Master thesis Organization Studies

Knowledge management and innovation in Professional Service Firms

A quantitative research of the relationship between knowledge management and innovative performance in professional service firms.

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Preface

With the achievement of this master thesis, the door of my study is definitely closed. But a new door has opened which is an entry of a challenging carrier instead. This past year was very instructive, stressfully, fatiguing, but above all, satisfactory, and finally this master thesis is finished within the master program Organization Studies of Tilburg University in the academic year 2010-2011.

Central to this research is the concept of knowledge management which has served as a source inspiration for my future perspective. After a long study period where I have acquired knowledge about management and organizations, I figured out that I'm rather a generalist than a specialist. With this thesis about knowledge management, it basically gave my knowledge 'hands and feets', how to acqurately utilize these knowledge in practice. I'm now convinced of specialism, my added value and contribution to the professional service businesses. Again, this has served as the basic of the exiting and enjoyable process of writing the thesis.

Finally, I realize that without the help of certain people I could not have accomplished my master thesis. I want to use this opportunity to name and thank certain people:

- First, I wanted to thank my first supervisor Dr. Nord Sovik for his great advise and support, and most important his 'open' way of doing thing.
- Secondly, I want to thank my second supervisor Dr. K. Pitsakis for his valuable feedback on this thesis and his willingness to function as second reader.
- Third, I like to thanks my fellow students who also attended this thesis circle for their helpful feedback and mutual supports.
- Fourth, I like to thank all the firms and respondents who has participate in this research. Without them it was impossible to conduct this research.
- Last, but not at least, my family and friends, who supported me during this stressful period and motivate me to finish my last part of this study.

Thank you all!

Ka Kin Pang

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Summary

The increasing importance of Professional Service Firms (PSFs) is clearly evident both nationally and internationally. PSFs are now face greater challenges to organize and manage their resources in order to create competitive advantage and differentiate themselves in the sector. One central issue that is fundamental in this research is why are some PSFs more successful than others that have the same or more resources? The professional service industry is a typically industry where is knowledge is seen as the key resource and knowledge management (KM) is regarded as a significant source of competitive advantage to enhance the innovative performance of PSFs.

This research aims to develop an understanding of KM and innovation. More specifically, this study examines the relationship between KM and the innovative performance of PSFs and the moderating influence of task centralization and formalization. Moreover, this study also examines the use of external and internal knowledge sources and its relation with innovation as an additional part of this research.

Empirical data were collected from 95 PSFs in the Netherlands among which consulting, accounting and law firms. The results indicate that there is a positive relationship between KM and the innovative performance of PSFs. Furthermore, task centralization has a positive influence of this relationship. On the contrary, task formalization has a negative influence of the relationship between KM and service innovation. In addition, the use of external knowledge sources has a positive effect of the innovative performance of PSFs.

Key words: Knowledge management, Innovative performance, Professional Service Firms

Contents

1. Introduction

The increasing importance of Professional Service Firms (PSFs) is clearly evident both nationally and internationally. As Drucker has already emphasized the number of 'knowledge workers', as the total professionals in accounting, law, management consultancy, IT and education and training doubled within a decade (Drucker, 1993, 1999). In Europe and the USA, service professionals are 16% of the population. The same percentage goes for the Netherlands which has more than 105.000 PSFs and 600.000 professionals active in the service industry (Kwakman, 2007). The expectation is that this number will grow towards 900.000 service professionals in 2010 (Kwakman, 2007). In conclusion, professional services are a growing share of both the population and GDP. Professional services are an increasingly important driver of economic activity in the knowledge economy (Kox 2002, Kox et al. 2003, Den Hertog 2000). PSFs are now face greater challenges to organize and manage their resources in order to create competitive advantage and differentiate themselves in the sector. (Guldberg 2003, Kox, 2002, Verma 2000, Stumpf et al. 2002, Kox 2004, Kox and Rubalca 2007).

1.1. Research problem

From this perspective the central issue arises: why are some PSFs more successful than others that have the same or more resources? The professional service industry is a typically industry where is a lot of knowledge and information deal with. Information and knowledge is essential in the input, throughput and output of the delivery of the service. Knowledge is therefore an important boundary condition within the primary process in PSFs. Due to the 'difficult to replicate' character of knowledge resource, knowledge is seen as the key resource within PSFs. Managing knowledge resource has become increasingly important for service organizations (Nunes et al. 2007).

Knowledge management (KM) is regarded as a significant source of competitive advantage to enhance the innovative performance of PSFs (Corso et al., 2003; Chirico, 2008). The greatest value of knowledge is contained in service products and vice versa. PSFs differentiate themselves from their competitors by providing services which arises from unique knowledge, expertise or knowhow. Businesses that can efficiently capture the knowledge embedded in their organizations and deploy it into their operations, productions and services will have an edge over their competitors (Wong and Asinwall, 2005).

KM is also a way to increase the internal efficiency of the organization. Since, KM optimizes existing knowledge, absorbs new knowledge and the distribution throughout the organization (Weggeman, 2000). It allows the organization recognize similar problems in the past and even new phenomena's of problems due to changing environments. KM allows the possibility to share 'real time' ideas among employees within projects. The necessary

information, knowledge and experience are bundled effectively in order to create new and revolutionary services or processes, also recognized as innovation. Boh (2007) argues that KM must be seen as a strategy to manage organizational knowledge assets to support management decision making to enhance competitiveness and to increase capacity for creativity and innovation. Innovation is therefore in turn one way to increase the competitive advantage of PSFs e.g. by develop of new services in interaction between service providers and clients, changing internal processes and investing new knowledge (Flikkema et al. 2003, Flikkeman and Jansen 2004, Den Hertog 2000, Mumford 2000, Stumpf et al. 2002). However, is innovation truly a natural consequence of effective KM? According to Wong and Aspinwall (2005) it is, knowledge, if properly harnessed and leverage can propel organizations to become more adaptive, innovative, intelligent and sustainable.

The importance of knowledge management (KM) and its relationship to innovation is widely acknowledged. Empirical work, however, is still in its infancy and characterized by heterogeneous measurement approaches (Hall et al., 2006, 296). Furthermore, it has done little to explain how firms manage themselves internally to achieve innovative change and ensure that their change is sustainable within the firm. Most empirical studies of knowledge management and its relationship with innovations are focused on technological firms. The main focus of this research is to examine the relationship of KM and innovation in PSFs. This may be a first step in filling the gap in the literature between technical and non-technical aspects of KM and its relationship with innovation.

An additional question addressed in this research is whether certain organizational dimensions of PSF moderate this relationship between KM and innovative performance of PSFs. In the research "Organizational dimensions as determinants factors of KM approaches in SMEs", they proposed: size, geographical dispersion and task nature as determinant factors that may influence the KM approaches (Zanjani, Mehrasa & Modiri, 2008). Especially, the task nature of PSFs is of importance, because this may determine the KM strategy, which in turn may have a consequence of the outcomes. The KM strategy chosen should create value for the firm's customers, turn a profit for the firm, and focus on how the firm's employees deliver on the value and economics (Zanjani, Mehrasa & Modiri, 2008). Thus, the way in which PSFs coordinate the tasks may also influence the relationship between KM and innovation.

1.2. Research question

The following research question can be formulated:

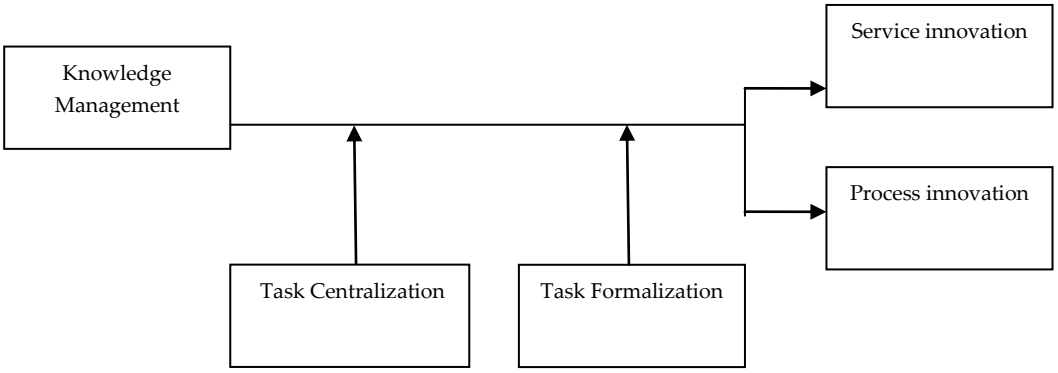
> *"What is the effect of knowledge management on the innovative performance of PSFs and how is this relationship moderated by task centralization and formalization?*

1.3. Conceptual model

In line with the research question, the following conceptual model can be represented:

Figure 1

Conceptual model



1.4. Relevance

From a scientific perspective, this research adds to the empirical work in the context of PSFs in a wider range of additional sectors. There is very little systematic evidence that compares different PSFs within different sectors. Most of the empirical studies on KM or innovation are examine in the context of industrial and technical firms. Instead, this research examines empirically the relationship between KM and innovative performance of PSFs in a non-technical context. This will add to the empirical work of PSFs and innovation in general. Furthermore, the categorization of knowledge management practice and the development of measurement instrument that is empirically tested can further support theorizing and conceptualization of the topic.

From a practical perspective, this research brings more insight and understanding to managing knowledge resources in PSFs in general. The management of knowledge is now a key factor in promoting innovations in organizations both by private firms and public authorities (Foray and Gault, 2003). The results of this research can inform the development of knowledge management practice in PSFs. Further, it addresses managerial implication and clarifies best practice of knowledge management activities in order to improve the innovative performance in PSFs on the long run. Through this 'knowledge workers' and managers are more aware and capable of implementing KM policies e.g. better use of existing knowledge, solving co-ordination problems, recombination of knowledge, transforming knowledge into direct source of value and attracting talents (Foray and Gault, 2003).

1.5 Bookmarks

In the next chapter, the most important theoretical concepts will be defined and justified by means of different scientific articles. In this part, particular attention will be paid to existing literature around PSFs in general, knowledge management and innovation. Furthermore, some other essential concepts will be discussed such as: task centralization and –formalization. One additional concept is added to this theoretical framework, that is the use of external and internal knowledge sources. Finally, the relationships between the theoretical concepts will be discussed which results in the formulation of several hypotheses.

In the third chapter, the methodology will be discussed that is used in this quantitative research. This part includes the explanation of the research design and sample strategy. Furthermore, we will explain and clarify how the theoretical concepts are operationalized into measurable indicators, the procedure of data collection and analysis, and in the end, how the reliability and validity of this research is secured.

In the fourth chapter, empirical analysis will be executed and results will be presented and discussed. In this part, the descriptive statistics of each variable will be discussed. Followed by a reliability analysis, the extent which the items are measuring the same underlying constructs, and Pearson's correlation matrix. Furthermore, the results of the multiple linear regression analysis are presented and discussed in order to test the hypotheses. In the end, we will do an additional analysis of the use of external and internal knowledge sources and its relationship with innovation.

The last chapter includes the most important conclusions and discussions of this research. Furthermore, some recommendation for future research will be discussed. In the last part of this chapter some limitations of this research will be reflected. In this master thesis there will be continuously reference to figures and tables. The appendix on Page 50 includes an overview of all the figures and tables.

2. Theoretical framework

In this theoretical framework, the variables of the conceptual model are further specified and constructed into measurable theoretical concepts. Next to it, the hypotheses are formulated and theoretically justified. First, a general picture of PSFs is discussed. After, different typology of innovation within service organizations are distinguished. Finally, knowledge management are described, followed by a discussion of the influence of the use of external and internal knowledge sources.

2.1. Professional Service Firms

As the importance of PSFs in general is briefly discussed in the introduction, a significant obstacle in the understanding of PSFs is the ambiguity of the central term. This lack of clarity of the term is either undefined or indirectly defined and cannot be applied for a wider range of PSFs (Von Norderflycht, 2009). Rather than proposing a single definition of PSFs. Different scholars focus on a range of distinctive characteristics in order to identify multiple categories of firms which can be associated with the term PSF (Von Norderflycht, 2009; Kwakman, 2009). Though, de Jong defines PSFs as:

> *"Professional service firms are organization whose core business consists of independent, highly educated and skilled people performing knowledge work and providing non routine services to other firms or institutions in close interaction with client representatives on a temporary basis" (de Jong, 2007. P.44.)*

Von Norderflycht (2009) focuses on three important main characteristics of PSFs: *knowledge intensity, low capital intensity and professionalized workforce.* He argues that these characteristics of PSFs share similar organizational features, but may vary in intensity to some extent. Thus, instead of categorical definition of PSFs, he focuses on the degree of professional service intensity, based on the presence of three characteristics. Von Norderflycht (2009) categorize PSFs as: Technology Developers, Neo PSFs and Classical PSFs. See below table 1.

Table 1

Taxonomy of Professional Service Firms

Categories of PSFS	Knowledge intensity	Low capital intensity	Professionalized workforce
Technology Developers *e.g.bio-tech, R&D labs*	X		
Neo PSFs *e.g. consulting, advertising*	X	X	
Professional Campuses *e.g. hospitals*	X		X
Classical PSFs *e.g. law, accounting, architecture*	X	X	X

In this research, the focus is on the classical PSFs and the NEO PSFs. The two other categories of PSFs technology developers and professional campuses are not included in the sample. The difference between the two categories of knowledge intensive firms (Technology Developers and Professional campuses vs. classical and Neo PSFs) can basically be distinguished into technical and non-technical aspects. Technical PSFs with enough capital are able to invest in unique machinery, tools or equipment to deliver services, whereas non-technical PSFs need to rely more on their internal and external management of knowledge.

Within this scope, human- and knowledge resources are much more important than having financial capital to buy machinery. Hence, the way in which non-technical PSFs organize and manage their professionalized workforce is more likely to be related to competitive advantage and innovation. The organization and management of professionalized workforce depends on the nature of the service and the type of knowledge that is needed to provide the service. The nature of services and the type of knowledge may refer to the task nature of PSFs to some extent e.g. Routine or custom based services, personalized or codified knowledge. As Hansen, Nohria and Tierney (1999) argued that firms should start by indentifying what kind of organization you have and what your information needs are, and then primarily focus on the knowledge strategy and the how to coordinate tasks. Task nature intends to take to align its knowledge resources and capabilities to the intellectual requirements of its strategy, thus reducing the knowledge gap existing between what a firm must know to perform its service and what it does know (Zanjani, Mehrasa & Modiri, 2008).

2.2. Innovative performance

According to Schumpeter, innovation is the result of a recombination of conceptual and physical materials that were previously in existence (Schumpeter, 1935). In other words, in the context of PSFs innovation is the combination of a firm's existing knowledge assets to create new knowledge. The primary task of the innovating firm is therefore to reconfigure existing knowledge assets and resources and to explore new knowledge (Galunic et al., 1998; Grant, 1996; Nonaka et al., 1995). In this research, innovative performance is defined as

> "*The achievement in the trajectory from conception of an idea up to the introduction of an invention into the market*" (Ernst, 2001; Hagedoorn & Cloodt, 2003:1367).

Innovation can be classified as one of two types: e*xploratory innovations,* radical innovations designed to meet the needs of emerging customers or markets (Benner and Tushman 2003, p. 243, Danneels 2002) and *exploitative innovations,* incremental innovations designed to meet the needs of existing customers or markets (Benner and Tushman 2003, p. 243, Danneels 2002). In contrast to this, Hipp et al. uses the term '*service innovation'* in general to define innovation in PSFs. Furthermore, Hipp et al. (2000) make a basic distinction between three types of innovations which are applicable in PSFs.

