Fostering Engagement in Knowledge Sharing
The Role of Perceived Benefits, Costs and Visibility

Sedighi, Mohammad

DOI
10.4233/uuid:d825f0b8-c6a7-4aac-91f3-25fea6f72046

Publication date
2017

Document Version
Final published version

Citation (APA)
Sedighi, M. (2017). *Fostering Engagement in Knowledge Sharing: The Role of Perceived Benefits, Costs and Visibility*. [Dissertation (TU Delft), Delft University of Technology].
https://doi.org/10.4233/uuid:d825f0b8-c6a7-4aac-91f3-25fea6f72046

Fostering Engagement in Knowledge Sharing: The Role of Perceived Benefits, Costs and Visibility

Proefschrift

ter verkrijging van de graad van doctor

aan de Technische Universiteit Delft,

op gezag van de Rector Magnificus prof. ir. K.C.A.M. Luyben;

voorzitter van het College voor Promoties,

in het openbaar te verdedigen op maandag 3 juli 2017 om 10:00 uur

Door

Mohammadbashir SEDIGHI

Master of Business Administration (MBA)

Sharif University of Technology

geboren te Tehran, Iran

Dit proefschrift is goedgekeurd door de promotor:

promoters: Prof. dr. F.M.T. Brazier and Prof. dr. C.P. van Beers

copromotor: Dr. S.G. Lukosch

Samenstelling promotiecommissie:

Rector Magnificus	Voorzitter
Prof.dr. F.M.T. Brazier	Technische Universiteit Delft, promotor
Prof. dr. C.P. van Beers	Technische Universiteit Delft, promotor
Dr. S.G. Lukosch	Technische Universiteit Delft, copromotor

Onafhankelijke leden:

Prof.dr.ir. M.T. Isaai	Sharif University of Technology
Prof.dr. K. Lauche	Radboud Universiteit
Prof.dr.ir. Y.H. Tan	Technische Universiteit Delft
Prof.dr. H. Bakker	Technische Universiteit Delft
Prof.dr.ir. C. Jonker	Technische Universiteit Delft, reservelid

SIKS Dissertation Series No. 2017-20 The research reported in this thesis has been carried out under the auspices of SIKS, the Dutch Research School for Information and Knowledge Systems.

To my family…

That knowledge which remains only on your tongue is very superficial. The intrinsic value of knowledge is that you act upon it.

Imam Ali (AS), (601-661 AD)

Acknowledgment

Your supremacy over others is in proportion to the extent of your knowledge and wisdom.

- Imam Ali (AS), (601-661 AD)

This thesis is beyond the outcome of a PhD research. This document represents my journey to receive PhD degree by deep understanding about the "*participation*" as an important social phenomenon among people within business context. This movement would not have been feasible without the support and provision of many individuals.

First of all, my deep appreciation goes to Prof. Frances Brazier and Prof. Cees van Beers, my promoters, for their supports and helps during my PhD. They supported me, assisted me, guide me and helped me grow academically. Second I want to thank my co-promoter, Dr. Stephan Lukosch, for his valuable participation in the last part of my PhD research. Moreover, I would like to express my gratitude to my prior daily supervisors, Dr. Sander van Splunter and Dr. Fardad Zand, for providing the opportunity to learn, understanding research approach and scientific reasoning.

My special thanks go out to my colleagues in the Economics of Technology and Innovation section at the faculty of Technology, Policy and Management. I would like to thank Roland, Marloes, Mojdeh and Ardalan for their support and constructive comments on my study, which have meaningfully improved my research quality. Further, I express my thankfulness to the secretary of the ETI section: El Arkesteijn, thank you for your support during my PhD period. Furthermore, I would like to thank my colleagues of the System Engineering section at the faculty of Technology, Policy and Management. I would like to express my gratitude to them: Alireza, Amir, Thieme, Tanja, Xavier, Heide, Yakup, Michel, Martijn and Zulkuf.

I am grateful to all my Iranian friends in TPM faculty for their supports during my PhD. Many thanks to Yashar, Vahideh, Ahmad Reza, Amir Ahmad, Ebrahim, Ardalan, Sam, Mohsen, Behzad, Masoud and Ali. I really appreciate my close friend Hamed Abolhadi for his strong support; whenever I confronted any challenge, he kindly helped me.

I was so fortune to find a lot of Iranian friends at Delft University. I would like to thank Mohammad, Hossein, Shahab, Akbar, Ali, Amir Reza, Amin, Ebrahim, Esmaeil, Hojjat and

Mohammad. I am grateful to my Iranian colleagues in my Iranian case studies for their supports. I express my thankfulness to Prof. Hamedi, Ms. Sadeghi, Ms. Hadian, Ms. Barikani, Mr. Shariat, Mr. Gharibnavaz, Mr. Vahedi and Ms. Aboutalebi.

I would like to especially thank my family back in Iran. I am extremely thankful to my parents for their love and blessings. Thanks to my mother for her unconditional love and support. Thanks for my father for his support and his love. Thanks for travelling such a long distance to support me during my PhD. I am really proud of you. Hope to be able to compensate only a small part of their kindness. I am very grateful to my sister, who was always my main source of inspiration and motivation. You are the greatest sister in the world who does not need words to understand the feelings of her brother miles away. I am grateful toward the tenderness of my grandfather, who always supports me with his praying. Thanks to Raziyeh for cheering me up with funny video clips in Instagram. Thanks to Ensiyeh for her technical supports in my computer challenges. Last but not least, special thanks to my wife, Hamideh, who has been by my side during the PhD. She has been the closest person during every minute of the last part of my PhD. She has been my best supporter, friend and companion during the PhD.

Brief Contents

Contents

TABLE OF FIGURES

List of Tables

Chapter 1 Introduction

During the past decades, knowledge has become a vital driving factor and strategic capital for business success (Donate and de Pablo 2015). Many businesses have supported a series of mechanisms to sustain their competitive advantage through managing organisational knowledge, leveraging and capturing the value of knowledge (Cham, Lim et al. 2016). The field of Knowledge Management (KM), includes all organisational mechanisms that support creation, receiving and sharing knowledge, for increasing efficiency and effectiveness of organisations performance (Huber 1991, Cabrera and Cabrera 2002). While KM has become an important subject in academic and practical environments, less than 50% of KM activities meet their goals and gain meaningful performance impact (Frost 2014).

Knowledge sharing is one of the core activity within KM, in both research and practical studies (Wang and Noe 2010). Further, knowledge sharing is a significant process of organisational innovation and leveraging knowledge asset (Massa and Testa 2009, Boer, Berends et al. 2011). Companies claim that the knowledge sharing process provides a base for their competitive advantages (Ipe 2003). Knowledge sharing is defined as a process of exchanging knowledge through knowledge exchange channels between individuals, groups and organisations (Oyemomi, Liu et al. 2016). Knowledge sharing between employees occurs via written documents, observations and face-to-face communications in synchronous or asynchronous systems. Knowledge sharing allows companies to capitalize on knowledge-based resources (Wang, Wang et al. 2014), increasing business efficiency, cutting extra costs, improving innovation process (Lin 2007, Mesmer-Magnus and DeChurch 2009, Wang and Noe 2010).

Two generations have been distinguished in the KM literature. The initial generation is adopted by centralised computer-mediated systems (Huysman and Wit 2004), focuses on integrated knowledge repositories and personal codified experiences. This approach defines knowledge as an object that can be protected, saved, transferred, and retrieved with IT platforms (van den Hooff and Huysman 2009). This top-down approach supports knowledge sharing through a central repository, providing as an organisational asset for all employees. This approach has yielded somewhat disappointing outcomes, due to its focus on explicit knowledge but not on the social participation and individual interactions needed to exchange tacit knowledge (Huysman and Wulf 2006). A second generation has been developed regarding the need of individual social interaction and participation in practice to enable both explicit and tacit knowledge to be shared

(van den Hooff and Huysman 2009). This approach emphasizes that participants who engage in a knowledge sharing process are not just exchanging knowledge or transferring information; they are engaging in a knowledge sharing process to meet others, to create social relations, and to gain a sense of friendship (Chiu, Hsu et al. 2006). From the theoretical perspective, knowledge sharing is a relational process, which is formed among participants based on characteristics of individual engagement (Gherardi, Nicolini et al. 1998). This approach highlights the emergent nature of knowledge exchange that emphasises the social nature of knowledge sharing in different knowledge exchange channels (van den Hooff and Huysman 2009, Zhang, De Pablos et al. 2013).

Participation in knowledge sharing is a key enabler in the second KM generation to effectively satisfy knowledge needs (Agichtein, Castillo et al. 2008) and afford competitive advantage (Wang and Noe 2010). This thesis explores factors behind knowledge sharing participation to understand how to design participation for knowledge exchange between employees.

This chapter describes the research motivation and research scope in section 1.1. Section 1.2 presents the research objectives with the main research question. Section 1.3 describes the research method, research philosophy and research design. Section 1.4 focuses on the research strategy and sub research questions distinguished, and section 1.5 presents the structure of the dissertation.

1.1 Research Motivation & Research Scope

As discussed above, several critical enablers or barriers influence the ability of organisations to adopt knowledge management (KM) systems (Sedighi and Zand 2012), including the global (macro-level) factors such as the economic situation of a region, (Sedighi, van Splunter et al. 2015). This thesis focuses on the Iranian business context, a resource-constrained economy. World Bank reports (World-Bank 2015) that the Iranian economy is the second biggest economy in the region of the Middle East and North Africa with an estimated 78.8 million population (2015). This economy provides $5,442.875 as the Gross Domestic Product (GDP) per capita in 2014. A resource-constrained economy refers to an environment with limitations on external resources (e.g. finance, technology, etc.) as well as internal inefficiency of technological, legal and governance systems, which is found in developing countries (Bloom, Mahajan et al. 2010). Resource-constrained economies are characterized by higher transaction costs of doing business than those in nonrecourse-constrained economies due to phenomena as sub-optimal governance, sanctions or corruption. The international sanctions in the Joint Comprehensive Plan of Action (JCPOA) between Iran and the United Nations Security Council (P5+1: UK, Russia, China,

France, USA + Germany) imposed such limitations. Such limitations increase transaction costs of organisations and hence require a different, more flexible internal organisation as compared with similar organisations in resource efficient economies. Further, the World Bank reports several governance indicators for countries to evaluate the capability of the government to successfully implement sound policies; and the state of the government to manage economic and social issues (Kaufmann and Kraay 2017). These indicators rank Iran among all countries in six dimensions of governance (0 correspond to lowest rank and 100 correspond to highest rank). Table 1.1 reports six indicators of Iranian governance in 2015. Another example is the corruption perception index, which is measured by the Transparency International organisation. This index ranks Iran 131 out of 176 countries (1 = least corrupt; 176 is most corrupt). Therefore trading in markets in these economies is restricted by an economic environment that is not market transactions conducive. This becomes even more dominant when knowledge sharing/trading is taken into account, as knowledge is a particular good, namely a good with public good characteristics. Dealing with knowledge in such an environment can be expected to be different than is usually assumed in the literature on knowledge sharing in firms in well-defined and properly functioning markets. Knowledge sharing among employees to exchange tacit knowledge and experiences can be expected a meaningful improvement for organisations with limited resources (Asrar-ul-Haq, Anwar et al. 2016).

Table 1.1 Iranian governance indicators in 2015

Indicator	Rank
Voice and Accountability	5
Political Stability and Absence of Violence	17
Government Effectiveness	47
Regulatory Quality	7
Rule of Law	16
Control of Corruption	32

Individual engagement in knowledge sharing is a well-recognised key enabler in KM to effectively satisfy knowledge needs (Agichtein, Castillo et al. 2008) and afford competitive advantage (Wang and Noe 2010). For instance, the Caterpillar Company has initiated a knowledge network project to improve employees' engagement in KM activities. They reported a 200% return-on-investment (ROI) by promoting employees' participation for knowledge sharing among participants (Chiu, Hsu et al. 2006). Moreover, a recent report shows four out of five companies in 2012 deploy network technologies to facilitate participation and knowledge sharing within their firms (Overby 2012).

Individual engagement in KM is influenced by several psychological and technological factors. These factors have been mentioned as participants' enablers or barriers in the KM literature (Wu and Zhu 2012). However, these factors have not been studied in the context of different levels of knowledge sharing systems, nor have they been the focus of many studies in business environments in the Middle East (To our knowledge most results are based on studies in Europe and North America, and South East Asia, and only a few have focussed on the Middle East.) Bridging this scientific gap is the main challenge this thesis considers, exploring both enablers and barriers of participation in knowledge sharing at different levels of knowledge exchange.

1.2 Main Research Question

The main challenge addressed in the dissertation is that "*high-tech organisations need sustainable participation in knowledge sharing to improve quality and quantity aspects of individual knowledge contributions in the Iranian businesses*." Thus, the main research question is:

Can engagement for knowledge sharing within organisations in the Iranian business environment be fostered?

The research employs Hevner's design science method (Hevner and Chatterjee 2010) to answer the main research question.

1.3 Research Method

This section presents the research design construction as well as the research instruments.

1.3.1 Research Design

Design activities are an essential part of science. Studies in design approaches have a long background in many domains like Sociology, Management Studies, Educational Science, Psychology, and the Arts (Cross 2001). There has been a boosted attention in the "*design science*" approach and its potential to improve the relevance and application (van Aken 2004) of design solutions. Design Science research provides knowledge to answer questions such as: "*How should things be?*" (Denyer, Tranfield et al. 2008). These approaches use field-tested guidelines to provide scientific backgrounds to solve design challenges. The Design Science approach supports researchers in different domains (e.g. Engineering, Law and Management Sciences) to advance knowledge on designing artefacts, solving complex challenges, or improving performance of current systems to meet new business needs (Hevner, March et al. 2004). Van Aken (2004) identifies two conditions for design science research: 1- Research questions related to design in a practical domain. (Concerning "*How*" and "*What*" questions) 2- Research that

focuses on providing prescriptive knowledge to design an intervention for solving field challenges.

Design Science approaches use both description-driven and prescription-driven methods to design interventions in, for example, the field of management (van Aken 2004). Although the mission of description-driven approach is restricted to explore relationships between variables by causal models and quantifying relations, this approach creates insight in the relations between constructions, improvement problems and properties of the design components (van Aken 2004). By using the paradigm of "*exploratory science*", Design Science develops technological rules and interventions to advance abstract knowledge on designing solutions to practical challenges in the field.

To design participation between participants, it is essential to use the design research methods to explore the underlying principles of KM systems. As mentioned earlier, this thesis uses Hevner's design science research model (2004) The three cycles distinguished in this model represent (1) designing process of artefacts, (2) with respect to organisational needs and (3) improving current knowledge base, as depicted in Figure **1.1** (Hevner, March et al. 2004). The relevance cycle connects the business needs with the design process. The rigour cycle associates design actions with the background of theoretical foundations, knowledge, and expertise. The design cycle bridges the design artefacts' process with evaluating the design procedure in the design science context (Hevner and Chatterjee 2010).

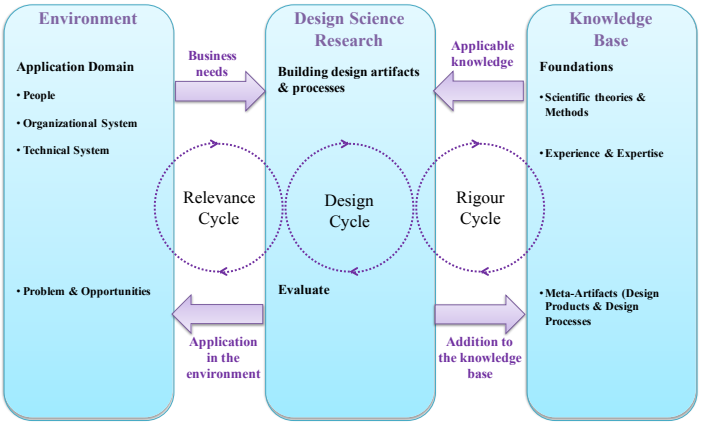


Figure 1.1 Design science research cycles Ref: (Hevner, March et al. 2004)

This design-science process necessarily includes environmental factors as design activities are performed to address the problems and dynamic interaction of users, businesses, and technology. The environmental part of the design model expresses the problem area, including social, technical and humanity factors. Recognizing real problems in business contexts often is identified as an initial step of the design science research (Hevner and Chatterjee 2010). Furthermore, employing existing theoretical foundations and literature enhances rigour in Design Science research. Rigour is designed with the efficient use of the theoretical foundations and research methods (Hevner, March et al. 2004). The knowledge base part of the design model includes design foundations such as theories, models, knowledge, expertise and methods from the outcomes of prior studies to support the design process. Two fundamental phases are distinguished: The design science phase includes developing artefacts regarding to the business needs. The appropriateness of the design output with the business needs are assessed in the behavioural science phase (Hevner, March et al. 2004).

1.3.2 Research Instruments

In addition to the literature, this thesis uses pairwise comparisons method and semi-structured interviews to explore employees' participation in knowledge exchange in Iran. Quantitative surveys with questionnaires are employed to explore the impact of factors on participation in knowledge exchange. Statistical analysis is used to identify level of factors' impacts on participation for knowledge exchange, as well as impacts of knowledge exchange visibility in different case studies in Iran. As in collecting information, insight and knowledge about the participation for knowledge exchange, the proposed research framework is designed to test relationships between different model's elements. A field-experiment is conducted to assess the design.

1.4 Research Strategy and Sub-Research Questions

Hevner et al's (2004) design science research model is deployed in this thesis as shown in Figure **1**.**2**. The research strategy includes three main phases to employ theoretical foundations and business needs to the design of participation for knowledge contribution.

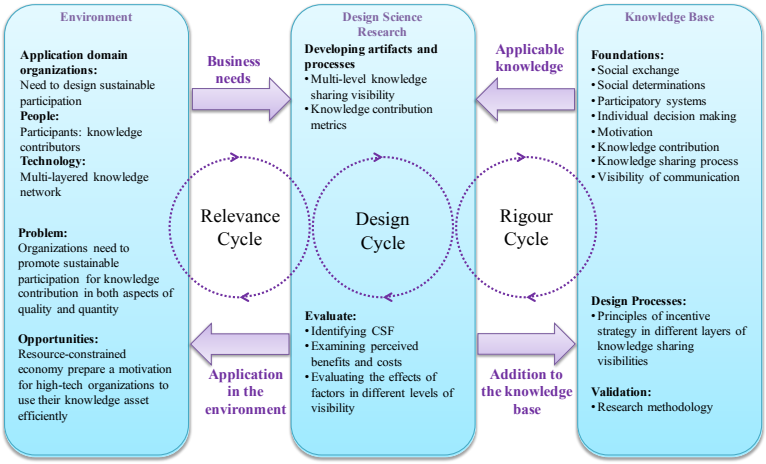


Figure 1.2 Design science research

As mentioned earlier, the main research question this thesis addresses is: Can engagement for knowledge sharing within organisations in the Iranian business environment be fostered?

The sub questions related to the main question are mapped to the model of design science research together with the chapter is which they are addressed.

