. (2003). A complex adaptive perspective on learning within innovation projects. The Learning Organization, 10(6), 340-346.

Hart, S. L. (1992). An integrative framework for strategy-making processes. Academy of management review, 17(2), 327-351.

Hasanali, F. (2002). Critical success factors of knowledge management.

Havens, C., & Knapp, E. (1999). Easing into knowledge management. Strategy & Leadership, 27(2), 4-9.

He, Z. L., & Wong, P. K. (2004). Exploration vs. exploitation: An empirical test of the ambidexterity hypothesis. Organization science, 15(4), 481-494.

Heisig, P. (2009). Harmonisation of knowledge management-comparing 160 KM frameworks around the globe. *Journal of knowledge management*, *13*(4), 4-31.

Henderson, R. M., & Clark, K. B. (1990). Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. Administrative science quarterly, 9-30.

Hendriks, P. (1999). Why share knowledge? The influence of ICT on the motivation for knowledge sharing. Knowledge and process management,6(2), 91.

Hendriks, P. H. (2001). Many rivers to cross: from ICT to knowledge management systems. Journal of Information Technology, 16(2), 57-72.

Herschel, R. T., & Jones, N. E. (2005). Knowledge management and business intelligence: the importance of integration. Journal of knowledge management, 9(4), 45-55.

Hervas-Oliver, J. L., Sempere-Ripoll, F., & Boronat-Moll, C. (2014). Process innovation strategy in SMEs, organizational innovation and performance: a misleading debate?. Small Business Economics, 43(4), 873-886.

Hesse-Biber, S. N. (2010). Mixed methods research: Merging theory with practice. Guilford Press.

Hey, J. (2004). The data, information, knowledge, wisdom chain: the metaphorical link. *Intergovernmental Oceanographic Commission*, *26*.

Hirukawa, H. (2015, June). Robotics for innovation. In *2015 Symposium on VLSI Circuits (VLSI Circuits)* (pp. T2-T5). IEEE.

Hitt, M. A., Ireland, R. D., & Hoskisson, R. E. (2012). Strategic management cases: competitiveness and globalization. Cengage Learning.

Hitt, M. A., Keats, B. W., & DeMarie, S. M. (1998). Navigating in the new competitive landscape: Building strategic flexibility and competitive advantage in the 21st century. The Academy of Management Executive, 12(4), 22-42.

Ho, C. T. (2009). The relationship between knowledge management enablers and performance. Industrial Management & Data Systems, 109(1), 98-117.

Hoffman, J. J., Hoelscher, M. L., & Sherif, K. (2005). Social capital, knowledge management, and sustained superior performance. Journal of knowledge management, 9(3), 93-100.

Hollen, R. M. A., Van Den Bosch, F. A. J., & Volberda, H. W. (2013). Business model innovation of the Port of Rotterdam Authority (2000–2012). Smart Port Perspectives: Essays in Honour of Hans Smits. Rotterdam, the Netherlands: Erasmus Smart Port Rotterdam, 29-47.

Holsapple, C. W., & Singh, M. (2001). The knowledge chain model: activities for competitiveness. Expert systems with applications, 20(1), 77-98.

Hooper, D., Coughlan, J., &; Mullen, M. (2008). Structural equation modelling: Guidelines for determining model fit. Articles, 2.

Hornsby, J. S., Kuratko, D. F., & Zahra, S. A. (2002). Middle managers' perception of the internal environment for corporate entrepreneurship: assessing a measurement scale. Journal of business Venturing, 17(3), 253-273.

Howard W.G., Guile B.R. (1992). Profiting from Innovation. The Free Press.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Structural equation modeling: a multidisciplinary journal, 6(1), 1-55.

Huang, K. T., Lee, Y. W., & Wang, R. Y. (1999). Quality information and knowledge management. Publisher: Prentice Hall.

Huber, G. P. (1991). Organizational learning: The contributing processes and the literatures. Organization science, 2(1), 88-115.

Huggins, R., & Izushi, H. (2011). Competition, competitive advantage, and clusters: the ideas of Michael Porter. Oxford University Press.

Hughes, B., & Wareham, J. (2010). Knowledge arbitrage in global pharma: a synthetic view of absorptive capacity and open innovation. *R&D Management*, *40*(3), 324-343.

Hughes, T. P. (1987). The evolution of large technological systems. The social construction of technological systems: New directions in the sociology and history of technology, 51-82.

Huizingh, E. K. (2011). Open innovation: State of the art and future perspectives. Technovation, 31(1), 2-9.

Hunter, J., Falkovych, K., & Little, S. (2004, September). Next Generation Search Interfaces–Interactive Data Exploration and Hypothesis Formulation. In International Conference on Theory and Practice of Digital Libraries (pp. 86-98). Springer Berlin Heidelberg.

Hurley, R. F., & Hult, G. T. M. (1998). Innovation, market orientation, and organizational learning: an integration and empirical examination. *The Journal of Marketing*, 42-54.

Hussain, M., Kazmi, S., Mubin, M., Mughal, S. L., & Qadri, W. (2013). Measuring Business Performance: Comparison of Financial, Non Financial and Qualitative Indicators.

IBM Global CEO Study Team. (2006). Expanding the Innovation Horizon: The Global CEO Study 2006. IBM Global Services.

Inkpen, A. (1996). Creating knowledge through collaboration. *California Management Review*, 39(1), 123-140.

Inkpen, A., & Beamish, P. (1997). Knowledge, bargaining power, and the instability of international joint ventures. *Academy of management review*, 22(1), 177-202.

Inkpen, A., & Dinur, A. (1998). Knowledge management processes and international joint ventures. *Organization science,* 9(4), 454-468.

Islam, Z. M., Low, K. C., & Hasan, I. (2011). Knowledge management practices and organizational effectiveness: Empirical evidence from banks of an underdeveloped country. *Global Education Journal*, *2011*(3), 1-28.

Islam, Z. M., Low, K. C., & Hasan, I. (2011). Knowledge management practices and organizational effectiveness: Empirical evidence from banks of an underdeveloped country. *Global Education Journal*, *2011*(3), 1-28.

Ives, W., Torrey, B., & Gordon, C. (1997). Knowledge management: an emerging discipline with a long history. Journal of Knowledge Management, 1(4), 269-274.

J€ager, H.-W. & J€ager, A. (2011). Communication Management via Web – The Web-based Tool ICOM Compass. In M. H€ulsmann, & N. Pfeffermann (Eds.), Strategies and Communications for Innovations. Berlin: Springer

Jackson, C. M., Chow, S., & Leitch, R. A. (1997). Toward an understanding of the behavioral intention to use an information system. Decision sciences, 28(2), 357-389.

Jaffe, A. B., & Trajtenberg, M. (2002). Patents, citations, and innovations: A window on the knowledge economy. MIT press.

Jagdev, H., Bradley, P., & Molloy, O. (1997). A QFD based performance measurement tool. Computers in industry, 33(2), 357-366.

Jaworski, B. J., & Kohli, A. K. (1993). Market orientation: antecedents and consequences. The Journal of marketing, 53-70.

Jennex, M. E., & Olfman, L. (2008). A model of knowledge management success. Strategies for knowledge management success. Exploring organizational efficacy, 14-31.

Johnson, B. H. (1992). Institutional learning. National systems of innovation: Towards a theory of innovation and interactive learning.

Johnston, R. E., & Bate, J. D. (2013). The power of strategy innovation: a new way of linking creativity and strategic planning to discover great business opportunities. AMACOM Div American Mgmt Assn.

Joo, J. (2011). Adoption of Semantic Web from the perspective of technology innovation: A grounded theory approach. International journal of human-computer studies, 69(3), 139-154.

Joo, J., & Lee, S. M. (2009). Adoption of the Semantic Web for overcoming technical limitations of knowledge management systems. Expert systems with applications, 36(3), 7318-7327.

Junnarkar, B., & Brown, C. V. (1997). Re-assessing the enabling role of information technology in KM. Journal of Knowledge Management, 1(2), 142-148.

Kabir, N. (2012, October). Effects of Advances in Technology on Tacit Knowledge Transferability. In ICICKM2012-*Proceedings of the 9th International Conference on Intellectual Capital, Knowledge Management and Organisational Learning: ICICKM (p. 113). Academic Conferences Limited.*

Kabir, N., & Carayannis, E. (2013). Big Data, Tacit Knowledge and Organizational Competitiveness. Journal of Intelligence Studies in Business, 3(3).

Kabir, N. (2014, September). Knowledge Management-Time to Rethink the Discipline. In European Conference on Knowledge Management (Vol. 2, p. 516). Academic Conferences International Limited.

Kabir, N. (2016, September). Exploration-Codification Strategy Mix in Innovation: Managing Knowledge of the Ideation Stage. *Proceedings of the 17th European Conference on Knowledge Management. Academic Conferences International Limited*.

Kalender, M., & Dang, J. (2012, October). SKMT: A Semantic Knowledge Management Tool for Content Tagging, Search and Management. In Semantics, Knowledge and Grids (SKG), 2012 Eighth International Conference on (pp. 112-119). IEEE.

Kalling, T. (2003). Knowledge management and the occasional links with performance. *Journal of knowledge management*, *7*(3), 67-81.

Kamal M.M. (2006). IT Innovation Adoption in the Government Sector: Identifying the Critical Success Factors. Journal of Enterprise Information Management, Vol. 19, No 2, pp. 192–222.

Kanter, R. M. (1984). Change masters. Simon and Schuster.

Kanter, R. M. (1988). Three tiers for innovation research. Communication Research, 15(5), 509-523.

Kaplan, R. S. (1983). Measuring manufacturing performance: a new challenge for managerial accounting research. In Readings in accounting for management control (pp. 284-306). Springer US.

Kaplan, R. S., & Cooper, R. (1998). Cost & effect: Using integrated cost systems to drive profitability and performance. Harvard Business Press.

Kaplan, R. S., & Norton, D. P. (2004). Strategy maps: Converting intangible assets into tangible outcomes. Harvard Business Press.

Kaplan, R. S., & Norton., D. P. (1992) The balanced scorecard-measures that drive performance. Harvard Business Review, 70(1-2), 71–79.