- *Service innovations*, which include innovation in the service offer in the form of introductions of new or significantly improved services (Damanpour & Gopalakrishnan, 2001; Oke, 2007).
- *Process innovations*, which include new and improved work methods in the process by which a specific service is produced (Damanpour & Gapalakrishnan, 2001; Oke, 2007; den Hertog, 2000).
- *Organizational innovations,* which includes significant improvements in wider organizational structures or processes (Hipp et al., 2000).

This is an essentially "black box" approach whereby innovation is measured by the variation in outputs from the firm. The typology of Hipp et al. (2000) is more suitable in this research, because it focus on types of innovative outputs rather on whether innovation is radical or incremental. Innovation in PSFs could differ by e.g. organizational- and industry features which will likely results in different innovative outputs (Flikkema et al 2003, Flikkema and Jansen 2004, Den Hertog 2000, Mumford 2000, Stumpf et al. 2002).

Service Innovation refers to a new or considerably changed service concept, client interaction channel, service delivery system or technological concept that individually, but most likely in combination, leads to one or more (re)new(ed) service functions that are new to the firm and do change the service/good offered on the market and do require

structurally new technological, human or organizational capabilities of the service organization (Van Ark et al., 2003). Gadrey et al. (1995) categorized four types of service innovation according to service context, namely (1) innovations in service products, (2) architectural innovations that bundle or un-bundle existing service products, (3) innovations that result from the modification of an existing service product and (4) innovations in processes and organization for an existing service product.

Process innovation refers to a new or significantly improved production or delivery method, which includes significant changes in techniques, equipment and/or software (Damanpour & Gapalakrishnan, 2001). Lyytinen & Rose (2003) identified service process innovations as services that (1) support the administrative core (administrative process innovation), (2) support functional processes (technological processes innovation), (3) expand and support customer interfacing processes (technological service innovation) and (4) support inter-organizational processes and operations (technological integration innovation).

However, organizational innovation is excluded from this research because this type of innovation refers to the wider improvement of the whole organization. Organizational innovation may appear in every PSFs regardless of its organizational features or services. Instead, service- or process innovation may vary in different PSFs to some extent. Due to organizational features e.g. professionalized workforce, and the management of industry specific knowledge it may result in service- or process innovation, which is a better indicator of the quality and the delivery of services.

2.3. Knowledge Management

Wiig (1997) puts his emphasis on the management of existing knowledge and states that the purpose of KM is "*to maximize the enterprise's knowledge-related effectiveness and returns from its knowledge assets and to renew them constantly*" (Wiig, 1997, 2). There are many definitions and conceptualization of KM (Alavi et al., 2001; Coombs et al., 1998; Davenport, 1998; Nonaka et al., 1995; Probst et al., 1999). Most of the conceptualization of KM focused on the creation, diffusion, storage and application of either existing or new knowledge (Coombs et al., 1998). KM is defined as "*any systematic activity related to the capture and sharing of knowledge by the organization*" (Earl, 2000). KM actually covers any intentional and systematic process or practice of acquiring, capturing, sharing and using productive knowledge, wherever it resides, to enhance leaning and performance in organizations (Scarbrough, Swan & Preston, 1999).

That knowledge management and innovation activities are closely linked is axiomatic to innovation research. As a consequence of three major trends, a comprehensive analysis of KM must take into consideration the meaning of KM for the innovation process (Edler, 2003). First, Edler (2003) argues that there is no doubt that the firm's capacity to innovate is the key condition to withstand competitive pressure and create competitive advantage. Secondly, 'knowledge economies' indicates that knowledge has become very important in the competition as well as innovations e.g. firms are increasing their efficiency in order to speed up their innovative performance by using KM tools. Finally, the absorption of knowledge from external sources and the integration of knowledge from internal stock and flows are necessary inputs for innovation (Edler, 2003). Hence, the higher the level of knowledge management, the greater the innovative performance in the PSF. In other words, the better firms manage their knowledge flow from either external or internal sources, the better potential for firms to innovate. In line with the above reasoning, I hypothesize:

H1: The higher the level of knowledge management, the greater the service innovative performance of the PFS.

H2: The higher the level of knowledge management, the greater the process innovative performance of the PFS

2.4. Task centralization and formalization

Zanjani, Mehrasa & Modiri (2008) proposed that the task nature intends to take to align its knowledge resources and capabilities to the intellectual requirements of its strategy; it can be assumed that the coordination of the tasks is necessary to deliver effective and efficient services. One of the theories that are relevant and applicable within this context is the seminal work of Burns and Stalker (1961) 'organic and mechanic' forms of organizational structures. Both types represent a 'rational' form of organizational that may create, maintain and exploit the human resource in the most efficient way in certain circumstances (Burns and Stalker, 1961). This typology can be interpreted as the opposite poles continuum. The main difference between these two organizational structures is that the mechanic form is characterized by formal, hierarchal structures and an efficiency focus, whereas the organic form is more flexible, dynamic and the focus is on special knowledge and expertise. Based on the combination of components complexity, centralization and formalization, organizations are rather more mechanic or organic natured (burns and Stalker, 1961). In addition, the structure of the organization implies that labor has to be divided into differentiated tasks, after which it has to be coordinated throughout the organizational units. Hence, tasks need to be structured and coordinated differently when interdependent tasks are allocated to different organizational actors and units in either mechanic or organic forms. Mechanic structures are associated with routine task nature and organic structures with custom-based task nature (Zanjani, Mehrasa & Modiri, 2008).

Consequently, the way in which PSFs structure and manage human and knowledge resources directly related to the coordination of tasks and how it's divided by using 'coordination mechanisms'. PSFs could use various coordination mechanisms to link and integrate different parts of their units (Tushman and O'Reilly 1996, Van de Ven 1986). Coordination mechanisms determine the way how employees act and behave in their job (Hackman, 1967) and the delivery of the organization's economically valuable services (Zanjani, Mehrasa and Modiri, 2008). Coordination mechanisms direct attention and group together key resources and interdependent functions needed to develop innovations (Van de Ven 1986). Coordination mechanisms may differently moderates the relationship between knowledge management and the innovative outputs. Therefore, the examination of two types of coordination mechanisms: task centralization and -formalization are necessary to incorporate in this research.

Centralization

Centralization of decision making reflects the locus of authority and decision-making (Damanpour 1991) and refers to the extent to which decision making is concentrated in an organization (Aiken and Hage 1968). Centralization narrows communication channels (Cardinal 2001) and reduces the quality and quantity of ideas and knowledge retrieved for

problem solving in services (Nord and Tucker 1987, Sheremata, 2000). Hence, high centralized decision-making is associated with a mechanistic organizational structure and implies that tasks are embedded in standardized routines and procedure that are focused on efficiency (Burns and Stalker, 1961). In addition, it may decrease the sense of control over work in a broader sense and diminish the likelihood that unit members seek innovative and new service /processes (Atuahene-Gima 2003, Damanpour 1991). However, effective decision making processes for pursuing innovations tend to be narrowly channeled and more centralized (Cardinal, 2001). Sheremata (2000) suggest that centralized authority is beneficial to speeding up innovation. There is no need for complex decision-making that involves employees at operational level. Decision-making on higher level may foster standardized policies and procedures on operational level, and enforce innovations throughout the whole organization. Thus, high centralization may benefit the creation of new or improved services and delivery processes. In line with the above reasoning, I hypothesize:

H3a: The relationship between the level of KM and the process innovative performance is positively moderated by the level of centralization.

H3b: The relationship between the level of KM and the service innovative performance is positively moderated by the level of centralization.

Formalization

Formalization is the degree to which rules, procedures, instructions, and communications are formalized or written down (Khandwalla 1977). In addition, formalization and the reliance on procedures may hinder experimentation and accurate problem solving (March and Simon 1958). Hence, it may decrease the likelihood of innovative services since it requires more ad hoc processes and expert driven knowledge which is only available in low formalization (Gadrey & Gallouj, 1998). Accordingly, high formalization is characterized by a more rigid structure and is typically found where the environment is stable and tasks are routine based in order to provide high quality and efficient services whereas low formalization is characterized by a much more flexible set of workforce arrangement and tasks are customized based in order to provide creative and customized solutions to clients (Burns and Stalker, 1961; (Hansen et al., 1999). In line with the above reasoning, I hypothesize:

H4a: The relationship between the level of KM and the process innovative performance is negatively moderated by the level of formalization.

H4b : The relationship between the level of KM and the service innovative performance is negatively moderated by the level of formalization.

2.5. Sources of knowledge

The management of knowledge is essential and obvious in knowledge intensive firms. One important aspect of KM is capturing and acquiring knowledge from outside the firm (Edler, 2003). Knowledge can be acquired from different sources which are key elements for the acquisition of new knowledge (Caloghirou, Kastelli & Tsakanikas, 2004). However, which knowledge source do PSFs use to acquire specific knowledge? The acquisition of knowledge from diverse knowledge sources is necessary to develop a broader knowledge base (Bierly & Charkabarti,1996). Knowledge is a source of competitive advantage and the renewal of this competitive advantage occurs through acquiring new knowledge (Foss & Pedersen, 2002). The categories and indicators of both external and internal knowledge sources are derived from the literature study by Martens (2008) 'knowledge acquirement'.

In general, knowledge can be categorized into external knowledge and internal knowledge based on the typology of Parikh (2001) which is widely used by different scholars (e.g. Decarolis & Deeds, 1999; Gavious & Rabinowitz, 2003; Liebowitz et al., 2000; Malerba, 1992; Roessner & Wise, 1994; Rosenkopf & Nerkar, 2001).

External knowledge sources are defined as sources of knowledge located outside the organization (Parikh, 2001). Acquiring external knowledge may allow firms to view from different perspectives. Knowledge that is new and not common in their processes or services e.g. routines, procedures, strategy. The combination of the firms existing knowledge and new knowledge from external sources may allow firms to broaden their current knowledge base and provide new perspectives to PSFs, which in turn enable firms to develop new knowledge in terms of process- and service innovation. In line with above reasoning, I formulate the first additional hypothesis:

> *H5a: The higher the use of external knowledge sources, the greater the process innovative performance of the PSF.*

> *H5b: The higher the use of external knowledge sources, the greater the service innovative performance of the PSF.*

Internal knowledge sources are defined as sources of knowledge located inside the organization (Parikh, 2001). Internal knowledge that is controlled and manage by the firm (Ciborra & Andreu, 2001). The strength of internal knowledge is therefore related to the extent to which firms apply an adequate knowledge management system. The use of internal knowledge sources is necessary for the development of the firms absorptive capacity, which enable firms to acquire knowledge from external sources more adequately (Cohen & Levinthal, 1990). However, the use of only internal knowledge may narrow the firms knowledge base, which in turn make the firm more rigid and less able to adapt innovations (Volberda, 1996). On the other hand, the stronger the firms knowledge base, the greater the

firm's ability to exploit unique resources (Maskell, 2001). In line with above reasoning, I formulate the second additional hypothesis:

> *H6a: the higher the use of internal knowledge sources, the greater the process innovative performance of the PSF.*
>
> *H6b: The higher the use of internal knowledge sources, the greater the service innovative performance of the PSF.*

In sum, both the use of external and internal knowledge sources may enhance firms innovative performance. External knowledge for the acquirement of new and diverse knowledge which broaden its current knowledge base. Internal knowledge which enable the firm's ability to absorb diverse knowledge, which in turn increase the use of external knowledge. Simply because the firm is able to acquire and understands more knowledge, and is able to generate more unique resources such as process- and service innovation.

3. Methodology

In this methodology section, the theoretical concepts are operationalized into measurable concepts in order to collect data. First, the research design is discussed. After, the sample strategy that is used is described. Next, the way in which de data is collected and analyzed is described. Finally, the quality indicators are discussed.

3.1. Research design

This research can be characterized as deductive. The main goal of this research is to test the hypotheses which are derived from the literature. Furthermore, this research can be labeled as cross-sectional, because the data is collected at a single moment of time. The unit of analysis are the individual professional service firms. The unit of observations are also the individual professional service firms represented by the contact person who completed the questionnaire. This research design has been chosen because it allows us to empirically test the hypotheses and to answers the research question. Due to the time constrains it was not feasible to use a more extended research design.

3.2. Sample strategy

The samples for this research are PSFs located in the Netherlands. The following types of PSFs are included in this research: consulting, accounting and law firms. The research sample are selected by purposive sampling strategy. Using search engines, several databases of firm's contact information were found. Also personal contact is used to approach firms. The firms are first contacted by email and followed by a phone call whether firm are willing to cooperate to this research. Next, the participating firms receive an email with a hyperlink to the online survey. Firms can also receive a written questionnaire if preferable.

As for the statistical quality of the research, there are some rules and formula concerning the minimum observation size. The number of cases (observation) must substantially exceed the number of predictor variables you are using in your regression. The absolute minimum is 5 observation for each independent variables, a more acceptable ratio is 10:1 and there are even scholars who argue that this should be high as 40:1 (Brace, Kemp & Snelgar, 2003). Hence, there is no clear consensus about the correct minimum observation for regression analysis. However, the target is to reach a minimum of 100 firms by the end of July. Ultimately, out of approximately 2000 contacted, only 95 firms participated to this research.

3.3. Data collection

This research was started with an in-depth literature study in order to uncover the state of art of the relevant concepts. This literature study has to be done in order to construct the theoretical frameworks and formulate hypotheses. The relevant literature is

selected via the Web of science, Google Scholars, the database of Tilburg's University and Management Executive base. The keywords to find literature in the search engines are: knowledge management practice, service- and process innovation, professional service firm. Furthermore, the reference lists of recent literature were used to find more related articles.

Second, the survey are distributed to PSFs by means of the program NETQ Internet Survey and monitor online the results in clear graphs. The answers of the questionnaire can be simply exported to the statistical program SPSS including all variables and values. The construction of this survey is based and derived on the basis of several existing questionnaires that were originally developed by the Organization for Economic Cooperation and Development (OECD), the Community Innovation Survey (CIS6) and from other empirical ariticles. Out of these questionnaires, relevant indicators and questions are used to construct a questionnaire adapted to this research. The KM questionnaire that is used, is the result of considerable international consensus building and at least four national pilot surveys. Also throughout the process, several experts in the field have played an active role in the design and analysis of the KM survey in these studies. The constructed KM questionnaire is therefore of good validity. See B appendix for the questionnaire.

3.4. Measurements

Dependent variables

The level of innovative performance is categorized by means of two dependent variables of innovations: service innovation and process innovation. Both dependent variables are measured by using a four-point importance scale ranging from: (1) not important, (2) low importance, (3) medium importance and (4) high importance. The scale of service innovation was adapted and modified mainly from Avlonitis et al. (2001) and Gadrey et al. (1995), using six question items to measure service innovation regarding: service modifications, service line extensions, service repositioning and improvements in existing services. As for process innovation, the scale was adopted and modified mainly from Zaltman et al. (1973) and Davenport and Short (1990), with six question items to measure new service processes within a firm regarding customer service, information inquiry, promotion, trade, administration and new service development. The six question items of each dependent variable are taken together as a sum score for both service- and process innovative. These dependent variables are analyzed separately in order to determine to what extent PSFs differ in their innovation outputs.