1. Relevance Cycle (Figure 1.3)

1a. How to rank priority of critical success factors (CSF) for successful knowledge management systems in the Iranian business environment? (Chapter 3)
1b. What are important factors that influence participants' engagement in knowledge exchange in the Iranian business environment? (Chapter 4)
1c. How do individual perceived benefits and costs affect participation in knowledge sharing in the Iranian business environment? (Chapter 5)
1d. How do participants' perceived benefits influence participation at different levels of knowledge sharing visibility in the Iranian business environment? (Chapter 6)

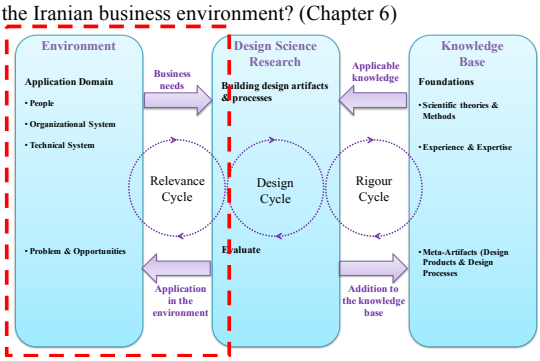


Figure 1.3 Research questions (environment)

2. **Rigour Cycle** (Figure **1.4)**

2a. What are critical success factors (CSF) for successful knowledge management systems? (Chapter 2)
2b. Why are participants willing to share knowledge and participate for knowledge exchange? (Chapters 2)
2c. Which Key Performance Indicators (KPIs) are identified for evaluating participation in knowledge exchange? (Chapter 2)
2d. Which perceived benefits and costs have been identified for knowledge exchange? (Chapters 2)
2e. How does knowledge sharing visibility interact with knowledge exchange? (Chapters 2)
2f. Which KM systems have been recognised to support participation in knowledge exchanges? (Chapter 3)
2g. How does knowledge sharing visibility influence individual perceived benefits? (Chapter 7)

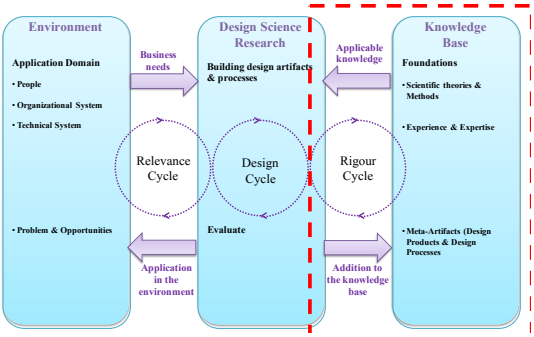


Figure 1.4 Research questions (knowledge base)

3. **Design Cycle** (Figure **1.5)**

3a. How to design visibility of knowledge sharing to promote participations in the Iranian business environment? (Chapters 7)
3b. Can visibility of knowledge sharing be designed to promote participations in the Iranian business environment? (Chapter 8)

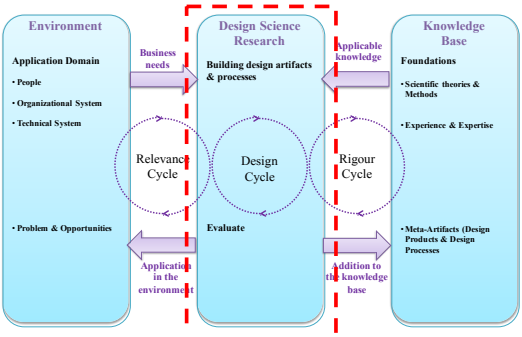


Figure 1.5 Research questions (Design Science Research)

The structure of the research questions represents a research strategy for the whole of thesis. First, the knowledge base of knowledge exchange and participation is reviewed. Second, influential factors are identified, clustered and prioritized from relevant studies and practical data. The influences of the identified factors are analysed by semi-structured interviews, questionnaire, data analysis and case studies. The outcome of these steps supports research to design a proposed model for the design cycle. The proposed model is designed, evaluated and verified by a field experiment. This exploratory research approach (Stebbins 2001) identifies factors that influence participation in the first part, while the second part uses outcome of understanding critical elements and their impact on participation to design participation between employees.

1.5 Dissertation Structure

This thesis is organised in nine chapters, shown in Figure **1.6** . The research methodology, research design and strategy are discussed in Chapter 1, while theories, concepts and relevant background are examined in Chapter 2. The systematic literature reviewing in Chapter 3 provides a theoretical foundation to identify influential factors on knowledge sharing. A qualitative method has been employed in Chapter 4 to examine perceived benefits and perceived costs of knowledge exchange. Chapter 5 and Chapter 6 explore the relationships between perceived benefits and perceived costs with quality and quantity of individual engagement in knowledge sharing. The visibility of knowledge sharing as an important factor is explored in different chapters. Both theoretical foundations and practical insights are synthesised in Chapter 7 to propose an integrated framework to analyse individual engagement for different levels of knowledge exchange visibility. A field experiment is used for verification and validation of the proposed model in a real knowledge exchange environment in Iran in Chapter 8. The thesis concludes with overall finding interpretation, reflections on the research questions and recommendations for future studies in Chapter 9.

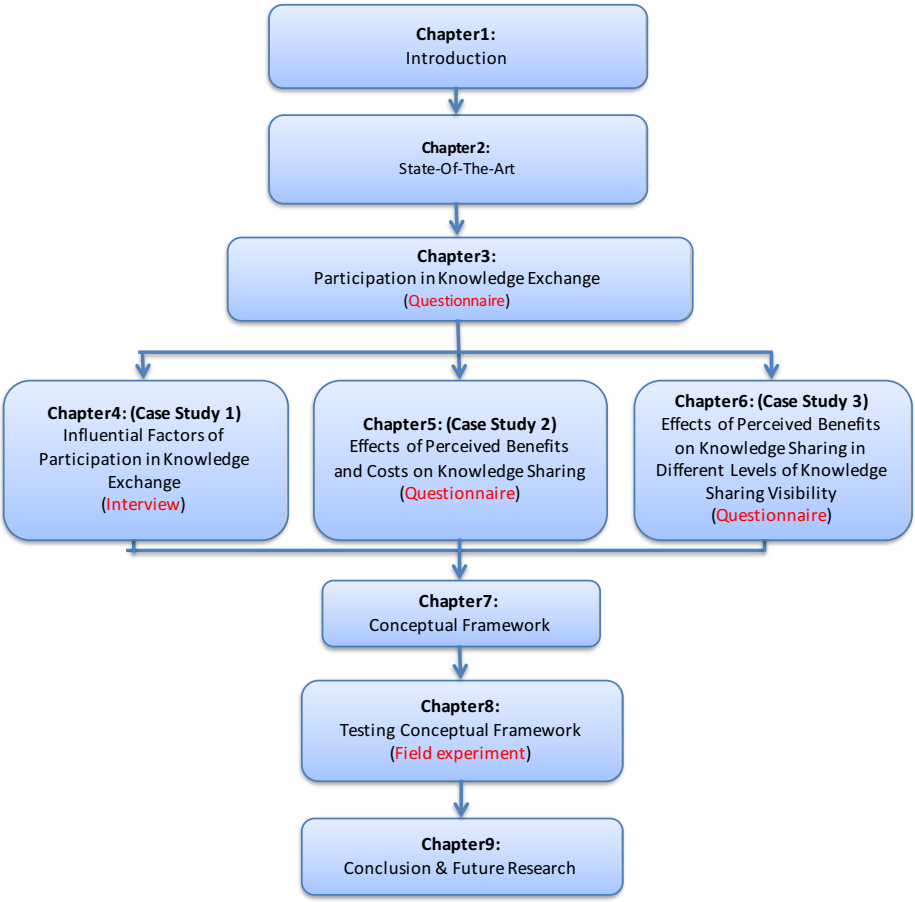


Figure 1.6 Thesis structure and chapters outline

Chapter 2 The State-of-the-Art

This chapter reviews the State-of-the-Art on knowledge sharing, participation, knowledge network, knowledge contribution, knowledge exchange visibility, influencing factors of knowledge sharing behaviour and knowledge sharing in Iranian business context. This chapter addresses the following research questions: [*What are Critical Success Factors (CSF) for successful knowledge management systems? (Research question 2a), Why are participants willing to share knowledge and participate for knowledge exchange? (Research question 2b), Which Key Performance Indicators (KPIs) are identified for evaluating participation for knowledge exchange? (Research question 2c), Which perceived benefits and costs have been identified for knowledge exchange? (Research question 2d) and how does knowledge sharing visibility interact with knowledge exchange? (Research question 2e)*].

This chapter is structured as follows: Section 2.1 reviews different KM systems with classifying technologies to the supply-side, demand-side and combination clusters. Section 2.2 introduces critical success factors of KM. Section 2.3 elaborates on KM literature on the role of knowledge sharing, knowledge seeking and knowledge exchange. Section 2.4 presents research that focuses on individual participations in the knowledge sharing process. Section 2.5 represents the role of participants' engagement in knowledge sharing. Section 2.6 examines literature on knowledge contribution by introducing the quality aspect and the quantity aspect of knowledge contributions. Section 2.7 focuses on literature on perceived benefits and costs of participation in knowledge sharing. Section 2.8 explores literature on the role of the visibility level of knowledge sharing in KM systems. Section 2.9 presents literature on the role of knowledge sharing in the Iranian business context. The last section (Section 2.10) provides a comprehensive summary for this chapter.

2.1 Knowledge Management Systems

Many KM systems have been developed in the first generation of KM to encourage knowledge sharing behaviour, but practical evidence shows that technology alone cannot guarantee the success of KM systems (Sedighi, van Splunter et al. 2015). KM systems focus on knowledge exchange using IT as an enabler (Becerra-Fernandez, Gonzalez et al. 2004). These systems are designed to acquire, create and share knowledge with a collection of employees, processes and technology with different organisational and environmental constraints (Sedighi and Zand 2012). Accordingly, KM systems have been developed to support KM activities to support "*conscious strategy of getting the right knowledge to the right people at the right time and helping people*

share and put information into action in ways that strive to improve organisational performance" (O'Dell and Jackson 1998). These systems provide an integrated structure between KM process and technologies to support KM mechanisms. KM studies have been suggested different KM process. Table 2.1 summarizes literature on KM processes distinguished in the KM literature.

Table 2.1 Knowledge management processes

KM Process	Source
Creation/ Transfer/ Application	(Spende 1996)
Creation/ Dissemination/ Utilization	(Murray and Myers 1997)
Acquire/ Store/ Access/ Maintain/ Re-use	(Eschenfelder, Heckman et al. 1998)
Capturing/ Storing/ Sharing/ Using	(Davenport and Prusak 1998)
Acquisition/ Refining/ Storage and Retrieval/ Distribution/ Presentation	(Zack 1999)
Capturing/ Storing/ Transmitting/ Using	(Gupta, Iyer et al. 2000)
Creation/ Validation/ Presentation / Distribution/ Application	(Bhatt 2001)
Creation/ Storage/ Distribution/ Application	(Shin, Holden et al. 2001)
Creation/ Storage (Retrieval)/ Transfer/ Application	(Alavi and Leidner 2001)
Acquisition/ Conversation/ Application/ Protection	(Gold, Malhotra et al. 2001)
Creation/ Storage/ Distribution/ Application	(Shin, Holden et al. 2001)
Creating/ Sharing/ Distributing/ Using	(Darroch 2003)
Creation/ Capture/ Organization/ Storage/ Dissemination/ Application	(Allameh, Zare et al. 2011)

There are several different approaches for deploying KM systems. Hansen (2000) classifies KM systems for two KM strategies, "*personalization*" and "*codification*". The knowledge codification strategy focuses on documenting and saving knowledge in a repository, whereas the knowledge personalization strategy focuses on the tacit part of organisational knowledge and views social interaction as a main demarche for facilitating knowledge exchange. Best practice repositories, corporate knowledge directories and knowledge networks are the three main systems identified by Alavi and Leidner (2001).

The second generation of KM is aligned with the rapid growth of social networks. Driven by the second generation of KM, organisations have distinguished KM systems that facilitate social interactions between employees. Participants are empowered to organise their own knowledge exchange. (Lave and Wenger 1991). Wenger (1998) states that participants are empowered by peer-to-peer relations to seek learning opportunities. Though this has extensively been discussed (Desouza and Awazu 2005, Cabrera, Collins et al. 2006, Mergel, Lazer et al. 2008), there are still no clear solutions to improve individual participation. Von Krogh goes as far as to claim that "*knowledge cannot be managed, but only enabled*" (Von Krogh 2012). Contemporary KM systems (e.g. Enterprise social networks) have been developed to improve participation in KM process. These systems are becoming more accessible, effective, cloud-based, connected,

personalized, and integrated with other organisational technologies, shaping new knowledge exchange environments. Using intra-organisational Web 2.0 systems as Enterprise 2.0 technologies rather than using centralized, structured, conventional technologies enable companies to improve individuals' participation (Ellison, Gibbs et al. 2014, Oostervink, Agterberg et al. 2016). In general, improving employees' participation for knowledge sharing has been identified as the main motivation for designing new KM technologies.

McElroy (2000) is the first author to categorise KM systems with respect to the two sides of knowledge sharing: supply-side KM (knowledge-push system) and demand-side KM (knowledge-pull system). Further, the combination of supply and demand sides represents a new cluster of KM systems designed to this purpose. Figure 2.1 depicts some examples of demand-side KM and supply-side KM technologies, and those that enable both sides of knowledge exchange with the combination approach.

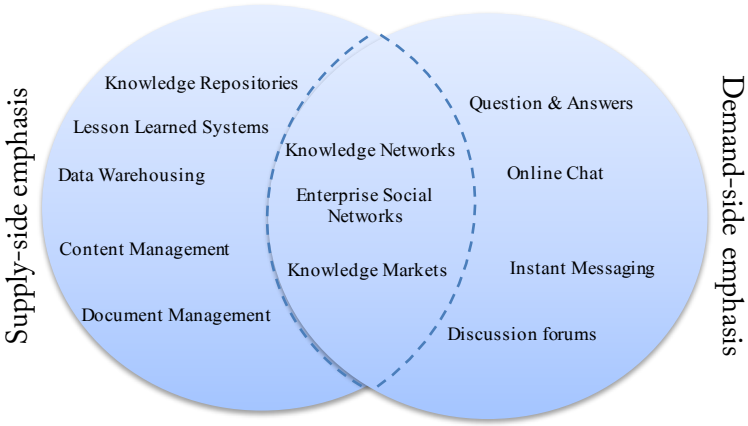


Figure 2.1 Classifying Supply-side & Demand-side KM technologies

Supply-side KM systems provide pre-compiled knowledge to passive participants. Supply-side KM focus on making existing knowledge within a business available to their employees. Knowledge owners customize and create knowledge in response to knowledge needs and requests in Demand-Side KM approaches (Firestone and McElroy 2003). Open questions and answers (Q&A) was one of the first technologies used to improve knowledge sharing performance (Bolisani and Scarso 2014). The combination of supply-side and demand-side KM promotes emergent knowledge on the demand-side and strategic knowledge on the supply-side, however conditions of KM systems to support both sides of KM have not yet been introduced.

KM systems play an important role in high-tech industries to manage organisational knowledge as an extremely tacit, complex and valuable resource for creating competitive advantage (Ranft and Lord 2000). "*High-tech*" companies have been categorised as a kind of organisations, which meet four main conditions (Rogers and Larsen 1984): (1) assigning a high percentage of high-skilled employees and engineers on the shop floors; (2) following a high rate of growth; (3) spending a high percentage of total revenue as the R&D budget; (4) joining to the global markets. If companies or sectors meet these conditions, they can be categorised as high-tech. These organisations use a comprehensive R&D process to utilize new technologies as a major competitive advantage (Riggs 1985). This thesis investigates the main research question in high-tech companies.

2.2 Critical Success Factor for Knowledge Management[1]

This section relates to the research question: [*2a. What are critical success factors CSFs for successful knowledge management systems?]* A comprehensive KM critical success factors model (Sedighi and Zand 2012), is used to structure this literature review to identify critical success factors incorporating both organisational (internal) and environmental (external) factors.

Critical Success Factors (CSFs) are factors that influence successful performance of individual employees, of individual departments, of individual businesses, and of sectors (Alazmi and Zairi 2003, Huang and Lai 2012). Often KM enablers and barriers are defined as critical success and failure factors (Yeh, Lai et al. 2006), however these are most often related to the individual perspective. Understanding critical success factors of KM is necessary to be able to support knowledge sharing (Laudon and Laudon 2004).

KM studies have identified a broad range of CSFs that can influence KM implementations. These factors are the enablers to influence KM performance. The comparative importance of these factors is, however, not addressed. Figure 2.2 (Sedighi and Zand 2012) proposes a conceptual classification model that identifies critical factors from two main perspectives: external environment (Moffett, McAdam et al. 2003), and internal organisation. Table 2.2 depicts the

[1] This section is based on two papers:

Sedighi, M. and Zand, F. (2012). "*Knowledge management: Review of the Critical Success Factors and development of a conceptual classification model".* 10th International Conference of ICT and Knowledge Engineering, Bangkok IEEE Explore, 1-9.

Sedighi, M., Van Splunter, S., Zand, F. and Brazier, F. (2015). "*Evaluating critical success factors model of knowledge management: An analytic hierarchy process (AHP) approach*". International Journal of Knowledge Management, Vol. 11 No. 3, PP. 17-36.

CSFs distinguished in the literature. Businesses often focus on managing tasks in the organisational domain and not on environmental factors. A relationship between factors is indicated in our conceptual classification model with a dashed line border between the factors.

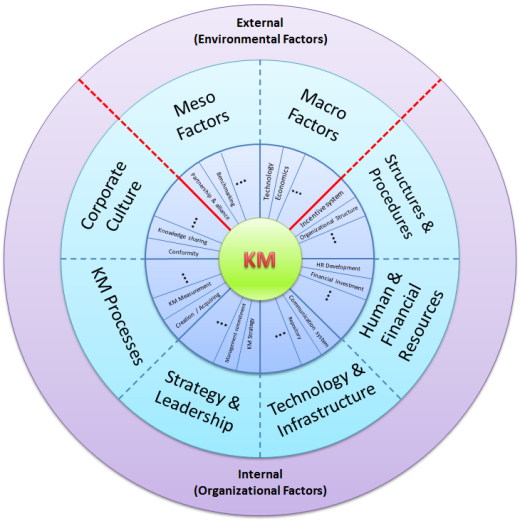


Figure 2.2 Conceptual classification model of KM critical success factors

2.2.1 Environmental (External) Factors

Environmental factors are identified as a critical enablers or barriers for organisations to design KM in rapidly changing complex competitive environments (Liao, Chuang et al. 2011). Environmental factors that are drastically changing over the time create pressure for organisations to adopt their internal KM mechanisms. Companies have limited control over their very dynamic external environmental factors. Several external factors that influence KM success are classified into two main categories in (Sedighi and Zand 2012): factors relating to the macro and meso environment. The macro environment examines global area, which can affect meso and micro (firm) atmospheres. The meso environment represents close atmosphere (market forces) directly around the firm.

Macro Factors: The macro environment refers to legal, economic, political, technological, social, educational, and globalization factors that affect the internal organisational factors of a KM system (Moffett, McAdam et al. 2003). Changes in macro factors affect businesses' organisational processes and procedures.

Meso Factors: The meso environment refers to the market segment and industry in which a business operates and competes. Meso factors include, supply chains, strategic partnerships and competitors in the same industry (Slater and Narver 1995, Bennett and Gabriel 1999). KM benchmarking is used to compare a firm's KM performance metrics and best practices to other business (O'Dell and Jackson 1998).

Table 2.2 Critical success factor of KM

Aspects	Categories	Factors	Sources
External (Environmental) Factors	**Macro factors**	Legal factor	(Holsapple and Joshi 2000)
		Economic factor	(Holsapple and Joshi 2000)
		Policy factor	(Holsapple and Joshi 2000)
		Social relations	(Holsapple and Joshi 2000)
		Educational system	(Holsapple and Joshi 2000)
		Technological factor	(Moffett, McAdam et al. 2003)
		Globalization process	(Moffett, McAdam et al. 2003)
	Meso factors	Supply chain	(Moffett, McAdam et al. 2003)
		Commercial competitors	(Chong 2006); (Choi 2000); (Chong and Choi 2005)
Internal (Organisational) Factors	**Corporate Culture**	Knowledge sharing	(Ajmal, Helo et al. 2010); (Yeh, Lai et al. 2006); (Bose 2004); (Lindner and Wald 2011); (Zheng, Yang et al. 2010); (Wong and Aspinwall 2005); (Akhavan, Jafari et al. 2006); (Chong and Choi 2005, Akhavan and Jafari 2006); (Khalid 2006); (Chong 2006); (Plessis 2007);
		Collaboration culture	(Lee and Choi 2003) ;(Gold, Malhotra et al. 2001); (Akhavan, Jafari et al. 2006); (Alavi, Kayworth et al. 2006);(Alavi, Kayworth et al. 2006); (López, Peón et al. 2004); (Yang 2007); (Akhavan and Pezeshkan 2014); (Jennex and Olfman 2005)
		Pro-social culture	(Cyr and Choo 2010); (Wasko and Faraj 2000); (Yue Wah, Menkhoff et al. 2007); (Chong 2006)
	Structures & Procedures	Organisational structural	(Chua and Lam 2005); (Moffett, McAdam et al. 2003); (Zheng, Yang et al. 2010); (Akhavan, Jafari et al. 2006); (Jafari, Fathian et al. 2007); (Plessis 2007); (Chang, Hung et al. 2009); (Ajmal, Helo et al. 2010); (Wong and Aspinwall 2005); (Al-Alawi, Al-Marzooqi et al. 2007); (Santos, Wane et al.)
		Incentive system	(Ajmal, Helo et al. 2010); (Wong 2005); (Davenport, Long et al. 1998); (Leonard-Barton 1995); (Szulanski 1996); (Wong and Aspinwall 2005); (Plessis 2007); (Kulkarni, Ravindran et al. 2006); (Akhavan and Pezeshkan 2014);(Al-Alawi, Al-Marzooqi et al. 2007); (Jennex and Olfman 2005)
		Channels for knowledge transfer	(Davenport, Long et al. 1998); (Plessis 2007); (Jennex and Olfman 2006)
		Organisation Size	(Connelly and Kelloway 2003); (Bennett and Gabriel 1999)
		Network/Community of practice	(Skyrme and Amidon 1997)
	Human & Financial Resources	Human resource management	(Lee and Choi 2003); (Yeh, Lai et al. 2006); (Holsapple and Joshi 2000); (Bose 2004); (Wong 2005); (Wong and Aspinwall 2005); (Akhavan and Jafari 2006); (Chang, Hung et al. 2009); (Moffett, McAdam et al. 2003); (Kulkarni, Ravindran et al. 2006); (Khalid 2006)
		Employee training	(Chua and Lam 2005); (Hung, Huang et al. 2005); (Wong 2005); (Moffett, McAdam et al. 2003); (Leonard-Barton 1995); (Pang-Lo 2011); (Chong 2006); (Akhavan, Jafari et al. 2006, Jafari, Fathian et al. 2007); (Plessis 2007); (Khalid 2006); (Wong and Aspinwall 2005); (Chong 2006); (Akhavan and Pezeshkan 2014); (Jennex and Olfman 2005)
		Teamwork skill	(Hung, Huang et al. 2005); (Chong 2006); (Choi 2000); (Chong and Choi 2005); (Chong 2006)
		Empowerment program	(Moffett, McAdam et al. 2003); (Chong 2006); (Choi 2000); (Chong and Choi 2005); (Chong 2006)
		Financial investment	(Wong 2005); (Akhavan and Jafari 2006)
	Technology & Infrastructure	Communication system	(Moffett, McAdam et al. 2003); (Plessis 2007); (Lee and Choi 2003); (Yeh, Lai et al. 2006); (Pang-Lo 2011); (Chong 2006); (Plessis 2007); (Chong and Choi 2005);