Karahanna, E., Straub, D. W., & Chervany, N. L. (1999). Information technology adoption across time: a cross-sectional comparison of pre-adoption and post-adoption beliefs. MIS quarterly, 183-213.

Karaszewski, R. (2008). The influence of KM on global corporations' competitiveness. Journal of Knowledge Management, 12(3), 63-70.

Katila, R., & Ahuja, G. (2002). Something old, something new: A longitudinal study of search behavior and new product introduction. Academy of management journal, 45(6), 1183-1194.

Keegan, D.P., Eiler, R.G. and Jones, C.R. (1989), Are your performance measures obsolete? Management Accounting. 45-50.

Kelm, K. M., Narayanan, V. K., & Pinches, G. E. (1995). Shareholder value creation during R&D innovation and commercialization stages. Academy of Management Journal, 38(3), 770-786.

Khalifa, M., Lam, R., & Lee, M. (2001). Adequacy of Knowledge Management Structures. Department of Information Systems of City University of Hong Kong.

Khurana, A., & Rosenthal, S. R. (1998). Towards holistic "front ends" in new product development. Journal of product innovation management, 15(1), 57-74.

Kim, J. B., Sebastiano, V., Wu, G., Araúzo-Bravo, M. J., Sasse, P., Gentile, L., ... & Meyer, J. (2009). Oct4-induced pluripotency in adult neural stem cells. cell, 136(3), 411-419.

Kim, S., Suh, E., & Hwang, H. (2003). Building the knowledge map: an industrial case study. Journal of knowledge management, 7(2), 34-45.

Kimberly, J. R., & Evanisko, M. J. (1981). Organizational innovation: The influence of individual, organizational, and contextual factors on hospital adoption of technological and administrative innovations. Academy of management journal, 24(4), 689-713.

Kincaid, D. L. (2000). Mass Media, Ideation, and Behavior. A Longitudinal Analysis of Contraceptive Change in the Philippines. Communication Research, 27(6), 723-763.

King, N., & Anderson, N. (2002). Managing innovation and change: A critical guide for organizations. Cengage Learning EMEA.

King, N., & West, M. A. (1987). Experiences of innovation at work. Journal of Managerial Psychology, 2(3), 6-10.

Kline, R.B. (2005), Principles and Practice of Structural Equation Modeling (2nd Edition ed.). New York: The Guilford Press.

Kline, S. J., & Rosenberg, N. (1986). An overview of innovation. The positive sum strategy: Harnessing technology for economic growth, 14, 640.

Kodama, F. (1992). Technology fusion and the new R&D. Harvard Business Rev., 70, 70–78.

Koen, P., Ajamian, G., Burkart, R., Clamen, A., Davidson, J., D'Amore, R., ... & Karol, R. (2001). Providing clarity and a common language to the "fuzzy front end". Research-Technology Management, 44(2), 46-55.

Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization science*, *3*(3), 383-397.

Kogut, B., & Zander, U. (1993). Knowledge of the firm and the evolutionary theory of the multinational corporation. *Journal of international business studies*, *24*(4), 625-645.

Kogut, B., & Zander, U. (1996). What firms do? Coordination, identity, and learning. Organization science, 7(5), 502-518.

Kothari, C. R. (2004). Research methodology: Methods and techniques. New Age International.

KPMG. 1999. The knowledge journey — a business guide to knowledge systems. http://www.kpmg. co.uk/kpmg/uk/services/manage/pubs/journey.html

Krugman, P., and M. Obstfeld (2000): International Economics - Theory and Policy. *Redding, Mass.: Addison-Wesley, 5th Edition.*

Kulkarni, U. R., Ravindran, S., & Freeze, R. (2006). A knowledge management success model: Theoretical development and empirical validation. Journal of management information systems, 23(3), 309-347.

Kumar, N. (2012). Exploring the effects of human capital loss on relationships with clients in knowledge-intensive service firms and the moderating effect of knowledge management. International Journal of Globalisation and Small Business, 4(3-4), 342-359

Lai, J. Y. (2009). How reward, computer self-efficacy, and perceived power security affect knowledge management systems success: An empirical investigation in high-tech companies. Journal of the American society for information science and technology, 60(2), 332-347.

Langlois, R. N. (2001). Knowledge, consumption, and endogenous growth. In *Escaping Satiation* (pp. 97-113). Springer, Berlin, Heidelberg.

Lau, R. S. M. (2002). Competitive factors and their relative importance in the US electronics and computer industries. International Journal of Operations & Production Management, 22(1), 125-135.

Laudon, K., and Laudon, J. Management Information Systems-Organization and Technology in the Networked Enterprise. Englewood Cliffs, N.J.: Prentice Hall, 1999.

Laursen, K., & Salter, A. (2006). Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms. Strategic management journal, 27(2), 131-150.

Law, C. C., & Ngai, E. W. (2008). An empirical study of the effects of knowledge sharing and learning behaviors on firm performance. Expert Systems with Applications, 34(4), 2342-2349.

Lawson, C. (1999). Towards a competence theory of the region. Cambridge Journal of Economics, 23(2), 151-166.

LeBlanc, L. J., Nash, R., Gallagher, D., Gonda, K., & Kakizaki, F. (1997). A comparison of US and Japanese technology management and innovation. International Journal of Technology Management, 13(5-6), 601-614.

Lee, A. H., Chen, W. C., & Chang, C. J. (2008). A fuzzy AHP and BSC approach for evaluating performance of IT department in the manufacturing industry in Taiwan. Expert systems with applications, 34(1), 96-107.

Lee, C. K., & Al-Hawamdeh, S. (2002). Factors impacting knowledge sharing. Journal of Information & Knowledge Management, 1(01), 49-56.

Lee, H., & Choi, B. (2003). Knowledge management enablers, processes, and organizational performance: An integrative view and empirical examination. Journal of management information systems, 20(1), 179-228.

Lee, K. C., Lee, S., & Kang, I. W. (2005). KMPI: measuring knowledge management performance. Information & Management, 42(3), 469-482.

Lee, L. T. S., & Sukoco, B. M. (2007). The effects of entrepreneurial orientation and knowledge management capability on organizational effectiveness in Taiwan: the moderating role of social capital. International Journal of Management, 24(3), 549.

Lee, R. P., & Zhou, K. Z. (2012). Is product imitation good for firm performance? An examination of product imitation types and contingency factors. Journal of International Marketing, 20(3), 1-16.

Lee, S., & Hong, S. (2002). An enterprise-wide knowledge management system infrastructure. Industrial Management & Data Systems, 102(1), 17-25.

Lee, S., Gon Kim, B., & Kim, H. (2012). An integrated view of knowledge management for performance. Journal of Knowledge Management, 16(2), 183-203.

Leidner, D. (2000). Editorial. The Journal of Strategic Information Systems, 9(2), 101-105.

Lengnick-Hall, C. A. (1992). Innovation and competitive advantage: What we know and what we need to learn. Journal of management, 18(2), 399-429.

Leonard-Barton, D. (1995). Wellsprings of knowledge: Building and sustaining the sources of innovation. University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship.

Leonard-Barton, D. (1998), Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation, *Harvard Business School Press*, *Cambridge, MA*.

Leonard-Barton, D., & Swap, W. C. (1999). When sparks fly: Igniting creativity in groups. Harvard Business Press.

Levin, D. Z., & Cross, R. (2004). The strength of weak ties you can trust: The mediating role of trust in effective knowledge transfer. Management science, 50(11), 1477-1490.

Levine, A. (1980). Why innovation fails. SUNY Press.

Levitin, A. V., & Redman, T. C. (1998). Data as a resource: Properties, implications, and prescriptions. MIT Sloan Management Review, 40(1), 89.

Li, L. X. (2000). An analysis of sources of competitiveness and performance of Chinese manufacturers. *International Journal of Operations & Production Management*, *20*(3), 299-315.

Li, Y. F., Kennedy, G., Ngoran, F., Wu, P., & Hunter, J. (2013). An ontology-centric architecture for extensible scientific data management systems. Future Generation Computer Systems, 29(2), 641-653.

Liao, C., & Chuang, S. H. (2006, January). Exploring the role of knowledge management for enhancing firm's innovation and performance. In*Proceedings of the 39th Annual Hawaii International Conference on System Sciences (HICSS'06)* (Vol. 7, pp. 158a-158a). IEEE.

Liao, S. H. (2003). Knowledge management technologies and applications—literature review from 1995 to 2002. *Expert systems with applications*, *25*(2), 155-164

Lichtenthaler, U. (2009). Outbound open innovation and its effect on firm performance: examining environmental influences. R&D Management, 39(4), 317-330.

Lichtenthaler, U., & Lichtenthaler, E. (2009). A capability-based framework for open innovation: Complementing absorptive capacity. Journal of Management Studies, 46(8), 1315-1338.

Liebowitz, J. (2007). The hidden power of social networks and knowledge sharing in healthcare. In Healthcare Knowledge Management (pp. 104-111). Springer New York.

Liebowitz, J. (Ed.). (1999). Knowledge management handbook. CRC press.

Liebowitz, J., & Beckman, T. J. (1998). Knowledge organizations: What every manager should know. CRC Press.

Lin, H. F. (2007). Effects of extrinsic and intrinsic motivation on employee knowledge sharing intentions. Journal of information science.

Lin, R. J., Che, R. H., & Ting, C. Y. (2012). Turning knowledge management into innovation in the high-tech industry. Industrial Management & Data Systems, 112(1), 42-63.

Lin, T. C., & Huang, C. C. (2009). Understanding social loafing in knowledge contribution from the perspectives of justice and trust. Expert Systems with Applications, 36(3), 6156-6163.

Lincoln, Y. S. (2001). Engaging sympathies: Relationships between action research and social constructivism. *Handbook of action research: Participative inquiry and practice*, 124-132.

Lindvall, M., Rus, I., & Suman Sinha, S. (2003). Software systems support for knowledge management. Journal of knowledge management, 7(5), 137-150.