Independent variable

The items of KM was derived from an existing knowledge management survey as part of an international initative headed by the OECD. The survey was used in several pilot studies in different countries such as: Canadian study - Statistics Canada, 2001; German

study – Fraunhofer ISI, 2002; Danish study – CFL, 2001; French study – SESSI, 2000. The level of Knowledge management is captured by means of four categories: sharing and communication of knowledge and information, training and mentoring, policies and strategies and knowledge capture and acquisition. *Sharing and communication of knowledge and information* was measured by using five items that refers to the sharing and communication of results of projects, knowledge skills, know-how, methods and other information through written documents, meetings, virtual project teams, databases and daily operations. *Training and mentoring* was measured by five items that refers to the increase of knowledge and experiences through formal trainings, mentor- and apprenticeship, experiences workers, training compensation and off-site trainings. *Policy and strategy* was measured by three items that refers to a written KM policy, promotion of knowledge sharing and development and partnership and alliances to acquire knowledge. Knowledge *capture and acquisition* was measured by five items that refers to knowledge obtained from other industry sources, research institutes, internet and literature and experts/ experienced workers. Respondents were asked to indicate to what extent the organization has applied the following KM practices in the last 12 months. All of the items are measured by means of five-point scale ranging from (1) never, (2) rarely, (3) sometimes, (4) often, (5) always. The items of each category are added together as a sum score. In turn, these categories can be seen as sub-variables which may influence the dependent variables to some extent per se. Consequently, it is possible to determine the effect of each category separately. The level of knowledge management was measured by four categories taken together as a total sum score.

Moderating variables

The task coordination of the professional workforce was measured by: centralization and formalization. Both moderating variables was measured by using a five-point scale ranging from (1) never, (2) rarely, (3) sometimes, (4) often, (5) always. The scale of *centralization* was adapted from Hage and Aiken (1967), Dewar et al. (1980), using five question items to measure centralization regarding the approval of decisions and the autonomy of decision making. The scale of formalization was adapted from Desphande and Zaltman (1982), using five question items to measure *formalization* regarding rules and procedures and the autonomy to off-track the procedures. The indicators of each category will be taken together as a sum score.

Control variables

Two control variables are included in this research in order to control for confounding effects. The first control variable is *firm size* which is measured by the natural logarithm of the number of employees. As large firms may have more resources (Bhattacharyya, Surajit and Saxena, Arunima, 2009). The second control variable is *firm*

age is which measured by the natural logarithm of the years of founding. Older firms may have increased experiences that enhance innovation (Sorensen and Stuart 2000). Note that the use of a neutral position in the Likert scale is purposively excluded, as the neutral response is often used to express the respondent's lack of opinion. The exact items and indicators of all the variables are presented in appendix A.

3.5. Data analysis

In order to answer the research question and to confirm or reject the hypotheses, it is necessary to use quantitative research methods to determine the relationship between the variables. All the data collected from the questionnaires are analyzed with the statistical program SPSS. First, the variables names and values are set up by means the program NETQ Internet Survey. After, the raw data are exported to SPSS and has to be made appropriate for analysis. The raw data is first checked for errors and outliers, and so none of the scores are out of range. Second, the data are analyzed by means of the descriptive statistics to describe the characteristics of the sample and to address specific items. This is done using the function *Frequencies* and *Descriptives*. Third, the validity and the reliability of the operationalization and the measurements of the variables are checked and tested. This was done using the *reliability statistics* to check the scales that are used measures the variables correctly. After, the *factor analysis* is used to check if the items are suitable for the measurement of the variables and so all items and scales are regard sufficient. The data set is now ready to expore the relationships among variables. Next, the items are computed into variables, which result in the following variables: firm age, firm size, industry, KM, centralization, formalization, process innovation, service innovation, external sources and internal sources. Fourth, the relationship between the variables are analyzed by means of the *Pearon's product-moment correlation* and *Hierarchical multiple regression analysis*. The correlation analysis is used to describe the strength and direction of the linear relationships between the variables. The multiple regression analysis is used to analyze how well the independent variables predict the dependent variables when entered in specified models. In addition, four multiple regression analysis were executed. The first regression analysis concerns the relationship between KM and process innovation, and the influence of task centralization and formalization. The second regression analysis concerns the relationship between KM and service innovation, and the influence of task centralization and formalization. The thrird regression analysis concerns the relationship between external and internal knowledge sources and process innovation and the last regression analysis concerns the relationship between external and internal knowledge sources and service innovation. More detailed information can be found in chapter 4.5. and appendix G.

3.6. Quality indicators

Validity – To conduct this research, there has been chosen for a cross sectional research design. This design is in general less valid compared to longitudinal research design, because this research design only collected data a one single time, whereas a longitudinal design has more data collection moments in a longer period. The operationalization of the concepts are based on both existing literature reviews and empirical studies. Moreover, the operationalization and measurements of the concept is widely acknowledged and uses by various scholars and research institutes. Furthermore, the construct validity is checked en tested by means of a factor analysis. Also the use of the control variables firm size and age will likely increase the internal validity. It is generally known that firm size and age affects the dependent variables and thus affects the outcome of the research. Furthermore, this research focus on the relationship of KM and innovation within non-technical context. It is possible to replicate this study in other non technical settings which is beneficial to the external validity.

Reliability – The procedure and methods to conduct this research are documented systematically which make it possible for other scholars to replicate this study. Due to the systematic procedure the likelihood of unsystematic measurements errors are minimized. Furthermore, to increase the reliability, the operationalization and the measurement of all variables are check and tested by means of the reliability analysis. In the end of this thesis, the validity and reliability of this research will be reflected.

4. Empirical Results

In this chapter, the results of the data analysis are presented. First, the sample characteristics and descriptive statistics of the variables are discussed, followed by the reliability analysis and factor analysis. After, the hypotheses are tested by means of multiple regression analysis and finally some other additional analysis are presented.

4.1. Descriptive statistics

Following, the descriptive statistics of the sample characteristics, firm age, firm size and industry are discussed. Next, the descriptive statistics of the variables items scales of KM, Task centralization and formalization, process- and service innovation are discussed. In addition, the descriptive statistics analysis is necessary to reveal information about the extent in which PSFs have applied certain KM practices and the types of innovative outputs.

4.1.1. Sample characteristics of the total sample

In total there are 95 professional service firms which have participated to this research. The total sample can be distinguish in: consulting firms (N=25/26.3%), accounting firms (N=28/29.3%), Law firms (N=27/28.4%) and other firms (N=15/16.3%). The average age of the firms is 27 years, ranging from 2 to 196 years. The average number of employees of the firms is 136, ranging from 2 to 750 employees. The results show a diverse representation of different PSFs in the sample. In addition, firm age and firm size are included as control variable. The sample characteristics of the total sample and the variables are presented in appendix C.

4.1.2. Statistics of knowledge management

In the following part, the descriptive statistics of the independent variable KM are discussed. The independent variable KM is composed by four categories of KM practices namely: (1) Sharing knowledge and information, (2) training and mentoring, (3) policies and strategy and (4) Knowledge capture and acquisition. In this section, each KM practice are discussed in order to determine which KM practices are used the most or less by PSFs. By doing so, it may provide deeper insight of which KM practices enhance the firms innovative performance. The following percentage are composed by PSFs who has answered 'rarely to always' to the questions. This indicates that the firms have applied the KM practice at least once in the past 12 months. Firms who have answered 'never' are excluded from the analysis. In addition, the firms who have answered 'often and always' are included in the conclusion because this indicates that these firms frequently apply KM practices.

Sharing knowledge and information

The first category of KM is (1) sharing knowledge and information that indicates the extent in which firms share explicit knowledge and information, and the communication of these knowledge and information throughout the organization in the past 12 months. This category is composed by five question items. The results indicate that item sharing A is the most frequent used knowledge sharing practice. 97.9% of the firms indicate that all results of projects, knowledge, skills, know-how, methods and other information are documented (sharing A), of which 78.9% have answered 'often and always'. This suggest that firms are well aware of the fact that important knowledge and information needs to be turned explicit in order to share adequately. 95.8% of the firms indicate that all written documents are commonly updated and stored in a central database (sharing D), of which 58.9% have answered 'often and always'. One reason for this is that written documentation are mainly used for daily operations e.g. lessons learned, training manuals, reference and publications, indicated by 93.7% of the firms (sharing E), of which 58.9% have answered 'often and always'. Furthermore, besides the fact that all knowledge are documented and shared through a central database, 94.7% of the firms indicate that all knowledge and information are shared through meetings (sharing B), of which 74.7% even indicated to do this on 'often and always' bases. However, a notable lower extent of the firms, 72.6%, has indicated to share of knowledge and information through virtual project team (sharing C), only 29.5% have answered 'often and always'. This result is reasonable, this implies that project teams are commonly used only for specific tasks and therefore the share specified knowledge and information is needed rather than general information that is shared through a central database. See table 2 for more details.

Table 2

Frequency table

Knowledge storage and sharing

	Mean	Std. deviation	Never	Rarely	Sometimes	Often	Always
Sharing A	3.08	.942	2	4	14	39	36
Sharing B	2.81	.937	5	4	15	53	18
Sharing C	1.58	1.251	26	20	21	24	4
Sharing D	2.68	1.142	4	11	24	28	28
Sharing E	2.49	1.157	6	15	18	38	18

Training and mentoring

The second category of KM is (2) Training and mentoring that indicates the extent in which tacit knowledge (e.g. experiences, know-how) are transferred between workers in the past 12 months. This category is composed by five question items. The results indicate that the most frequent used practices to increase the internal tacit knowledge is to provide financial (partly) compensation for employees who attend to work related trainings or courses (training D) indicated by 97.9% of the firms, of which 77.9% have answered 'often and always'. This implies that firms regard financial compensation as a way to motivate employees to acquire knowledge from external sources. A slightly lower percentage 96.8% of the firms have indicated to provide internal trainings to increase knowledge (training A), but only 53.7% have answered 'often and always'. 91.6% of the firms has indicated to provide off-site external training (training E), a higher percentage 64.2% have answered 'often and always' compare to training A. Furthermore, it is commonly used that experienced workers transfer their tacit knowledge to new or less experienced workers (training C), indicated by 100% of the firms. In addition, 69.8% of the firms have answered often and always which is a better indication of the importance. 96.8% of the firms indicate that knowledge and experiences are shared and passed down through mentor- or apprenticeships (training B). However, only 47.4% of the firms have indicated to provide internships 'often and always'. The results of this category implies that firms do invest in the development of employees by providing both internal and external trainings. To keep tacit knowledge and experiences in the organization, it is common that experienced employees transfer their knowledge to new or less experienced employees by either through mentor- or apprenticeship and internships.

Table 3

Frequency table

Training and mentoring

	Mean	Std. deviation	Never	Rarely	Sometimes	Often	Always
Training A	2.44	.964	3	16	25	41	10
Training B	2.37	.957	3	16	31	35	10
Training C	2.88	.861	0	6	23	42	24
Training D	3.26	1.002	2	5	14	21	53
Training E	2.69	1.195	8	6	20	34	27

Policy and strategy

The third category of KM is (3) policy and strategy that indicated the extent in which firms are dedicated to KM practices in the past 12 months. This category is composed by three question items. 77.9% of the firms indicated to have an written knowledge management policy (policy A), of which 34.7% have answered 'often and always'. A slightly lower percentage 76.8% indicates that this KM policy stimulates the corporate culture to promote knowledge sharing and development (policy B), but a higher percentage 50.5% have answered 'often and always'. 81.1% of the firms indicate to have an active partnership or alliance policy to acquire knowledge (policy C). 51.6% of the firms even answered 'often and always'. The results show that this category is the most used KM policy practice. Policy A is used less by firms. See table 4 for more details.

Table 4

Frequency table

Policy and strategy

	Mean	Std. deviation	Never	Rarely	Sometimes	Often	Always
Policy A	1.77	1.292	21	18	23	25	8
Policy B	2.09	1.384	22	9	16	37	11
Policy C	2.20	1.396	18	12	16	31	18

Knowledge capture and acquisition

The last category of KM is knowledge capture and acquisition that indicates the extent in which firms applied the following knowledge capture and acquisition practices in the past 12 months.. This category knowledge capture and acquisition is composed by five indicators. The results show that item capture C is the most used knowledge capture and acquisition practice. 97.9% of the firms indicate to use internet and literature to acquire knowledge (capture C), of which 73.7% have answered 'often and always'. 94.7% of the firms indicate to acquire knowledge from other industry (capture A). This implies that firms learn over time in the interaction with other industries. 46.3% have answered 'often and always'. Another source in which firms use to acquire knowledge is from external expert or experienced workers (capture E) indicated by 82.1% of the firms, of which 13.7% 'often and always'. The least used source to obtain knowledge is from research institutes (capture B), used by 97.9% of the firms. Only 47.4% have answered 'often to always'. The search and need for external knowledge is obvious based on the results. 100% of the firms have indicated to spend a significant amount of energy to obtain external knowledge (capture D), of which 73.7% have answered 'often and always'. See table 5 for more details.

Table 5

Frequency table

Knowledge capture and acquisition

	Mean	Std. deviation	Never	Rarely	Sometimes	Often	Always
Capture A	2.45	.886	5	8	38	35	9
Capture B	2.39	.972	2	16	32	35	10
Capture C	2.88	.836	2	3	20	49	21
Capture D	3.29	.861	0	8	17	48	22
Capture E	1.33	.972	17	48	17	11	2

4.1.3. Statistics of task centralization and formalization

The coordination of task is specified by two moderating variables: centralization and formalization. Both variables are composed by five questions items related to the coordination of tasks within the firm in the past 12 months. The following percentage are composed by PSFs who have answered 'rarely to always' to the questions. This indicates that the workers has to follow the firm's procedures in terms of decision making in the past 12 months. Firms who have answered 'often and always' will be included in the conclusion, because despite the expections, some has to follow the firm's procedures anyway. Again, firms who have answered 'never' are excluded from the analysis.

Centralization

Centralization indicates the extent in which decisions are centralized and concentrated in the organization. The variable centralization is composed by five indicators. Most of the firms indicate that decisions are commonly taken by the supervisors (centralization A) 97.9%, of which 55.8% have answered 'often and always'. 97.9% of the firms have indicated that unit members may take their own decision, but have to ask permission of their supervisors (centralization D). 33.7% have answered 'often and always'. However, unit members may take decisions on small matters indicated by 95.8% (centralization C), of which 12.6% have answered 'often and always'. In addition, 86.3% of the firms have indicated that workers have no or little influence on a decision (centralization B), of which 20% have indicated that this is 'often and always' the case. However, 100% of the firms have indicated that workers are free to decide things on their own with respect to the fulfillment of the tasks (centralization E), of which 65.3% have indicated that this is 'often to always' the case. In sum, the results implied that there is a certain balance between the hierarchy of the firm and the autonomy of the workers. However, the hierarchy within the firm is slightly greater than the autonomy of workers. See table 6 for more details.

Table 6

Frequency table

Task centralization

	Mean	Std. deviation	Never	Rarely	Sometimes	Often	Always
Centalization A	2.53	.873	2	7	33	42	11
Centalization B	1.59	1.047	13	39	24	15	4
Centalization C	1.61	.867	4	45	34	8	4
Centalization D	2.14	.952	2	23	38	24	8
Centalization E	2.71	.874	0	9	24	45	17

Formalization

Formalization indicates the extent to which rules, procedures, instructions and communications are formalized or written down within the firm in the past 12 months. The variable formalization is composed by five indicators. 87.4% of the firms have indicated that on whatever situation arises, there are written procedures to deal with it (formalization A). 23.2% have answered 'often and always' In addition, workers do know what steps to take whatever situation arises (formalization C) indicated by 97.9% of the firms, of which 62.1% have answered 'often and always'. However, 92.6% of the firms have indicated that rules and procedures needs to be followed in any situation (formalization D), of which 34.7% have answered 'often and always'. Moreover, 95.8% of the firms hav indicated that workers are regularly checked for rule and procedures violations (formalization B). 24.2% have answered that this is 'often and always' the case. Finally, 92.6% of the firms have indicated that rules and procedures are in attendance to remain in the task framework, but workers may be off track if they like (formalization E). But only 17.9% of the firms have answered 'often and always'. Concluding, most of the tasks are formalized to some extent. But there are some situation where there is no procedures for it. In that case, workers have to improvise in order to fulfill the task. In sum, the firms task formalization is on intermediate level. See table 7 for more details.