			(Chang, Hung et al. 2009); (Khalid 2006); (Chong 2006); (Al-Alawi, Al-Marzooqi et al. 2007); (Santos, Wane et al.); (Jennex and Olfman 2006)
		System usability	(Chua and Lam 2005); (Moffett, McAdam et al. 2003)
		Access to communication technology	(Liebowitz 1999); (Lindner and Wald 2011)
		Information Security system	(Plessis 2007); (Jennex and Olfman 2005); (Jennex and Olfman 2006)
		Search engine	(Plessis 2007); (Sher and Lee 2004); (Wong 2005); (Cepeda and Vera 2007); (Kulkarni, Ravindran et al. 2007); (Syed-Ikhsan and Rowland 2004); (Jennex and Olfman 2005); (Chang, Hung et al. 2009); (Jennex and Olfman 2006)
		Intellectual property	(Bose 2004); (Hanel 2006)
	Strategy & Leadership	KM Strategy	(Hung, Huang et al. 2005); (Yeh, Lai et al. 2006); (Wong 2005); (Moffett, McAdam et al. 2003); (Lindner and Wald 2011); (Zheng, Yang et al. 2010); (Chong 2006); (Akhavan, Jafari et al. 2006); (Akhavan and Jafari 2006); (Plessis 2007); (Kulkarni, Ravindran et al. 2006); (Khalid 2006); (Jennex and Olfman 2005); (Jennex and Olfman 2006)
		Top management commitment	(Chua and Lam 2005); (Hung, Huang et al. 2005); (Pang-Lo 2011); (Chong 2006); (Akhavan, Jafari et al. 2006); (Jafari, Fathian et al. 2007); (Plessis 2007); (Chong 2006); (Lindner and Wald 2011); (Akhavan and Pezeshkan 2014); (Jennex and Olfman 2005)
		Change management	(Moffett, McAdam et al. 2003); (Akhavan and Jafari 2006); (Plessis 2007)
	KM processes	KM Measurement tool	(Chua and Lam 2005); (Wong 2005); (Wong and Aspinwall 2005); (Chong 2006); (Plessis 2007); (Chong and Choi 2005); (Chang, Hung et al. 2009); (Khalid 2006); (Chong 2006); (Akhavan and Pezeshkan 2014); (Jennex and Olfman 2005)
		KM processes	(Wong 2005); (Alazmi and Zairi 2003); (Lindner and Wald 2011); (Plessis 2007); (Chang, Hung et al. 2009); (Khalid 2006); (Akhavan and Pezeshkan 2014); (Jennex and Olfman 2006)

2.2.2 Organisational (Internal) Factors

Organisational factors, shaped by internal organisational procedures and processes, are classified in (Sedighi and Zand 2012) into six categories.

Corporate Culture: An organisational culture shapes the behaviour and values of employees (Zheng, Yang et al. 2010). Thus, a corporate culture determines work values and beliefs that influence knowledge creation, knowledge sharing, and decision-making processes.

Structures & Procedures: Organisational structures and procedures that support the operational execution, such as task allocation, coordination, standards and supervision. Communities of Practice (CoP), for example, is a structure to improve knowledge sharing and manage organisational knowledge (Bolisani and Scarso 2014).

Human & Financial Resources: Human resources are vital to manage knowledge in a business affecting the execution of leadership, coordination, control, and measurement of KM. Further, financial resources are required to create, maintain and support the infrastructure for exchanging knowledge.

Technology & Infrastructure: The technologies and infrastructures used by knowledge workers to share knowledge, experiences and lesson learned within an organisation. These infrastructures support the KM system in operating both efficiently and effectively. Moreover the security and protection of knowledge and intellectual property are issues of concern.

Strategy & Leadership: The KM literature indicates top management commitment as one of the main success factors for implementing KM (Davenport, Long et al. 1998). KM strategy focuses on a particular core competency of the organisation aligning with organisational strategy to support organisational goals.

KM Processes: KM Processes include concurrent, repeated non-linear sequence and systematic activities of creating, sharing and executing knowledge in organisations (Kahraman and Tunc Bozbura 2007). Furthermore, KM processes help managers to translate the KM program to employees' daily work activities (Wong 2005). The KM process includes assessment methods to make connections between KM results and financial performance measures (Lee, Lee et al. 2005).

2.3 Knowledge Sharing

The resource-based view identifies knowledge as a valuable organisational resource, which can create an organisational competitive advantage (Brush and Artz 1999). Knowledge sharing is an essential activity for knowledge application, organisational innovation, intellectual capital and ultimately the competitive advantage of enterprises (Wang, Sharma et al. 2016). Specifically, high-tech companies (using most advanced technologies) are grown by utilizing and sharing scientific knowledge among employees (Himmelberg and Petersen 1994). Knowledge sharing is a sustained process of transferring experience and organisational knowledge to business processes through communication channels between individuals, groups and organisations (McAdam, Moffett et al. 2012, Oyemomi, Liu et al. 2016). Studies have shown that knowledge sharing can improve organisational efficiency, reduce costs, improve development time of new products, reduce overall project time and improve the capacity of business innovation (Lin 2007, Mesmer-Magnus and DeChurch 2009, Wang and Noe 2010). Knowledge sharing can be defined as voluntarily sharing knowledge and experiences within organisations (Cyr and Wei Choo 2010), is often addressed from the perspective of an individual's willingness, intention, or propensity to share information with colleagues (Wang and Noe 2010). Knowledge sharing is not equal with knowledge exchanges within organisations. Several articles have been used "*knowledge exchange*" interchangeable with "*knowledge sharing*" (e.g., (Cabrera, Collins et al. 2006)).

Knowledge exchange is defined as a process of knowledge sharing (participants who send knowledge) and knowledge seeking (participants who acquire knowledge) (Wang and Noe 2010). Both knowledge sharing and knowledge seeking (acquisition) activities identify two distinct participants' roles in knowledge exchanges within organisations: knowledge providers, knowledge recipients. In this thesis, "*knowledge exchange*" is used to signify both knowledge sharing and knowledge seeking activities within organisations[1]. Figure 2.3 indicates knowledge exchange between employees within organisations.

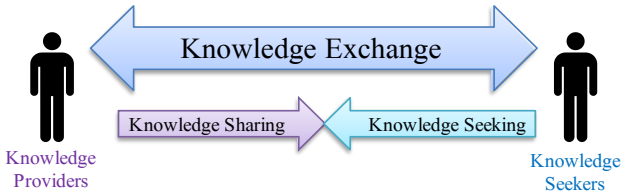


Figure 2.3 Knowledge exchange between knowledge providers and knowledge seekers

As indicated above knowledge sharing studies distinguish two generations of KM. Second generation KM systems require contemporary technologies to enable self-organising activities, individual interactions and participation among employees in today's networked and distributed organisations (Ellison, Gibbs et al. 2014). Employees' participation and engagement are key motivations for designing novel knowledge sharing technologies (Chang and Chuang 2011). Participation, defined as "*being part of a specific larger whole with reciprocal relations and the capability to act and take responsibility*" (Brazier and Nevejan 2014), requires the ability for participants of a KM system to create, share and use knowledge within the context of an organisation's goals. Employees' participation is an essential activity in KM system to form knowledge networks within companies (Bolisani and Scarso 2014). For instance, studies of virtual communities suggest frequency of knowledge visiting and contribution to knowledge contents to assess level of employee participation (Chiu, Hsu et al. 2006).

2.4 Participation in Knowledge Sharing

Participation is defined as "*being part of a specific larger whole with reciprocal relations and the capability to act and take responsibility*" (Brazier and Nevejan 2014). Knowledge sharing as an organisational phenomenon refers to individual participation in knowledge sharing (Hall 2001). Improving employees' participations is a main motivation for designing contemporary knowledge

[1] Re-use/reusability of knowledge is outside of the scope of this thesis.

sharing systems (Chang and Chuang 2011). Since participation in knowledge sharing has been defined as level of involvement in knowledge sharing processes to share contents, information and knowledge within organisation, the different levels of employees' participation lead to different degrees of knowledge contribution (Chang and Chuang 2011). Success of KM systems strongly relates on voluntary propensity of employees to participate in knowledge sharing (Wiertz and de Ruyter, 2007). Sallis and Jones (Wallis, 2003) show that most KM systems fail due to inadequate participation in knowledge sharing processes.

Participation in an organisation's KM requires abilities to create, share and use knowledge within organisations. Second generation KM considers knowledge sharing as an open, voluntary activity supported by the social process, for which individual participation plays an important role (Choi, Lev et al. 2014, Llopis and Foss 2016). With advances in knowledge sharing technologies, contemporary KM systems are developed to support participation in knowledge sharing (Wasko, Teigland et al. 2009).

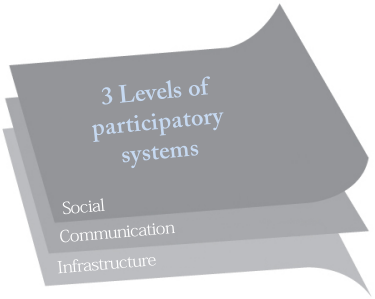


Figure 2.4 Three levels of participatory system

Participatory system concept identifies a kind of systems design approach to support individual's engagement in the participation process. Participatory systems are "*large-scale social-technical systems enabled by technology, coordinating and orchestrating self-organisation, designed to provide individuals and organisations the ability to act and take responsibility in today's networked society"* (Brazier and Nevejan 2014). As depicted in Figure 2.4, three different levels structure participatory systems. When designing a participatory system three major design principles are of key importance (Brazier and Nevejan 2014). First, trust is essential to the social process facilitated by mechanisms for transparency, security, integrity, privacy, identifiability, traceability, accessibility, proportionality, reliability and robustness. Second, engagement necessitates interaction, design of presence, enactment, communication, awareness and co-

creation. Third, a participation process empowers participants respecting participants' autonomy (reactivity and pro-activeness) and providing them the ability to act through interaction, communication and self-regulation (Brazier and Nevejan 2014).

2.5 Participants Engagement in Knowledge Sharing

Employing the design principle for engagement in participatory KM systems, an engaging KM system needs to support a social process and provide an infrastructure facilitating interaction, presence, enactment, communication, awareness and co-creation (Brazier and Nevejan 2014). Participants' engagement indicates a level of involvement in knowledge sharing processes to share contents, information and knowledge within organisation (Chang and Chuang 2011). Success of KM systems strongly depends on participants' willingness to engage in knowledge sharing (Wiertz and de Ruyter 2007). All KM systems need participants' engagement in knowledge sharing to improve both quality and quantity of knowledge contribution within organisations, to make sharing memorable, satisfying, enjoyable and rewarding process (Benyon, Turner et al. 2005).

Two types of employees' engagement are proposed in KM studies. Passive engagement is a type of participation in which users receive knowledge from a centralized system and they have no opportunities to send any feedbacks. Active engagement refers to a type of interaction, which people can react to others by developed features. KM technologies facilitate the user's participation. KM 1.0 tools support passive participation, while, KM 2.0 approach that uses web 2.0 technologies supports active participation through KM systems (Paroutis and Al Saleh 2009).

Participant engagement is developed in different communication channels of KM systems (Sedighi, Splunter et al. 2016). Communication channels are distinguished with the level of knowledge sharing engagement visibilities (Zhang, De Pablos et al. 2013). Private communication channels are developed in KM systems to transfer knowledge between two persons: a knowledge sender and a knowledge recipient. Group communication channels create a knowledge exchange platform among a group of employees with considering to few-to-few communication. Public communication technologies support employees to share knowledge with all employees within organisation. These platforms support many-to-many communication.

2.6 Key Performance Indicators

To evaluate and measure the performance of knowledge sharing, key performance indicators are required. As the one to implement knowledge management systems (KMS) (Sedighi and Zand

2012), measurement of the knowledge management (KM) outputs are essential (Holsapple and Joshi 1999, Sage and Rouse 1999).

Employees' participation can be measured by evaluating knowledge contribution; a greater level of individual participation indicates a higher amount of knowledge contribution (Kankanhalli, Tan et al. 2005, Wasko and Faraj 2005, Lou, Fang et al. 2013). Two main approaches have been followed by researchers to determine the level of knowledge contribution in the KM systems. First, a significant number of studies have focused on the volume of shared knowledge (Sun, Fang et al. 2012) to assess the level of users' knowledge contribution (Chen and Hung 2010). Second, a few KM studies have focused on the quality aspect to examine the value of knowledge contribution (Lou, Fang et al. 2013). Wasko and Faraj (2005) study social capital dimensions and motivational factors in relation to the quality aspect of shared knowledge, as well as the quantity aspect. Both sides of knowledge sharing performance can be improved if all participants have both motivation and opportunity to participate[1].

2.7 Participants' Perceived Benefits and Costs

Many KM studies have investigated influencing factors that affect knowledge sharing behaviour (e.g. (Cyr and Wei Choo 2010, Hung, Durcikova et al. 2011, Sedighi, van Splunter et al. 2015)). In general, all factors can be positioned in a range from hard factors such as technologies and infrastructure to soft factors like individuals' benefits and costs (Wu and Zhu 2012). This section discusses different participants' perceived benefits and perceived costs that influence participation in KM activities.

Several social theories have been developed to examine participants' perceived benefits and costs of knowledge sharing. Social Cognitive Theory (SCT) discusses a phenomenon that people observe and remember the consequences of behaviours to perform the behaviour again (Bandura 1986). Therefore, favourable consequences of behaviour result in repeated behaviour. Further, social exchange theory examines individual behaviour as a rational social phenomenon is formed with subjective cost-benefit analysis (Lin and Huang 2008). The Social Exchange Theory (Blau 1964) is extensively employed to elucidate individual behaviour in different domains, such as information technology (Gefen and Keil 1998), customer behaviour (Shiau and Luo 2012) and online information sharing (Hall, Widén et al. 2010). This thesis uses the Social Exchange Theory to identify knowledge sharing phenomenon regarding to the perceived benefits and costs. From the Social Exchange Theory perspective, participants' behaviour is significantly imposed by the

[1] This thesis focuses on participation in knowledge sharing and its effect and not on knowledge structuring and reusability.

process of comparing perceived benefits with perceived costs (Lin 2007). Individuals' perceived benefits can be examined by reciprocating knowledge, collective reputation, and enjoyment from helping colleagues, while expending effort and taking time for knowledge contribution can be clustered as perceived costs (Lin 2007, Hung, Durcikova et al. 2011).

2.7.1 Perceived Benefits

Self Determination Theory (SDT), as an important psychological theory, distinguishes two types of individual benefits: extrinsic and intrinsic benefits (Ryan and Deci 2000). This definition has been employed in the KM studies (e.g., (Kankanhalli, Tan et al. 2005)) to classify participants' perceived benefits in knowledge exchange. Intrinsic motivation is defined as a type of perceived benefit that focuses on inherent satisfaction rather than on external tangible and intangible rewards. Altruism and knowledge self-efficacy are two main intrinsic benefits for participation. Altruism represents a perception of gratification achieved by helping co-workers in knowledge sharing (Wasko and Faraj 2005). KM literature (e.g. (Cyr and Wei Choo 2010, Chang and Chuang 2011) categorises this kind of behaviour as an individual perceived benefit because participants enjoy helping others by sharing their knowledge. In addition, knowledge self-efficacy refers to participants' confidence in their competency to prepare knowledge for other employees (Bandura 1994). Bandura and Locke (2003) distinguish four key sources of self-efficacy in an organisational context:

- Past performance: employees have a high level of self-efficacy if they can track their previous successes or past performances (e.g. challenging tasks)
- Vicarious experience: employees have a high level of self-efficacy if they watch other co-workers' succeed (e.g. identifying most success people or success story)
- Verbal persuasion: employees have a high level of self-efficacy if they are told that they have the skill and talent to complete task (e.g. mentoring)
- Emotional cues: employees have a high level of self-efficacy if they feel the low level of expectations of their emotional well-being and their vulnerability to stress and depression to complete task (e.g. realistic goals)

Extrinsic benefits include tangible and intangible rewards for knowledge sharing often regulated by external rewarding, (Lou, Fang et al. 2013). Two main clusters of extrinsic benefits are distinguished in the literature: external regulation and internalized extrinsic benefit (Ryan and Deci 2000). Self-cognition or reputation and material rewards have been identified as external regulation in the extrinsic benefits taxonomy (Deci and Ryan 2002). Participants' reputation

represents the level of professional recognition that can be enhanced by contributing knowledge to KM systems (Hsu and Lin 2008). Material rewards include monetary and non-monetary benefits such as promotion and job security to compensate knowledge sharing behaviours (Lou, Fang et al. 2013). Studies have specified that extrinsic benefits affect participants' willingness to voluntarily share knowledge in a knowledge network environment (Hung, Durcikova et al. 2011, Wang, Noe et al. 2014). Few studies have recommended financial (monetary) rewards for knowledge sharing (Bartol and Srivastava 2002). This is consistent with the social exchange concept that presupposes that participants engage in a social process such as knowledge sharing if and only if the social benefits exceed the costs.

The SDT positions reciprocity in the cluster of internalized extrinsic benefits, because reciprocity is internally determined by individuals (Lou, Fang et al. 2013). Reciprocity is a combination of intrinsic benefits and external benefits which is also dissimilar from external regulations (Lou, Fang et al. 2013). Two kinds of reciprocal behaviour are distinguished: direct reciprocity and generalized reciprocity (Wasko and Faraj 2005). Direct reciprocity is the expectation of knowledge return between any two participants to maintain a mutual knowledge relation, whereas generalized reciprocity is participants' expectations to future knowledge return from whole of community not a specific member (Faraj and Johnson 2011).

2.7.2 Perceived Costs

Prior studies examine perceived costs, like participation's perceived benefits, as critical factors to predict individuals' knowledge contribution (Fan, Zhang et al. 2014). Adaptive Cost Theory (Cohen and Lambie 1978) explains people inherently adapt to their environment by prioritising tasks; reacting comes at a cost: this cost can be expressed by physical or psychological costs (Cohen 1980). Time and effort are also defined as psychological costs in Adaptive Cost Theory, and can be used to examine participants' decisions about sharing their knowledge with others (Zhou and Chen 2011, Connelly, Ford et al. 2014). These perceived costs refer to the concerns of taking time and expending efforts to participate in KM activities. Participants' mental efforts for participation have been defined as cognitive costs of knowledge sharing, while spending time for participation has been identified by executional costs of knowledge sharing (Yan, Wang et al. 2016). Studies in the enterprise social media domain examine both time and effort as the most significant barriers to participate in knowledge sharing (Vuori and Okkonen 2012). Further, risk of losing face is recognised as a perceived cost of knowledge sharing (Ardichvili, Maurer et al. 2006). Participants feel that they lose face if they share low-quality knowledge in KM systems. The cost of losing face is defined by Huang, Davison et al. (2008) as a sociological perception of

feeling embarrassment and disrespect in organisations. Ardichvili et al. (2003) states that users of online knowledge sharing communities are concerned about losing face during active participation. From the social exchange theory perspective, participants do not participate if the cost of sharing knowledge outweighs the potential benefit of knowledge contribution (Bock, Zmud et al. 2005). Increasing perceived costs of participation reduces the participants' voluntary willingness to participate in KM activities. Table 2.3 presents definitions of the main perceived benefits and costs.