Liu, P. L., Chen, W. C., & Tsai, C. H. (2004). An empirical study on the correlation between knowledge management capability and competitiveness in Taiwan's industries. *Technovation*, *24*(12), 971-977.

López-Nicolás, C., & Meroño-Cerdán, Á. L. (2011). Strategic knowledge management, innovation and performance. International journal of information management, 31(6), 502-509.

Lowe, A. (1995). The basic social processes of entrepreneurial innovation. International Journal of Entrepreneurial Behavior & Research, 1(2), 54-76.

Luczak-Rösch, M., Simperl, E., Stadtmüller, S., & Käfer, T. (2014). The role of ontology engineering in linked data publishing and management: An empirical study. International Journal on Semantic Web and Information Systems (IJSWIS), 10(3), 74-91.

Lytras, M., Sicilia, M., Davies, J. and Kashyap, V. (2005). 'Digital libraries in the knowledge era: knowledge management and semantic web technologies, Library Management, 26, (4/5),170–175.

Maass, W., & Kowatsch, T. (Eds.). (2012). Semantic Technology in Content Management Systems: Trends, Applications and Evaluations. Springer Science & Business Media.

Machlup, F. (1962). The production and distribution of knowledge in the United States (Vol. 278). Princeton university press.

Magnier-Watanabe, R., & Senoo, D. (2008). Organizational characteristics as prescriptive factors of knowledge management initiatives. Journal of knowledge management, 12(1), 21-36.

Mahnke, V., Pedersen, T., & Venzin, M. (2005). The impact of knowledge management on MNC subsidiary performance: the role of absorptive capacity. MIR: Management International Review, 101-119.

Maidique, M. (1980), "Entrepreneurs, champions and technological innovation", Sloan Management Review, Winter, pp. 59-76.

Maidique, M. A., & Zirger, B. J. (1984). A study of success and failure in product innovation: the case of the US electronics industry. IEEE Transactions on engineering management, (4), 192-203.

Maier, R., & Remus, U. (2002). Defining process-oriented knowledge management strategies. Knowledge and Process management, 9(2), 103-118.

Malhotra, Y. (2005). Integrating knowledge management technologies in organizational business processes: getting real time enterprises to deliver real business performance. *Journal of knowledge management*, *9*(1), 7-28.

Manning, M. L. (2006). Improving clinical communication through structured conversation. *Nursing Economics*, *24*(5), 268

Mansfield, E., & Wagner, S. (1975). Organizational and strategic factors associated with probabilities of success in industrial R & D. the Journal of Business, 48(2), 179-198.

Mansfield, E., J. Rapoport, A. Romeo, S. Wagner & G. Beardsley (1977). Social and private rates of returns from industrial innovation. Quarterly Journal of Economics. 91-05, 221-240.

March, J. G. (1991). Exploration and exploitation in organizational learning. Organization science, 2(1), 71-87.

Marqués, D., & Garrigós Simón, F. (2006). The effect of knowledge management practices on firm performance. *Journal of Knowledge Management*, *10*(3), 143-156.

Marquis, D. G., and Myers, S. (1969). Successful industrial innovations. National Science Foundation, Washington.

Marr, B. (2004). Measuring and benchmarking intellectual capital. Benchmarking: An International Journal, 11(6), 559-570.

Marr, B., Gupta, O., Pike, S., & Roos, G. (2003). Intellectual capital and knowledge management effectiveness. Management decision, 41(8), 771-781.

Marsh, H. W., Balla, J. R., & Hau, K. T. (1996). An evaluation of incremental fit indices: A clarification of mathematical and empirical properties. Advanced structural equation modeling: Issues and techniques, 315-353.

Marshall, M. N. (1996). Sampling for qualitative research. Family practice, 13(6), 522-526.

Martín Rubio, I., & Casadesús Fa, M. (1999). Las TIC como factor determinante del aprendizaje organizativo. El caso de una empresa suministradora en el sector del automóvil. Economía Industrial, (326), 73-84.

Maskell, B. H. (1991). Performance measurement for world class manufacturing: A model for American companies. CRC Press.

Maskell, P., & Malmberg, A. (1999). Localised learning and industrial competitiveness. Cambridge journal of economics, 23(2), 167-185.

Massa, S., & Testa, S. (2009). A knowledge management approach to organizational competitive advantage: Evidence from the food sector. *European Management Journal*, *27*(2), 129-141.

Massey, A. P., Montoya-Weiss, M. M., & Holcom, K. (2001). Re-engineering the customer relationship: leveraging knowledge assets at IBM. Decision Support Systems, 32(2), 155-170.

Massingham, P. (2013). Cognitive complexity in global mindsets. International Journal of Management, 30(1), 232.

Mathews, S. (2010). Innovation portfolio architecture. Research-Technology Management, 53(6), 30-40.

Mayer, W. E., Stumptner, M., Grossmann, G., & Jordan, A. (2013). Semantic Interoperability in the Oil and Gas Industry: A Challenging Testbed for Semantic Technologies (Doctoral dissertation, Association for the Advancement of Artificial Intelligence).

Mazdeh, M., & Hesamamiri, R. (2014). Knowledge management reliability and its impact on organizational performance: an empirical study. Program, 48(2), 102-126.

McDonald, R. P., & Ho, M. H. R. (2002). Principles and practice in reporting structural equation analyses. Psychological methods, 7(1), 64.

McDougall, P. P., Shane, S., & Oviatt, B. M. (1994). Explaining the formation of international new ventures: The limits of theories from international business research. Journal of business venturing, 9(6), 469-487.

McGrath, R. G., Tsai, M. H., Venkataraman, S., & MacMillan, I. C. (1996). Innovation, competitive advantage and rent: A model and test. Management Science, 42(3), 389-403.

McInerney, C. (2002). Knowledge management and the dynamic nature of knowledge. Journal of the American society for Information Science and Technology, 53(12), 1009-1018.

McNaughton, R. B. (2002). The use of multiple export channels by small knowledge-intensive firms. International Marketing Review, 19(2), 190-203.

Melymuka, K. (2000), "Showing the value of brainpower", ComputerWorld, Vol. 34 No. 13, pp. 58-9.

Menon, A., Chowdhury, J., & Lukas, B. A. (2002). Antecedents and outcomes of new product development speed: An interdisciplinary conceptual framework. Industrial Marketing Management, 31(4), 317-328.

Mertens, D. M. (2014). Research and evaluation in education and psychology: Integrating diversity with quantitative, qualitative, and mixed methods. 4th edition. Sage publications.

Meso, P., & Smith, R. (2000). A resource-based view of organizational knowledge management systems. Journal of knowledge management, 4(3), 224-234.

Meyer, M.W. and Gupta, V. (1994). The performance paradox, Research in Organizational Behavior, (16). 309-69.

Michie, J., & Sheehan, M. (2005). Business strategy, human resources, labour market flexibility and competitive advantage. The International Journal of Human Resource Management, 16(3), 445-464.

Miller, D. J., Fern, M. J., & Cardinal, L. B. (2007). The use of knowledge for technological innovation within diversified firms. Academy of Management Journal, 50(2), 307-325.

Mills, A. M., & Smith, T. A. (2011). Knowledge management and organizational performance: a decomposed view. *Journal of Knowledge Management*, *15*(1), 156-171.

Mintzberg, H. (1979). The structuring of organization. A Synthesis of the Research. Englewood Cliffs, NJ.

Mitev, N. N. (1994). The business failure of knowledge-based systems: linking knowledge-based systems and information systems methodologies for strategic planning. Journal of Information technology, 9(3), 173-184.

Moffett, S., & McAdam, R. (2003). Contributing and enabling technologies for knowledge management. International Journal of Information Technology and Management, 2(1-2), 31-49.

Moffett, S., McAdam, R., & Parkinson, S. (2002). Developing a model for technology and cultural factors in knowledge management: a factor analysis. Knowledge and Process Management, 9(4), 237-255.

Moffett, S., McAdam, R., & Parkinson, S. (2003). An empirical analysis of knowledge management applications. *Journal of knowledge Management*, *7*(3), 6-26.

Morgan, R. E., & Strong, C. A. (2003). Business performance and dimensions of strategic orientation. Journal of Business Research, 56(3), 163-176.

Mouhim, S., El Aoufi, A., Cherkaoui, C., Megder, E., & Mammass, D. (2011, April). Towards a knowledge management system for tourism based on the semantic web technology. In Multimedia Computing and Systems (ICMCS), 2011 International Conference on (pp. 1-6). IEEE.

Mouton, J. (1996). Understanding social research. *Van Schaik Publishers.*

Mouton, J., & Marais, H. C. (1992). Basic concepts: Methodology of the behavioural sciences. Pretoria: Human Sciences Research Council.

Mowery, D., & Rosenberg, N. (1979). The influence of market demand upon innovation: a critical review of some recent empirical studies. Research policy, 8(2), 102-153.

Muellbauer, J. (1991). Productivity and competitiveness. Oxford Review of Economic Policy, 7(3), 99-117.

Mulaik, S. A., James, L. R., Van Alstine, J., Bennett, N., Lind, S., & Stilwell, C. D. (1989). Evaluation of goodness-of- fit indices for structural equation models. Psychological bulletin, 105(3), 430.

Mulatu, A. (2016). On the Concept of 'Competitiveness' and its Usefulness for Policy. Structural Change and Economic Dynamics, 36, 50-62.

Murray, J. Y., & Chao, M. C. (2005). A cross-team framework of international knowledge acquisition on new product development capabilities and new product market performance. Journal of International Marketing, 13(3), 54-78.

Mustafa, J., Khan, S., & Latif, K. (2008, September). Ontology based semantic information retrieval. In 2008 4th International IEEE Conference Intelligent Systems (Vol. 3, pp. 22-14). IEEE.

Myers, S., & Marquis, DG (1969). Successful industrial innovations. NSF 69-17. National 44, 199-215

Nachtigall, C., Kroehne, U., Funke, F., & Steyer, R. (2003). Pros and cons of structural equation modeling. Methods Psychological Research Online, 8(2), 1-22.