Table 7

Frequency table

Task formalization

	Mean	Std. deviation	Never	Rarely	Sometimes	Often	Always
Formalization A	1.73	.961	12	24	37	22	0
Formalization B	1.86	.963	4	32	36	16	7
Formalization C	2.62	.840	2	6	28	49	10
Formalization D	2.04	1.110	7	28	27	23	10
Formalization E	1.61	1.003	7	43	28	11	6

4.1.4. Statistics of innovative performance

The innovative performance of PSFs is specified into two dependent variable namely: process innovation and service innovation. The both depend variables are composed by six question items related to the kind of innovative performance and its importance in the firm in the past 12 months. Firms who have answered 'none' are excluded from the analysis and firms who have indicated that their innovative performance was of 'medium and high importance' are included in the conclusion. This may provide a better indication of the importance of the innovative performance of the firm.

Process innovation

The category process innovation is composed by six indicators. The analysis indicates how important the following process innovation was for the organization in the past 12 months. The resutls show that process E was the most applied process innovation, but process D is seen as a more important kind of process innovation within the firm. 87.4% of the firms have indicated to applied new or improved internal administration and operations (process E), of which 55.8% are of 'medium and high importance. 82.1% of the firms have indicated to have improved development activities in order to increase the internal knowledge and application of knowledge (process D), of which 68.4% of 'medium and high' importance. 81.1% of the firms have indicated to have new or imporved activities for customer service (process A), of which 60% was of 'medium and high' importance. Followed by 74.7% of the firms who have indicated to have new or improved methods for the production of services (process C), of which 49.5% was of 'medium and high' importance. The least applied process innovation is the use of new or improved methods for the leverage of services (process B) indicated by 71.6% of the firms, of which 55% was of 'medium and high' importance. This implies that firms are least willing to invest in high cost innovations. In general, it can be stated that 85.3% of the firms have relatively more new and improved

processes compared to a year ago (process F), of which 66.3% were of 'medium and high' importance. See table 8 for more details.

Table 8

Frequency table

Process innovation

	Mean	Std. deviation	Not applied	Low importance	Medium importance	High importance
Process A	1.64	1.041	18	20	35	22
Process B	1.43	1.068	27	13	41	14
Process C	1.49	1.129	24	24	23	24
Process D	1.71	.966	17	13	47	18
Process E	1.65	.965	12	30	32	21
Process F	1.78	1.002	14	18	38	25

Service innovation

The category service innovation is composed by six indicators. The analysis indicates how important the following service innovation was for the organization in the past 12 months. The most applied service innovation is service B, but service A is seen as a more important kind of service innovation within the firm. 85.3% of the firms have indicated to have revised and improved services for their existing market (service A), of which 70.5% have indicated 'medium and high' importance. A slightly higher percentage 88.4% have indicated to have repacked their existing services by a new of improved market introduction (service B). 60% have indicated this as'medium and high' importance. 82.1% of the firms have indicated to accept exclusive questions of clients that are out of the regular services (service E), of which 53.7% are of 'medium and high' importance. Followed by 74.7% of the firms who have indicated to have extened services by adding new or improved services (service C), of which 55.8% are of 'medium and high' importance. The less applied service innovation is the creation and establishment of new lines of services (service D) indicated by 70.5% of the firms, of which 51.6% was of 'medium and high; importance. In general, it can be stated that 81.1% of the firms have relatively more new and improved services compared to a year ago (service F),of which 55.8% are of 'medium and high' importance. See table 9 for more details.

Table 9

Frequency table

Service innovation

	Mean	Std. deviation	Not applied	Low importance	Medium importance	High importance
Service A	1.83	.996	14	14	41	26
Service B	1.78	.980	11	27	30	27
Service C	1.55	1.118	24	18	30	23
Service D	1.46	1.156	28	18	26	23
Service E	1.57	.986	17	27	33	18
Service F	1.62	1.064	18	24	29	24

4.2. Reliability analysis

Before the regression analysis can be executed, the reliability of the measurement scales of the variables first needs to be checked, the extent in which the items measure the same underlying constructs (Pallant, 2005). The items scales are analyzed by means of the Cronbach's alpha reliability coefficients in order to determine the internal consistency of the variables. The reliability coefficient can range from 0 to 1 as it can be considered as a correlation coefficient (Pallant, 2005). Furthermore, the value of the Cronbach's alpha coefficient has to be at least .6 since the unit of analysis is on organizational level (Evers, van Vliet-Mulder & Groot, 2000). Values above 0.7 are preferable (Pallant, 2005; Evers, van Vliet-Mulder & Groot, 2000). Following, the scales of each variable used in the regression model will be discussed. The tables of the reliability analysis can be found in appendix D.

The KM variable is composed by four categories of KM practices. Therefore, the reliability of each category need to be checked. The first category 'knowledge sharing' is measured by five items. The computed Cronbach's alpha is .765. None of the Cronbach's alpha if item deleted has a higher value of .765. The second category 'training and mentoring' is also measured by five items. The Cronbach's alpha is .822. None of the Cronbach's alpha if item deleted has a higher value of .822. The third category 'policy and strategy' is measured by three items. The Cronbach's alpha is .810. However, one item of this category shows a Cronbach's alpha if item deleted value of .922. Thought, this category is only measured by three items and the Cronbach's alpha of the total item scale is above .8, which indicates a good value. Therefore, this item will not be deleted from the scale. The last category 'knowledge capture and acquisition' is measured by five items. The Cronbach's alpha is .279. The overall analysis of this category shows negative values and one of the items show a Cronbach's alpha if item deleted value of .769. After this item is deleted from the analysis, the Cronbach's alpha is .769. Still, one items has a Cronbach's alpha if item deleted value of .777. This is slightly higher than the Cronbach's alpha of the total item scale and therefore not deleted from the scale. The deleted item will be excluded from the regression analysis. Finally, the four categories are taken together in the reliability analysis. The Cronbach's alpha is .870 and none of the categories has a higher Cronbach's alpha if item deleted value of .870. Concluding, only one item of the category 'knowledge capture and acquisition' is deleted from the scale. The overall reliability of the item scale of KM is sufficient and thus measures the same constructs.

Next, the reliability scales of centralization and formalization are discussed. First, the variable centralization is measured by five items. The Cronbach's alpha of the total item scale is .646, which is an acceptable value. However, two of the items show a Cronbach's alpha if item deleted value of .653 and .667. This is slightly higher than the Cronbach's alpha of the total item scale and also because of its theoretical relevance for the measurement of the variable centralization. So therefore, these two items will not be deleted from the scale. The other task coordination scale is formalization, also measured by five items. The Cronbach's alpha scale is .767. But one item shows a Cronbach's alpha if item deleted value of .827. This is higher than the total item scale. Since the measurement items are derived from the theory and its theoretical relevance, these items will not be deleted from the scale. Furthermore, the Cronbach's alpha of the total item scale has a rather good value above .7, thus, sufficient to keep all items in the scale.

Finally, the reliability scales of process- and service innovation are discussed. Process innovation is measured by six items. The analysis shows a Cronbach's alpha value of .878. Also none of the items has a Cronbach's alpha if item deleted value higher than .878. The used scales for process innovation is therefore sufficient and indicates a good internal consistency of the item scales. Next, service innovation is also measured by six items and has a Cronbach's alpha of .890, which is a very good value. However, one of the items show a Cronbach's alpha of .897, which is slightly higher and marginal. Thus, this items will not be deleted from the scale.

All in all, the reliability analysis shows that scales in this research are all sufficient and reliable. The four categories of KM practices show a Cronbach's alpha values of respectively above .7 and .8. Though, one item of the category 'knowledge capture' is deleted from the scale. The two innovation variables also has a Cronbach's alpha values above .8, which indicates a very good scale. The variable formalization also has a Cronbach's alpha value above .7. Except for Centralization, this scale has a Cronbach's alpha of .646, which is acceptable. In general, all the scales are sufficient and reliable.

4.3. Factor analysis

In the following part, the factor analysis is executed in order to check the validity of the factors of the items. First, the Kaiser-Meyer-Olkin of Sampling Adequacy (KMO) will be check, which must have a value above .6 and the Barlett's Test of Sphericity has to be significant (Pallant, 2005). Furthermore, to determine the total component, each component must have a recorded eigenvalue above 1 to be considered as one factor. Another way to determine the number of factors is to check the Component Matrix, which have to shows strong items loadings within one component. More detailed tables are shown in appendix E.

The variable KM is composed by four categories of KM practices which is indicated by 18 items. These items are assessed in the factor analysis. The results show a KMO value of .791 and the Barlett's Test of Sphericity is shown significant. The results also show that the first components have a recorded eigenvalue above 1, which means that this variable is composed by four components, thus the four categories of KM practices. In the Component matrix, all items show strong items loading between .5 and .7, which means that all items can also be seen as one factor, as KM.

Next, task centralization and formalization are jointly assessed in the factor analysis. The results show a KMO value of .661 and is shown significant. However, the results show that the first three components have a eigenvalue above 1, which means that there is three factors. Though, the component matrix only shows strong items loading on formalization and intermediate items loadings on centralization. Also, both centralization E and formalization E shows a negative value, this is due to the reverse scores of the items. Though, we decided to keep the items for both centralization and formalization since the KMO above .6 is an acceptable value and is shown significant.

Finally, process- and service innovation are also jointly set in the factor analysis. The results show a KMO value of .876 and is shown significant. The first two components show eigenvalue above 1. This is correct, as process- and service innovation is put together in the analysis. The items in the component matrix shows strong item loadings. This confirms the fact that both factors can put together as one component, but also shows clearly that this is composed by two factors.

Concluding, the statistical quality of this analysis is quite high, which means that the validity of the items is also high. However, only centralization and formalization shows less strong items loadings. Though, we have decided not to adjust any of the items of centralization and formalization. This is because the items and indicators are derived from previous research and commonly used in theoretical literature. In additions, it is not necessary to execute an factor analysis because it is already determined as a factor in literature and the theoretical cohesion between the items is clear.

4.4. Pearon's correlation matrix

In below table the Pearson's correlation matrix is presented. The Pearson's product-moment were preformed to ensure no violation of the assumptions of normality, linearity and homoscedasticity (Pallant, 2005). The table shows that the correlations are positive and significant to a large extent. The categories of KM are separately assesd in the correlation analysis. The results show that all KM categories have positive correations on both process- and service innovation. This imply that there is a relationship between the KM practices and innovation. This may conclude the confirmation of hypothesis 1 and 2. Also, both centralization and formalization shows positive and significant correlations with innovation. This indicates that there is a relationship between the variables. However, it doesn't indicates that the variable causes the other variable because of a possible influence of a third variable (Palant, 2005). As both centralization and formalization are seen as moderating variables, hypothsesis 3 and 4 cannot be confirmed in this correlation analysis. In addition, other findings can be derived in this correlation analysis. Both external and internal knowledge shows strong correlations with innovation and are shown significant. This may imply that there is a relationship between the use of external and internal knowledge sources and innovation. This confirms the additional hypothesis 5 and 6. Furthermore, the KM categories shows strong relationships with the external and internal knowledge sources. This implies that these variables may be interacting with eachother. This could be an interesting point for future research.

Table 9

Means, Standard Deviations, and Correlations among Variables (N = 95)

		M	SD	1	2	3	4	5	6	7	8	9	10	11	12
1	Firm age	2,7534	1,03352	1,000											
2	Firm size	3,8110	1,94223	,526**	1,000										
3	Sharing	12,6526	3,92420	,201	,437**	1,000									
4	Training	13,6526	3,83092	,381**	,410**	,593**	1,000								
5	Policy	6,0632	3,46966	,291**	,412**	,697**	,596**	1,000							

6	Capture	10,9789	2,73659	,177	,118	,600**	,568**	,554**	1,000						
7	Centralization	479,1579	176,32648	,097	,115	,539**	,539**	,546**	,537**	1,000					
8	Formalization	515,6421	255,07450	,339**	,211*	,706**	,683**	,807**	,674**	,647**	1,000				
9	External Knowledge	30,3544	12,34238	,371**	,586**	,760**	,708**	,600**	,637**	,419**	,599**	1,000			
10	Internal Knowledge	32,9294	9,00237	,365**	,357**	,431**	,667**	,484**	,558**	,403**	,520**	,680**	1,000		
11	Process innovation	9,7053	4,87258	,304**	,449**	,296**	,295**	,274**	,266**	,296**	,208*	,464**	,539**	1,000	
12	Service innovation	9,8105	5,07244	,166	,269**	,285**	,354**	,227*	,387**	,299**	,200	,540**	,671**	,721**	1,000

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

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

4.5. Hierarchical multiple regression analysis

In the following part, hierarchical multiple regression analysis was applied to test the hypotheses. First, the data has to be checked whether there is no multicollinearity between the variables in the models. This will be done by checking the VIF value and the Tolerance value. According to Pallant (2005), the VIF may not exceed the value of 10 and the tolerance may not go beyond the value of 0.10. Consequently, no VIF value and Tolerance value exceeds the criteria in the models. Thus, there is no multicollinearity problems, no variables are highly correlated to each other (see tables in the appendix G). Hence, the dataset is now ready to be analyzed.

4.5.1. Knowledge management and process innovation

The first part of the multiple regression analysis in this research regards to the statistical testing of the influence of the independent variable KM on the dependent variable process innovation. To test this relationship, the variables will be entered in steps into the model in order to assess the prediction of the dependent variable. The first model includes the dependent variable process innovation and the two control variables firm age and firm size. The results in de model summary shows that the control variables explain 20.8% of the variance in the dependent variable at the significant level of p=<0.01. In the second model, the main effect and independent variable knowledge management is added to the model. The R square now increases indicating that the model now explain 23.1% of the variance at the significant level of p=<0.01. In the third model, the interaction effect centralization and formalization is added to the model. The model now again increase in R square explaining 28% of the variance at the significant level of p=<0.01. Concluding, all model are shown significant. See more detailed tables in appendix G.

In the first model, the standardized Beta coefficients of the control variables Firm Age and Firm Size are positive and respectively β=0.093 and β=0.400. This indicates that the larger and older the firm, the greater the process innovation of the firm. However, only Firm Size is shown significant at the level of p=<0.01.

In the second model, the independent variable KM is added to the regression analysis. The results show a positive relationship (β=0.171) between KM and process innovation at the significance level of p=<0.10. Although, this is a less strict significance level.The significance level is a arbirtarial choice, however, the significance level of 10% is really the reporting limit (Van den Ende & Verhoef, 1973). Thus, this may confirm Hypothesis 1, the more KM practices is applied within the firm, the greater the firm's ability to innovate on the internal processes.

In the third model, both interaction effect centralization and formalization are added to the regression analysis. The results show that the positive effect of KM is increased (β=0.194), but not significant anymore. Also the interaction effect centralization is positive related (β=0.288) to process innovation at the significance level of p=<0.05. This implies that the relationship between KM and process innovation is positively moderated by the level of centralization, confirming hypothesis 3a. The interaction effect formalization shows a negative effect (β=-0.256) on process innovation. However, this relationship is not significant. Therefore, hypothesis 3b is not confirmed. More detailed tables are presented in appendix G.

Table 10

Results of regression analysis

Process innovation

Variables	Model 1	Model 2	Model 3
Centralization			.288**
Formalization			-.256
KM		.171*	.194
Firm Age	.093	.071	.135
Firm Size	.400***	.338***	.316**
R Square	.208	.231	.280
Adjusted R Square	.191	.206	.240
R2 change	.208	.231	.280

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

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

*. Correlation is significant at the 0.10 level (2-tailed).