Table 2.3 Definitions of perceived benefits and costs

Perceived benefits and costs	Definitions	Source
Material rewards	Participants' perception of the value of material rewards (non-monetary) through participation in a KM system	(Kankanhalli, Tan et al. 2005, Benbya 2015)
Reputation	Participants' perception of the value of enhancing respect or earning prestige through participation in a KM system	(Lin 2007, Chang and Chuang 2011, Lou, Fang et al. 2013)
Reciprocity	Participants' perception of the value of receiving knowledge in return in a KM system	(Bock, Zmud et al. 2005, Wasko and Faraj 2005, Lou, Fang et al. 2013)
Altruism	Participants' perception of the value of enjoyment to help others by sharing knowledge in a KM system	(Wasko and Faraj 2005, Hsu and Lin 2008, Papadopoulos, Stamati et al. 2013)
Self-efficacy	Participants' judgment of the value of his/her competency to provide/share knowledge to others users in a KM system	(Kankanhalli, Tan et al. 2005, Chang and Chuang 2011)
Effort	Participants' perception of the value of the effort that needs to be made to participate in a KM system	(Chiu, Hsu et al. 2006)
Time	Participants' perception of the value of the amount of time needed to participate in a KM system	(Chiu, Hsu et al. 2006)
Risk of losing face	Participants' perception of the value of the feeling embarrassment and disrespect if they share low-quality knowledge in organisations	(Ardichvili, Page et al. 2003, Huang, Davison et al. 2008)

2.8 Knowledge Sharing Visibility

Employees can be aware about "*who knows what and who knows whom*" by observing knowledge objects and knowledge links (Leonardi 2014). Zahng, et al. (2013) identify knowledge sharing visibility as employees' opportunities to observe and monitor knowledge sharing behaviour within an organisation. The visibility aspect of KM system has grown in the past decade by transforming traditional communication technologies (e.g. telephone or face-to-face meeting) to contemporary communication systems (e.g. enterprise knowledge networks). Visibility of

communications is one of the imperative attributes of knowledge exchange channels that can influence knowledge sharing behaviour (Fulk and Yuan 2013).

Table 2.4 Summary of key research in perceived benefits knowledge sharing visibility

Theoretical foundation	Technology	Visibility level	Perceived benefits & costs (selected)	Dependent variables	Data collection/ Research scope	Source
• **Theory of reasoned action** • **Social-determination**	-	Public	• Material rewards • Reciprocity • Knowledge self-efficacy • Enjoyment in helping others	• Knowledge sharing intention	Survey / 50 organisations in Taiwan	(Lin 2007)
• **Collective action** • **Individual motivation** • **Social capital** • **Social exchange**	Electronic networks of practice	Public	• Reputation • Enjoy helping • Self-rated expertise • Reciprocity	• Helpfulness of contribution • Volume of contribution	Survey /a national legal professional association in the USA	(Wasko and Faraj 2005)
• **Social exchange**	-	Group	• Reputation • Reciprocity • Economic rewards • Self-efficacy • Enjoyment of helping	• Explicit knowledge sharing • Implicit knowledge sharing	Mixed method: interview and survey/ an organisation work of computer-based education systems	(Zhang, De Pablos et al. 2014)
• **Social exchange**	-	Public	• Material rewards	• Explicit knowledge sharing • Implicit knowledge sharing	Survey/ a Chinese hospital	(Lin and Lo 2015)
• **Expectation-confirmation** • **Theory of reasoned action**	Knowledge repository	Public	• Image • Reciprocity • Organisational rewards • Enjoyment in helping	• Contribution on KM • Seeking knowledge	Survey/ an international IT company	(He and Wei 2009)
• **Theory of reasoned action**	-	Public	• Extrinsic rewards • Reciprocity	• Intention to share knowledge • Attitude toward knowledge sharing	Survey/ 13 organisations in 7 industries in Korea	(Bock, Zmud et al. 2005)
• **Social exchange** • **Social capital**	Knowledge repository	Public	• Knowledge self-efficacy • Reciprocity • Enjoyment in helping • Image	• Knowledge repository usage	Survey/ 10 public sector organisations in Singapore	(Kankanhalli, Tan et al. 2005)
• **Theory of planned behaviour** • **Economic exchange** • **Social exchange** • **Self-determination**	Knowledge management system	-	• Organisational Incentives • Reciprocal Benefits • Reputation Enhancement • Enjoyment in Helping Others	• Knowledge sharing intention • Knowledge sharing behaviour	Survey/ 10 companies in China	(Wu and Zhu 2012)
• **Social capital** • **Rational action**	-	-	• Organisational rewards • Reciprocity • Enjoyment	• Tacit knowledge sharing intention • Explicit knowledge sharing intention	Survey/ 7 firms in Korea	(Hau, Kim et al. 2013)
• **Social exchange**	Online health community	Public	• Sense of self-worth • Face concern • Reputation • Social support • Cognitive costs • Executional costs	• General knowledge sharing behaviour • Specific knowledge behaviour	Survey/ 2 major firms Online health community in China	(Yan, Wang et al. 2016)

All KM systems develop different communication channels between participants. Communication channels are characterised by the level of knowledge sharing visibilities (Zhang, De Pablos et al. 2013). Private communication channels are developed in KM systems to transfer knowledge between two persons: a knowledge sender and a knowledge recipient (Appleyard 1996). Group communication channels enable knowledge sharing between a group of employees with few-to-few communication (Brandzaeg and Heim 2009). Public communication technologies enable knowledge sharing with all employees within an organisation. These platforms support many-to-many communication (Raman, Ryan et al. 2005). In the review of relevant literature, key studies related to perceived benefits and costs are summarized by identifying visibility of knowledge sharing in Table 2.4.

2.9 Knowledge Sharing in Iran

Knowledge sharing has been part of research and practical studies in different domains in different societal contexts for many years (Witherspoon, Bergner et al. 2013, Hwang, Singh et al. 2015). Most research in knowledge sharing domain have been developed in America, Europe, and South East Asian, while only a few studies have investigated the organisational knowledge sharing in the Iranian business context. Table 2.5 summarizes organisational knowledge sharing studies in the Iranian context.

Table 2.5 Summary of KM studies in Iranian business context

Aim	Method	Research Scope (in Iran)	Source
Evaluate the influence of different factors on knowledge donation and collection	Structural equation model	Oil industry	(Tohidinia and Mosakhani 2010)
Examining effective factors on knowledge sharing	Correlation research	Institute for International Energy Studies	(Abili, Thani et al. 2011)
Examining the relationship between Knowledge Sharing and Innovation	Multiple regression analysis	Electronic Industry	(Zohoori, Mohseni et al. 2013)
Explore the role of knowledge architecture in an enterprise	Binomial test	-	(Jafari, Akhavan et al. 2009)
Exploring KM features	Multiple regression analysis	SMEs	(Jafari, Fathian et al. 2007)
Discussion essential issues of knowledge management adoption	Regression model	Aerospace industry	(Jafari, Akhavan et al. 2007)

One of the important external factors that affects KM procedures is economical situation of a society (Sedighi, van Splunter et al. 2015). The World Bank reports (World-Bank 2015) Iranian economy is the second biggest economy in the region of the Middle East and North Africa. However, World Bank reports the Iranian economy produces $5,442.875 as the Gross Domestic Product (GDP) per capita in 2014, while Germany (almost same population size with Iran) as a

developed country produces $47,902.653 GDP per capita. The next section represents different economical constraints, which can influence business environments as well as KM systems.

2.9.1 Restrictions of Iranian Economy

This thesis explores individual engagement in knowledge sharing activities in Iran as a resource-constrained economy. Resource constrained economies are characterized by higher transaction costs of doing business than those in non-resource-constrained economies due to phenomena as sub-optimal governance and corruption. The Iranian economy is limited by internal and external restrictions. Internal constraints refer to inefficient governing technological and legal systems that are often found in developing countries. These inefficient systems increase transaction costs of organisations and hence require a different, more flexible internal organisation as compared with similar organisations in resource efficient economies. The Iranian business context like other businesses in developing countries suffers by financial constraints, access to the resources and low productivity of firms (Bloom, Mahajan et al. 2010). The corruption perception index is measured by the Transparency International organisation to provide a rank list of 176 countries. This index ranks Iran 131 out of 176 countries (1 = least corrupt; 176 is most corrupt).

On the other hand, Iranian business is limited by international sanctions (external constraints). Although the United States has imposed limitations on economical/commercial activities with Iran since 1979, the main part of the recent sanctions is initially passed for oil, natural gas and petrochemicals products as well as business contacts with the Iranian Revolutionary Guard Corps by UN Security Council in 2006 (UN 2006). The list of sanctions was extended with banking, insurance limitations and disconnecting from the SWIFT-banking network in March 2012 (Torchia, Blenkinsop et al. 2016). Table 2.6 represents Iranian sanctions regarding to sectors and sources.

Table 2.6 Sanction by sectors and sources (Solomon 2015)

Sector / Industry	Source of sanctions	
	The United State	European Union
Missile/arms industry	×	×
Revolutionary Guard Corps	×	×
Nuclear industry	×	×
Energy/petroleum industry	×	×
Banking	×	×
Central bank	×	×
Shipping industry	×	×
International trade	×	×
Insurance	×	×
Foreign firms dealing with Iran	×	

These external and internal restrictions place Iranian businesses for unique challenges. Crude oil export as an important source of Iranian revenue is reduced over the sanction from 2.5 million barrels per day in 2011 to 1.1 million barrels per day by 2013. Further, the international sanctions make a barrier to access to more than $120 billion in international banks in western countries (Katzman 2016). These restrictions caused a big value reduction of the Iranian currency unit (Rials) by 50% from 2012 until 2014. The drop in the value of the Iranian currency unit (Rials) against foreign currencies (such Dollar or Euro) caused a high inflation rate (more than 20%) during 2011-2013 (CBI 2015). Increasing the inflation rate and financial restrictions of international trading provides a challenging environment for Iranian companies to import materials; products or initial parts for production lines. For instance, these restrictions affected the Iranian car industry reducing production by 50% between 2001 and 2013. Therefore trading in markets in these economies is restricted by an economic environment that is not market transactions conducive. This becomes even more dominant when knowledge sharing is taken into account, as knowledge is a particular good, namely a good with public good characteristics. Dealing with knowledge in such an environment can expected to be different than is usually assumed in the literature on knowledge sharing in firms in well-defined and properly functioning markets.

2.9.2 Knowledge Management Strategy in Iran

KM studies have distinguished a spectrum of KM strategies. Two main dimensions have been identified by Choi, et al. (2008) to classify KM strategies: (1) KM focus and (2) KM source. KM focus dimension classifies KM strategies by considering explicit or tacit types of knowledge. The explicit-oriented KM strategy considers improving organisation efficiency with documenting and reusing knowledge mostly through information technologies (Hansen, Nohria et al. 2000). The tacit-oriented KM strategy considers to participants social process with sharing tacit knowledge through communication and socialization processes (Zack 1999). Although earlier studies emphasize direct face-to-face communication, recent KM studies examine social media technologies for the tacit-oriented KM strategy (Kwahk and Park 2016). External-oriented KM strategies focus on knowledge acquisition from external sources by collecting or imitating (Lee, Chang et al. 1999) others. Organisations also develop internal-oriented KM strategies to create and share knowledge within their own organisational borders (Choi, Poon et al. 2008).

Few KM studies have explored knowledge sharing behaviour for resource-constrained economies such as Iran. Constrained access to (international) sources such as new technologies and external knowledge negatively influences competitive advantage. As a result, organisations need to invest

more in the internal knowledge exchange and explication of tacit knowledge (Howells 2002). Iranian government has been developed the "*economy of resistance*" plan to bypass international sanctions by reducing organisations' dependencies on international technologies and knowledge (Bozorgmehr 2012). Knowledge sharing among employees to exchange tacit knowledge and experiences is a meaningful improvement for organisations with limited resources (Asrar-ul-Haq, Anwar et al. 2016).

2.10 Summary

The motivation of this chapter is to examine the position of knowledge exchange through KM systems in the literature of the KM domain. Further, this chapter addresses the following research questions: What are Critical Success Factors (CSF) for successful knowledge management systems? (Research question 2a), Why are participants willing to share knowledge and participate for knowledge exchange? (Research question 2b), Which Key Performance Indicators (KPIs) are identified for evaluating participation for knowledge exchange? (Research question 2c), Which perceived benefits and costs have been identified for knowledge exchange? (Research question 2d) and How do knowledge sharing visibility interact with knowledge exchange? (Research question 2e).

This chapter explains individuals' participation in knowledge exchange as the main motivation for several KM studies to sustain competitive advantages. CSFs of knowledge management have been categorised by examining organisational and environmental factors. Further, this chapter distinguishes participants' knowledge contributions by separating the quality side versus the quantity side of knowledge contribution. Individual perceived benefits and costs, and knowledge sharing visibilities that are considered influential factors of participation in knowledge exchange are discussed in the chapter. The Iranian business context as the scope of this thesis is explained in the last part of this chapter. This chapter provides the foundation for the rest of the thesis.

Chapter 3 Participation in Knowledge Exchange

This chapter focuses on the participation in knowledge exchange by discussing two major issues. First, this chapter addresses the research question [*How to rank priority of critical success factors for successful knowledge management systems in the Iranian business environment? (Research question 1a)*] Second, this chapter explores the research question: [*Which types of knowledge management systems have been recognized to support participation in knowledge exchanges? (Research question 2f)*]

3.1 Ranking Critical Success Factors[1]

This section assesses the relative importance of critical success factors (CSF) for KM in Iran. To this purpose, KM experts in the Iranian energy industry, who are directly involved in implementing and designing KM projects, are asked individually to assess the relative importance of these factors. As discussed in Chapter 2, the Iranian energy industry is constrained by several international sanctions, in a resource-constrained economy.

The KM critical success factors model in Figure 2.2 (Sedighi and Zand 2012) classifies the critical organisational and environmental factors found in the literature (Chapter 2). Figure 3.1 extends this model to a hierarchy of factors with three levels (objective, categories, factors). The second level of the hierarchy depicts the eight KM CSFs categories distinguished in Figure 2.2. The third level depicts the specific factors within each category. This chapter analyses the outcomes of a questionnaire (Appendix A) to calculate factors' weights of these elements with respect to the experts' perceptions in the Iranian energy industry as one of the biggest industries in Iran. The assessment procedure described in this section is designed to obtain experts' perceptions on the relative importance of CSFs to establish a ranking of importance. The next section explains the technique of pairwise assessment followed by an analysis of the results.

[1] This section is based on Sedighi, M., Van Splunter, S., Zand, F. and Brazier, F. (2015). "*Evaluating critical success factors model of knowledge management: An analytic hierarchy process (AHP) approach*" published in the International Journal of Knowledge Management and Sedighi, M. and Zand, F. (2012). "*Knowledge management: Review of the Critical Success Factors and development of a conceptual classification model.*"10th International Conference of ICT and Knowledge Engineering, Bangkok IEEE Explore, 1-9.

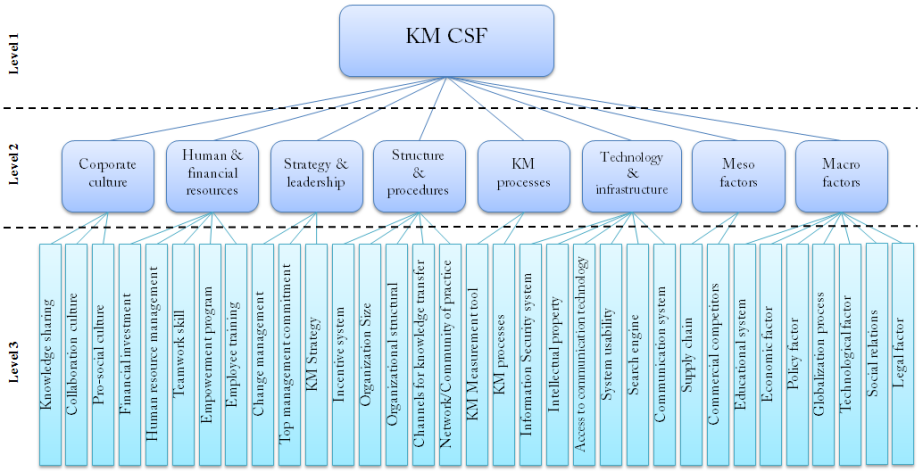


Figure 3.1 The hierarchy model of knowledge management critical success factors

3.1.1 Pairwise Comparison of CSFs

The Analytic Hierarchy Process (AHP) technique (Saaty 1980) is used to quantify the importance of CSFs.[1] This technique distinguishes three steps (Saaty 1980): Firstly, the computation of each factor's weight is determined by pairwise assessments. Second includes pairwise comparison between categories to determine the weights of each category. Third includes calculation of the consistency level of results (Salmeron and Herrero 2005).

The nine-point scale questionnaire (the original scale of AHP) (Saaty 1977) is used for pairwise assessment between categories and factors. Table 3.1 represents pairwise comparison scale for this AHP ranking method. Saaty's standard questionnaire is deployed for pairwise comparisons. As all comparisons are to be considered, this method requires $m_k(m_k - 1)/2$ number of comparisons to be performed where m is the number of attributes in the category A. By employing this procedure, there is no symmetric inconsistency between two attributes; however, transitive inconsistencies need to be analysed.

[1] The AHP method has been widely applied in the KM studies to select KM tools and strategies (e.g. Wu, W.-W. and Y.-T. Lee (2007). "Selecting knowledge management strategies by using the analytic network process." Expert Systems with Applications **32**(3): 841-847, Grimaldi, M. and P. Rippa (2011). "An AHP-based framework for selecting knowledge management tools to sustain innovation process." Knowledge and Process Management **18**(1): 45-55, Bratianu, C. and I. Orzea (2012). "Knowledge Strategies Analysis by Using the Analytic Hierarchy Process." The IUP Journal of Knowledge Management **10**(2): 7-21.), while few studies have been employed this method to assess KM CSFs.

Table 3.1 Pairwise assessment (AHP) (Saaty 1996, Salmeron and Herrero 2005)

Rate	Explanations
1	Factor (category) A is equally preferred to Factor (category) B
2	Factor (category) A is equally to moderately preferred over factor (category) B
3	Factor (category) A is moderately preferred over factor (category) B
4	Factor (category) A is moderately to strongly preferred over factor (category) B
5	Factor (category) A is strongly preferred over factor (category) B
6	Factor (category) A is strongly to very strongly preferred over factor (category) B
7	Factor (category) A is very strongly preferred over factor (category) B
8	Factor (category) A is very strongly to extremely preferred over factor (category) B
9	Factor (category) A is extremely preferred over factor (category) B

The comparison analysis represents the pairwise factor assessments in each category in the matrix A_k. All elements of the lower triangle of the matrix A_k are the inverse of the elements of the other triangle. Matrix factors (a_{ij}) are determined as ratios of the importance of factor *i* comparing with factor *j* (López and Salmeron 2011). Thus, the matrix is created by the questionnaire results.

$$A_k = \begin{bmatrix} 1 & \cdots & a_{ij} \\ \vdots & 1 & \vdots \\ 1/a_{ij} & \cdots & 1 \end{bmatrix}$$

The matrix confirms Aw is equal to nw, where *w* defined as the vector of the actual. The matrix is used to depict the weights of each factor. Further, the biggest eigenvalue is *n* (Saaty 1977). The next step includes measuring the eigenvalues. The standard AHP software (Super decision[1]), is used to calculate the eigenvalues and eigenvectors (Liu, Yu et al. 2003).

3.1.2 Consistency of CSF Ranking

A key step in AHP is to assure the consistency of the pairwise evaluations provided by the respondents. AHP determines a criterion of consistency for the pairwise comparison by calculating the consistency ratio. The consistency ratio represents an estimation of the consistency of respondents in answering the questionnaire. The consistency ratio is commonly calculated by the difference of the largest eigenvalue ($\lambda_{\max}$) to the number of attributes (n) in each category. The consistency index is calculated with a matrix with size n by $\mathrm{CI} = (\lambda_{\max} - \mathrm{n})/(\mathrm{n} - 1)$. The consistency index is used to calculate the consistency ratio according to the formula: Consistency Ratio = Consistency Index / Random Index. The random index is the consistency index measured for each matrix of size n with random matrices (Saaty 1980). Therefore, reducing the consistency ratio to zero makes greater pairwise consistency. The consistency ratio of less than 0.1 indicates acceptable outcomes (Saaty and Vargas 1994). This

[1] Super decision is AHP/ANP-based multi-objectives decision support software

ratio is calculated for assessing the consistency level of respondents. Further the results are used to evaluate the consistency level of the KM CSF model.

3.1.3 Results of Ranking CSF in the Knowledge Management Domain

All data is collected from the Iranian energy industry. An initial pilot study involves 15 KM professionals and HR experts with experience in designing KM systems, managing intellectual capital and protecting KM practices in the energy sector. They are requested to examine the structure, consistency and the clarity of the questions and to complete the CSF questionnaire. The questionnaires are sent via e-mail to 151 KM experts in the Iranian energy industry.