Nagy, S., & Hesse-Biber, S. (2010). Mixed methods research: merging theory with practice. New York. London. The Guilford Press. Nasser, Nigel.(2012). Ayo: The rejected HIV-Positive Teacher Gets Back Her Job.'in'The New Vision. Wednesday, January, 25, 28.

Narayanan, V. K. (2000). Managing technology and innovation for competitive advantage.

Narock, T., & Wimmer, H. (2017). Linked data scientometrics in semantic e-Science. *Computers & Geosciences*, *100*, 87-93.

Nås, S. O., and Leppãlahti, A. (1997). Innovation, firm profitability and growth(No. 199701). The STEP Group, Studies in technology, innovation and economic policy.

Neely, A., Gregory, M., & Platts, K. (1995). Performance measurement system design: a literature review and research agenda. International journal of operations & production management, 15(4), 80-116.

Nelson, R. (1982). Government and Technical Progress: a cross-industry analysis. Pergamon.

Nelson, R. R., Todd, P. A., & Wixom, B. H. (2005). Antecedents of information and system quality: an empirical examination within the context of data warehousing. Journal of management information systems, 21(4), 199-235.

Neuman, W. L. (2000). Social Research methods: qualitative and quantitative approaches. 4th edition. Allyn and Bacon, Boston

Neuman, W. L. (2006). Analysis of qualitative data. Social research methods: Qualitative and quantitative approaches, 457-489.

Neuman, W.L. (2011), Social Research Methods: Qualitative and Quantitative Approaches, 7th edn, Pearson/Allyn and Bacon, Boston.

Neuman, W.L. (2011), Social Research Methods: Qualitative and Quantitative Approaches, 7th edn, Pearson/Allyn and Bacon, Boston.

Nevo, D., & Chan, Y. E. (2007). A Delphi study of knowledge management systems: Scope and requirements. Information & Management, 44(6), 583-597.

Newman, B. D., & Conrad, K. W. (2000, October). A Framework for Characterizing Knowledge Management Methods, Practices, and Technologies. In PAKM.

Nguyen, T. D., Arch-Int, S., & Arch-Int, N. (2016). An adaptive multi bit-plane image steganography using block data-hiding. *Multimedia Tools and Applications*, *75*(14), 8319-8345.

Nickols, F. (2000). The knowledge in knowledge management. The Knowledge Management Yearbook, 2000–2001.

Nijssen, E. J., Hillebrand, B., Vermeulen, P. A., & Kemp, R. G. (2006). Exploring product and service innovation similarities and differences. International Journal of Research in Marketing, 23(3), 241-251.

Niosi, J. (1999). Fourth-generation R&D: From linear models to flexible innovation. Journal of business research, 45(2), 111-117.

Nissen, M., Kamel, M., & Sengupta, K. (2000). Integrated analysis and design of knowledge systems and processes. Knowledge Management and Virtual Organizations, 13(1), 24-43.

Nissen, M.E. (2005-2006), Dynamic knowledge patterns to inform design: a field study of knowledge stocks and flows in an extreme organization. Journal of Management Information Systems, 22(3), 225-63

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. Organization science, 5(1), 14-37.

Nonaka, I., & Konno, N. (1998). The concept of" ba": Building a foundation for knowledge creation. California management review, 40(3), 40-54.

Nonaka, I., & Takeuchi, H. (1995). The knowledge-creating company: How Japanese companies create the dynamics of innovation. Oxford university press.

Nonaka, I., Toyama, R., & Konno, N. (2000). SECI, Ba and leadership: a unified model of dynamic knowledge creation. Long range planning, 33(1), 5-34.

Nonaka, I., Von Krogh, G., & Voelpel, S. (2006). Organizational knowledge creation theory: Evolutionary paths and future advances. Organization studies, 27(8), 1179-1208.

Nord, W. R., & Tucker, S. (1987). Implementing routine and radical innovations. Free Press.

Nunnally, J. C., & Bernstein, I. H. (1994). The assessment of reliability. Psychometric theory, 3(1), 248-292.

O'Dell, C. & Grayson, C.J. Jr (1998), If Only We Knew What We Know, *The Free Press, New York, NY.*

O'Sullivan, K. (2005). Leveraging knowledge management technologies to manage intellectual capital. Creating the discipline of knowledge management: the latest in university research, Elsevier, Oxford, pp134-140.

OECD (1992). Technology and the Economy: The Key Relationships. Paris: OECD.

Olson, C. A., & Schwab, A. (2000). The performance effects of human resource practices: the case of interclub networks in professional baseball, 1919–1940. Industrial Relations: A Journal of Economy and Society, 39(4), 553-577.

Ōmae, K. (1995). The end of the nation state: The rise of regional economies. Simon and Schuster.

O'Reilly, C. A., & Tushman, M. L. (2013). Organizational ambidexterity: Past, present, and future. The Academy of Management Perspectives, 27(4), 324-338.

Osterloh, M., & Frey, B. S. (2000). Motivation, knowledge transfer, and organizational forms. Organization science, 11(5), 538-550.

Ostroff, C., & Schmitt, N. (1993). Configurations of organizational effectiveness and efficiency. Academy of management Journal, 36(6), 1345-1361.

Oxford University, New York (2005)

Palacios Marqués, D., & José Garrigós Simón, F. (2006). The effect of knowledge management practices on firm performance. Journal of Knowledge Management, 10(3), 143-156.

Pallant, J. (2013). SPSS survival manual. McGraw-Hill Education (UK).

Passin, T. B. (2004). *Explorer's guide to the semantic web* (pp. 141-169). Greenwich: Manning.

Patel, P., & Pavitt, K. (1994). National innovation systems: why they are important, and how they might be measured and compared. Economics of innovation and new technology, 3(1), 77-95.

Pearson, K. (1896). Mathematical Contributions to the Theory of Evolution-- On a Form of Spurious Correlation Which May Arise When Indices Are Used in the Measurement of Organs. Proceedings of the royal society of London,60(359-367), 489-498.

Penrose, E. T. (1959). The theory of the growth of the firm. New York: Sharpe.

Pentland, B. T. (1995). Information systems and organizational learning: the social epistemology of organizational knowledge systems. Accounting, Management and Information Technologies, 5(1), 1-21.

Perrow, C. (1986). Economic theories of organization. Theory and society, 15(1), 11-45.

Peter, J. P. (1981). Construct validity: A review of basic issues and marketing practices. Journal of marketing research, 133-145.

Peteraf, M. A. (1993). The cornerstones of competitive advantage: a resource-based view. Strategic management journal, 14(3), 179-191.

Pettigrew, A., & Whipp, R. (1991). Managing change and corporate performance. In European industrial restructuring in the 1990s (pp. 227-265). Palgrave Macmillan UK.

Phillips, A. (1966). Patents, potential competition, and technical progress. The American Economic Review, 56(1/2), 301-310.

Phillips, D. C., & Burbules, N. C. (2000). Postpositivism and educational research. Rowman & Littlefield.

Piaget, J. (1969). Mechanisms of Perception. (Translation by GN Seagrim) New York: Basic Books

Pisano, G. P. (1997). The development factory: unlocking the potential of process innovation. Harvard Business Press.

Pohle, G., & Chapman, M. (2006). IBM's global CEO report 2006: business model innovation matters. Strategy & Leadership, 34(5), 34-40.

Polanyi, M. (1962). Tacit knowing: Its bearing on some problems of philosophy. *Reviews of modern physics*, *34*(4), 601.

Polit, DF, & Hungler, BP (1995). Nursing research foundations. In nursing research fundamentals. Medical Arts.

Polkinghorne, D. E. (2005). Language and meaning: Data collection in qualitative research. Journal of counseling psychology, 52(2), 137.

Popadiuk, S., & Choo, C. W. (2006). Innovation and knowledge creation: How are these concepts related? International journal of information management, 26(4), 302-312.

Porter, M. E. (1985). Technology and competitive advantage. Journal of business strategy, 5(3), 60-78.

Porter, M. E. (1990). The competitive advantage of nations. Harvard business review, 68(2), 73-93.

Porter, M. E. (1998). Clusters and Competition. New Agenda for Companies. In Governments and Institutions, in: Ibid., On Competition.

Porter, M. E. (2011). Competitive advantage of nations: creating and sustaining superior performance. Simon and Schuster.

Porter, M. E., & Stern, S. (2001). Innovation: location matters. MIT Sloan management review, 42(4), 28.

Powell, T. C., & Dent-Micallef, A. (1997). Information technology as competitive advantage: The role of human, business, and technology resources. *Strategic management journal*, 375-405.

Powell, W. W. (1990). The Transformation of Organizational Forms: How Useful Is Organization Theory-f-1 in Accounting for Social Change?!! Beyond the marketplace: Rethinking economy and society, 301.

Powell, W. W., & Snellman, K. (2004). The knowledge economy. *Annu. Rev. Sociol.*, *30*, 199-220.

Powell, W. W., Koput, K. W., & Smith-Doerr, L. (1996). Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology. Administrative science quarterly, 116-145.

Prahalad, C. K., & Hamel, G. (1994). Strategy as a field of study: Why search for a new paradigm? Strategic management journal, 15(S2), 5-16.

Prahalad, C. K., & Hamel, G. (2006). The core competence of the corporation. In Strategische unternehmungsplanung—strategische unternehmungsführung (pp. 275-292). Springer Berlin Heidelberg.

Prajogo, D. I., & Ahmed, P. K. (2007). The relationships between quality, innovation and business performance: An empirical study. International Journal of Business Performance Management, 9(4), 380-405.

Premkumar, V., Krishnamurty, S., Wileden, J. C., & Grosse, I. R. (2014). A semantic knowledge management system for laminated composites. *Advanced engineering informatics*, *28*(1), 91-101.

Preston, C. C., & Colman, A. M. (2000). Optimal number of response categories in rating scales: reliability, validity, discriminating power, and respondent preferences. Acta psychologica, 104(1), 1-15.

Prusak, L. (2001). Where did knowledge management come from?. IBM systems journal, 40(4), 1002.

Pyka, A. (2002). Innovation networks in economics: from the incentive-based to the knowledge-based approaches. European Journal of Innovation Management, 5(3), 152-163.