4.5.2. Knowledge management and Service innovation

The second part of the multiple regression analysis in this research regards to the statistical testing of the influence of the independent variable KM on the dependent variable service innovation. To test this relationship, the same steps are conducted to assess the prediction of the dependent variable service innovation. The first model includes now the dependent variable service innovation and the two control variables firm age and firm size. The results in de model summary shows that the control variable only explains 7.3% of the variance in the dependent variable at the significance level of p=<0.05. In the second model, the independent variable knowledge management is added to the model. The R square now explain 15.1% of the variance at the significant level of p=<0.05. In the third model, the interaction effect centralization and formalization are added. The model increases in R square explaining 21.7% of the variance at the significant level of p=<0.05. Concluding, all models are significant at the level of p=<0.05. More detailed tables are presented in appendix G.

The main finding of the second regression analysis is that there is also a positive relationship between KM and service innovation. The coefficients of each variables on service innovation is presented in below table 11. In the first model, the standardized Beta coefficients of the control variables Firm Age and Firm Size are positive and respectively β=0.034 and β=0.251. Again, only firm size is shown significant at the level of p=<0.05, indicating that the larger the firm, the greater the service innovation in the firm.

In the second model, the independent variable KM is added to the regression analysis. The results show a positive relationship (β=0.311) between KM and service innovation at the significance level of p=<0.01. This confirmed hypothesis 2, the more KM practices is applied within the firm, the greater the firm's ability to innovate on the firm's services.

In the third model, both interaction effect centralization and formalization is added to the regression analysis. The results now show a large increase of the standardized Beta coefficient of KM (β=0.621) at the significance level of p=<0.01. The interaction effect centralization has a positive relationship with service innovation. The standardized Beta coefficient is β=0.218 at the significance level of p=<0.05. Therefore, hypothesis 4a is confirmed. The interaction effect formalization shows again a negative effect on service innovation. But in this model the relationship is significant at the level of p=<0.05. Therefore, hypothesis 4b is also confirmed. More detailed tables are presented in appendix G.

Table 11

Results of regression analysis

Service innovation

Variables	Model 1	Model 2	Model 3
Centralization			.218**
Formalization			-.514**
KM		.311***	.621***
Firm Age	.034	-.006	.105
Firm Size	.251**	.138	.030
R Square	.073	.151	.217
Adjusted R Square	.053	.123	.173
R2 change	.073	.151	.217

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

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

*. Correlation is significant at the 0.10 level (2-tailed).

4.6. Additional analysis

In the next section, the descriptive statistics of the use of external and internal knowledge sources are presented and discussed. Furthermore, the reliability and the validity of the scale and items will be check. Finally, the results of the regession analysis of the relationship between external and internal knowledge sources and innovation will be discussed.

4.6.1. Statistics of the use of external and internal knowledge sources

Both independent variables external and internal knowledge sources are composed by 14 items. External knowledge sources: (a) books, (b) popularizing articles, (c) scientific articles, (d) websites, (e) licensed methods and concepts, (f) competing consultants, (g) consultancy partners, (h) clients, (i) academics, (j) research institutes, (k) education programs, (l) conference/ lectures, (m) courses/ workshops and (n) external communities of practice. Internal knowledge sources: (a) own personal experience, (b) own qualitative research, (c) own quantitative research, (d) own literature study, (e) company library, (f) intranet, (g) documented experiences, (h) colleagues, (i) internal researchers, (j) graduates, (k) internal education program, (l) internal conferences/ lectures, (m) internal courses/ workshops and (n) internal community of practice. Also in this additional analysis, the percentage are composed by PSFs who have answered 'rarely to always'. Firms who have answered 'never' will be excluded from the analysis and again, firms who answered 'often and always' shall be included in the conclusion which indicates a frequent used of certain source.

External knowledge sources

The use of external knowledge sources indicates the extent in which firms use the following external sources in the past 12 months. The most used external sources are respectively websites (d), books (a), clients (h) and consultancy partners (g). None of the firms answered 'never' on these items. The percentage of firms who have answered 'often and always' are respectively (d) 85.9%, (a) 63.5%, (h) 64.7% and (g) 45.9%. These are also sources in which firms have easy access and in combination of internactions in their daily operations. Furthermore, licenced methods and concepts (e); competing consultants (f) and research institutes (j) were less used by the firms. The remaining sources are used by at least 75% of the firms. Hence, firms who have answered 'often and always on these sources vary from 40 to 45%. This implies that firms do not regard these sources as a favorable way to acquire knowledge, but are still essential. See table 12 for more details.

Table 12

Frequency table

External knowledge sources

	Mean	Std. deviation	Never	Rarely	Sometimes	Often	Always
External A	2.89	.900	0	4	27	28	26
External B	2.54	1.007	3	5	35	26	16
External C	2.60	1.082	2	11	27	23	22
External D	3.12	.762	0	4	8	47	26
External E	1.72	1.259	21	14	28	14	8
External F	1.86	.990	9	15	43	14	4
External G	2.52	.683	0	2	44	32	7
External H	2.76	.908	0	9	21	37	18
External I	1.85	1.190	18	9	30	24	4
External J	1.81	1.139	18	8	33	24	2
External K	2.33	1.127	9	4	29	31	10
External L	2.26	1.093	10	6	27	36	6
External M	2.61	1.166	8	6	14	40	17
External N	2.06	1.158	10	15	26	25	9

Internal knowledge sources

The use of internal knowledge sources indicates the extent in which firms use the following internal sources in the past 12 months. The most used internal knowledge sources are firms own experiences (a) and experiences of workers (h), respectively (a) 94.1% and (h) 97.%. Again, the use of these sources are very likely because of the easy access and the interaction between colleagues. Followed by qualitative research (b) and documented experiences (g) of which respectively 60% and 64.7% who has answered 'often and always'. Other internal sources are used less frequent, but are still important sources to acquire knowledge. The less used sources are internal researchers (i) and graduates (j) in order to acquire knowledge. Although, 85.9% of the firms indicated to use graduates as internal sourcs, only 17.6% has answered 'often to always'. More details are shown in below frequency table 13.

Table 13

Frequency table

Internal knowledge sources

	Mean	Std. deviation	Never	Rarely	Sometimes	Often	Always
Internal A	2.95	1.180	5	4	14	27	37
Internal B	2.30	1.268	15	8	13	41	10
Internal C	1.93	1.261	17	10	23	29	6
Internal D	2.34	1.199	10	6	31	24	16
Internal E	1.97	1.215	12	19	25	21	10
Internal F	2.31	1.512	18	10	8	26	23
Internal G	2.56	1.300	12	4	16	33	22
Internal H	3.13	.950	2	4	10	36	35
Internal I	1.56	1.523	35	8	17	11	14
Internal J	1.62	1.026	12	28	32	11	4
Internal K	1.71	1.346	24	14	20	21	8
Internal L	1.88	1.331	19	11	25	20	10
Internal M	2.07	1.362	18	12	14	32	11
Internal N	1.95	1.397	20	12	21	20	14

4.6.2. Reliability and factor analysis

Before the regression analysis can be done, again the scales and items needs to checked on their reliability and validity. The external knowledge sources is measured by 14 items. The Cronbach's alpha value is .873. None of the items has a Cronbach's alpha if item deleted value higher than .873, which indicates that the internal consistency is very good. The internal knowledge sources is also measured by 14 items. The Cronbach's alpha value is .916 and again none of the items has a Cronbach's alpha if item deleted value higher than .916. Both scales are of good reliability.

Also the validity of the items are tested by means of a factor analysis. External knowledge is indicated by 14 items. The KMO value is .776 and is shown significant. The same goes for internal knowledge sources, which is also indicated by 14 items. The KMO value is .758 and again significant. Both variables show more components, as in the results show four components that is higher than 1. Though, all items have strong loadings, thus means that these items can be seen as one factor.

4.6.3. External and internal knowledge sources and process innovation

In this part of the additional analysis, we will also test the relationship between the use of external and internal knowledge sources on the innovative performance of the firm by means of a multiple regression analysis. First, the relationship between the two independent variables, the use of external and internal knowledge sources on the dependent variable process innovation. After, the relationship of the independent variable on the dependent variable service innovation. More detailed tables are presented in appendix H.

In this multiple regression analysis, the same control variables are used. The analysis includes two models. The first model only includes the control variables and in the second model, the two independent variables are added. The regression analysis provide the following results: the model summary shows that the control variables explain 25.6% of the variance on process innovation. In the second model, the two independent variables are added in the analysis. The R square now increases to 42.9%. Both models are shown significant at the level of p=<.01.

In the first model, both control variables has a positive relationship with process innovation. The standardized Beta coefficient of the control variables Firm Age and Firm Size are respectively β=.015 and β=.498. The coefficient of Firm Age is very weak and is shown not significant. In addition, the coefficient of Firm Size is strong and is significant at the level of p=<.01. This implies that the larger the firm, the greater the process innovation of the firm.

In the second model, the two independent variables external and internal knowledge sources are added to the analysis. The results show that the use of internal knowledge source has a weak and negative relationship on process innovation. Also this relationship is not significant. This effect shall therefore not taken into consideration, thus hypothesis 6a is not confirmed. In addition, the use of external knowledge shows a strong and positive relationship with process innovation, and is shown significant at the level of p=<0.01. This confirms hypothesis H5a, the more the firm uses external knowledge sources, the greater the process innovation of the firm if one controls for firm age and firm size.

Table 14

Results of additional regression analysis

Process innovation

Variables	Model 1	Model 2
Internal Knowledge sources		-.050
External Knowledge sources		.480***
Firm Age	.015	-.086
Firm Size	.498***	.409***
R Square	.256	.429
Adjusted R Square	.235	.397
R2 change	.256	.429

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

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

*. Correlation is significant at the 0.10 level (2-tailed).

4.6.4. External and internal knowledge sources and service innovation

In the second part of the regression analysis, the relationship between external and internal knowledge sources on service innovation is tested. This analysis shall again included two models, one with the control variable and the second with the independent variables. The first model shows that the control variables only explain 8.8% of the variance. This is clearly less than the first analysis. However, the second model where the independent variables are added. The model now explains 60.2% of the variance and this is clearly stronger than in the first analysis. Both models are shown significant.

In the first model, only Firm Size is shown positive and less strong (β=.327) than in the first analysis. Again, only Firm Size is significant at the level of p=<.01. In the second model, the use of internal knowledge sources has again a weak relationship with service innovation and is shown not significant. Thus, hypothesis 6b is not confirmed. The relationship use of external knowledge on service innovation in addition to the first analysis, is even stronger with a standardized Beta coefficient of β=.726 and is shown significant at the level of p=<.01. This comfirms hypothesis 5b, the more external knowledge sources are used, the greater the service innovation of the firm if one controls for firm age and firm size. The results of this additional analysis will be added to the conclusion.

Table 15

Results of additional regression analysis

Service innovation

Variables	Model 1	Model 2
Internal Knowledge sources		.097
External Knowledge sources		.726***
Firm Age	-.087	-.265***
Firm Size	.327**	.102
R Square	.088	.602
Adjusted R Square	.064	.580
R2 change	.088	.602

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

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

*. Correlation is significant at the 0.10 level (2-tailed).

5. Conclusion and discussion

In this last chapter, the research question will be answered and the main research findings will be discussed in the light of the theory. Furthermore, some recommendation will be given for future research and in the end some limitations of this research will be discussed.

5.1. Conclusion

In the research, the following research question was formulated: *"what is the effect of knowledge management on the innovative performance of PSFs and how is this relationship moderated by task centralization and formalization?* " In order to answer the research question, four hypotheses were formulated and tested. The first two hypotheses are concerning the main effect of the relationship between KM and process- and service innovation. The last two hypotheses are concerning the moderating effect of task centralization and formalization on the relationship between KM and process- and service innovation. The hypotheses will be discussed in the next section. Furthermore, some other research finding will be discussed after and finally the findings of the additional analysis will discussed.

Based on the findings of the statistical analysis it can be concluded that hypothesis 1 and 2 are confirmed. The level of KM is positively related to the innovative performance of the PSFs if one controls for firm age and firm size. Therefore, it can be concuded that if the level of KM increases, both procese- and service innovation of the PSFs also increases. But, notice that the effect of KM on process innovation is less strong and less significant compared to the effect of KM on service innovation (see tables 10 and 11, appendix G). Furthermore, the statistical analysis have shown that hypothesis 3 is confirmed and hypothesis 4 is partly confirmed. The relationships between KM and process- and service innovation are positively moderated by task centralization if one controls for firm age and firm size. It can be concluded that the effect of KM on both process- and service innovation is greater if moderated by a higher level of task centralization. Hypothesis 4b is also confirmed. The relationship between KM on serice innovation is negatively moderated by task formalization if one controls for firm age and firm size. This suggest that the effect of KM on service innovation turns negative if moderated by a higher level of task formalization. The relationship between KM on process innovation also shows a negative effect if moderated by task formalization, but is however not significant. So in general, the research question can be answered and it can be concluded that KM has a positive effect on process- and service innovation of PSFs. This relationship is positively moderated by task centralization and only the relationship between KM and service innovation is negatively moderated by task formalization.

Besides this main conclusion, other research findings are provided. Starting with the results of the statistics of KM practices. The most used KM practices categories by the means are ordered in array: knowledge sharing, training and mentoring, knowledge capture and finally knowledge policy and strategy. The most used KM practices within the categories based on the frequencies are: knowledge sharing through docuemented results of projects, knowledge, skills, knowhow and methods; updated and stored databases; external trainings; knowledge capture from the internet and literature. The less used KM practices within the categories are to use written docuementations for daily operations; the use of external experts to obtain knowledge; written KM documents. In general, most of the KM practices are used often and always by more than half of the PSFs.

Furthermore, it can be concluded that most of the PSFs have an intermediate level of centralized tasks. However, there are expections if taken into the extrems such as no influence of decisions, small matters and reference to higher supervisions. However, there is also some space for workers to decide things on their own with respect to the fulfillment of tasks. The same goes for the formalization of tasks which is on intermediate level. Most of the tasks are formalized, either explicit or tacit, to some extent. However, some situation could arise where there is not procedure for it. Though, most workers know what steps to take and may off track rules and procedures if necessary.

Finally, some conclusion can be derived from the innovative performance of PSFs. There are relatively more service innovation than process innovation within PSFs based on the means. The most applied process innovations are new or improved developments activities in order to increase the internal knowledge and internal administration and operations. The less applied process innovation is the use of new or improved methods for the leverage of service such as hardware, software and outsourcing. The most applied service innovations are revised and improved service, repackaged of existing services for the existing and new markets. In general, more than half of the PSFs have indicated to have relavtively more new and improved process- and service innovations compared to a year ago.

At last, some conclusion can be made from the additional analysis. Based on the statistical results of the additional analysis it can be concluded that hypothesis 5 is confirmed. The level of external knowledge sources is positively related to the innovative performance of the PSF it one control for firm age and firm size. If the use of external knowledge sources increase, both process- and service innovation also increases (see table 14, 15 and appendix H). The most frequent used external knowledge sources are websites, books, clients and consultancy partners. The less used frequent external sources are licensed methods, competing consultants and research institutes. The most frequent used internal knowledge sources are mainly tacit experiences, explicit expiences and qualitative researches. The less frequent used internal sources are internal researchers and graduates.

5.2. Discussion

In the theoretical frameworks and literature it was suggested that KM increase the firm's ability to create and apply diverse knowledge in order to develop new and revolutionary process- and service innovations (Coombs et al., 1998). The research findings of this thesis clearly confirm and support this statement. The findings provide an answer to our research question, Knowledge management has a positive effect on the innovative performance of PSFs. Firms which intensively apply KM in their organizations have shown significant increased innovative processes and services.