Table 3.2 Descriptive statistics of respondents

	Items	Number of respondents	Percentage (%)
Gender	*Male*	64	75.3
	Female	21	24.7
	Total	**85**	**100**
Age (mean = 36.7)	*20-24*	2	2.4
	25-28	9	10.6
	29-32	10	11.8
	33-36	18	21.2
	37-40	20	23.5
	41-44	16	18.8
	45-48	5	5.9
	49-52	2	2.4
	53-56	2	2.4
	57-60	1	1.2
	Total	**85**	**100**
Work Experience (mean = 10.4)	*1-4*	8	9.4
	5-8	12	14.1
	9-12	27	31.8
	13-16	15	17.6
	17-20	12	14.1
	21-24	8	9.4
	25-28	1	1.2
	29-32	1	1.2
	33-36	1	1.2
	Total	**85**	**100**
Organisational Positions	*Manager*	21	24.7
	Team manager	15	17.6
	Executives	49	57.6
	Total	**85**	**100**

The questionnaire was sent on 15th January 2014 through email. Each respondent completed the questionnaires individually. Overall 85 questionnaires are returned, completed by 64 males and 21 females which all of them are acceptable (consistency ratio < 0.1). Approximately 76% of all respondents have more than 8 years work experiences in the energy sector as indicated in Table 3.2. The average consistency ratios are given in Table 3.3 for integrated matrixes with more than 2 factors, thus not for the categories of KM processes and the meso environmental. All consistency ratios as well as average consistency ratios are within the acceptable boundaries (lowest 0.021 and highest 0.077). The overall consistency of AHP assessment process fall within the acceptable ratio of 0.10 (Saaty and Vargas 1994).

Table 3.3 Factors consistency ratios

Critical success factor	Average consistency ratio	Min	Max
Corporate culture	0.02199	0.00	0.03
Human & financial resources	0.03972	0.014	0.074
KM Processes	0.00	0.00	0.00
Strategy & leadership	0.02968	0.00	0.04
Structures & procedures	0.02501	0.002	0.085
Technology & infrastructure	0.05531	0.011	0.075
Macro factors	0.07525	0.0235	0.095
Meso factors	0.00	0.00	0.00
KM CSF	0.07734	0.011	0.086

With respect to the normalized priority weights of CSF categorises, "*corporate culture*" (priority weight 0.2668) is found to be the most important of the CSFs and the least important is "Technology & infrastructure" with a priority weight of 0.0699. The priority weights of the CSFs specify their relative importance during implementation of KM, the order of importance of the KM CSF is shown in Table 3.4.

Table 3.4 Global priority weights

Ranking	Category	Weights
1	Corporate culture	0.2668
2	Human & Financial Resources	0.1512
3	Strategy & Leadership	0.1157
4	Structure & Procedures	0.1117
5	Meso Factors	0.1108
6	KM Processes	0.0942
7	Macro Factors	0.0792
8	Technology & Infrastructure	0.0699

Table 3.5 shows that the local weights of categories are largely consistent. The normalized scores at level two specify the relative importance of sub-factors in CSF categories in level one. As all respondents' answers have the same importance in our study, the geometric mean is used to calculate global priority weights and average local weights.

Table 3.5 represents local weight in normal and idealized styles. Ideal weights can be measured in each cluster of CSF by assigning 1.00 to the most important factor and calculating distances between other factors and the most important factor. As presented, a culture of knowledge sharing is the most important CSF (local weight is 0.523) in the Corporate culture category. It is almost twice as important as the Collaboration culture (0.249), and the Pro-social culture (0.227). Financial investment is shown to be the most important CSF for the second category (local weight: 0.337) in the Human & Financial Resources category. Human resource management is positioned after financial investment with a local weight of 0.207. Teamwork skill (0.205),

Empowerment program (0.169) and Training program (0.079) follow Human resources management. Change management is the most important CSF (0.519) in the Strategy and Leadership category. It is near one to three times larger than top management commitment (0.346) and KM strategy (0.133).

Table 3.5 Local weights results (level three)

Categories	Local ranking	Factors	Local weights	Idealized local weights
Corporate Culture	1	Knowledge sharing	0.523	1.00
	2	Collaboration	0.249	0.476
	3	Pro-social	0.227	0.434
Human & Financial Resources	1	Financial investment	0.337	1.00
	2	Human resource management	0.207	0.613
	3	Teamwork skill	0.205	0.609
	4	Empowerment program	0.169	0.503
	5	Employee training	0.079	0.235
Strategy & Leadership	1	Change management	0.519	1.00
	2	Top management commitment	0.346	0.666
	3	KM Strategy	0.133	0.256
Structure & Procedures	1	Incentive system	0.366	1.00
	2	Organisation Size	0.280	0.764
	3	Organisational Structural	0.197	0.539
	4	Channels for knowledge transfer	0.107	0.293
	5	Network/Community of practice	0.048	0.130
Meso-Environmental Factors	1	Supply chain	0.651	1.00
	2	Commercial competitors	0.348	0.534
KM Processes	1	KM processes	0.588	1.00
	2	KM Measurement tool	0.411	0.69
Macro-Environmental Factors	1	Educational system	0.326	1.00
	2	Economic factor	0.181	0.577
	3	Policy factor	0.152	0.467
	4	Globalization process	0.114	0.350
	5	Technological factor	0.102	0.312
	6	Social relations	0.071	0.217
	7	Legal factor	0.053	0.163
Technology & Infrastructure	1	Information Security system	0.367	1.00
	2	Intellectual property	0.222	0.605
	3	Access to communication technology	0.154	0.421
	4	System usability	0.114	0.311
	5	Search engine	0.086	0.236
	6	Communication system	0.055	0.152

The incentive system is the most important CSF with a local weight of 0.366 in the Structure and Procedure category. Organisational size (0.280), Organisational structure (0.197), Communication channel for knowledge transfer (0.107) and Community of practices (0.048) are positioned after the Incentive system. Supply chain is about twice as important as Commercial competitors by 0.651 in the Meso Environmental factor category. The KM process is the most important factor with a weight of 0.588, and Knowledge measurement tool scores 0.411 in the KM Process category. Education is the most important CSF (0.326) in the Environmental Macro Factor category; Economics are positioned after Education (0.181); Politics (0.152), Globalization (0.114), Technology (0.102), Social relations (0.071) and legal factor (0.053) are positioned after Economic factor. Information system security is the most important (0.367) in the Technology and Infrastructure category. Intellectual property is ranked after Information system security with a weight of 0.222. Access to communication technology (0.154), Usability (0.114), Search engine (0.086) and Communication system (0.055) are ranked after Intellectual property.

Table 3.6 CSF ranking and global weights

Global ranking	Factors	Global Weight	Categories
1	Knowledge sharing	0.14	Corporate Culture
2	Supply chain	0.072	Meso-Environmental Factors
3	Collaboration	0.067	Corporate Culture
4	Pro-social	0.061	Corporate Culture
5	Change management	0.06	Strategy & Leadership
6	KM processes	0.055	KM Processes
7	Financial investment	0.051	Human & Financial Resources
8	Incentive system	0.041	Structure & Procedures
9	Top management commitment	0.04	Strategy & Leadership
10	Commercial competitors	0.039	Meso-Environmental Factors
11	KM Measurement tool	0.039	KM Processes
12	Human resource management	0.031	Human & Financial Resources
13	Teamwork skill	0.031	Human & Financial Resources
14	Organisation Size	0.031	Structure & Procedures
15	Empowerment program	0.026	Human & Financial Resources
16	Educational system	0.026	Macro-Environmental Factors
17	Information Security system	0.026	Technology & Infrastructure
18	Organisational Structural	0.022	Structure & Procedures
19	Intellectual property	0.016	Technology & Infrastructure
20	KM Strategy	0.015	Strategy & Leadership
21	Economic factor	0.014	Macro-Environmental Factors
22	Employee training	0.012	Human & Financial Resources
23	Channels for knowledge transfer	0.012	Structure & Procedures
24	Policy factor	0.012	Macro-Environmental Factors
25	Access to communication technology	0.011	Technology & Infrastructure
26	Globalization process	0.009	Macro-Environmental Factors
27	Technological factor	0.008	Macro-Environmental Factors
28	System usability	0.008	Technology & Infrastructure
29	Social relations	0.006	Macro-Environmental Factors
30	Search engine	0.006	Technology & Infrastructure
31	Network/Community of practice	0.005	Structure & Procedures
32	Legal factor	0.004	Macro-Environmental Factors
33	Communication system	0.004	Technology & Infrastructure

Table 3.6 indicates global weights-based CSF ranking. Knowledge sharing as a part of corporate culture category is the most important CSF with a global weight of 0.14. Knowledge sharing is almost twice the weight of the other CSFs The second CSF signifies supply chain capability from the meso environmental factor (0.072) and the third factor from corporate culture category refers to collaboration culture with a global weight of 0.067.

3.1.4 Summary of the Ranking CSF

This section discusses results of ranking CSF distinguished in the classification CSF model (Sedighi and Zand 2012), in the categories - Human and Financial Resources; Strategy and Leadership; Structures and Procedures; KM Process; Micro- and Macro Environment; Technology and Infrastructure.

Exploring the KM CSF hierarchy model using the AHP technique makes it possible to determine the relative importance of each category: Corporate Culture (0.267), Human and Financial Resources (0.151), Strategy and Leadership (0.116), Structure and Procedures (0.112), Meso-Environmental Factors (0.111), KM Processes (0.094), Macro-Environmental Factors (0.079) and

Technology & Infrastructure (0.070). According to these results, the most important category is Corporate Culture, and the least important category is Technology & Infrastructure. All of the other factors are shown to be of importance to the implementation of KM, some more than others. Culture, Human Resources and Leadership are the three top ranked categories while, the KM Technology and Infrastructure are ranked at the end of the list. These results assert that implementing KM projects, as socio-technical systems requires social process management and not just KM tools. This finding is consistent with the emergent approach toward knowledge sharing (van den Hooff and Huysman 2009) that focuses on KM as a social process rather than a knowledge transferring tool. This finding also approves our finding that technological (hard) factors are less critical than culture, social and human (soft) elements.

The ranking results represent the importance of each factor and category from respondents' perspectives in Iran. Our results are consistent with other studies in Iran. For instance, the ranking outcome is consistent with Valmohammadi (2010) study, in which he found leadership and culture are important factors of KM success in Iran. However, the focus on the Iranian energy industry may lead to different insights on the relative importance of constraints and success factors for KM systems when compared to results gathered in non-constrained environments. A survey (Wong and Aspinwall 2005) in UK ranks IT as an important factor. A feasible explanation is that because of external constraints of Iranian economy as well as lack of financial investments of international software companies in Iran, companies do not accede to software copyright. Thus, they can access to the relevant KM software without spending more resources.

3.2 Participation in Knowledge Sharing[1]

This section elaborates on participation in knowledge sharing. As elucidated above, success of KM projects strongly depends on soft factors such as knowledge sharing and participants' collaboration, for which engagement (Chang and Chuang 2011) is essential.

3.2.1 Participants' Engagement Dimensions

Participatory systems are large-scale social-technical systems enabled by technology, coordinating and orchestrating self-organisation, designed to provide individuals and organisations the ability to act and take responsibility in today's networked society (Brazier and Nevejan 2014). When designing a participatory system three major design principles are of key importance (Brazier and Nevejan 2014). First, trust is essential in the social process facilitated by

[1] This section is based on a paper presented at the 8th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management, Portugal - 2016

mechanisms for transparency, security, integrity, privacy, identifiability, traceability, accessibility, proportionality, reliability and robustness. Second, engagement necessitates interaction, presence, enactment, communication, awareness and co-creation. Third, a participation process empowers participants respecting participants' autonomy (reactivity and pro-activeness) and providing them the ability to act through interaction, communication and self-regulation (Brazier and Nevejan 2014).

Employing the design principle for engagement in participatory KM systems, implies that an engaging KM system needs to support a social process and provide an infrastructure facilitating interaction, presence, enactment, communication, awareness and co-creation (Brazier and Nevejan 2014).

The classification framework this chapter introduces distinguishes 6 dimensions (Figure 3.2) of engagement adopted from KM studies listed below. These dimensions are used to evaluate KM systems:

- **Interaction:** level of participant engagement in the knowledge exchange and social processes with respect to perceived costs and benefits (Cyr and Wei Choo 2010).
- **Presence:** level of participant presence in relation to time, place, actions and relations (Riva, Waterworth et al. 2011, Nevejan and Brazier 2012).
- **Enactment:** level of participant engagement in legislation and self-regulation in the governance of KM systems (Tseng and Kuo 2014).
- **Communication:** level of participants' possibilities to communicate in different levels of knowledge sharing channels (Snyder and Eng Lee-Partridge 2013).
- **Awareness:** level of participants' opportunities to be aware of structures, networks and governance of KM systems (Leonardi 2014).
- **Co-creation:** level of participants' opportunities to jointly generate knowledge with other participants (Kazadi, Lievens et al. 2016).

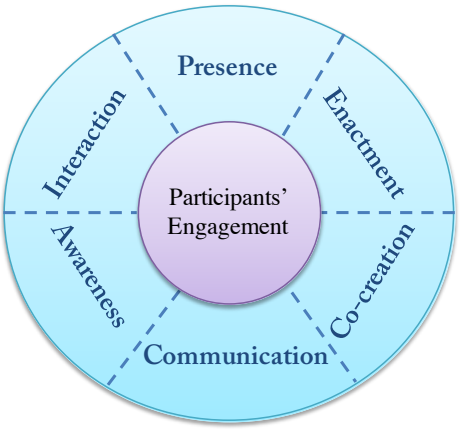


Figure 3.2 Participants' engagement dimensions

3.2.2 Method of Evaluating Engagement's Dimensions

The Qualitative Exploratory Multi-case Study method is used in this chapter to identify in-depth relations between complex phenomena (Kaae, Søndergaard et al. 2010) by assessing the above mentioned engagement dimensions in KM systems. This exploratory method is chosen due to (1) its aim to understand and explain complex phenomena (Yin 2013) through qualitative analysis of data and the literature, (2) the limited availability of relevant data, (3) the opportunity to analyse specific case studies (Sekaran 2006)

3.2.3 Engagement Assessment Procedure

This section presents an assessment procedure to appraise individual engagement in knowledge exchange in different KM systems. For the first step, KM systems are selected using the winner list of "*Globally Most Admired Knowledge Enterprises*" (MAKE) award. The MAKE award, initiated by Teleos in relation with the KNOW network, focuses on the KM process and evaluating mechanisms in organisations (Pandey and Dutta 2013). As shown in Table 3.7, 17 companies are acknowledged in the winner list. The KM systems considered in this study are selected from these award-winning companies.

The original goal of these KM systems addresses one of three approaches: some KM systems focus more on the supply-side as nurtured in the first generation of KM, others more strongly emphasize the demand side, more commonly found in second generation KM. Knowledge repositories are an example of corporate knowledge directories (Dalkir 2013) of the first type. For instance, Accenture uses a portal as a knowledge repository system for disseminating and storing knowledge. Lessons Learned Systems are a type of best practice systems, used to collect and

share individual experiences for a wide range of topics. Both Accenture and Price Waterhouse Coopers companies use lessons learned databases for sharing experiences and best practices within their organisations. Both knowledge repositories and lesson learned systems emphasize the supply-side.

Table 3.7 Top MAKE winners (2009 to 2014)

Winner Companies	2009	2010	2011	2012	2013	2014	Sum
Accenture	✓	✓	✓	✓	✓	✓	6
Apple	✓	✓	✓	✓	✓	✓	6
Fluor	✓	✓	✓	✓	✓	✓	6
Google	✓	✓	✓	✓	✓	✓	6
IBM	✓	✓	✓	✓	✓	✓	6
PwC	✓	✓	✓	✓	✓	✓	6
Samsung Group	✓	✓	✓	✓	✓	✓	6
Schlumberger	✓	✓	✓	✓	✓	✓	6
Tata Group	✓	✓	✓	✓	✓	✓	6
Ernst & Young	✓	✓		✓	✓	✓	5
Infosys Limited	✓	✓	✓		✓	✓	5
Microsoft		✓	✓	✓	✓	✓	5
ConocoPhillips			✓	✓	✓	✓	4
Deloitte	✓			✓	✓	✓	4
McKinsey & Company	✓	✓	✓		✓		4
Siemens		✓	✓	✓		✓	4
Toyota			✓	✓	✓	✓	4

On the other hand, the demand-side KM approach focuses on knowledge needs and knowledge demands. Two main KM system examples are Discussion Forums, and Question and Answer (Q&A) systems. These KM systems use Web 2.0 technologies to promote knowledge sharing within organisations. Discussion forums are used, for example, by Shell and Siemens to facilitate knowledge sharing in their organisations. Q&A systems are based on demand-side KM technology that enable knowledge sharing in organisations (Iske and Boersma 2005). A Q&A page is an important feature of Siemens' shareNet system.

Approaches that focus both on supply-side and demand-side for knowledge sharing, are, in this chapter, referred to as combination systems. Examples of such approaches include the practice of designing a knowledge market to develop internal knowledge transfer recently started in business environments. DogEar, for example, is a social network used by IBM to coordinate IBM's internal knowledge market (Zhang and Jasimuddin 2012). Enterprise social networks (ESN), an increasing phenomenon, combine knowledge exchange with social relations. Gartner predicts that 50% of all large enterprises will use ESN by 2016 (Stamford 2013). As depicted in Table 3.8, six

main KM systems are classified by the demand-side, supply-side and combination approach classification.

To evaluate engagement characteristics in the selected systems, Google Scholar website (www.scholar.google.com) is used to find academic journals, and book chapters on knowledge management, business management, and information systems, published between 2010 and 2015. The key words include "*Knowledge repositories*", "*lesson learned systems*", "*discussion forums*", "*question and answer systems*", "*knowledge market*" and "*enterprise social network*". All studies are filtered by the research scope in organisational environments. Regarding key words, 32 qualitative and quantitative studies are recognized.

Table 3.8 KM systems' classification regarding to supply-side demand-side KM

Supply-side KM	Demand-side KM	Combination approach
Knowledge Repositories	Discussion Forums	Knowledge Markets
Lessons Learned Systems	Q&A Systems	Enterprise Social Networks

3.2.4 Participants' Engagement Measures

To evaluate the engagement dimensions, first two judges (one of whom is the author and the second is an assistant professor at Delft University of Technology) independently identify structures, properties and technical features of the selected KM systems in the 32 studies using an open coding scheme. They compare their results on level of engagement for each of the dimensions for these 32 studies and negotiate consensus on their results as depicted in Table 3.9. They negotiate consensus about the level of engagement in the selected KM systems, for each of the dimensions.

As knowledge repositories and lesson learned systems are designed with just unidirectional interactions, they do not support the social process as well as engagement dimension. During the next phase of this study, the author ranked systems with respect to the best KM system in each dimension with three-point scale (*low, medium, high*).

Table 3.9 Data regarding engagement dimensions

KM systems	Interaction	Presence	Enactment	Awareness	Communication	Co-creation
Knowledge Repository	-	-	-	-	-	-
Lessons Learned	-	-	-	-	-	-
Discussion Forum	• Visible comments on knowledge content	• Display content and user profiles • Notification of knowledge changing • Share knowledge through synchronous or asynchronous systems	• Regulating by designers	• Display content and user profiles	• Visible comments on knowledge content	• History of knowledge editing
Questions and Answers	• Freely ask questions • Responding to knowledge needs	• Asynchronous communication	• Contributing by accepting both roles: knowledge creator and knowledge recipient	• Knowledge workers' profiles (experiences and interests)	• Visible comments on knowledge content	• Visible communication within organisation
Internal Knowledge Market	• Exchanging knowledge by virtual monetary mechanism	• Presenting contributions, locations and knowledge relations	Regulating the market by designers	• Experts' profiles (experiences and interests)	•Knowledge publishing consisting of text, video, or audio •Knowledge exchange in private, group and organisational levels	• Visible rating of experiences by knowledge recipients
Enterprise Social Network	• Representing knowledge connections • Knowledge content map • Knowledge workers' profiles (experiences and interests)	• Trigger attendance •Representing knowledge connections	• Enacting for regulating process	• Status knowledge updates • Knowledge workers' profiles (experiences and interests)	• Visible rating and reviews of knowledge objects and comments • Three levels of communication •Real-time text transmission	• Knowledge content map • Visible rating and reviews of knowledge objects and comments

3.2.5 Results of Exploring Engagement Dimensions

In the first phase, qualitative research is used to acquire in-depth understanding of the 6 KM systems chosen. The different types of KM systems are described below together with analysing of the engagement value.

3.2.5.1 Knowledge Repository System

Knowledge repository systems are designed to support saving, disseminating and retrieving knowledge supported by IT (van den Hooff and Huysman 2009). As knowledge repositories are primarily designed for knowledge access and storage and not for the social process of

engagement between participants, this class of systems is not further considered in the context of this thesis. The dimensions of engagement are not evaluated.

3.2.5.2 Lesson Learned System

Lessons Learned systems are designed to enhance the capability of organisations to identify and capture valuable lessons learned through project activities (Burley and Pandit 2008), to disseminate past experiences to others within an organisation to improve individual performance and collective actions. Like knowledge repositories and all other systems developed in the supply-side KM approach, learners are passive participants whom only obtain lessons from such systems, and do not contribute. Lesson learned systems only support one-way communication between experts and knowledge recipients, and thus do not support a social process for knowledge exchange and engagement.