Qiu, J., & Lv, H. (2014). An overview of knowledge management research viewed through the web of science (1993-2012). Aslib Journal of Information Management, 66(4), 424-442.

Quine, W. V. (1951). Main trends in recent philosophy: Two dogmas of empiricism. *The philosophical review*, 20-43.

Quintas, P., Lefrere, P., & Jones, G. (1997). Knowledge management: a strategic agenda. Long range planning, 30(3), 385-391.

Rabhi, M. (2011). Key Performance Indicators Metrics Effect on the Advancement and Sustainability of Knowledge Management. *Electronic Journal of Knowledge Management*, *9*(2).

Raffel G (2010). Ideenmanagement im Web 20 Ideenmanagement. Zeitschrift f€ur Vorschlagswe- sen und Verbesserungsprozesse (Erich Schmidt Verlag), 2: 46–47.

Ram, S. (1989). Successful innovation using strategies to reduce consumer resistance: An empirical test. Journal of Product Innovation Management, 6(1), 20-34.

Randolph, J. J. (2009). A guide to writing the dissertation literature review. Practical Assessment, Research & Evaluation, 14(13), 1-13.

Rastogi, P. N. (2000). Knowledge management and intellectual capital–the new virtuous reality of competitiveness. Human systems management, 19(1), 39-48.

Rastogi, P. N. (2002). Knowledge management and intellectual capital as a paradigm of value creation. Human systems management, 21(4), 229-240.

Rathore, A. S., Garcia-Aponte, O. F., Golabgir, A., Vallejo-Diaz, B. M., & Herwig, C. (2017). Role of Knowledge Management in Development and Lifecycle Management of Biopharmaceuticals. Pharmaceutical research, 34(2), 243-256.

Reich, R. B. (2010). The Work of Nations: Preparing Ourselves for 21st Century Capitalis. Vintage.

Reichstein, T., & Salter, A. (2006). Investigating the sources of process innovation among UK manufacturing firms. Industrial and Corporate Change, 15(4), 653-682.

Reinganum, J. F. (1983). Uncertain innovation and the persistence of monopoly. The American Economic Review, 73(4), 741-748.

Ribino, P., Oliveri, A., Re, G. L., & Gaglio, S. (2009, June). A knowledge management system based on ontologies. In New Trends in Information and Service Science, 2009. NISS'09. International Conference on (pp. 1025-1033). IEEE.

Richter, A., Stocker, A., Müller, S., & Avram, G. (2013). Knowledge management goals revisited: A cross-sectional analysis of social software adoption in corporate environments. Vine, 43(2), 132-148.

Roberts, E. (1988). What we've learned: Managing invention and innovation. Research-Technology Management, 31(1), 11-29.

Roberts, P. W. (1999). Product innovation, product-market competition and persistent profitability in the US pharmaceutical industry. Strategic management journal, 20(7), 655-670.

Roberts, R. M. (1989). Serendipity: Accidental discoveries in science. Serendipity: Accidental Discoveries in Science, by Royston M. Roberts, pp. 288. ISBN 0-471-60203-5. Wiley-VCH, June 1989., 1.

Robson, C. (1993). Real world research: A resource for social scientists and practitioners-researchers. *Massachusetts: Blackwell Pushers*.

Rodan, S., & Galunic, C. (2004). More than network structure: how knowledge heterogeneity influences managerial performance and innovativeness. Strategic Management Journal, 25(6), 541-562.

Rogers, E. M. (2010). Diffusion of innovations. Simon and Schuster.

Rogoff, B. (1990). Apprenticeship in thinking: Cognitive development in social context. Oxford University Press.

Roos, J., Edvinsson, L., & Dragonetti, N. C. (1997). *Intellectual capital: Navigating the new business landscape*. Springer.

Roos, J., Roos, G., Dragonetti, N. C., & Edvinsson, L. (1997). Intellectual capital. Mac Millan Business, England.

Roper, S. (1997). Product innovation and small business growth: a comparison of the strategies of German, UK and Irish companies. *Small Business Economics*, *9*(6), 523-537.

Rorty, R. (1990). Introduction: Pragmatism as anti-representationalism. In J.P. Murphy, Pragmatism: From Peirce to Davidson. Boulder, CO: Westview Press.

Rosch, E. (2005). Principles of categorization. Etnolingwistyka. Problemy języka i kultury, (17), 11-35.

Rosenau, J. N. (2003). Distant proximities: Dynamics beyond globalization. Princeton University Press.

Rosenau, P. M. (1991). Post-modernism and the social sciences: Insights, inroads, and intrusions. Princeton University Press.

Rosenberg, N. (1982). Inside the black box: Technology and economics. Cambridge: Cambridge University Press.

Rosenkopf, L., & Almeida, P. (2003). Overcoming local search through alliances and mobility. Management science, 49(6), 751-766.

Rosenkopf, L., & Nerkar, A. (2001). Beyond local search: boundary-spanning, exploration, and impact in the optical disk industry. Strategic Management Journal, 22(4), 287-306.

Ross, A. (2002). A multi-dimensional empirical exploration of technology investment, coordination and firm performance. International Journal of Physical Distribution & Logistics Management, 32(7), 591-609.

Rousseau, R. (1985). On relative indexing in fuzzy retrieval systems. Information Processing and Management, 21(5), 415-417.

Rubenstein-Montano, B., Liebowitz, J., Buchwalter, J., McCaw, D., Newman, B., Rebeck, K., & Team, T. K. M. M. (2001). A systems thinking framework for knowledge management. Decision support systems, 31(1), 5-16.

Ruggles, R. (1998). The state of the notion: knowledge management in practice. California management review, 40(3), 80-89.

Ruggles, R., & Holtshouse, D. (1999). Gaining the knowledge advantage. The Knowledge Advantage, 14.

Salojärvi, S., Furu, P., & Sveiby, K. E. (2005). Knowledge management and growth in Finnish SMEs. Journal of knowledge management, 9(2), 103-122.

Sambamurthy, V., & Subramani, M. (2005). Special issue on information technologies and knowledge management. MIS quarterly, 1-7.

Samsudin, A., Miah, S., & McGrath, G. (2014). An ontology-based record management systems approach for enhancing decision support.

Sapolsky, H. M. (1967). Organizational structure and innovation. The Journal of Business, 40(4), 497-510.

Saunders, M., Lewis, P., & Thornhill, A. (2006). Understanding Research Approaches. London, SAGE Publications.

Scarbrough, H. (2003). Knowledge management, HRM and the innovation process. International journal of manpower, 24(5), 501-516.

Scheepers, R., Venkitachalam, K., & Gibbs, M. R. (2004). Knowledge strategy in organizations: refining the model of Hansen, Nohria and Tierney. The Journal of Strategic Information Systems, 13(3), 201-222.

Schmookler, J., (1966). Invention and Economic Growth. Harvard University Press, Cambridge

Schoonhoven, C. B., Eisenhardt, K. M., & Lyman, K. (1990). Speeding products to market: Waiting time to first product introduction in new firms. Administrative Science Quarterly, 177-207.

Schultze, U., & Leidner, D. E. (2002). Studying knowledge management in information systems research: discourses and theoretical assumptions. MIS quarterly, 213-242.

Schultze, U., & Stabell, C. (2004). Knowing what you don't know? Discourses and contradictions in knowledge management research. Journal of management studies, 41(4), 549-573.

Schulze, A., & Hoegl, M. (2008). Organizational knowledge creation and the generation of new product ideas: A behavioral approach. *Research policy*, *37*(10), 1742-1750.

Schumpeter, J. A. (1934). The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle (Vol. 55). Transaction publishers.

Schumpeter, J. A. (1942). Creative destruction. Capitalism, socialism and democracy, 82-5.

Schutt, R. K. (2011). Investigating the social world: The process and practice of research. Pine Forge Press.

Schwartz, D.G., Divitini, M. and Brashethvik, T. (2000), Internet-based Organizational Memory and Knowledge Management, Idea Group Publishing, Hershey, PA

Seddon, P. B. (1997). A respecification and extension of the DeLone and McLean model of IS success. Information systems research, 8(3), 240-253.

Sekaran, U., & Bougie, R. (2003). Research method of business: A skill building approach. New York: John Willey & Sons.

Semantic KMS further literature review

Senge, P. (1990). The fifth discipline. New York: Currency Doubleday.

Shani, A. B., Sena, J. A., & Olin, T. (2003). Knowledge management and new product development: a study of two companies. European Journal of Innovation Management, 6(3), 137-149.

Sharma, B., & Fisher, T. (1997). Functional strategies and competitiveness: An empirical analysis using data from Australian manufacturing. Benchmarking for quality management & technology, 4(4), 286-294.

Shepherd, W. G. (1967). What does the Survivor Technique show about Economies of Scale?. Southern Economic Journal, 113-122.

Sher, P. J., & Lee, V. C. (2004). Information technology as a facilitator for enhancing dynamic capabilities through knowledge management. Information & management, 41(8), 933-945.

Sinotte, M. (2004). Exploration of the field of knowledge management for the library and information professional. Libri, 54(3), 190-198.

Skyrme, D. J., & Amidon, D. M. (1997). The knowledge agenda. Journal of knowledge management, 1(1), 27-37.

Skyrme, D. J., & Amidon, D. M. (1998). New measures of success. Journal of Business Strategy, 19(1), 20-24.

Slater, S. F. (1997). Developing a customer value-based theory of the firm. Journal of the Academy of marketing Science, 25(2), 162-167.

Slater, S. F., Mohr, J. J., & Sengupta, S. (2014). Radical product innovation capability: Literature review, synthesis, and illustrative research propositions. *Journal of Product Innovation Management*, *31*(3), 552-566.

Smith, K. G., Collins, C. J., & Clark, K. D. (2005). Existing knowledge, knowledge creation capability, and the rate of new product introduction in high-technology firms. Academy of management Journal, 48(2), 346-357.

Smith, R. G., & Farquhar, A. (2000). The road ahead for knowledge management: an AI perspective. AI magazine, 21(4), 17.