This also gives answer to a fundamental question in organization theory why some PSFs are more succesfull than others that have the same or more resources. Drawing from both the resources based view theory and absorptive capacity literature the idea is addresses which assume that knowledge resources and capabilities controlled by a firm are the determinants of its subsequent performance and enable certain firms to outperform others (Barney, 1991). In line with this idea, KM basically increases the firm's internal knowledge base by means of knowledge acquirements from other knowledge sources and the distribution of both explicit and tacit experiences, know-how and expertise within the firm. Hence, the stronger its internal knowledge base, the better they are able to combine diverse knowledge and the application of knowledge. Firms require a strong internal knowledge base themselves in order to benefits from resources complementarities (Lavie, 2006). As a result, the development of unique and specified knowledge resources in the forms of process- and service innovations that are hard to imitate by others firm. In addition, the idea of absorptive capacity was suggested to be the underlying mechanism that converse knowledge resources into innovative outputs (Cohen & Levinthal, 1990). Hence, the internal knowledge base confers an ability to recognize the value of new information and knowledge, assimilate it, and apply it to commercial ends (Cohen & Levinthal, 1990). For instance, firms may be able to recognize new and relevant information and knowledge for a particular market, knowledge and experiences may provide the firm new insight of methods or process for the leverage of services.

The results of this research are in line with both theories. KM is basically the complementary link between the firm's accesable knowledge resources and the ability to exploit these resources. Concluding, the more intense KM within the firm, the stronger the firm's internal knowledge base. The stronger the firm's internal knowledge base, the greater its ability to absorb and exploit existing and new knowledge into innovative process- and service developments. Thus, the greater the firm's innovative performance.

The findings of this research also indicates that the coordination of tasks have both an increased or reduced effects on KM and innovation. The theoretical frame work suggest

that task centralization may foster the management of knowledge resources to support management decision making to enhance competitiveness and to increase capacity for innovations (Boh, 2007). On the other hand, task formalization may hamper the firm's flexibility and creativity which results in a decreased innovative and customized solutions (Gadrey & Gallouj, 1998). Both arguments are in line with the theorectical statements and confirmed by the research findings.

Finally, the findings of the additional analysis indicates that PSFs acquire and use diverse knowledge from either external and internal knowledge sources. The main result of the additional analysis is that there is a positive relationship between the use of external knowledge sources and the innovative performance of PSFs. The fact that mainly external knowledge sources contributes to the innovative performance shows that open innovation is significant (Chesbrough et al., 2008). Internal knowledge sources turn out to be less important in the generation of innovative performance, althought this is used very habitually in practice. Perhaps, it is more effective to pay more attention to the use of external knowledge sources e.g. collaborations with different actors such as clients, alliances, competitors or research institutes. Instead the focus on the use of internal knowledge sources, PSFs should rather focus on the firm's internal intelligence level and learning skills of professionals, thus to increase the internal knowledge base which in turn increases the firm's absorptive capacity.

5.3. Recommendation for future research

The insight of the research findings may provide and suggest several recommendation for future researches. The literature as well as the research findings show that KM has a positive effect on the innovative performance of the firm. First of all, KM is distinguish in four catorgies and indicated by 18 items of KM practices. Scholars should take notice of the KM practices that are not included in this questionnaire, but are used in practice. One should incorporate those practices in order to create a complete as possible list of KM practices. Secondly, in spite of only KM practices, future research should incorporate reasons and results of using certain KM practices. This way it may provide more insight in the importance and effectiveness of KM practices. Third, this research only has included process- and service innovation. Future research should incorporate organizational innovations as well as the extent in which the innovations are incremental or radical. This way, it may provide broader view of the firm's innovative outputs. Fourth, organizational characteristics are also important factors that may influence the firm's KM and innovative performance. Organizational characteristics such as: (non) technology based, R&D intensity, and % of highly educated personnel maybe determinant factors. Finally, the relationship between KM, the use of external and internal knowledge sources and innovative performance are examined separately. However, based on the research findings it can be assumed that there is a possible interaction effect between the use of external and internal

knowledge sources and the level of KM. This may increase the prediction of the firm's innovative performance. Future research should included external and internal knowledge sources as moderating variables.

5.4. Limitations

The goal of this research has been accomplished. The relationship between KM and the innovative performance of PSFs is successfully examined and an answered is given to the research question. Though, it is necessary to reflect on the quality indicators and limitations of this research.

First, the steps in this research process are described in details as much as possible. This makes replication of this research with the same research findings possible which may increase the reliabilty. Second, the reliability of the item-scales are checked by means of a reliability analysis. All most all of the item-scales of the variables show no violations of the Cronbach's alpha value except for one item. This items is therefore removed from the scale. This can be concluded that the item-scales have measured the same underlying contructs, which is benefitial for the internal consistency of the variables. The reliability of this research can therefore be named of good reliability.

The operationalization of the items and indicators are derived from previous research and literatures, which is good for the construct validity. Furthermore, to amplify the validity of the construct, the items and indicators are tested by means of a factor analysis to determine the underlying factors, which has led to an adequate operationalization. The analysis shows rather high item loadings of the indicators. However, only the indicators of centralization and formalization shows rather less strong items loadings. Though, still sufficient to keep in the scale. Furthermore, the use of control variables contributes to the internal validity of this research, to the extent in which these variables have interfered in the causal relationship between the independent and dependant variable. The validity of this research can therefore be named of good validity.

However, there are some limitations to mention. The first limitation is that the explained variance of the dependent variable is rather low. In the regression model with the most favourable position of the independent variables only explain 28% of process innovation and 21% of service innovation. This can be seen as one limitation of this research. Though, it can be concluded that the independent variable KM have explained a valid part of the variance of the dependent variables. The second limitation is that the response rate was very low. It was very hard to approach firms that are willing to cooperate with this research. Out of approximately 2000 contacted firms by email and telephone, only 95 firms participated. Though, N=95 is still a low rate and is really the mimium observation size. As a results, the industy variable was not added as control variable. The sub-samples

would be to small to compare. This is the third limitation. Students and scholars should take these limitations into considerations in future research.

6. References

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Appendix A - Operationalization table

Operationalization Table

Variable	Dimension	Indicator	Items
Dependent variables			
Process innovation Four point answer scale ranging from (1) not important; (2) low important; (3) medium important; (4) high important	New or improved	Customer service	Process A
		Methods for the leverage of services	Process B
		Methods for the production of services	Process C
		Development activities of employees	Process D
		Internal administration and operations	Process E
		Processes compared to a year ago	Process F
Service innovation Four point answer scale ranging from (1) not important; (2) low important; (3) medium important; (4) high important	New or improved	Services for existing market	Service A
		Services for new markets	Service B
		Extended services	Service C
		Lines of service	Service D
		Exclusive services	Service E
		Services compared to a year ago	Service F
Independent variables			
Knowledge management Five point Likert scale ranging from 1) never; (2) rarely; (3) sometimes; (4) Often; (5) Always	Knowledge sharing	Documented results of projects, know-how, methods and other information	Sharing A
		Knowledge share through meetings	Sharing B
		Knowledge share through virtual project teams	Sharing C
		Storage of documentation	Sharing D
		Documentation for daily operations	Sharing E
	Training and mentoring	Formal trainings	Training A

		Mentor- and apprenticeships	Training B
		Knowledge transfer	Training C
		Training costs compensation	Training D
		Off-site trainings	Training E
	Policy and strategy	Written KM policy	Policy A
		Sharing and development culture	PolicyB
		Partnership or alliance policy	Policy C
	Knowledge capture and acquisition	Knowledge from other industry	Capture A
		Knowledge from research institutes	Capture B
		Knowledge from internet or literature	Capture C
		Energy spent to obtain external knowledge	Capture D
		Knowledge from experts	Capture E
External knowledge sources		Books	External A
		Popularizing articles	External B
		Scientific articles	External C
Five point Likert scale ranging from 1) never; (2) rarely; (3) sometimes; (4) Often; (5) Always		Websites	External D
		Licensed method/ concepts	External E
		Competing consultants	External F
		Consultancy partners	External G
		Clients	External H
		Academics	External I
		Research institutes	External J
		Educational program	External K
		Conference/ lectures	External L
		Course/ workshops	External M
		External community of practice	External N
Internal knowledge sources		Personal experience	Internal A
		Qualitative research	Internal B
		Quantitative research	Internal C
Five point Likert scale ranging from 1) never; (2) rarely; (3) sometimes; (4) Often; (5) Always		Literature study	Internal D
		Company library	Internal E
		Intranet	Internal F

	Documented experiences	Internal G
	Colleague	Internal H
	Internal researchers	Internal I
	Graduates	Internal J
	Internal educational program	Internal K
	Internal conference/ lecture	Internal L
	Internal course/ workshops	Internal M
	Internal communicty of practice	Internal N
Moderating variables		
Centralization Five point Likert scale ranging from 1) never; (2) rarely; (3) sometimes; (4) Often; (5) Always	Decisions taken by supervisor	Centralization A
	Influence on decisions	Centralization B
	Small matters	Centralization C
	Decision making	Centralization D
	Free decisions	Centralization E
Formalization Five point Likert scale ranging from 1) never; (2) rarely; (3) sometimes; (4) Often; (5) Always	Written procedures	Formalization A
	Rules and procedure violation	Formalization B
	Unexpected situations	Formalization C
	Rules and procedure	Formalization D
	Off track rules and procedure	Formalization E
Control variables		
Firm age Natural logarithm	Years of existence	Firm age
Firm size Natural logarithm	Number of employees	Firm size
Industry	Firm activity	Industry

Appendix B - Questionnaire

Tilburg's university, Organization studies

Knowledge management Practices in Professional Service Firms, 2011

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Welcome to this survey conducted by Tilburg's university. First, we want to thank you for participating to this survey. The department of Organization Studies is conducting a survey among professional service firms. The aim of this research is to gain insight to which knowledge management activities are used by professional service organization in practice in the past 12 months.

Why this research?
Knowledge plays an important role in nowadays organization and in the knowledge economy even a major role. Knowledge management is an approach in which the role of knowledge in organizations is central. In order to coordinate and support knowledge workers effectively, it is necessary to utilize knowledge to its surplus value. The aim of this research is to determine the relationship between an active knowledge management policy and the innovative performance of organizations. The results of this research will lead to some recommendations of effective knowledge management practices.

This survey will consist of the following topics: Knowledge management practice, task centralization and –formalization and innovative performances.

Filling in this survey will takes about approximately 15 minutes. Your data will be treated with **strictest confidentiality**, will only be used for the purpose of this study and presented anonymous. It is illegal for us to reveal your data or identify your business to unauthorized persons or organizations.

Instructions
Please answer the questions as below. You can choose the following answers:

1= Never 2= Rarely 3= Sometimes 4= Often 5= Always

Example

1. Does your firm work together with Universities?

   Never 1 2 (3) 4 5 Always

   Circle the best answer.

To start the survey, please click on the hyperlink below.

http://kpang-uvt-edu.survey.netq.nl/nq.cfm?q=26eaa0ca-d2ab-48e9-a6cc-772421e4e206

If you require assistance in the completion of this questionnaire or have any questions regarding the survey, please contact:

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Your response is very much appreciated. Thank you for participating!

The aim of this research is to determine the relationship between knowledge management practice, task coordination and the innovative performance of PSFs. This survey will handle the following topics: knowledge management practice, task centralization and –formalization and innovative performance in the past 12 months. This survey will end with some optional questions about knowledge sources. First, we will starts with three general questions.

1.1. Please indicate the industry of your firm

Consulting firm	O
Accounting firm	O
Law firm	O
Others:	O

1.2. Please indicate the age of the firm since establishment _____ Years

1.3. Please indicate the numbers of employees in the firm _____ Employees

2. The following questions are about knowledge management practice within your firm. Knowledge management refers to the involvement of any systematic activity related to the capture and sharing of knowledge by the organization.

Please indicate to what extent your organization has applied the following knowledge management practices in the past 12 months.

	Sharing knowledge and information	Never	Rarely	Sometimes	Often	Always
2.1.	Results of projects, knowledge, skills, know-how, methods and other information are documented.	O	O	O	O	O
2.2.	Results of projects, knowledge, skills, know-how, methods and other information are shared through meetings.	O	O	O	O	O
2.3.	Results of projects, knowledge skills, know-how, methods and other information are shared through virtual project teams.	O	O	O	O	O
2.4.	Written documentation are commonly updated and stored in a database.	O	O	O	O	O
2.5.	Written documentations are used for daily operations such as lessons learned, training manuals, reference, and publications.	O	O	O	O	O
	Training and mentoring	**Never**	**Rarely**	**Sometimes**	**Often**	**Always**
2.6.	Formal trainings are used to increase and to share knowledge.	O	O	O	O	O
2.7.	Experience, knowledge and information are shared and passed down through mentor- or apprenticeships.	O	O	O	O	O
2.8.	Experienced workers transfer their knowledge to new or less experienced workers.	O	O	O	O	O

2.9.	Work related training, courses and workshops are (partly) compensated.	O	O	O	O	O
2.10.	Offers off-site training to workers in order to keep skills current.	O	O	O	O	O
	Policies and strategies	Never	Rarely	Sometimes	Often	Always
2.11.	A written knowledge management policy is edited proceeding the financial year.	O	O	O	O	O
2.12.	The knowledge management policy stimulates the corporate culture to promote knowledge sharing and development.	O	O	O	O	O
2.13.	The organization has an active partnerships or alliances policy to acquire knowledge.	O	O	O	O	O
	Knowledge capture and acquisition	Never	Rarely	Sometimes	Often	Always
2.14.	The organization uses knowledge obtained from other industry sources.	O	O	O	O	O
2.15.	The organization uses knowledge obtained from research institutions.	O	O	O	O	O
2.16.	The organization uses the internet or literature to obtain external knowledge.	O	O	O	O	O
2.17.	The organization spent a significant amount of energy to obtain external knowledge.	O	O	O	O	O
2.18.	The organization uses knowledge of external expert or experienced workers to obtain tacit knowledge.	O	O	O	O	O

3. The following questions are about task centralization and – formalization of employees. Task centralization and -formalization refers to the extent to which decision making is concentrated in an organization and the degree to which rules, procedures, instructions, and communications are formalized or written down.

Please indicate to what extent your organization has used the following mechanism (1) centralization and (2) formalization to coordinate the tasks of employees in the past 12 months.

	Task centralization	Never	Rarely	Sometimes	Often	Always
3.1.	In the organization, decisions are taken by the supervisor.	O	O	O	O	O
3.2.	In the organization, workers have no or little influence on a decision.	O	O	O	O	O
3.3.	Even small matters have to be referred to someone higher up for a final decision.	O	O	O	O	O
3.4.	Unit members need to ask their supervisor before they make any decision.	O	O	O	O	O
3.5.	Workers are free to decide things on their own with respect to the fulfillment of the task.	O	O	O	O	O
	Tasks formalization	**Never**	**Rarely**	**Sometimes**	**Often**	**Always**
3.6.	Whatever situation arises, written procedures will deal with it	O	O	O	O	O
3.7.	Workers are regularly checked for rule and procedure violations.	O	O	O	O	O
3.8.	Whatever situation arises, workers know exactly what steps to take.	O	O	O	O	O
3.9.	Rules and procedures needs to be followed in any situation.	O	O	O	O	O
3.10.	Rules and procedures are in attendance to remain in the task framework, but workers may be off track if they like.	O	O	O	O	O

4. The following questions are about innovative performance of your firm. The innovation (new or improved) has to be new to the organization, but does not necessary be new for the sector or market. It doesn't matter whether the innovation is originally developed by your organization of by others.

Service innovation **is the market introduction of a new or improved service with certain characteristics such as: improved software, new components or subsystems.** ***Process innovation*** **the application of a new or improved production process, distribution methods or supporting activities for you services.**

Please indicate what the importance were of the following innovative performance in your firm applied in the past 12 months.