3.2.5.3 Discussion Forum System

Discussion forums are computer-based knowledge systems that enable employees to exchange knowledge and ideas (Montero, Watts et al. 2007). Discussion forums have been developed to promote active engagement in decentralized environments.

Knowledge content in forums is visible to others within an organisation, and participants are aware that everyone within their organisation can read their knowledge. While, participants benefit from in-direct reciprocity, participants do not have the option to use a one-to-one communication channel to interact directly with another person in the organisation, nor to link the discussion to a public forum. Therefore, discussion forum systems support participants' interaction on a medium level, are ranked on the communication dimension, and medium on the co-creation dimension.

Discussion forums are designed for individual presence. They allow members to share knowledge via transparent synchronous or asynchronous communication systems. Thus, discussion forum systems support the high-level individual presence dimension. Such systems are not designed to support self-regulation and intervention on the governance of system. Hence, discussion forum systems support a low-level of individual enactment. Besides, these systems are only designed for communication among group members. Knowledge exchanges on private and public levels are eliminated from the scope of discussion forums. Therefore, discussion forum systems rank low on the communication dimension. Participants share their knowledge to create knowledge in a collaborative environment, but these systems have no technical opportunity to create knowledge in public-level knowledge exchange. Thus, discussion forum systems rank medium on the co-

creation dimension. Discussion forum systems rank low on the awareness dimension, in particular with respect to changes in forum content. Figure 3.3 presents a summary of the engagement assessment for discussion forums.

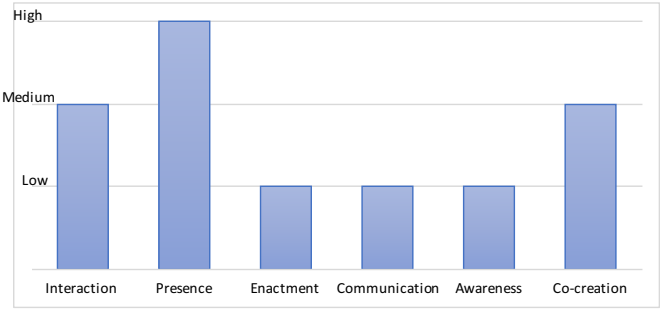


Figure 3.3 Assessment of engagement dimensions as supported in discussion forums

3.2.5.4 Question and Answer System

Question and answer (Q&A) systems employ a transparent environment between knowledge creators and knowledge recipients to transfer personal advice and opinions and employees perceive professional recognition as a benefit (Harper, Moy et al. 2009), Q&A systems promote reciprocal behaviours by indirect knowledge exchange in which employees share knowledge that they have previously seen, engaging in knowledge exchange with others (Nowak and Sigmund 2000). While, employees benefit from in-direct reciprocity, participants have no opportunity to use private communication tools to promote direct reciprocity. Therefore, Q&A systems rank medium-level on the interaction dimension, and low on the communication dimension. As group-level knowledge sharing is supported at the public-level, Q&A systems rank medium-level on the co-creation dimension.

Employees can observe knowledge exchange interactions between inquirers and responders ranking medium-level support for individual presence. Further, participants cannot influence regulations for the system, thus Q&A systems rank low on the enactment dimension. As there is no option for the system to make changes in the Q&A system known to participants in the system, Q&A systems rank low on the awareness dimension in Q&A systems. As these systems also do not support private and group knowledge sharing, Q&A systems rank low on the communication dimension. These systems also have been developed to create knowledge in public-level knowledge exchange. Participants share their knowledge to answer knowledge needs in a Q&A environment, but these systems have restrictions to create knowledge in group-level

knowledge sharing. Thus, Q&A systems support the co-creation dimension on medium-level. Figure 3.4 summarizes the engagement assessment for Q&A system within organisations.

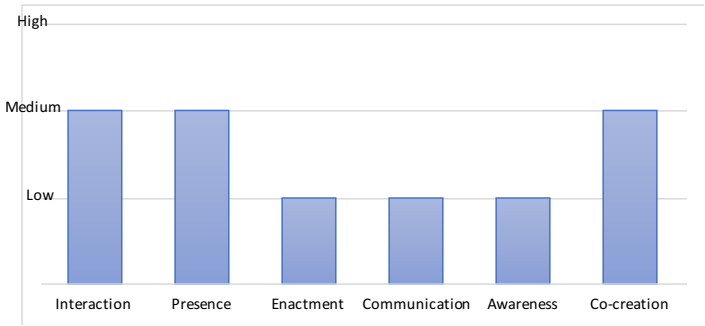


Figure 3.4 Assessment of engagement dimensions as supported in Q&A systems

3.2.5.5 Internal Knowledge Market System

Knowledge markets are defined as a space where knowledge buyers and knowledge sellers can exchange knowledge within organisations (Jeong, Ahn et al. 2012). Knowledge market systems foster knowledge sharing using a dynamic price mechanism within organisations capturing the value of knowledge by virtual monetary mechanisms provided by a system (Zhang and Jasimuddin 2012). Extrinsic rewards like reputation incentive are used for participant engagement (Chen, HO et al. 2010). Nevertheless, knowledge markets damage intrinsic perceived benefits such as altruistic behaviours because of focusing on extrinsic rewards (Frey and Oberholzer-Gee 1997). Internal knowledge market systems are ranked medium on the interaction dimension.

Internal knowledge markets support the presence of participants by presenting their contributions, locations and knowledge relations, ranking high on the presence dimension. As participants' have little or no autonomy to pass legislation and regulation for these markets internal knowledge markets rank medium-level on the enactment dimension. Within internal markets knowledge exchange can occur on private, group and organisational levels, thus ranking high on the communication dimension. Employees receive notifications about the changes in the market, such as new knowledge, thus ranking high on the awareness dimension. Internal knowledge markets support multi-level knowledge exchange scoring high on the co-creation dimension. Figure 3.5 summarizes the engagement assessment for internal knowledge markets.

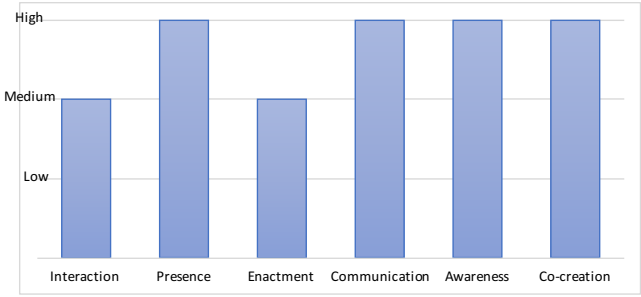


Figure 3.5 Assessment of engagement dimensions as supported in IKM

3.2.5.6 Enterprise Social Network System

Enterprise social networks (ESNs) provide a distributed communication system among participants to promote knowledge exchange unconstrained by the limitations of time and space (Li and Ma 2014), supporting social network sites, blogs, wikis, social networks of practice, micro blogs, social bookmarking and social tagging tools (Leonardi, Huysman et al. 2013). These technologies facilitate social interactions among employees by providing all of these tools in desktop computers, tablets or smartphones at their convenient time and place (Li and Ma 2014).

Employees benefit from both in-direct and direct reciprocity (Nowak and Sigmund 2000), by using different synchronous and asynchronous communication channels, with different levels of visibility within an organisation ranking high on the interaction dimension.

ESNs support the presence of individuals within an organisation through public profiles and knowledge links (Fulk and Yuan 2013) ranking high on the presence dimension. This advantage helps participants to find other knowledge workers who have common interests or same problems. Further, some ESNs provide opportunities for participants to organise themselves and become involved in governance issues, resulting in a medium score on the enactment dimension.

Employees are enabled to share their knowledge in a spectrum of knowledge exchange channels from invisible to visible communication levels, ranking high on the communication dimension. Participant's awareness is stimulated by trigger mechanisms when changes in relevant knowledge sources take place (Majchrzak, Faraj et al. 2013), thus ranking high on the awareness dimension. ESNs support individual engagement in knowledge co-creation at private, group and organisational knowledge sharing, scoring high on the co-creation dimension. Figure 3.6 summarizes the engagement assessment for ESN.

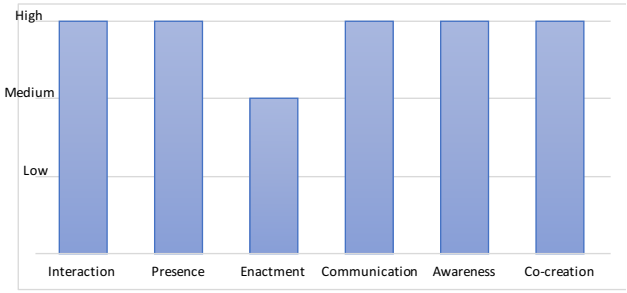


Figure 3.6 Assessment of engagement dimensions as supported in ESN

3.2.6 Discussion

This section discusses the results of the analysis. As depicted in Table 3.10, knowledge repository systems and lesson learned systems do not support social interaction and thus do not support employee engagement in the knowledge exchange process. Open discussion forums, Q&A systems, knowledge markets and ESNs provide communication channels to support engagement and participation. These systems do support employee engagement with transparent platforms for users to ask questions, create new knowledge and disseminate knowledge. Comparing different engagement dimensions in Figure 3.7 shows that individual enactment is low for all KM systems categories. Further, Table 3.10 summarizes the assessment results of engagement dimensions. Table 3.10 indicates the frequency of low, medium and high scores on engagement for each KM system.

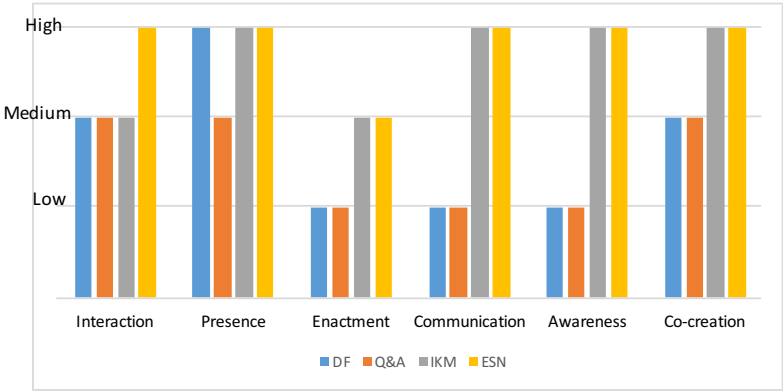


Figure 3.7 Assessment engagement dimensions in KM systems

Discussion forums, although they employ collaborative mechanisms, have limited capabilities to support employees' enactment, communication and awareness and thus do not score highly on engagement.

Table 3.10 Summary of assessment

KM systems	Social process	Summary of assessment		
		Low	Medium	High
Knowledge Repository	No	-	-	-
Lessons Learned	No	-	-	-
Discussion Forum	Yes	3	2	1
Questions and Answers	Yes	3	3	0
Internal Knowledge Market	Yes	0	2	4
Enterprise Social Network	Yes	0	1	5

Q&A Systems support engagement for collective knowledge but do not support co-creation and awareness and communication dimensions or proactive behaviour. Knowledge markets are designed for co-creation with Wisdom of crowds as a common method, to include participants' insights. Lack of self-governing and intrinsic incentives reduces the capacity of knowledge markets to support individual engagement. ESNs support different possible roles for participants to contribute to the networks, structure and governance, and self-regulation processes. ESN are designed for participant engagement.

3.3 Summary

This chapter explores the participation of individuals in knowledge exchange to answer two research questions: [*1a- How to rank priority of critical success factors (CSF) for successful knowledge management systems in the Iranian business environment? 2f- Which types of KM systems have been recognised to support participation in knowledge exchanges?*]

The first part of this chapter uses the AHP method to determine the importance of participation in knowledge exchange. The results of the AHP analysis show that soft factors such as collaboration and pro-social behaviour have scored higher than hard factors such as technological infrastructure in Iran, a resource-constrained economy. Further, a qualitative case study in the second part of this chapter explores the influence of different dimensions of the individual engagement in knowledge sharing systems. The outcome shows that the lack of a social process in the supply-side KM systems eliminates participants' opportunities to engage in knowledge sharing activities. Although the demand-side KM system supports a social process often using Web 2.0 technologies, the dimensions of engagement are not supported appropriately. KM systems, that support both the demand-side and the supply-side, have the highest capacity to support

individual's engagement. These results demonstrate the importance of participation in knowledge exchange in the combination demand- and supply-side KM . Hence, this chapter provides following insights:

- Participation in knowledge sharing, participants' collaboration and social interaction are the three top-ranked organisational CSF referring to the status of the soft factors in the Iranian business context.
- KM technology and infrastructure as hard CSF of knowledge management are ranked at the end of the priority list.
- Achievement of KM projects strongly depends on soft factors such as knowledge sharing and participants' collaboration.
- Lack of a social process in the supply-side KM system excludes participants' opportunities to engage in knowledge exchange activities.
- Although the demand-side KM systems support the social process between participants, all engagement's dimensions are not supported appropriately.
- KM systems that combine the demand-side and supply-side approaches have the highest capacity to support the individual's engagement.

Chapter 4 Influential Factors of Participation in Knowledge Exchange[1]

This chapter explores factors that influence individual participation in knowledge exchange in Iran, to answer the research question [*What are important factors that influence participants' engagement in knowledge exchange in the Iranian business environment? (Research question 1b)*]

Participants exchange valuable knowledge in electronic communities, but it is often unclear if they expect anything in return (Chang and Chuang 2011). The Social Exchange Theory explains participation in a social process from the perspective of maximizing benefits and minimizing costs. For knowledge exchange expectations about perceived benefits and perceived costs are leading (Bock, Zmud et al. 2005). Participants' perceived benefits are the key enablers of participation in knowledge sharing and knowledge seeking activities (Sedighi and Zand 2012). Perceived costs of knowledge exchange are the barriers of knowledge exchange. This chapter examines perceived benefits and costs of knowledge exchange in a corporate group in Iran, within a holding, in contrast to most past studies that have examined either single company or groups of independent companies. It focuses on knowledge exchange within electronic networks of practices (ENoP), i.e. self-organised systems in which participants share their knowledge voluntarily (Wasko, Teigland et al. 2009).

This chapter starts by presenting the research methodology including a description of the data collection methods and the data analysis procedure. The results on factors that influence individual knowledge sharing behaviour are presented in Section 4.2 identifying perceived benefits and costs. Section 4.3 extends these results to include insights on the visibility of participation, comparing perceived benefits and perceived costs, and discussing knowledge sharing versus knowledge seeking. Section 4.4 summaries the chapter.

4.1 Methodology of Exploring Influential Factors

Factors that influence participation are identified in a case study in an Iranian corporate group with 15 subsidiaries, in worldwide construction and development of electrical power plants. Eight cross subsidiary ENoPs within which knowledge is exchanged on design, development, installation and maintenance of electrical generators, are studied. Twenty-five participants,

[1] This chapter is based on a submitted paper in the Journal of Knowledge Management, Research & Practice

randomly selected from the eight ENoPs, have been interviewed individually. Table 4.1 summarises demographic data of the participants. As depicted in Table 4.1, 36% respondents hold managerial positions, and 64% work as experts, 84% are male and most of them in the 36 – 42 age range.

Table 4.1 Demographic characteristics (N = 25)

	Items	Frequency	Percentage %
Gender	*Male*	21	84
	Female	4	16
Age	*18-28*	3	12
	29-35	7	28
	36-42	12	48
	>42	3	12
Position level	*Managers*	9	36
	Experts	16	64

During a period of six months all knowledge shared within ENoPs are analysed and classified, in total 235 knowledge objects: 66.6% of shared knowledge is classified as "*practical experiences*": participants' experiences or suggestions that are not described in technical documents or scientific articles; 7.7% is categorised as "*book knowledge*", basic facts, such as policies, statutes, and standards (Hara 2007); 25.7% is classified as "*experienced knowledge*" book knowledge that is applied to a real problem and adapted with practical constraints. Figure 4.1 depicts these results.

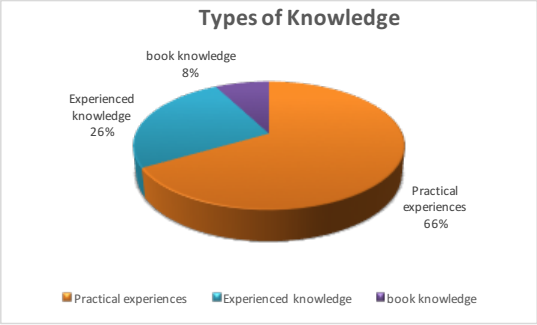


Figure 4.1 Shared knowledge in ENoPs

4.1.1 Data Collection Procedure

A semi-structured interview protocol (Appendix B) is used to explore perceived benefits and costs from the perspective of the individual expert. Twenty-two (88%) interviews are held face-

to-face on location, each taking 40-55 minutes. Three interviews are conducted by telephone, each taking between 30-45 minutes due to geographical distance[1]. The research protocol for the semi-structured interviews has the following three distinct parts: (1) questions related to demographics data, e.g. "*What is your organisational position*?" and "*How old are you*?", (2) detailed questions about perceived benefits of participation in knowledge sharing and knowledge seeking, e.g. "*What types of individual incentives or perceived benefits do you experience when participating in the ENoPs*?"; (3) questions related to perceived costs of participation in knowledge sharing and knowledge seeking, e.g. "*What kinds of individual perceived costs do you experience when sharing or seeking knowledge in the ENoPs?*". In total 35 pages of interview records are acquired as raw data for analysis.

Demographical data are recorded, unique keys assigned, and all personal data removed. Interviewees are assigned a unique key to maintain anonymity during data analysis. All interviews are performed during a 4-week period in November 2014 and December 2014.

4.1.2 Data Analysis

The interview scripts are transcribed and analysed as follows. The replies to the second and third open-ended questions on perceived benefits and perceived costs of participation are analysed to identify relevant themes. In total, 28 independent initial codes (i.e. themes) are distinguished. Axial coding is used on these initial coding results to create a new classification within which similar categories are merged (Corbin and Strauss 2014). The axial coding procedure distinguishes fourteen cost and benefit categories for knowledge sharing. Figure 4.2 represents the different steps of the data analysis procedure.

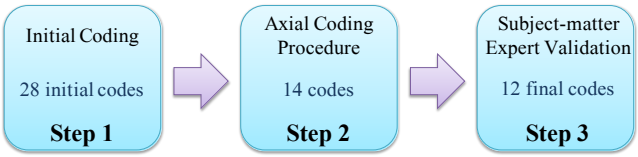


Figure 4.2 Analysis procedure to identify participation's influential factors

The result of this categorisation process is validated by 3 KM experts in the company. Based on their feedback, instead of fourteen classes of costs and benefits, twelve benefits and costs

[1] Qualitative research studies emphasize that the quality of information collected by telephone is equal to face-to-face interviews Sturges, J. E. and K. J. Hanrahan (2004). "Comparing telephone and face-to-face qualitative interviewing: a research note." Qualitative Research 4(1): 107-118.

classifications are identified: monetary and non-monetary rewards are merged into one category, as are two different kinds of altruistic behaviours. They too become one category.

Table 4.2 Data analysis procedure

Data Analysis Level	Data collection / procedure	Findings
1. Creating initial codes	25 semi-structured interviews (face-to-face / telephone)	28 initial codes represent individual perceived benefits and perceived costs of participation in ENoPs
2. Axial Coding procedure	Reassembling codes in two different perceived benefits and costs clusters	Creating new codes: • 7 codes indicating perceived benefits of knowledge sharing • 2 codes indicating perceived costs of knowledge sharing • 3 codes indicating perceived benefits of knowledge seeking • 2 codes indicating perceived costs of knowledge seeking
3. Validating results	Validating codes with three independent KM experts in the company	Validation coding procedure: • 5 validated codes indicating perceived benefits of knowledge sharing • 2 validated codes indicating perceived costs of knowledge sharing • 3 validated codes indicating perceived benefits of knowledge seeking • 2 validated codes indicating perceived costs of knowledge seeking

4.2 Findings

This section presents the results of the interviews on perceived benefits and costs of participation in knowledge sharing. Table 4.3 indicates coding results for different levels of data analysis.

Table 4.3 Coding results

Perspective	Benefits / Costs	First Level	Second Level	Third Level
Knowledge sharing	Perceived benefits	Professional recognition Enjoyment helping colleagues Enjoyment helping company Job security Monetary rewards Promotion program Solving problems Religious status Receiving knowledge in future Access to new knowledge Self-efficacy Reaching individual goals Connecting with experts Connecting with managers Traveling package	Helping others Helping organisation Reciprocity Professional recognition Knowledge self-efficacy Monetary rewards Non-monetary rewards	Altruism Reciprocity Professional recognition Knowledge self-efficacy Material rewards
Knowledge sharing	Perceived Costs	Taking time for reading Taking time for writing Mental efforts Physical efforts	Time Effort	Taking time for knowledge sharing Expending effort for knowledge sharing
Knowledge seeking	Perceived benefits	Finding practical solutions Being informed Gaining new information Gaining organisational news	Problem solving Quick access Being informed	Problem solving Quick access Being informed
Knowledge seeking	Perceived Costs	Taking time for searching Searching effort Taking time for reading	Time Effort	Taking time for knowledge seeking Expending effort for knowledge seeking

First the perceived benefits and costs of participation in knowledge sharing are discussed, followed by the frequency of answers.