Smith, W. K., & Tushman, M. L. (2005). Managing strategic contradictions: A top management model for managing innovation streams. Organization science, 16(5), 522-536.

Snowden, D. (1998). A framework for creating a sustainable programme. Knowledge Management: A Real Business Guide, Caspian Publishing, London, 6-18.

Snyder, H., Witell, L., Gustafsson, A., Fombelle, P., and Kristensson, P. (2016). Identifying categories of service innovation: a review and synthesis of the literature. Journal of Business Research, 69(7), 2401-2408.

Snyder, L. V., Atan, Z., Peng, P., Rong, Y., Schmitt, A. J., & Sinsoysal, B. (2016). OR/MS models for supply chain disruptions: A review. IIE Transactions, 48(2), 89-109.

Song, M., Van Der Bij, H., & Weggeman, M. (2005). Determinants of the level of knowledge application: a knowledge-based and information-processing perspective. Journal of Product Innovation Management, 22(5), 430-444.

Spender, J. C. (1992). Limits to learning from the West: How Western management advice may prove limited in Eastern Europe. The International Executive, 34(5), 389-413.

Starbuck, W. (1997), "Learning by knowledge-intensive firms", in Prusak, L. (Ed.), Knowledge in Organizations , Butterworth-Heinemann, Boston, MA.

Stede, W. A. V. D., Chow, C. W., & Lin, T. W. (2006). Strategy, choice of performance measures, and performance. Behavioral research in accounting, 18(1), 185-205.

Stewart, T., & Ruckdeschel, C. (1998). Intellectual capital: The new wealth of organizations.

Stopford, J. M., Strange, S., & Henley, J. S. (1991). Rival states, rival firms: Competition for world market shares (Vol. 18). Cambridge University Press.

Storey, D. J. (1994). Understanding the small business sector. *University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship*.

Strebel, P. (1987). Organizing for innovation over an industry cycle. Strategic Management Journal, 8(2), 117-124.

Subramaniam M, Venkatraman N. (1999). The influence of leveraging tacit overseas knowledge for global new product development capability: an empirical examination. In Dynamic Strategic Resources. Hitt MA, Clifford PG, Nixon RD, Coyne KP (eds.). Wiley: Chichester; 373–401.

Subramaniam, M., & Youndt, M. A. (2005). The influence of intellectual capital on the types of innovative capabilities. Academy of Management journal, 48(3), 450-463.

Sudeepthi, G., Anuradha, G., & Babu, M. S. P. (2012). A survey on semantic web search engine. IJCSI International Journal of Computer Science Issues, 9(2).

Suhr, D. D. (2006). Exploratory or confirmatory factor analysis? (pp. 1-17). Cary: SAS Institute.

Sveiby, K. E. (1997). The new organizational wealth: Managing & measuring knowledge-based assets. Berrett-Koehler Publishers.

Sveiby, K. E., & Simons, R. (2002). Collaborative climate and effectiveness of knowledge work-an empirical study. Journal of knowledge Management, 6(5), 420-433.

Swan, J., & Scarborough, H. (2001). Editorial. Journal of Information Technology, 16, pp. 4955.

Swan, J., Newell, S., Scarbrough, H., & Hislop, D. (1999). Knowledge management and innovation: networks and networking. Journal of Knowledge management, 3(4), 262-275.

Syed-Ikhsan, O. S., & Rowland, F. (2004). Knowledge management in a public organization: a study on the relationship between organizational elements and the performance of knowledge transfer. Journal of knowledge management, 8(2), 95-111.

Szulanski, G. (1996). Exploring internal stickiness: Impediments to the transfer of best practice within the firm. *Strategic management journal,17*(S2), 27-43.

Szulanski, G., Cappetta, R., & Jensen, R. J. (2004). When and how trustworthiness matters: Knowledge transfer and the moderating effect of causal ambiguity. Organization science, 15(5), 600-613

Taminiau, Y., Smit, W., & De Lange, A. (2009). Innovation in management consulting firms through informal knowledge sharing. Journal of Knowledge Management, 13(1), 42-55.

Tan, L.P. and Wong, K.Y. (2015). Linkage between knowledge management and manufacturing performance: A structural equation modeling approach. Journal of Knowledge Management, 19(4), 814–835.

Tanriverdi, H. (2005). Information technology relatedness, knowledge management capability, and performance of multibusiness firms. *MIS quarterly*, 311-334.

Tapscott, D., & Williams, A. D. (2008). Wikinomics: How mass collaboration changes everything. Penguin.

Taylor, S., & Todd, P. (1995). Assessing IT usage: The role of prior experience. MIS quarterly, 561-570.

Teece, D. J. (1986). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. Research policy, 15(6), 285-305.

Teece, D. J. (1996). Firm organization, industrial structure, and technological innovation. Journal of Economic Behavior & Organization, 31(2), 193-224.

Teece, D. J. (1998). Capturing value from knowledge assets: The new economy, markets for know-how, and intangible assets. California management review, 40(3), 55-79.

Teece, D. J. (2000). Strategies for managing knowledge assets: the role of firm structure and industrial context. Long range planning, 33(1), 35-54.

Teece, D. J. (2007). Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. Strategic management journal, 28(13), 1319-1350.

Teece, D. J. (2010). Business models, business strategy and innovation. Long range planning, 43(2), 172-194.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. Strategic management journal, 509-533.

Templeton, G. F., Lewis, B. R., & Snyder, C. A. (2002). Development of a measure for the organizational learning construct. Journal of Management Information Systems, 19(2), 175-218.

Tersine, R. J., & Hummingbird, E. A. (1995). Lead-time reduction: the search for competitive advantage. International Journal of Operations & Production Management, 15(2), 8-18.

Thompson, B. (2005). Canonical correlation analysis. *Encyclopedia of statistics in behavioral science*.

Tidd, J., Bessant, J., & Pavitt, K. (2005). Managing innovation: integrating technological, managerial organizational change. New York.

Tiwana, A., & Ramesh, B. (2001). Integrating knowledge on the web. IEEE Internet Computing, 5(3), 32.

Toffler, A. (1990). Power shift: Knowledge, wealth, and violence at the edge of the 21st century (No. 303.49 T644p). Bantam.

Toledo, C. M., Ale, M. A., Chiotti, O., & Galli, M. R. (2011). An ontology-driven document retrieval strategy for organizational knowledge management systems. Electronic Notes in Theoretical Computer Science, 281, 21-34.

Tolson, J. (2004) A word's eventful journey. U.S. News & World Report Vol 136(4): 51

Tredennick, J. Collecting Data in the EU. Tedinnick, L. (2006), 'Post Structuralism, hypertext & the World Wide Web', Aslib, 59: 2, pp.169–186, 2007.

Trent, R. J., & Monczka, R. M. (2002). Pursuing competitive advantage through integrated global sourcing. The Academy of Management Executive,16(2), 66-80.

Tuomi, I. (1999, January). Data is more than knowledge: Implications of the reversed knowledge hierarchy for knowledge management and organizational memory. In *Systems Sciences, 1999. HICSS-32. Proceedings of the 32nd Annual Hawaii International Conference on* (pp. 12-pp). IEEE.

Tushman, M. L. (1997). Winning through innovation. Strategy & Leadership,25(4), 14-19

Tushman, M. L., & Anderson, P. (1986). Technological discontinuities and organizational environments. Administrative science quarterly, 439-465.

Tushman, M. L., & O'Reilly, C. A. (1996). The ambidextrous organizations: Managing evolutionary and revolutionary change. California management review, 38(4), 8-30.

Tushman, M. L., Anderson, P. C., & O'Reilly, C. (1997). Technology cycles, innovation streams, and ambidextrous organizations: organization renewal through innovation streams and strategic change. Managing strategic innovation and change, 3, 23.

Tuzovsky, A. F., & Yampolsky, V. Z. (2003, July). The system approach to knowledge management systems designing and development. In Science and Technology, 2003. Proceedings KORUS 2003. The 7th Korea-Russia International Symposium on (Vol. 2, pp. 319-323). IEEE.

Twiss, B. C. (1992). Forecasting for technologists and engineers: A practical guide for better decisions (No. 15). IET.

Tyndale, P. (2002). A taxonomy of knowledge management software tools: origins and applications. Evaluation and program planning, 25(2), 183-190.

Ulrich, D. (1993). Profiling organizational competitiveness: Cultivating capabilities. People and Strategy, 16(3), 1.

Ulwick, A. W. (2002). Turn customer input into innovation. Harvard business review, 80(1), 91-7.

Urban, G. L., & Von Hippel, E. (1988). Lead user analyses for the development of new industrial products. Management science, 34(5), 569-582.

Uren, V., Cimiano, P., Iria, J., Handschuh, S., Vargas-Vera, M., Motta, E., & Ciravegna, F. (2006). Semantic annotation for knowledge management: Requirements and a survey of the state of the art. Web Semantics: science, services and agents on the World Wide Web, 4(1), 14-28.

Utterback, J. M., & Abernathy, W. J. (1975). A dynamic model of process and product innovation. Omega, 3(6), 639-656.

Va´zquez, R., Santos, M.L. and A ´lvarez, L.I. (2001), ''Market orientation, innovation and competitive strategies in industrial firms'', Journal of Strategic Marketing, Vol. 9, pp. 69-90.

Vaccaro, A., Parente, R., & Veloso, F. M. (2010). Knowledge management tools, inter-organizational relationships, innovation and firm performance. Technological Forecasting and Social Change, 77(7), 1076-1089.

Van de Ven, A. (1986). Central problems in the management of innovation. Management science, 32(5), 590-607.

Van der Bij, H., Michael Song, X., & Weggeman, M. (2003). An empirical investigation into the antecedents of knowledge dissemination at the strategic business unit level. *Journal of Product Innovation Management*, *20*(2), 163-179.

Van der Panne, G., Van Beers, C., & Kleinknecht, A. (2003). Success and failure of innovation: a literature review. International Journal of Innovation Management, 7(03), 309-338.

Van Maanen, J. (1983). Qualitative Methods Reclaimed (No. TR-20-ONR). Sloan School of Business.