	Process innovation	None	High	medium	Low
4.1.	The organization has new or improved activities for customer service such as: information inquiry and consultation.	O	O	O	O
4.2.	The organization has new or improved methods for the leverage of services such as: hardware, software and outsourcing.	O	O	O	O
4.3.	The organization has new or improved methods for the production of services such as: systems, license for know-how and other forms of knowledge.	O	O	O	O
4.4.	The organization has new or improved development activities focused on the employees in order to increase the knowledge and the application of knowledge such as: training, researches and consulting.	O	O	O	O
4.5.	The organization has new or improved internal administration and operations.	O	O	O	O
4.6.	The organization has relatively more new and improved processes compared to a year ago.	O	O	O	O

	Service innovation	None	High	medium	Low
4.7.	The organization has revised and improved services for the existing market.	O	O	O	O
4.8.	The organization has repackaged existing services by a new or improved market introduction.	O	O	O	O
4.9.	The organization has extended services by adding new or improved services.	O	O	O	O
4.10.	The organization has created and established new lines of services	O	O	O	O
4.11.	The organization accepts exclusive questions of clients out of the regular services.	O	O	O	O
4.12.	The organization has relatively more new and improved services compared to a year ago.	O	O	O	O

Optional

5. **The following part is optional. Below questions only serves as an extension for future researches. Please feel free to answer below questions! Knowledge sources refer to the extent to which internal or external knowledge source your organization acquires or extracts either explicit or tacit knowledge from.**

Please indicate to what extent your organization has used the following knowledge sources in the period from January 2005 – December 2010.

	External sources	Never	Rarely	Sometimes	Often	Always
5.1.	Books	O	O	O	O	O
5.2.	Popularizing articles	O	O	O	O	O
5.3.	Scientific articles	O	O	O	O	O
5.4.	Websites	O	O	O	O	O
5.5.	Licensed method / concept	O	O	O	O	O
5.6.	Competing consultants	O	O	O	O	O
5.7.	Consultancy partners	O	O	O	O	O
5.8.	Clients	O	O	O	O	O
5.9.	Academics	O	O	O	O	O
5.10.	Research institutes	O	O	O	O	O
5.11.	Education program	O	O	O	O	O
5.12.	Conferences/ lectures	O	O	O	O	O
5.13.	Course/ workshop	O	O	O	O	O
5.14.	External community of practice	O	O	O	O	O
	Internal sources	**Never**	**Rarely**	**Sometimes**	**Often**	**Always**
5.15.	Own personal experiences	O	O	O	O	O
5.16.	Own qualitative research	O	O	O	O	O
5.17.	Own quantitative research	O	O	O	O	O
5.18.	Own literature research	O	O	O	O	O
5.19.	Company library	O	O	O	O	O
5.20.	Intranet	O	O	O	O	O
5.21.	Documented experiences	O	O	O	O	O
5.22.	Colleagues	O	O	O	O	O
5.23.	Internal researchers	O	O	O	O	O
5.24.	Graduates	O	O	O	O	O
5.25.	Internal education programs	O	O	O	O	O
5.26.	Internal conferences/ lectures	O	O	O	O	O
2.27.	Internal course / workshop	O	O	O	O	O
2.28.	Internal community of practice	O	O	O	O	O

How long did you take to complete this questionnaire? _____ minutes

If your want to receive a summary of the results of this survey, please fill in your email address

_____

Do you have any comments on the questionnaire? Your opinion is very important to us. Please feel free to add your comments below.

_____

_____

_____

_____

Your response is very much appreciated. Thank you for participating!

Appendix C - Descriptive statistics

Industry

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Consulting	25	26,3	26,3	26,3
	Accounting	28	29,5	29,5	55,8
	Law	27	28,4	28,4	84,2
	Marketing	6	6,3	6,3	90,5
	Others	9	9,5	9,5	100,0
	Total	95	100,0	100,0	

Firm age and Firm size

		Firm age	Firm size
N	Valid	95	95
	Missing	0	0
	Mean	26,97	233,47
	Std. Deviation	33,822	450,871
	Minimum	2	3
	Maximum	196	750

DescriptiveStatistics of all variables

		Sharing	Training	Policy	Capture	KM	Centralization	Formalization	Process	Service
N	Valid	95	95	95	95	95	95	95	95	95
	Missing	0	0	0	0	0	0	0	0	0
	Mean	12,6526	13,6526	6,0632	10,9789	43,3474	10,5684	10,6421	9,7053	9,8105
	Std. Deviation	3,92420	3,83092	3,46966	2,73659	11,72719	2,59563	3,52171	4,87258	5,07244
	Minimum	3,00	3,00	,00	2,00	13,00	6,00	,00	,00	,00
	Maximum	19,00	20,00	12,00	16,00	64,00	20,00	18,00	18,00	18,00

Frequency table Sharing

	Sharing A	Sharing B	Sharing C	Sharing D	Sharing E
Mean	3.08	2.80	1.57	2.69	2.49
Std. deviation	.942	.937	1.251	1.142	1.157
Never	2	4	26	4	6
Rarely	4	4	20	11	15
Sometimes	14	16	21	24	18
Often	39	53	24	28	38
Always	36	18	4	28	18
Total	95	95	95	95	95

Frequency table Training

	Training A	Training B	Training C	Training D	Training E
Mean	2.44	2.37	2.88	3.26	2.69
Std. deviation	.964	.957	.861	1.002	1.195
Never	3	3	0	2	8
Rarely	16	16	6	5	6
Sometimes	25	31	23	14	20
Often	41	35	42	21	34
Always	10	10	24	53	27
Total	95	95	95	95	95

Frequency table Policy

	Policy A	Policy B	Policy C
Mean	1.77	2.09	2.20
Std. deviation	1.292	1.384	1.396
Never	21	22	18
Rarely	18	9	12
Sometimes	23	16	16
Often	25	37	31
Always	8	11	18
Total	95	95	95

Frequency table Capture

	Capture A	Capture B	Capture C	Capture D	Capture E
Mean	2.45	2.39	2.88	3.29	1.33
Std. deviation	.886	.972	.836	.861	.972
Never	5	2	2	0	17
Rarely	8	16	3	8	48
Sometimes	38	32	20	17	17
Often	35	35	49	48	11
Always	9	10	21	22	2
Total	95	95	95	95	95

Frequency table Centralization

	Centralization A	Centralization B	Centralization C	Centralization D	Centralization E
Mean	2.53	1.59	1.61	2.14	2.71
Std. deviation	.873	1.047	.867	.952	.874
Never	2	13	4	2	0
Rarely	7	39	45	23	9
Sometimes	33	24	34	38	24
Often	42	15	8	24	45
Always	11	4	4	8	17
Total	95	95	95	95	95

Frequency table Formalization

	Formalization A	Formalization B	Formalization C	Formalization D	Formalization E
Mean	1.73	1.86	2.62	2.04	1.61
Std. deviation	.961	.963	.840	1.110	1.003
Never	12	4	2	7	7
Rarely	24	32	6	28	43
Sometimes	37	36	28	27	28
Often	22	16	49	23	11
Always	0	17	10	10	6
Total	95	95	95	95	95

Frequency table Process

	Process A	Process B	Process C	Process D	Process E	Process F
Mean	1.64	1.43	1.49	1.71	1.65	1.78
Std. deviation	1.041	1.068	1.129	.966	.965	1.002
Not applied	18	27	24	17	12	14
Low importance	20	13	24	13	30	18
Medium importance	35	41	23	47	32	38
High importance	22	14	24	18	21	25
Total	95	95	95	95	95	95

Frequency table service

	Service A	Service B	Service C	Service D	Service E	Service F
Mean	1.83	1.78	1.55	1.46	1.57	1.62
Std. deviation	.996	.980	1.118	1.156	.986	1.064
Not applied	14	11	24	28	17	18
Low importance	14	27	18	18	27	24
Medium importance	41	30	30	26	33	29
High importance	26	27	23	23	18	24
Total	95	95	95	95	95	95

Appendix D - Reliability statistics

Reliability Statistics- Sharing

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,765	,767	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Sharing A	9,57	11,588	,456	,236	,748
Sharing B	9,84	11,262	,518	,298	,730
Sharing C	11,07	9,729	,526	,320	,729
Sharing D	9,97	10,371	,506	,334	,733
Sharing E	10,16	9,219	,689	,507	,663

Reliability Statistics - Training

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,822	,820	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Training A	11,21	9,934	,627	,469	,784
Training B	11,28	9,908	,639	,484	,781
Training C	10,77	11,393	,437	,263	,833
Training D	10,39	9,474	,680	,672	,768
Training E	10,96	8,339	,712	,709	,759

Reliability Statistics – Policy

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,810	,814	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Policy A	4,29	5,465	,812	,763	,586
Policy B	3,97	5,456	,721	,735	,674
Policy C	3,86	6,651	,477	,262	,922

Reliability Statistics – Capture

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,769	,769	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Capture A	8,09	4,406	,618	,419	,687
Capture B	8,65	4,250	,572	,356	,715
Capture C	8,09	5,129	,438	,198	,777
Capture D	8,09	4,363	,663	,481	,665

Reliability Statistics – Centralization

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,646	,645	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Centralization A	6,63	6,895	,262	,156	,653
Centralization B	7,57	5,716	,409	,306	,591
Centralization C	7,55	5,718	,576	,456	,511
Centralization D	7,02	5,489	,552	,486	,514
Centralization E	7,86	7,034	,229	,174	,667

Reliability Statistics – Formalization

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,767	,773	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Formalization A	8,92	7,780	,690	,501	,670
Formalization B	8,78	8,068	,623	,588	,694
Formalization C	8,02	8,574	,635	,474	,697
Formalization D	8,60	7,604	,582	,394	,708
Formalization E	8,25	9,978	,224	,176	,827

Reliability Statistics – Process

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,878	,879	6

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Process A	8,06	17,209	,631	,460	,866
Process B	8,27	16,329	,726	,601	,850
Process C	8,21	16,083	,705	,558	,854
Process D	8,00	17,872	,604	,417	,870
Process E	8,05	17,008	,729	,595	,850
Process F	7,93	16,835	,718	,580	,852

Reliability Statistics – Service

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,890	,890	6

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Service A	7,98	18,872	,678	,655	,876
Service B	8,03	18,095	,800	,748	,857
Service C	8,26	17,664	,725	,585	,868
Service D	8,35	16,761	,806	,735	,854
Service E	8,24	20,100	,527	,415	,897
Service F	8,19	18,070	,722	,620	,869

Appendix E - Factor analysis

KMO and Bartlett's Test – Knowledge management

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,791
Bartlett's Test of Sphericity	Approx. Chi-Square	1098,944
	df	153,000
	Sig.	,000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7,767	43,149	43,149	7,767	43,149	43,149
2	1,565	8,692	51,841	1,565	8,692	51,841
3	1,464	8,131	59,971	1,464	8,131	59,971
4	1,105	6,139	66,110	1,105	6,139	66,110
5	,954	5,298	71,409			
6	,913	5,071	76,479			
7	,766	4,255	80,734			
8	,702	3,901	84,635			
9	,575	3,197	87,832			
10	,523	2,908	90,740			
11	,385	2,137	92,876			
12	,363	2,015	94,892			
13	,226	1,254	96,145			
14	,216	1,198	97,344			
15	,164	,909	98,252			
16	,127	,704	98,957			
17	,109	,607	99,564			
18	,078	,436	100,000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component			
	1	2	3	4
Sharing A	,548	,335	,127	-,039
Sharing B	,592	,304	-,058	,292
Sharing C	,647	,095	-,387	-,317
Sharing D	,523	-,036	-,427	,351
Sharing E	,774	,000	-,248	,170
Training A	,766	-,255	-,214	,343
Training B	,737	-,014	,050	,082
Training C	,559	,037	,358	-,232
Training D	,532	-,600	,460	,006
Training E	,631	-,609	,208	,023
Policy A	,771	,042	-,392	-,150
Policy B	,754	,000	-,311	-,126
Policy C	,621	,047	-,050	-,446
Capture A	,657	,452	,279	-,284
Capture B	,687	-,009	,180	,179
Capture C	,347	,525	,405	,476
Capture D	,749	,150	,274	-,100
Capture E	-,753	,218	-,128	,017

Extraction Method: Principal Component Analysis.

a. 4 components extracted.

KMO and Bartlett's Test – Task centralization and formalization

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,661
Bartlett's Test of Sphericity	Approx. Chi-Square	298,891
	df	45,000
	Sig.	,000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,007	30,068	30,068	3,007	30,068	30,068
2	2,072	20,722	50,790	2,072	20,722	50,790
3	1,358	13,584	64,375	1,358	13,584	64,375
4	,905	9,054	73,428			
5	,727	7,269	80,697			
6	,581	5,807	86,505			
7	,494	4,940	91,445			
8	,341	3,410	94,856			
9	,275	2,748	97,603			
10	,240	2,397	100,000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component		
	1	2	3
Centralization A	,431	,160	,458
Centralization B	,163	,604	,605
Centralization C	,282	,810	,001
Centralization D	,383	,750	-,121
Centralization E	-,392	-,292	,473
Formalization A	,780	-,293	,030
Formalization B	,820	-,151	-,237
Formalization C	,758	-,240	,128
Formalization D	,711	-,244	-,199
Formalization E	-,229	,389	-,656

Extraction Method: Principal Component Analysis.

a. 3 components extracted.

KMO and Bartlett's Test – Innovative performance

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,876
Bartlett's Test of Sphericity	Approx. Chi-Square	758,203
	df	66,000
	Sig.	,000

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	6,600	55,003	55,003	6,600	55,003	55,003	5,931
2	1,210	10,081	65,084	1,210	10,081	65,084	4,575
3	,984	8,204	73,288				
4	,701	5,839	79,127				
5	,565	4,704	83,831				
6	,487	4,059	87,890				
7	,393	3,275	91,165				
8	,307	2,557	93,722				
9	,246	2,052	95,774				
10	,216	1,797	97,571				
11	,164	1,364	98,935				
12	,128	1,065	100,000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Component Matrix[a]

	Component	
	1	2
Process A	,743	-,190
Process B	,755	-,322
Process C	,755	-,272
Process D	,624	-,383
Process E	,731	-,260
Process F	,770	-,155
Service A	,801	-,096
Service B	,818	,163
Service C	,770	,170
Service D	,795	,434
Service E	,528	,599
Service F	,760	,382

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

Appendix F - Pearson correlation matrix

Correlations

		FirmAge	FirmSize	Sharing	Training	Policy	Capture	ModCentralization	ModFormalization	Intern	Extern	Process	Service
FirmAge	Pearson Correlation	1,000	,526**	,201	,381**	,291**	,177	,097	,339**	,371**	,365**	,304**	,166
	Sig. (2-tailed)		,000	,051	,000	,004	,087	,350	,001	,001	,001	,003	,108
	N	95,000	95	95	95	95	95	95	95	79	85	95	95
FirmSize	Pearson Correlation	,526**	1,000	,437**	,410**	,412**	,118	,115	,211*	,586**	,357**	,449**	,269**
	Sig. (2-tailed)	,000		,000	,000	,000	,256	,268	,040	,000	,001	,000	,009
	N	95	95,000	95	95	95	95	95	95	79	85	95	95
Sharing	Pearson Correlation	,201	,437**	1,000	,593**	,697**	,600**	,539**	,706**	,760**	,431**	,296**	,285**
	Sig. (2-tailed)	,051	,000		,000	,000	,000	,000	,000	,000	,000	,004	,005
	N	95	95	95,000	95	95	95	95	95	79	85	95	95
Training	Pearson Correlation	,381**	,410**	,593**	1,000	,596**	,568**	,539**	,683**	,708**	,667**	,295**	,354**
	Sig. (2-tailed)	,000	,000	,000		,000	,000	,000	,000	,000	,000	,004	,000
	N	95	95	95	95,000	95	95	95	95	79	85	95	95
Policy	Pearson Correlation	,291**	,412**	,697**	,596**	1,000	,554**	,546**	,807**	,600**	,484**	,274**	,227*
	Sig. (2-tailed)	,004	,000	,000	,000		,000	,000	,000	,000	,000	,007	,027
	N	95	95	95	95	95,000	95	95	95	79	85	95	95
Capture	Pearson Correlation	,177	,118	,600**	,568**	,554**	1,000	,537**	,674**	,637**	,558**	,266**	,387**
	Sig. (2-tailed)	,087	,256	,000	,000	,000		,000	,000	,000	,000	,009	,000
	N	95	95	95	95	95	95,000	95	95	79	85	95	95