4.2.1 Participation Perceived Benefits

This section presents the results on questions related to perceived benefits reported in semi-structured interviews to the open-ended question: *What are individual benefits perceived to participate in knowledge exchange through ENoPs within your company?* [1]. Influential factors are classified with the role of participants in the knowledge exchanges through ENoPs.

The results are presented for the two sides of knowledge exchange within ENoPs: knowledge sharing and knowledge seeking. From the knowledge sharing perspective, six perceived benefits are found for knowledge providers: altruism, reciprocity, professional recognition, knowledge self-efficacy, material rewards (monetary or non-monetary rewards) and social interactions. From the knowledge seeking perspective, three perceived benefits are recognized: problem solving, quick access to knowledge and being informed about new knowledge. As shown in Figure 4.3, the most common perceived benefit of knowledge recipients (knowledge seeking) is problem solving, while the most common perceived benefit of knowledge providers (knowledge sharing) is altruism closely followed by reciprocity.

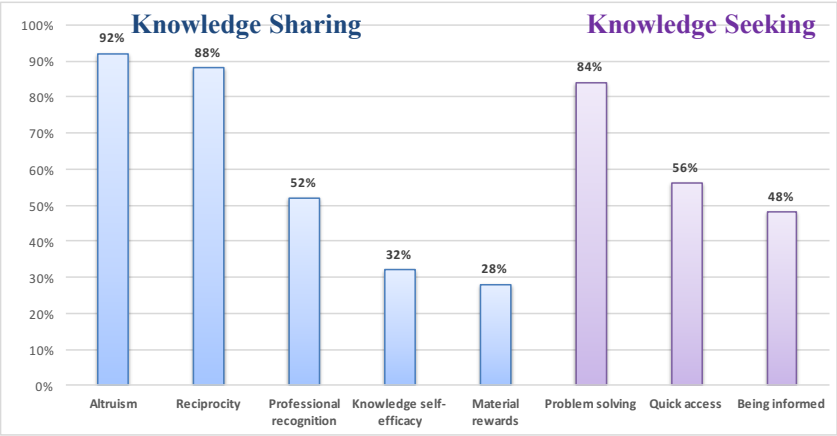


Figure 4.3 Frequency of perceived benefits of participation

4.2.1.1 Knowledge Sharing

Altruism: twenty-three respondents (92%) share their knowledge to help others by sharing knowledge without expecting anything in return. Altruistic behaviour is categorised as a

[1] As discussed in Chapter 2, knowledge exchange includes both knowledge sharing and knowledge seeking

perceived benefit because participants indicate that they enjoy helping others by sharing their knowledge. This kind of benefit has two dimensions: (1) altruism for colleagues and (2) altruism for the whole of the organisation. In the first dimension, participants indicate that knowledge is shared through an ENoP because they enjoy helping their colleagues. Further, eight respondents (34%) whom name altruism as a perceived benefit do so with a religious narrative as one of the several reasons about altruistically sharing knowledge. For instance, expert P17 explains: "*I like to help others to solve their problems. I am feeling good about answering questions. Moreover, I believe in an Islamic narrative, which emphasizes sharing knowledge, is obligatory alms of knowing knowledge"*. On the other hand, the second dimension explains participants' altruism helping the organisation as a whole. Twelve respondents (52%) mentioning altruism as a perceived benefit indicate that they want to help their organisation to reach its goals. For instance, expert P15 indicates: *"I would like to improve organisational service quality, efficiency and reduce organisational costs and reworks' times."*

Reciprocity: twenty-two participants (88%) feel an obligation to share their knowledge in return for knowledge they have received from the community. Participants indicate that they value generalized reciprocity in which employees return knowledge to the group. Knowledge is shared within ENoPs, because participants expect to receive knowledge in return from other network members. For instance, expert P12 elaborates: "*I share my knowledge, because I received knowledge from the network in the past. I don't like to be a knowledge lurker of the system that only gets knowledge from the network. Also, I share my valuable experiences because I expect to give knowledge in return in near future.*"

Professional recognition: thirteen participants (52%) mention that they share their knowledge in the ENoPs for the purpose of professional recognition in the corporate company. Participants indicate that it is essential to gain status in the company to acquire credit for personal networks and recognitions. For example, expert P10 clarifies: "*I like to participate in the network, because I need to show my expertise to the managers and network members. Also, my informal expert status in the network gets a chance for me to be selected by managers for new projects.*

Knowledge self-efficacy: eight respondents (32%) indicate that they believe their knowledge is valuable and that they can help people to solve practical problems and improve organisational efficacy. They are confident of their ability to create knowledge through ENoPs. For example, manager P2 explained: "*I have enough valuable knowledge to share helpful knowledge for my company"*

Material rewards: seven participants (28%) mention that they need material rewards for knowledge sharing through ENoPs. Material rewards include a spectrum of tangible rewards such as organisational bonuses and travel packages' subsidies to non-monetary rewards such as job promotions. For instance, expert P9 explains: "*I share my knowledge in the ENoPs because my organisation pays a bonus for each knowledge object. Also, my job security (extending contract) depends on the level of my contribution in the long term*"

Further, the results of the analysing perceived benefits of the knowledge sharing side indicates these factors can be distinguished by the visibility of knowledge sharing in ENoPs. Shared knowledge through ENoPs can be distributed by private or public communication channels. The visibility level of public knowledge sharing is restricted to the ENoPs members, not all employees of the company. Therefore, the frequency of the perceived benefits are distinguished by visibility of knowledge sharing in Figure 4.4. Further, we have not found any evidence to show that perceived benefits of knowledge seeking is influenced by communication channels.

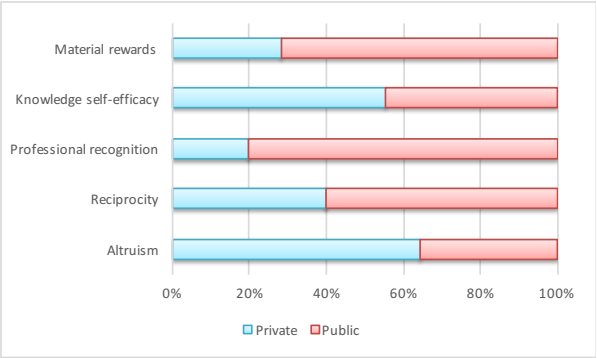


Figure 4.4 Comparing perceived benefits of two different visibility levels

4.2.1.2 Knowledge Seeking

Problem solving: twenty-one participants (84%) indicate that using practical knowledge and project experiences are their main perceived benefits of using ENoPs. A strong motivator is the geographically distributed nature of power plant projects, through which participation in ENoPs provides access to different experiences in different places. Secondly, a participant highlights the ability to send customised questions, resulting in adjusted answers from ENoPs' members fine-tuned to their specific question. For instance, expert P23 explains: "*This system helps me to reach geographically dispersed knowledge and lessons learned from an integrated system to solve my practical problems.*"

Quick access: fourteen respondents (56%) use ENoPs as knowledge seekers to acquire knowledge more quickly and efficiently than traditional means. For instance, expert P15 describes: "*I use ENoPs to acquire practical experiences quickly from knowledge creators whom I have never met face-to-face.*"

Being informed: twelve interviewees (48%) indicate that they deploy ENoPs to be aware of new knowledge of designing, installing and maintaining electric generators. The main incentive is to support the alignment of their various efforts throughout the company to handle new problems. For instance, manager P7 examined: "*I would like to know new problems and experiences from different power plant projects to design new projects or new solutions. Also, I can keep myself informed about new experiences.*"

4.2.2 Participation Perceived Costs

The second research question concentrates on the individual cost factors that negatively influence participation in knowledge exchange through ENoPs. This section presents the results reported in the semi-structured interviews to the open-ended question: *What are individual costs of knowledge exchanged perceived by participants of ENoPs within a corporate group?* The results are categorised for the two sides of knowledge exchange. Two main individual costs are identified: (1) time for knowledge contribution in networks, (2) efforts for knowledge contribution. Figure 4.5 depicts the frequency percentages for both types of knowledge exchange.

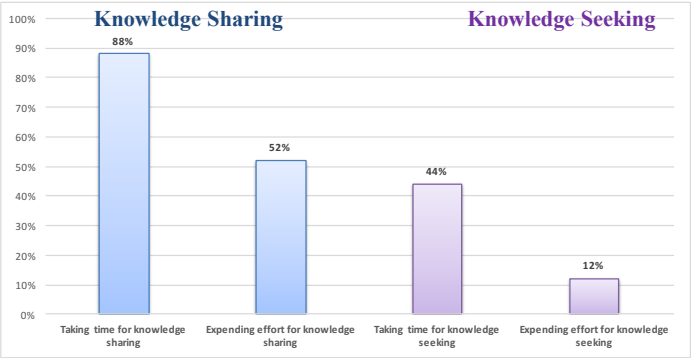


Figure 4.5 Frequency of perceived cost of participation

4.2.2.1 Knowledge Sharing

Taking time for knowledge sharing: twenty-two respondents (88%) indicate that spending time for knowledge sharing through ENoPs is a critical individual cost. This cost is a barrier for participation in ENoPs, because it reduces the time available for their normal tasks within their

respective companies. For example, expert P3 mentions: *"Because of pressures for delivering project tasks to the project employer, usually I am too busy to spend time to write my lessons learned in the ENoP."*

Expending effort for knowledge sharing: thirteen participants (52%) indicate that effort required to contribute knowledge to the network is a perceived cost of participation. However, ENoPs can reduce these efforts by enhancing their user interfaces. Participants comment that considerable effort is needed to transform the complex nature of practical knowledge of electric generator's context to understandable experiences, even though they have acceptable levels of technological skills. For instance, manager P10 remarked: *"I should take too much effort for preparing clear documents about my experiences in installing interface between turbines and generators in power plants."*

4.2.2.2 Knowledge Seeking

Taking time for knowledge seeking: eleven respondents (44%) indicate that taking time for knowledge seeking in ENoPs is a main perceived cost. Like spending time for knowledge sharing, this perceived cost is a barrier for knowledge seekers' participation in ENoPs. This cost reduces the participants' free time. For example, expert P6 highlights: *"I need to search for relevant knowledge through ENoPs, which can reduce my available time to spend on other organisational activities."*

Expending effort for knowledge seeking: three participants (12%) indicate that effort for searching knowledge is a perceived cost for participation in the knowledge seeking perspective. Although ENoPs reduce participants' expending effort using search engines, few respondents perceive a cost of using such system. The researchers could not find any pieces of evidence about the lack of participants' skill in using the system. For instance, expert P1 states: *"I need to expend effort to find the relevant information and knowledge of CHP's generators maintenance from networks."*

Figure 4.6 shows the research results for perceived benefits and costs of knowledge exchange from the individual perspective.

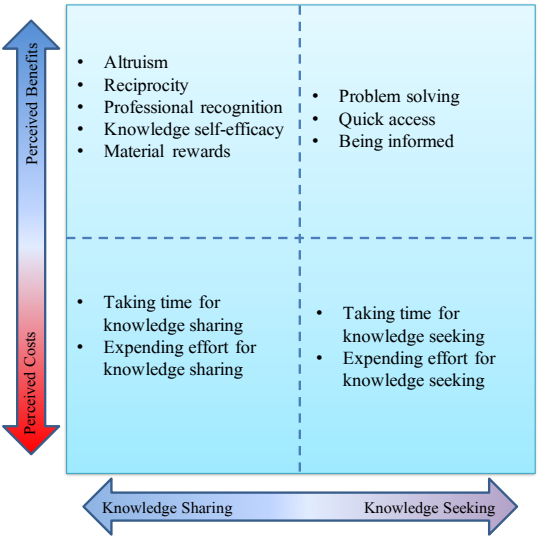


Figure 4.6 Perceived benefits and costs of participation in knowledge exchange

To sum up, different individual perceived benefits and costs of participation have been distinguished in the interviews with participants. Individual benefits and costs seem to be perceived interchangeably, since the lack of participation's benefits can be represented as a barrier, while the lack of participation cost can be identified as enablers (Hew and Hara 2007). In some interview cases, respondents had an incorrect understanding of the individual costs of participation and hence they mentioned some technological barriers (such as easy to use) and organisational cultural barriers that are not directly relevant for individual costs. Furthermore, perceived costs have a negative interrelation with the perceived benefits of participation. For instance, lack of time in the corporate group case study is the main individual perceived cost, while altruism is the main perceived benefit of participation through ENoP. Most participants mentioned altruistic behaviours for participation are diminished when they take precedence of their available time to project activities, which are related to their roles in their own projects.

All 25 participants experience knowledge seeking and knowledge sharing as two dependent processes of knowledge exchange in ENoPs, but indicate that the perceived cost of knowledge seeking is significantly lower than the perceived cost of knowledge sharing.

4.3 Discussion

This chapter addresses the two main questions using semi-structured interviews. The first research question explores perceived benefits, while the second question focuses on perceived costs of participation for knowledge exchange. Answer to the both questions supports this research to answer the research question: *1b. What are important factors that influence participants' engagement in knowledge exchange in the Iranian business environment?*

4.3.1 Perceived Benefits of Knowledge Sharing

Results identify five different perceived benefits for knowledge sharing in ENoPs. Most respondents (92%) feel they need to help others with their valuable knowledge. As mentioned earlier, two main dimensions describe participant altruistic behaviour. The first dimension shows that "*enjoy helping*" is related to doing the right thing and enjoyment from helping people (Wasko and Faraj 2000). This finding is consistent with several studies that have found altruism to be an important autonomous intrinsic motivation for knowledge sharing (e.g.(Wu, Lin et al. 2009, Ma and Chan 2014)).

The other type of altruistic behaviour is related to organisational commitment. This finding indicates participants' willingness to contribute to organisational success and support to reach strategic goals (Vuori and Okkonen 2012). This dimension is identified in KM studies to indicate participants' commitment to organisational values (King and Marks 2008). This finding is consistent with Liu (2011) who found that team members' commitment to organisational goal can improve individual knowledge sharing behaviour.

Reciprocity as the second most frequent perceived benefit of participation in knowledge sharing, explains knowledge contribution with respect to the expectation of knowledge return (Bock, Zmud et al. 2005). Direct reciprocity is limited to participant expectations to receive knowledge from the knowledge recipient, while generalized reciprocity signifies employees' expectations to gain knowledge from third parties (Wasko and Faraj 2005). All participants who mention reciprocity as a perceived benefit (88%) emphasize that when they share their knowledge, they expect to receive knowledge from network members in general, not only from a specific knowledge recipient. One possible reason is that knowledge exchange through a visible computer-mediate system is promoted by generalized reciprocity (Wasko and Faraj 2005). This finding is consistent with Hew and Hara's (2007) research, in which they found reciprocity to be a reason for members' contributions in online environments.

Professional recognition is indicated by some respondents as an extrinsic perceived benefit of participation in knowledge sharing. Reputation systems have been widely argued to be an incentive for contributors' activities and performance in knowledge sharing (Bock, Zmud et al. 2005, Lu and Hsiao 2007). Professional recognition through participation in knowledge sharing is also shown to be an individual benefit (Hsu and Lin 2008). This result is consistent with Kankanhalli et.al (2005), who indicate receiving reputation as an individual benefit for participants to improve their level of knowledge sharing.

Knowledge self-efficacy has also shown to be an intrinsic perceived benefit in ENoPs (Lin 2007). Few studies mention self-efficacy as a perceived benefit of creating knowledge through ENoPs. This finding is consistent with Kankanhalli et al. (2005), whom classify self-efficacy as an intrinsic benefit of participants in electronic KM systems. Certainly, ENoPs' participants that mentioned knowledge self-efficacy as a perceived benefit, have broader experiences in using ENoPs and they have more confidence in their capability to help ENoP's members (Wasko and Faraj 2005).

Material rewards, a spectrum of monetary and non-monetary rewards, is mentioned by a small group of participants. This perceived benefit promotes knowledge providers' behaviours externally (Vallerand 2000). Material rewards include a range of monetary rewards (e.g. increased salary or monetary bonuses) to non-monetary rewards (e.g. job promotions or job security) (Lin 2007). This finding is consistent with Vuori and Okkonen's (2012) study, in which they show that financial bonus and career development programs have least priority for knowledge contribution.

The outcome shows perceived benefits of knowledge sharing are modified in different visibility levels of communication. This finding is consistent with Fulk and Yuan (2013) research which represents the visibility level of knowledge exchange as one of the imperative attributes that can influence knowledge sharing behaviours. The communication channels are developed in different KM systems in the case study. The corporate company uses some private knowledge exchange channels for the one-to-one knowledge sharing between employees. Further, electronic communities are developed among participants to share their knowledge for a collection of people in the group-level knowledge exchange. Regarding interview results, participants' perceived benefits are influenced by different knowledge exchange visibilities (private and public).

4.3.2 Perceived Benefits of Knowledge Seeking

Coding results represent three perceived benefits for knowledge seeking in ENoPs. A high percentage of the participants use ENoPs as an experience repository, to solve practical problems from the knowledge seekers' perspective. This result is consistent with Ardichvili et al. (2003) who found that the majority of CoPs' members use a virtual knowledge sharing system as a kind of encyclopaedia to solve their problems.

Some respondents indicate these networked systems help them to access relevant knowledge quickly and to solve their problems efficiently. This result shows the importance of knowledge exchange using computer-mediated technology, to help participants expeditiously access lessons-learned dispersed across different geographical places. This finding is consistent with Vaast's (2004) study that shows that networks of practice can improve project teams' performance by connecting participants and bridging geographical distance. In addition, 48% of the participants indicate that ENoPs are used as a knowledge system to spread new knowledge in a specific subject within the group of companies. This finding is consistent with Ardichvili et.al (2003) who found that participants use CoPs to keep themselves informed of developments in their professional fields.

4.3.3 Perceived Costs of Knowledge Sharing

Four perceived costs are distinguished for the both knowledge sharing and knowledge seeking perspectives. This chapter explores individual perceived costs of participation that may hinder participants to engage in ENoPs. Barriers such as technological or cultural barriers have been removed from the results. Risk of receiving low-quality knowledge has been identified as a perceived seeking cost (Brydon and Vining 2006). This factor is not recognised in this study. A feasible explanation is that ENoPs in this study are regularly monitored by domain experts, and that knowledge contributors avoid the risk of ruining their reputation by sharing low-quality knowledge.

From the knowledge sharing perspective, the most important perceived cost is the time needed for knowledge sharing in ENoPs. Although the ENoP's platform is a simple platform and the experts in this study have the skills needed to use technical features, time is a significant cost of participation. This finding is consistent with Vuori and Okkonen (2012) who found that users of organisational social media indicate that time is a significant barrier to sharing knowledge. Further, the effort for contributing knowledge through ENoPs is identified as an individual perceived cost of knowledge sharing - individual mental and physical efforts to acquire, create, document and share knowledge through ENoPs (Sun, Fang et al. 2014). This perceived cost refers

to a knowledge-sharing barrier, in which participants assess contribution efforts: if the mental effort and time outweigh the overall benefit they refuse to participate in an ENoP system.

This study has not found any evidence to show that participants perceive risk of losing face in sharing knowledge. A possible explanation is that because our data have been collected from a high-tech company, ENoP's members have an acceptable background and valuable experience to provide high-quality knowledge. In other words, participants have a high self-confidence to contribute on ENoP without fear of losing face.

4.3.4 Perceived Costs of Knowledge Seeking

From the knowledge seeking perspective, the most important perceived cost is time for knowledge seeking in ENoPs. A possible explanation is that experts have a limited time to spend for seeking relevant knowledge. This finding is consistent with Phang et al. (2009) findings, in which time and effort of knowledge seeking are named as two barriers of knowledge exchange in online communities. Effort for knowledge seeking through ENoPs is shown to be a perceived cost - participants' efforts to search and find knowledge through ENoPs (Markus 2001). This finding is consistent with He et al. (2009) who found that effort for knowledge seeking is the main knowledge seekers' cost in KM systems.

To sum up, individual perceived benefits and costs seemed to be a double edged sword because the lack of benefits can be represented as barriers for participation, while lack of costs can be identified as perceived benefits for participation (Hew and Hara 2007). In some interview cases, respondents had a wrong understanding of the individual costs of participation and hence they mentioned some technological barriers (such as easy to use) and organisational cultural barriers, which are not directly relevant for individual costs. Furthermore, perceived costs have a negative interrelation with perceived benefits of participation. For instance, lack of time is the main individual perceived cost, while altruism is the main perceived benefit of participation through ENoP. Most participants indicate altruistic behaviours for participation are diminished when they take precedence of their available time to project activities, which are related to their roles in their own projects.