Van Teijlingen, E., & Hundley, V. (2002). The importance of pilot studies. Nursing Standard, 16(40), 33-36.

Vargo, S. L., & Lusch, R. F. (2004). Evolving to a new dominant logic for marketing. Journal of marketing, 68(1), 1-17.

Vera, D., & Crossan, M. (2003). Organizational learning and knowledge management: Toward an integrative framework.

Von Glasersfeld, E. (1996). Introduction: Aspects of constructivism. Constructivism: Theory, perspectives, and practice, 3-7. Columbia University.

Von Krogh, G. (1998). Care in knowledge creation. California management review, 40(3), 133-153.

Von Krogh, G., Ichijo, K., & Nonaka, I. (2000). Enabling knowledge creation: How to unlock the mystery of tacit knowledge and release the power of innovation. Oxford University Press on Demand.

Wahyuni, D. (2012). The research design maze: Understanding paradigms, cases, methods and methodologies. Journal of applied management accounting research, 10(1), 69-80.

Wahyuni, D. (2012). The research design maze: Understanding paradigms, cases, methods and methodologies. Journal of applied management accounting research, 10(1), 69-80.

Wang, C. C., & Lin, G. C. (2013). Dynamics of innovation in a globalizing china: regional environment, inter-firm relations and firm attributes. Journal of Economic Geography, 13(3), 397-418.

Wang, R. Y., & Strong, D. M. (1996). Beyond accuracy: What data quality means to data consumers. Journal of management information systems, 12(4), 5-33.

Wang, Z., & Wang, N. (2012). Knowledge sharing, innovation and firm performance. Expert systems with applications, 39(10), 8899-8908.

Warner, F. (2002). In a Word, Toyota Drives for Innovation.'. Fast Company, (61), 36.

Warren, P., Davies, J., & Simperl, E. (Eds.). (2011). Context and Semantics for Knowledge Management: Technologies for Personal Productivity. Springer Science & Business Media.

Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. MIS quarterly, xiii-xxiii.

Week, B. (2000). Knowledge management and new organization forms: a framework for business model innovation. Knowledge management and virtual organizations, 2.

Weibel, S., Kunze, J., Lagoze, C., & Wolf, M. (1998). *Dublin core metadata for resource discovery* (No. RFC 2413).

Wen, Y. F. (2009). An effectiveness measurement model for knowledge management. Knowledge-based systems, 22(5), 363-367.

Wernerfelt, B. (1984). A resource-based view of the firm. Strategic management journal, 5(2), 171-180.

West, M. A. (2002). Sparkling fountains or stagnant ponds: An integrative model of creativity and innovation implementation in work groups. Applied psychology, 51(3), 355-387.

West, M., & Farr, J. L. (1990). Innovation at work. In M. A. West, & J. L. Farr (Eds.), *Innovation and creativity at work: psychological and organizational strategies.* (pp. 3-13). Chichester: John Wiley & Sons, Ltd.

Westland, J. C. (2015). Structural equation models: From paths to networks(Vol. 22). Springer.

Wheelwright, S. C., & Clark, K. B. (1992). Revolutionizing product development: quantum leaps in speed, efficiency, and quality. Simon and Schuster.

White, G. P. (1996). A survey and taxonomy of strategy-related performance measures for manufacturing. International Journal of Operations & Production Management, 16(3), 42-61.

Wickramasinghe, N. (2006). Knowledge creation: a meta-framework. International Journal of Innovation and Learning, 3(5), 558-573.

Wiig, K. M. (1995). Knowledge management methods. Arlington (TX).

Wiig, K. M. (1997). Integrating intellectual capital and knowledge management. Long range planning, 30(3), 399-405.

Wiig, K. M. (2000). Knowledge management: an emerging discipline rooted in a long history. Knowledge horizons: the present and the promise of knowledge management, 3-26.

Wildemuth, B. M. (1993). Post-positivist research: two examples of methodological pluralism. *The Library Quarterly*, 450-468.

Wilkesmann, U., Wilkesmann, M., & Virgillito, A. (2009). The absence of cooperation is not necessarily defection: Structural and motivational constraints of knowledge transfer in a social dilemma situation. Organization Studies, 30(10), 1141-1164.

Winter, S. G., & Nelson, R. R. (1982). An evolutionary theory of economic change. University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship.

Wolfe, R. A. (1994). Organizational innovation: Review, critique and suggested research directions. Journal of management studies, 31(3), 405-431.

Wooten, J. O., & Ulrich, K. T. (2014). Idea generation and the role of feedback: Evidence from field experiments with innovation tournaments. SSRN 1838733.

Wu, D., Ngai, G., & Carpuat, M. (2003, May). A stacked, voted, stacked model for named entity recognition. In *Proceedings of the seventh conference on Natural language learning at HLT-NAACL 2003-Volume 4* (pp. 200-203). Association for Computational Linguistics.

Wu, J. H., & Wang, Y. M. (2006). Measuring KMS success: A respecification of the DeLone and McLean's model. Information & Management, 43(6), 728-739.

Xu, J., Houssin, R., Caillaud, E., and Gardoni, M. (2010). Macro process of knowledge management for continuous innovation. Journal of Knowledge Management, 14(4), 573-591.

Yeo, W., Kim, S., Coh, B. Y., & Kang, J. (2013). A quantitative approach to recommend promising technologies for SME innovation: a case study on knowledge arbitrage from LCD to solar cell. Scientometrics, 96(2), 589-604.

Yeung, A. K., Ulrich, D. O., Nason, S. W., & Von Glinow, M. A. (1999). Organizational learning capacity: Generating ideas with impact.

Yew Wong, K. (2005). Critical success factors for implementing knowledge management in small and medium enterprises. Industrial Management & Data Systems, 105(3), 261-279.

Yilmaz, C., Alpkan, L., & Ergun, E. (2005). Cultural determinants of customer-and learning-oriented value systems and their joint effects on firm performance. *Journal of business research*, *58*(10), 1340-1352.

Yu, S. H., Kim, Y. G., & Kim, M. Y. (2007). Do we know what really drives KM performance?. Journal of Knowledge Management, 11(6), 39-53.

Zack, M. H. (1999). Developing a knowledge strategy. California management review, 41(3), 125-145.

Zack, M. H. (2002, April). A strategic pretext for knowledge management. In Proceedings of the Third European Conference on Organizational Knowledge, Learning and Capabilities.

Zack, M., McKeen, J., & Singh, S. (2009). Knowledge management and organizational performance: an exploratory analysis. Journal of knowledge management, 13(6), 392-409.

Zahra, S. A., & Covin, J. G. (1994). The financial implications of fit between competitive strategy and innovation types and sources. The Journal of High Technology Management Research, 5(2), 183-211.

Zahra, S. A., & George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension. Academy of management review, 27(2), 185-203.

Zaim, H., Tatoglu, E., & Zaim, S. (2007). Performance of knowledge management practices: a causal analysis. Journal of knowledge management, 11(6), 54-67.

Zaltman, G., Duncan, R., & Holbek, J. (1973). Innovations and organizations. John Wiley & Sons.

Zander, U. (1991). Exploiting a technological edge: Voluntary and involuntary dissemination of technology. Stockholm: Institute of International Business, Stockholm School of Economics.

Zenuni, X., Raufi, B., Ismaili, F., & Ajdari, J. (2015). State of the Art of Semantic Web for Healthcare. Procedia-Social and Behavioral Sciences, 195, 1990-1998.

Zheng, W., Yang, B., & McLean, G. N. (2010). Linking organizational culture, structure, strategy, and organizational effectiveness: Mediating role of knowledge management. *Journal of Business research*, *63*(7), 763-771.

Zhou, H., & Uhlaner, L. M. (2009). Knowledge Management in the SME and its Relationship to Strategy, Family Orientation and Organization Learning.

Zhou, K. Z., Yim, C. K., & Tse, D. K. (2005). The effects of strategic orientations on technology-and market-based breakthrough innovations. Journal of marketing, 69(2), 42-60.

Zhou, L., Ding, L., & Finin, T. (2011). How is the Semantic Web evolving? A dynamic social network perspective. Computers in Human Behavior, 27(4), 1294-1302.

Zhu, K., & Kraemer, K. L. (2005). Post-adoption variations in usage and value of e-business by organizations: cross-country evidence from the retail industry. *Information systems research*, *16*(1), 61-84.

Zien, K. A., & Buckler, S. A. (1997). From experience dreams to market: crafting a culture of innovation. Journal of product innovation management, 14(4), 274-287.

Zikmund, W. G. (2003). Sample designs and sampling procedures. Business research methods, 7, 368-400.

Zirger, B. J., & Maidique, M. A. (1990). A model of new product development: An empirical test. Management science, 36(7), 867-883.

Zwell, M. (2000). Creating a culture of competence (p. 325). New York, NY: Wiley

APPENDICES

APPENDIX A: PILOT SURVEY COVER LETTER

PILOT SURVEY

Impact of knowledge management on firm's radical and incremental innovativeness

Dear Survey Participant,

We are conducting a research on the impact of knowledge management on firm's innovation and competitiveness and the impact of semantic web technologies on effective knowledge management.

Your opinion and perception as a knowledge management expert would be an important contribution to this study. Soon you will receive a link to a survey which will take just minutes to complete. This is an invitation only survey and I'll be really thankful for your support for this study.

Thanks and best wishes,

Nowshade Kabir,

MSc, MBA, PhD

.