ModCentralization	Pearson Correlation	,097	,115	,539**	,539**	,546**	,537**	1,000	,647**	,419**	,403**	,296**	,299**
	Sig. (2-tailed)	,350	,268	,000	,000	,000	,000		,000	,000	,000	,004	,003
	N	95	95	95	95	95	95	95,000	95	79	85	95	95
ModFormalization	Pearson Correlation	,339**	,211*	,706**	,683**	,807**	,674**	,647**	1,000	,599**	,520**	,208*	,200
	Sig. (2-tailed)	,001	,040	,000	,000	,000	,000	,000		,000	,000	,043	,052
	N	95	95	95	95	95	95	95	95,000	79	85	95	95
Intern	Pearson Correlation	,371**	,586**	,760**	,708**	,600**	,637**	,419**	,599**	1,000	,680**	,464**	,540**
	Sig. (2-tailed)	,001	,000	,000	,000	,000	,000	,000	,000		,000	,000	,000
	N	79	79	79	79	79	79	79	79	79,000	77	79	79
Extern	Pearson Correlation	,365**	,357**	,431**	,667**	,484**	,558**	,403**	,520**	,680**	1,000	,539**	,671**
	Sig. (2-tailed)	,001	,001	,000	,000	,000	,000	,000	,000	,000		,000	,000
	N	85	85	85	85	85	85	85	85	77	85,000	85	85
Process	Pearson Correlation	,304**	,449**	,296**	,295**	,274**	,266**	,296**	,208*	,464**	,539**	1,000	,721**
	Sig. (2-tailed)	,003	,000	,004	,004	,007	,009	,004	,043	,000	,000		,000
	N	95	95	95	95	95	95	95	95	79	85	95,000	95
Service	Pearson Correlation	,166	,269**	,285**	,354**	,227*	,387**	,299**	,200	,540**	,671**	,721**	1,000
	Sig. (2-tailed)	,108	,009	,005	,000	,027	,000	,003	,052	,000	,000	,000	
	N	95	95	95	95	95	95	95	95	79	85	95	95,000

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

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

Appendix G - Multiple regression analysis

Knowledge management and process innovation

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,456[a]	,208	,191	4,38322
2	,481[b]	,231	,206	4,34153
3	,530[c]	,280	,240	4,24772

a. Predictors: (Constant), FirmSize, FirmAge

b. Predictors: (Constant), FirmSize, FirmAge, KM

c. Predictors: (Constant), FirmSize, FirmAge, KM, ModCentralization, ModFormalization

ANOVA[d]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	464,187	2	232,093	12,080	,000[a]
	Residual	1767,561	92	19,213		
	Total	2231,747	94			
2	Regression	516,497	3	172,166	9,134	,000[b]
	Residual	1715,251	91	18,849		
	Total	2231,747	94			
3	Regression	625,910	5	125,182	6,938	,000[c]
	Residual	1605,838	89	18,043		
	Total	2231,747	94			

a. Predictors: (Constant), FirmSize, FirmAge

b. Predictors: (Constant), FirmSize, FirmAge, KM

c. Predictors: (Constant), FirmSize, FirmAge, KM, ModCentralization, ModFormalization

d. Dependent Variable: Process

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	4,671	1,320		3,539	,001		
	FirmAge	,439	,514	,093	,853	,396	,723	1,383
	FirmSize	1,004	,274	,400	3,667	,000	,723	1,383
2	(Constant)	2,471	1,858		1,330	,187		
	FirmAge	,335	,513	,071	,653	,515	,712	1,404
	FirmSize	,849	,287	,338	2,962	,004	,647	1,546
	KM	,071	,043	,171	1,666	,099	,804	1,244
3	(Constant)	,154	2,284		,068	,946		
	FirmAge	,635	,538	,135	1,178	,242	,620	1,613
	FirmSize	,792	,315	,316	2,518	,014	,514	1,947
	KM	,081	,088	,194	,917	,362	,180	5,551
	ModCentralization	,008	,003	,288	2,326	,022	,528	1,894
	ModFormalization	-,005	,004	-,256	-1,280	,204	,201	4,963

a. Dependent Variable: Process

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,270[a]	,073	,053	4,93672
2	,388[b]	,151	,123	4,75103
3	,465[c]	,217	,173	4,61390

a. Predictors: (Constant), FirmSize, FirmAge

b. Predictors: (Constant), FirmSize, FirmAge, KM

c. Predictors: (Constant), FirmSize, FirmAge, KM, ModCentralization, ModFormalization

ANOVA[d]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	176,437	2	88,219	3,620	,031[a]
	Residual	2242,152	92	24,371		
	Total	2418,589	94			
2	Regression	364,515	3	121,505	5,383	,002[b]
	Residual	2054,075	91	22,572		
	Total	2418,589	94			
3	Regression	523,951	5	104,790	4,922	,001[c]
	Residual	1894,638	89	21,288		
	Total	2418,589	94			

a. Predictors: (Constant), FirmSize, FirmAge

b. Predictors: (Constant), FirmSize, FirmAge, KM

c. Predictors: (Constant), FirmSize, FirmAge, KM, ModCentralization, ModFormalization

d. Dependent Variable: Service

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	6,858	1,486		4,614	,000		
	FirmAge	,166	,579	,034	,286	,776	,723	1,383
	FirmSize	,655	,308	,251	2,125	,036	,723	1,383
2	(Constant)	2,687	2,033		1,321	,190		
	FirmAge	-,031	,562	-,006	-,055	,956	,712	1,404
	FirmSize	,361	,314	,138	1,152	,253	,647	1,546
	KM	,135	,047	,311	2,887	,005	,804	1,244
3	(Constant)	-1,292	2,480		-,521	,604		
	FirmAge	,516	,585	,105	,882	,380	,620	1,613
	FirmSize	,078	,342	,030	,227	,821	,514	1,947
	KM	,269	,096	,621	2,811	,006	,180	5,551
	ModCentralization	,006	,004	,218	1,691	,094	,528	1,894
	ModFormalization	-,010	,004	-,514	-2,460	,016	,201	4,963

a. Dependent Variable: Service

Appendix H - Additional analysis

Frequency table External knowledge sources

	Mean	Std. deviation	Never	Rarely	Sometimes	Often	Always	Total
External A	2.89	.900	0	4	27	28	26	85
External B	2.54	1.007	3	5	35	26	16	85
External C	2.60	1.082	2	11	27	23	22	85
External D	3.12	.762	0	4	8	47	26	85
External E	1.72	1.259	21	14	28	14	8	85
External F	1.86	.990	9	15	43	14	4	85
External G	2.52	.683	0	2	44	32	7	85
External H	2.76	.908	0	9	21	37	18	85
External I	1.85	1.190	18	9	30	24	4	85
External J	1.81	1.139	18	8	33	24	2	85
External K	2.33	1.127	9	4	29	31	10	85
External L	2.26	1.093	10	6	27	36	6	85
External M	2.61	1.166	8	6	14	40	17	85
External N	2.06	1.158	10	15	26	25	9	85

Frequency table Internal knowledge sources

	Mean	Std. deviation	Never	Rarely	Sometimes	Often	Always	Total
Internal A	2.95	1.180	5	4	14	27	37	87
Internal B	2.30	1.268	15	8	13	41	10	87
Internal C	1.93	1.261	17	10	23	29	6	85
Internal D	2.34	1.199	10	6	31	24	16	87
Internal E	1.97	1.215	12	19	25	21	10	87
Internal F	2.31	1.512	18	10	8	26	23	85
Internal G	2.56	1.300	12	4	16	33	22	87
Internal H	3.13	.950	2	4	10	36	35	87
Internal I	1.56	1.523	35	8	17	11	14	85
Internal J	1.62	1.026	12	28	32	11	4	87
Internal K	1.71	1.346	24	14	20	21	8	87
Internal L	1.88	1.331	19	11	25	20	10	85
Internal M	2.07	1.362	18	12	14	32	11	87
Internal N	1.95	1.397	20	12	21	20	14	87

Reliability Statistics – external knowledge sources

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,873	,868	14

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
External A	30,04	72,154	,528	,601	,866
External B	30,39	72,121	,463	,719	,869
External C	30,33	71,938	,432	,602	,870
External D	29,81	75,274	,392	,437	,871
External E	31,21	72,955	,302	,491	,879
External F	31,07	72,233	,465	,573	,868
External G	30,41	77,817	,229	,450	,877
External H	30,16	75,092	,326	,529	,874
External I	31,08	65,862	,712	,681	,855
External J	31,12	66,700	,701	,688	,856
External K	30,60	65,029	,811	,839	,849
External L	30,67	66,247	,765	,735	,852
External M	30,32	65,648	,743	,798	,853
External N	30,87	68,757	,570	,588	,863

Reliability Statistics – Internal knowledge sources

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,916	,917	14

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Internal A	27,46	140,610	,364	,714	,919
Internal B	28,18	130,250	,714	,784	,907
Internal C	28,48	129,689	,718	,819	,907
Internal D	28,05	131,690	,682	,738	,908
Internal E	28,39	137,472	,491	,667	,915
Internal F	28,05	127,151	,662	,782	,909
Internal G	27,71	131,594	,695	,700	,908
Internal H	27,19	139,463	,614	,663	,912
Internal I	28,72	126,486	,679	,689	,909
Internal J	28,70	137,573	,563	,607	,913
Internal K	28,65	127,078	,757	,888	,905
Internal L	28,46	131,174	,633	,649	,910
Internal M	28,20	130,343	,660	,849	,909
Internal N	28,38	130,187	,660	,570	,909

KMO and Bartlett's Test – External knowledge sources

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,776
Bartlett's Test of Sphericity	Approx. Chi-Square	699,369
	df	91,000
	Sig.	,000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	5,571	39,790	39,790	5,571	39,790	39,790	5,143
2	2,108	15,057	54,847	2,108	15,057	54,847	2,130
3	1,412	10,085	64,932	1,412	10,085	64,932	3,035
4	1,255	8,964	73,896	1,255	8,964	73,896	1,649
5	,803	5,735	79,631				
6	,629	4,490	84,121				
7	,471	3,364	87,485				
8	,457	3,267	90,752				
9	,392	2,798	93,550				
10	,258	1,845	95,395				
11	,221	1,576	96,972				
12	,162	1,159	98,130				
13	,156	1,115	99,245				
14	,106	,755	100,000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Component Matrix[a]

	Component			
	1	2	3	4
External A	,601	-,306	,537	,150
External B	,577	-,611	,300	-,220
External C	,551	-,564	,011	-,287
External D	,455	-,166	,580	,326
External E	,367	,315	-,123	,742
External F	,521	,560	,099	-,297
External G	,262	,577	,287	-,532
External H	,346	,559	,529	,182
External I	,770	,303	-,156	-,087
External J	,771	,192	-,150	-,113
External K	,877	-,161	-,206	,107
External L	,844	-,105	-,199	-,033
External M	,827	-,149	-,342	,069
External N	,647	,222	-,253	,058

Extraction Method: Principal Component Analysis.

a. 4 components extracted.

KMO and Bartlett's Test – Internal Knowledge sources

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,758
Bartlett's Test of Sphericity	Approx. Chi-Square	806,993
	df	91,000
	Sig.	,000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	6,842	48,870	48,870	6,842	48,870	48,870	5,278
2	1,614	11,531	60,400	1,614	11,531	60,400	3,090
3	1,231	8,792	69,192	1,231	8,792	69,192	4,754
4	1,041	7,437	76,629	1,041	7,437	76,629	2,807
5	,741	5,295	81,924				
6	,582	4,159	86,083				
7	,459	3,280	89,362				
8	,376	2,686	92,049				
9	,362	2,584	94,632				
10	,280	1,997	96,629				
11	,170	1,213	97,842				
12	,141	1,008	98,850				
13	,108	,770	99,620				
14	,053	,380	100,000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Component Matrix[a]

	Component			
	1	2	3	4
Internal A	,435	,637	,521	,195
Internal B	,771	,243	-,273	,325
Internal C	,780	,172	-,380	,298
Internal D	,744	,217	-,304	-,237
Internal E	,569	,309	-,377	-,525
Internal F	,720	-,334	,070	-,218
Internal G	,742	,248	,204	-,156
Internal H	,665	,474	,248	-,148
Internal I	,729	-,100	,123	,311
Internal J	,628	-,195	-,387	,430
Internal K	,805	-,313	-,040	-,287
Internal L	,688	-,426	,310	,034
Internal M	,717	-,479	,105	-,101
Internal N	,707	-,157	,354	,087

Extraction Method: Principal Component Analysis.

a. 4 components extracted.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,505[a]	,256	,235	4,16618
2	,655[b]	,429	,397	3,69876

a. Predictors: (Constant), FirmSize, FirmAge

b. Predictors: (Constant), FirmSize, FirmAge, Extern, Intern

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	440,798	2	220,399	12,698	,000[a]
	Residual	1284,423	74	17,357		
	Total	1725,221	76			
2	Regression	740,203	4	185,051	13,526	,000[b]
	Residual	985,018	72	13,681		
	Total	1725,221	76			

a. Predictors: (Constant), FirmSize, FirmAge

b. Predictors: (Constant), FirmSize, FirmAge, Extern, Intern

c. Dependent Variable: Process

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	5,326	1,442		3,695	,000		
	FirmAge	,070	,514	,015	,137	,892	,787	1,271
	FirmSize	1,218	,277	,498	4,405	,000	,787	1,271
2	(Constant)	-,334	1,770		-,189	,851		
	FirmAge	-,392	,468	-,086	-,838	,405	,750	1,333
	FirmSize	1,000	,286	,409	3,493	,001	,578	1,730
	Intern	-,019	,054	-,050	-,354	,725	,396	2,524
	Extern	,255	,066	,480	3,888	,000	,520	1,922

a. Dependent Variable: Process

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,297[a]	,088	,064	4,67307
2	,776[b]	,602	,580	3,13108

a. Predictors: (Constant), FirmSize, FirmAge

b. Predictors: (Constant), FirmSize, FirmAge, Extern, Intern

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	156,696	2	78,348	3,588	,033[a]
	Residual	1615,979	74	21,838		
	Total	1772,675	76			
2	Regression	1066,810	4	266,703	27,204	,000[b]
	Residual	705,865	72	9,804		
	Total	1772,675	76			

a. Predictors: (Constant), FirmSize, FirmAge

b. Predictors: (Constant), FirmSize, FirmAge, Extern, Intern

c. Dependent Variable: Service

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	8,147	1,617		5,039	,000		
	FirmAge	-,403	,577	-,087	-,699	,487	,787	1,271
	FirmSize	,812	,310	,327	2,616	,011	,787	1,271
2	(Constant)	-1,357	1,499		-,905	,368		
	FirmAge	-1,223	,396	-,265	-3,091	,003	,750	1,333
	FirmSize	,254	,242	,102	1,047	,299	,578	1,730
	Intern	,038	,046	,097	,823	,413	,396	2,524
	Extern	,391	,056	,726	7,043	,000	,520	1,922

a. Dependent Variable: Service