APPENDIX B: PILOT SURVEY QUESTIONNAIRE

Impact of knowledge management on firm's radical and incremental innovativeness

Questionnaire

Since implementation of Knowledge management system:

1. Your firm has launched at least one new product or service that is completely new to the world
2. Your firm has introduced more new products and services new to your firm
3. Your firm has added more new products and services to the existing line
4. Your firm has improved and revised existing products or services
5. Your firm has hanged more of your products or services in order to lower cost
6. Your firm has repositioned more products and services to differentiate from existing ones

Correlation of KM and Innovation based on two aspects of knowledge base - existing knowledge and access to knowledge

1. Employees' opinion and ideas are highly valued in your firm

2. Your firm has more or equal level of employees with higher education than industry standard
3. Your firm's R&D expenditure is more and equal to industry standard
4. Your firm frequently forms partnership with others in various areas
5. Information in your firm is freely disseminated using KMS, social media, wikis and blogs
6. In your firm access to knowledge on the job is easy and simple
7. Your firm frequently uses costumer opinions and knowledge
8. Your firm monitors and uses knowledge found from competitors
9. Your firm is attentive to suppliers' opinion and use knowledge shared by them
10. You consider that knowledge is sufficiently codified in our firm

Correlation of KM with competitiveness factors (Productivity - lower cost and Innovation)

Performance factors that show the firm is more competitive:

1. Compared with the industry average your firm is more profitable
2. Compared with the industry average your firm's market share is increasing
3. Compared with the industry average your firm is growing faster

The impact of KM use on competitiveness through innovation

Since the implementation of KMS:

1. Your firm's performance has improved due to a recent process innovation which can be attributed to better knowledge use
2. There are noticeable improvements in product or service quality at least in one area that can be attributed to better knowledge use
3. There is a reduction of time in product or service development that can be attributed to better knowledge use
4. Your firm managed to reduce cost of at least one product or service thanks to better knowledge use

The impact of Semantic Technology on knowledge management in both knowledge exploration and exploitation

Since the implementation of KMS with Semantic Technology:

1. There is an improvement in knowledge search result
2. There is an improvement in identifying required knowledge
3. You have access to more information than before
4. You have access to more relevant information than before
5. It is easier to create new knowledge now than before

6. There is an improvement in knowledge sharing

APPENDIX C: SURVEY COVER LETTER

SURVEY

Impacts of Semantic KMS on the Effectiveness of Knowledge Management and KM Effectiveness on Organizational Innovation and Competitiveness

As a knowledge management expert, you are well aware of the situation that there are very few empirical researches done in proving and validating positive impact of knowledge management on corporate innovation and performance. Even fewer data is available on the impact of newer technologies like Semantic Technology on the effectiveness of knowledge management. I am doing a research to fill this void.

Please take a few minutes to give your feedback about your experience and perception of the impact of KM in your firm. This research result will allow firms to take informative decision on their future knowledge management initiatives. As a participant of the survey you will receive a copy of the research summary upon completion of the project.

The survey is confidential and will only take around 15 to 20 minutes to complete. You can take part by following this link:

The survey is only open for 10 days. So please use this opportunity to share your valuable experience and participate in developing better understanding of the effects of knowledge management within a firm.

Thanks and best wishes,

Nowshade Kabir,

MSc, MBA, PhD

APPENDIX D: SURVEY INTRODUCTION

SURVEY

Impacts of Semantic KMS on the Effectiveness of Knowledge Management and KM Effectiveness on Organizational Innovation and Competitiveness

Thank you for your time and your acceptance to participate in this short survey**.** It should take between 15 and 20 minutes to complete.

This research is aimed at understanding the impact of effective knowledge management on firm's innovation and competitiveness, and possible positive influence of Semantic Technology based knowledge management system on the effectiveness of knowledge management. The outcome of the research expected to show the importance of knowledge management on firm's innovation and its competitiveness. It also would deliver the message that knowledge management systems can produce better results if they are updated using advances of technologies such as Semantic Technology. The result of this research would contribute to improving support for KM initiatives in corporate world. As a participant of this survey, you will receive a copy of the study summary upon completion of the project.

All information given in this survey will be held securely and treated as confidential. Thanks again for taking part! Click on the button below to start the survey**.**

APPENDIX E: SURVEY QUESTIONS

Impacts of Semantic KMS on the Effectiveness of Knowledge Management and KM Effectiveness on Organizational Innovation and Competitiveness

Basic Information

A. Age:
    - Less than 25,
    - 26 -35,
    - 36-45,
    - 46-55,
    - 56 and over
B. Gender: Male/ Female
C. Position:
    - Executive,
    - Manager,
    - Assistant manager,
    - Consultant,
    - Other
D. Industry:
    - Information & communication technologies
    - Manufacturing
    - Construction
    - Consulting

- Hospitality
- Retail
- Education
- Government
- Nonprofit and Charities
- Financial Services
- Business Services
- Personal Services
- Other

E. Firm's Size:
- Small (50 or less employees)
- (51 to 500)
- Large (over 500)

F. Years in business:
- Less than 3,
- 3 to 10,
- 11 to 25
- over 25

G. Time Knowledge Management practices implemented in the firm:
- Less than 3
- 3 to 7,
- over 7

This section is related to the processes of Knowledge Management in your organization and how effectively they are performed.

KNOWLEDGE MANAGEMENT PROCESSES

Knowledge Acquisition

AQ1 Your firm regularly captures knowledge from external sources, i.e. competitors, partners, suppliers and outside research

AQ2 In your firm it is a company priority to identify and acquire new knowledge

AQ3 The knowledge management processes in your firm support learning and using lesson learnt from previous experiences, best practices and expert insights, etc.

Knowledge Application

AP1 Your firm is actively engaged in research and development

AP2 Newly acquired knowledge is regularly used in projects and tasks

Knowledge Accumulation

AC1 In your firm collected knowledge is well categorized and organized

AC2 It's a common practice in your firm to document and store new knowledge such as lesson learnt, best practices, expert's insights etc.

AC3 You consider that knowledge (know-how, technical skills, best practices, research works, etc.) is sufficiently codified in your firm

Knowledge Dissemination

The following aspects are common practice in your firm:

AS1 Information sharing using communities of practices, social media, wikis and blogs

AS2 Informal and formal meetings and dialogues to share knowledge

Transfer of knowledge within departments, units and partners

Knowledge management is a continuous process requiring constant readiness from various areas of the organization. This section is about how capable your firm is in implementing KM initiatives.

KM STRATEGIC READINESS

Human Capital

SH1 Your firm has more employees with higher education than key competitors

SH2 Your firm has more skilled workers than key competitors

Organization Capital

SO1 Your firm frequently forms partnership with others in various areas

SO2 In your firm access to knowledge from coworkers and experts is easy and simple

SO3 KM group in your firm is a recognized source of organizational value creation

SO4 Your firm has adopted a clear knowledge related strategy

SO5 Top management in your company participates in key knowledge management initiatives

SO6 Top management in your company emphasizes the importance of KM to employees

SO7 Employees' opinion and ideas are valued in your firm

SO8 A culture of continuous learning such as training and participation in seminars, trade shows, conferences, etc. exist in the firm

Information Capital

SI1 Information technology infrastructure in your firm is adequate for knowledge management initiatives

SI2 Your firm often invests in new technologies

This section demonstrates the innovation related aspects of your firm.

Organizational Innovation

Since the adoption of first KM initiative in your firm

OI1 Your firm has launched at least one new product or service that is completely new to the world

OI2 Your firm often introduces products and services new to the firm

OI3 Your firm regularly adds more new products and services to the existing line

OI4 Your firm often improves and revises existing products or services

OI5 Your firm frequently changes products or services in order to lower cost

OI6 Your firm regularly repositions products and services to differentiate from existing ones

This section shows how competitive your firm is in comparison to key competitors. Your immediate competitor company can be used as an anchoring point.

Organizational Competitiveness

Compared with key competitors, your firm

OC1 is more profitable

OC2 is growing faster

OC3 is more successful

OC4 has bigger market share

You should fill up this section only if your firm has implemented Semantic Technology based KM system at least in a part of KM initiatives.

Semantic Technology based KM System

Since the implementation of Semantic Technology based KM System

Convenience of Use

KC1 KM system response time is faster

KC2 KM system is easier to use

Knowledge Search

KS1 It is easier to find the knowledge you need

KS2 Classification is now well organized in the system

KS3 The KM system provides more relevant knowledge as search result

Knowledge Integration

KI1 You have access to more relevant knowledge from disparate information systems and the Web

KI2 More information is converted to an accessible format and stored in the KM system

Knowledge Quality

KQ1 Knowledge provided by the KM system is often adequate for the task at hand

KQ2 Knowledge provided by the KM system is accurate enough

KQ3 Knowledge provided by the KM system is reliable

Serendipity and Arbitrage

SA1 You are finding more unexpected and valuable knowledge than before

SA2 Better access to knowledge helped you using available knowledge at least in one new area

APPENDIX F: SURVEY SECOND LETTER

Dear Survey Participant,

As a knowledge management expert, you are well aware of the situation that there have been a very few empirical researches done in proving and validating the positive impact of knowledge management on corporate innovation and performance. Even fewer data is available on the impact of newer technologies like Semantic Technology on the effectiveness of knowledge management. I am doing a research to fill these voids.

Please take a few minutes to give your feedback about your experience and perception of the impact of KM in your firm. This research result will allow firms to take an informative decision on their future knowledge management initiatives. As a participant of the study, you will receive a copy of the research summary upon completion of the project. The survey is confidential and will only take around 15 to 20 minutes to complete. You can take part by following this link:

This survey is approved by Newcastle University Ethics Committee. The survey is only open for 15 days. So please use this opportunity to share your valuable experience and participate in developing better understanding of the effects of knowledge management on firm's performance.

Best regards, Nowshade Kabir, PhD.

Newcastle University

APPENDIX G: SURVEY REMINDER

SURVEY

Impacts of Semantic KMS on the Effectiveness of Knowledge Management and KM Effectiveness on Organizational Innovation and Competitiveness

Reminder Letter

I hope you remember that around a little more than two weeks ago, you have received a personal invitation from me to participate in a survey related to the impacts of effective knowledge management on innovation and organizational performance. To keep the survey highly relevant it was sent to a limited number of KM professionals. I am grateful to see that a substantial quantity of people has already completed the survey, however, the numbers show that the study needs more people to take part.

It will be a great help and a contribution to the cause of knowledge management in the organizational world if you spare some time and fill out the survey by clicking on the following link:

Please note that all information provided by you will be treated as confidential and you will, definitely, receive a summary of the study once it's done. If you have any other concern, suggestion or facing technical difficulties in completing the survey please let me know by a return email.

Best regards,

Nowshade Kabir, MSc, MBA, PhD