Evidence that individuals hoard knowledge is not found. A possible reason is that because most ENoP's members from different companies work on the same projects, with the same goals they promote knowledge sharing among members. Since employees are selected from different companies and diverse positions, the project goals make a particular aim for all members to share their knowledge.

4.3.5 Knowledge Sharing versus Knowledge Seeking

The results show participants extreme concern about the knowledge sharing rather than knowledge seeking in exchanging knowledge. The analysis outcome indicates perceived benefits and costs are essential for the sustained knowledge-providing behaviour through ENoPs. The results represent knowledge sharing play an important role in the knowledge exchange between participants. One possible explanation signifies the role of knowledge contribution costs from the individual perspective. The perceived costs of knowledge seeking are meaningfully less than perceived costs of knowledge sharing. Users spend less time and efforts in knowledge seeking compared to knowledge sharing. Further, knowledge seeking as a need-driven behaviour is promoted by knowledge needs. Moreover, the interviews' outcome signifies knowledge contribution costs in the knowledge sharing side are extremely bigger than individuals' costs in the knowledge seeking side. From the perceived benefit side, a big share of perceived benefits is supported by the nature of knowledge seeking behaviours, and then it is not necessary for organisations to invest more on knowledge seeking. This finding is consistent with the prior studies showing motivations have a weak power to explain knowledge seeking behaviour, because need-based behaviours are stimulated significantly by individual intentions to receive knowledge (He and Wei 2009).

4.4 Summary

This chapter proposes a variety of insights into participation in knowledge exchange to answer the research question [*1b- What are important factors that influence participants' engagement in knowledge exchange in the Iranian business environment?*]. Eight perceived benefits and four perceived costs of participation in ENoPs are identified. Altruism and reciprocity are the two main perceived benefits from the knowledge sharing perspective, while problem solving is indicated as the main perceived benefit from the knowledge seeking perspective. Knowledge seeking and knowledge sharing activities entail different individual perceived costs such as taking time and expending effort of participation. Further, the results of interviews show participants' perceived benefits of knowledge sharing are influenced by the level of participation visibility in ENoPs, while participants' perceived costs are not affected. Knowledge contribution within ENoPs is performed by participation in both parts of knowledge exchange: knowledge seeking and knowledge sharing. The cost of knowledge sharing is perceived to be higher than that of knowledge seeking. Therefore, this chapter provides following insights:

- Perceived benefits and costs of participation are recognized as main factors that influence individual knowledge sharing.

- Perceived benefits of knowledge sharing are influenced by the visibility level of communication channels.
- Perceived costs (time and efforts) are not influenced by knowledge exchange visibility in ENoPs.
- Five perceived benefits of participation in knowledge sharing have been identified in the semi-structured interviews. The perceived benefits are: altruism, reciprocity, professional recognition, knowledge self-efficacy and material rewards.
- Altruism and reciprocity are found to be the two main perceived benefits of participation in knowledge sharing.
- Two main perceived costs of participation in knowledge sharing have been identified in the semi-structured interviews. The perceived costs are time and effort needed for knowledge contribution.
- Although both knowledge sharing and knowledge seeking are essential to knowledge exchange within an organisation, knowledge sharing requires more investment.

Chapter 5 Effects of Perceived Benefits and Costs on Knowledge Sharing[1]

This chapter investigates the impact of both perceived benefits and perceived costs on knowledge sharing in the Iranian business environment. Hence, this chapter answers the following research question: [*How do individual perceived benefits and costs affect participation in knowledge sharing in the Iranian business environment? (Research question 1c)*]

Participation in knowledge sharing is influenced by participants' perceived benefits and costs (Wu and Zhu 2012). The combination and integration of benefits and costs is poorly understood. This scientific gap is the focus of this chapter. This chapter explores and quantifies complex influences of perceived benefits and costs on the quality and the quantity of participation, as perceived by the participations themselves.

This chapter adopts the Social Exchange Theory, in which employees only participate in knowledge sharing if their anticipated benefits surpass the expected costs (Bock, Zmud et al. 2005). This chapter assumes that each participant assesses his or her own benefits and costs for themselves, based on potentially partial and incomplete information. Two terms "*perceived benefits*" and "*perceived costs*" are used for this cost-benefit analysis.

This chapter presents a conceptual model of knowledge sharing in Section 5.1, Section 5.2 the research methodology and survey instrument, and Section 5.3 the results. Section 5.4 discusses the results of the data analysis. Section 5.5 summarises the results of the chapter.

5.1 Conceptual Research Model

This chapter develops a research model and hypotheses to examine how different perceived benefits and costs influence participation quantity and quality for knowledge sharing. As different perceived benefits and costs are identified, this chapter uses a list of perceived benefits and perceived costs to interpret knowledge sharing behaviour. These perceived benefits and costs are those identified in Chapters 2 and 4, represented below in Table 5.1.

[1] A modified version of this chapter is published in the Journal of Knowledge Management

Table 5.1 Definitions of perceived benefits and costs

Perceived benefits and costs	Definitions	Sources
Material rewards	Participants' perception of the value of material rewards (non-monetary) through participation in a knowledge network	(Kankanhalli, Tan et al. 2005, He and Wei 2009)
Reputation	Participants' perception of the value of enhancing respect or earning prestige through participation in a knowledge network	(Kankanhalli, Tan et al. 2005, He and Wei 2009)
Reciprocity	Participants' perception of the value of receiving knowledge in return in a knowledge network	(Wasko and Faraj 2005, Chang and Chuang 2011)
Altruism	Participants' perception of the value of enjoyment to help others by sharing knowledge in a knowledge network	(Kankanhalli, Tan et al. 2005, Lou, Fang et al. 2013)
Self-efficacy	Participants' judgement of the value of his/her competency to provide/share knowledge to others users in a knowledge network	(Kankanhalli, Tan et al. 2005, Lou, Fang et al. 2013)
Effort	Participants' perception of the value of the effort that needs to be made to participate in a knowledge network	(Chiu, Hsu et al. 2006)
Time	Participants' perception of the value of the amount of time needed to participate in a knowledge network	(Chiu, Hsu et al. 2006)

The research hypotheses in this chapter are organised with respect to the perceived benefits and costs, as shown in Table 5.1. From the extrinsic reward viewpoint, participant behaviour is influenced by material rewards accruing to the knowledge sharing. Material rewards include a spectrum of monetary and non-monetary incentives. A major line of KM researches disapproves of monetary rewards for knowledge sharing in knowledge networks (Bartol and Srivastava 2002, Lin 2007). This chapter considers the non-monetary side of material rewards such as job promotions, job security, employee travel bonus, flexible work hours, training, and sabbaticals. Non-monetary material rewards have been reported to improve knowledge sharing performance in organisations (Kankanhalli, Tan et al. 2005). As discussed in Chapter 2, the data are collected from the Iranian companies, which work in an environment of the resources-constrained economy. As a result of such environment (high inflation rate) the value of monetary rewards attractiveness has been reduced over the time. In contrast, the non-monetary rewards (e.g. job security or job promotion) have been defined as a main motivation for people (Pagès, Busso et al. 2003). Therefore, this chapter expects that non-monetary rewards will have positive effects on the knowledge sharing performance. The following two hypotheses relate to this effect of material rewards benefits on performance:

H1a. Material rewards have a positive influence on the quantity aspect of knowledge sharing behaviour in knowledge networks.

H1b. Material rewards have a positive influence on the quality aspect of knowledge sharing behaviour in knowledge networks.

Reputation can be defined as the degree to which a participant believes that participation in knowledge sharing will enhance individual recognition (Hsu and Lin 2008). Participants

exchange valuable knowledge to improve professional recognition in the knowledge network (Chang and Chuang 2011). Moreover, reputation systems provide track records of participants' knowledge sharing history that may influence knowledge seekers beliefs about other participants. (Lou, Fang et al. 2013). Reputation as a result of knowledge sharing is assumed to be a motivating factor for participants to share knowledge as formulated in the following hypotheses:

H2a. Reputation has a positive influence on the quantity aspect of knowledge sharing behaviour in knowledge networks.
H2b. Reputation has a positive influence on the quality aspect of knowledge sharing behaviour in knowledge networks.

Reciprocity signifies that network participants contribute to knowledge sharing because of the expectation of future knowledge return within knowledge networks. Participants benefit from concurrently both direct and generalised reciprocity in different knowledge exchange channels of knowledge networks (Wasko and Faraj 2005). Therefore, the following hypotheses are shown for reciprocate knowledge sharing motivation:

H3a. Reciprocity has a positive influence on the quantity aspect of knowledge sharing behaviour in knowledge networks.
H3b. Reciprocity has a positive influence on the quality aspect of knowledge sharing behaviour in knowledge networks.

Prior studies have examined altruism (Hsu and Lin 2008, Chang and Chuang 2011, Papadopoulos, Stamati et al. 2013) and knowledge self-efficacy (Tohidinia and Mosakhani 2010) as two elements of intrinsic benefits for knowledge sharing in organisations. Altruism relates to discretionary actions that benefit others without expecting anything in return (Chang and Chuang 2011) or gratification in helping others (Wasko and Faraj 2005). The hypotheses related to altruism are thus:

H4a. Altruism has a positive influence on the quantity aspect of knowledge sharing behaviour in knowledge networks.
H4b. Altruism has a positive influence on the quality aspect of knowledge sharing behaviour in knowledge networks.

Self-efficacy or competence can be defined as a participant's evaluation of their own competence to do something or to act to achieve specific levels of performance (Bandura 1994). KM researchers have found that participants with high confidence in their own capability to create knowledge are more willing to share knowledge (and hence higher quantity of participation) (Chen, Chuang et al. 2012) than those with less confidence, often with high quality knowledge (Bock and Kim 2002). The hypotheses related to self-efficacy depict these findings as:

H5a. Self-efficacy has a positive influence on the quantity aspect of knowledge sharing behaviour in knowledge networks.

H5b. Self-efficacy has a positive influence on the quality aspect of knowledge sharing behaviour in knowledge networks.

Knowledge networks provide knowledge exchange channels to reduce the cost of sharing knowledge, nevertheless employees need to spend resources (time and effort) in the knowledge sharing process (Chang and Chuang 2011, Davison, Ou et al. 2013). The time and effort needed for knowledge contributions are factors that influence knowledge sharing (Kankanhalli, Tan et al. 2005). Thus the following hypotheses are:

H6a. Spending effort for contribution has a negative influence on the quantity aspect of knowledge sharing behaviour in knowledge networks.
H6b. Spending effort for contribution has a negative influence on the quality aspect of knowledge sharing behaviour in knowledge networks.
H7a. Spending time for contribution has a negative influence on the quantity aspect of knowledge sharing behaviour in knowledge networks.
H7b. Spending time for contribution has a negative influence on the quality aspect of knowledge sharing behaviour in knowledge networks.

A conceptual research framework is proposed in Figure 5.1 to illustrate the costs and benefits, together with the above listed hypotheses. The quantity and the quality aspects of participation for knowledge sharing are represented as the endogenous constructs of the model. Both intrinsic and extrinsic benefits are predicted to have positive influence on the endogenous construct variables in the inner model. Moreover, two costs of knowledge sharing (time and effort) are expected to have negative effects on the endogenous construct variables.

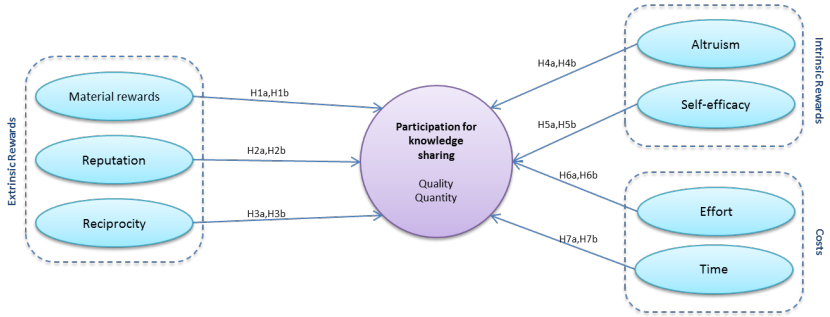


Figure 5.1 Conceptual research model of perceived benefits and costs of participation

5.2 Methodology

The proposed conceptual research model is evaluated using partial least squares structural equation modelling (SEM-PLS), a contemporary new generation multivariate technique for exploring causal models. The SEM-PLS method is selected because the research model extends the existing KM literature by integrating theories (Hair, Ringle et al. 2011). The SEM-PLS examines relationships by evaluating measurement and structural models. A measurement model is evaluated using confirmatory factor analysis (CFA) to check the reliability and validity of the model. A structural model is examined by evaluating the strength of relationships between model constructs using the partial least square method. The SEM-PLS technique has been widely used in recent years in the business research disciplines such as management information system, strategic management and marketing (Hair, Sarstedt et al. 2014).

5.2.1 Research Setting

The data is collected from employees working at a high-tech corporate group of companies in automotive industry in Iran, a resource-constrained economic environment. This group of companies produces different classes of cars. A questionnaire (Appendix C) is distributed to four clusters of managers, supervisors, experts and technicians whom have the opportunity and need to use their knowledge network on a regular basis. All participants of the organisation who have the opportunity to contribute to the knowledge network are included in this study.

The data is collected through a questionnaire (Appendix C) to assess the validity of the hypotheses, and the strengths of relations between the factors visualised in the conceptual model.. Different communication levels for knowledge sharing are available to all participants. Questions relate to these three different levels of communication (private, group and public) to determine participants' perceptions about perceived benefits and costs. Furthermore, participants are asked to assess both the quality and quantity of knowledge sharing. To measure the quantity of knowledge sharing a five-point scale is used with 5 = daily, 4 = several times per week, 3 = several times per month, 2 = more than one per quarter, 1 = less than once per quarter. The questionnaire designed using an online survey tool (collector - Survalyzer[1]), was launched on June 15, 2014 and available during one month. The questionnaire items are based on factors distinguished in Chapter 4 (Appendix C).

[1] *http://www.survalyzer.com/en/*

5.2.2 Evaluation Methodology

The research model relationships are verified with the partial least squares (PLS). Specifically, the R-code "*plspm*" (version 0.4.2) package (Sanchez, Trinchera et al. 2015) is used to explore the statistical model. PLS is a multivariate analytic technique that supports path analytic of endogenous variables. PLS applies two-stage assessment procedures (Tenenhaus, Vinzi et al. 2005). First, the measurement model structure (outer model estimation) is evaluated. Second, the structural model is assessed. Furthermore, the ability of PLS model prediction is assessed by both the coefficient of determination (R^2) and the cross-validated redundancy (Q^2). The minimum sample size needed for a SEM-PLS model is estimated by the 'rule of thumb' of ten times the largest number of inner model connections in a specific construct (Barclay, Higgins et al. 1995). Thus, the minimum sample size of the conceptual research model would be 140 cases. The sample size of 283 respondents is above the recommended threshold of SEM-PLS sample size.

5.3 Results

The questionnaires have been completed by 283 of the 385 respondents. Table 5.2 summarizes the characteristics of the respondents. As illustrated in Table 5.2, while 7.1% of the respondents have had less than 8 years work experience, 70.7% have been in the car industry between 9 and 16 years. Some 22.2% respondents have worked for more than 17 years in this branch, and are considered to be senior, while some 7% have less than 9 years (juniors) experience. Therefore, this thesis assumes that respondents are competent to create reliable judgments regarding their work experiences.

Table 5.2 Demographics of respondents (N= 283)

Characteristics	Values	Frequency	%	Characteristics	Values	Frequency	%
Gender	Male	225	79.5	**Position level**	Managers	13	4.6
	Female	58	20.5		Supervisors	83	29.3
Age	18-28	45	15.9		Experts	158	55.8
	29-35	121	42.7		Technicians	29	10.2
	36-42	75	26.6	**Work Experience**	1-8	20	7.1
	>42	42	14.8		9-16	200	70.7
					>17	63	22.2

The Harman's one-factor test is employed to check the common method bias on self-reported surveys (Sharma, Yetton et al. 2009). The common method bias is defined as a potential risk for internal validity of self-reported surveys. The outcome of the test, however, does not confirm a unique factor to explain the majority of variances for all questionnaire elements. Thus, the common method bias is not considered to be a serious risk for the survey. Another potential risk is the nonresponse bias. To address this risk, the demographic information of non-respondents,

collected by the Human Resource Department of the company, is used to explore potential bias in the data set. A Chi-square test shows that there is no significant difference between response and non-response employees for: gender (p = 0.337), age (p = 0.413), position (p = 0.566) and work experience (p = 0.621). Furthermore, the difference between late-respondents and early-respondents has been evaluated by the MANOVA test to evaluate cases in the earlier 15% and last 15% of respondents. The difference between two groups is not significant.

5.3.1 Results of Measurement Model Analysis

Confirmatory factor analysis is used to measure the reliability and construct validity. Reliability of the model refers to the consistency of measurement. As depicted in Table 5.3, the composite reliability values for each lead variable exceeds the minimum acceptance level. Convergent validity is evaluated using "*average variance extracted*" (AVE) values. Table 5.3 presents all AVE values that exceed the recommended 0.5 threshold (Chin 1998) for which the model's constructs explains more than 50% of the indicator's variance. Table 5.3 depicts the latent factor loadings of observed variables. The results show factor loading of all items surpasses the threshold level (0.6) (Chin, Gopal et al. 1997).

Table 5.3. Item relevant statistics

Latent Items	Manifest Items	Factor Loading	Composite Reliability	Average variance extracted (AVE)
Altruism	Private	0.808**	0.827	0.745
	Group	0.906**		
	Public	0.872**		
Self-efficacy	Private	0.809**	0.765	0.673
	Group	0.906**		
	Public	0.872**		
Reciprocity	Private	0.754**	0.765	0.601
	Group	0.798**		
	Public	0.765**		
Reputation	Private	0.802**	0.786	0.702
	Group	0.887**		
	Public	0.822**		
Material rewards	Private	0.917**	0.890	0.819
	Group	0.910**		
	Public	0.886**		
Effort	Private	0.906**	0.851	0.771
	Group	0.862**		
	Public	0.867**		
Time	Private	0.775**	0.832	0.747
	Group	0.893**		
	Public	0.918**		
Quantity	Private	0.843**	0.798	0.708
	Group	0.892**		
	Public	0.787**		
Quality	Private	0.896**	0.844	0.764
	Group	0.899**		
	Organisation	0.825**		

* p <0.05, ** p<0.01

The discriminant validity compares the constructs' shared variances of the model's indicators with other models' constructs (Hair, Sarstedt et al. 2014). Therefore, to test this validity, the squared AVE of each leading variable compares with correlation shared between any other exogenous variable. As shown in Table 5.4, the measurement model has sufficient discriminant validity, as the correlations shared between leading variables are less than the squared AVEs.

Table 5.4 Correlations between constructs

Construct	Mean	S.D	Alt	Self	Rec	Rep	Mat	Eff	Tim	Qun	Qul
Alt	3.745	0.894	**0.863**								
Self	3.564	0.981	0.302	**0.820**							
Rec	3.389	0.969	0.461	0.447	**0.775**						
Rep	2.942	1.105	0.306	0.267	0.358	**0.837**					
Mat	2.187	0.987	0.164	0.045	0.006	0.057	**0.904**				
Eff	2.993	1.239	-0.366	-0.288	-0.395	-0.142	-0.175	**0.878**			
Tim	2.419	1.085	-0.403	-0.305	-0.345	-0.124	-0.275	0.575	**0.864**		
Qun	3.299	1.125	0.601	0.190	0.454	0.387	0.153	-0.407	-0.402	**0.841**	
Qul	3.692	0.871	0.451	0.524	0.521	0.229	0.179	-0.510	-0.537	0.457	**0.874**

Note1: the bold diagonal elements are the square root of the AVE values
Note2: Alt=Altruism, Self=Self-efficacy, Rec=Reciprocity, Rep=Reputation, Mat=Material rewards, Eff=Effort, Tim=Time, Qul=Quality of knowledge sharing, Qun=Quantity of knowledge sharing

5.3.2 Results of Structural Model Analysis

The outcomes of the structural equation model analysis are shown in Figure 5.2 . Significant and non-significant paths between independent and independent variables are indicated by arrows and numbers in Figure 5.2 . While Figure 5.1 shows the conceptual relations between independent and dependent constructs, Figure 5.2 indicates the results of the structural model. The inner model is evaluated by assessing its ability to forecast the endogenous constructs (quantity and quality of knowledge sharing). The coefficient of determination (R^2) and cross-validated redundancy (Q^2) are used to evaluate inner models (Hair, Sarstedt et al. 2014). R^2 is a criterion that identifies the variance explained with each endogenous construct (the factors) to assess a PLS-SEM model's predictive accuracy. The R^2 value of 0.463 for knowledge sharing quantity and 0.525 for quality of knowledge sharing specify that the structural model explains a reasonable proportion of the variances. Moreover, blindfolding procedure (Q^2) is calculated to assess the model's predictive relevance for each of the endogenous constructs. Non-zero cross-validated redundancy values (Q^2) indicate that the model's predictive accuracy is acceptable for particular endogenous constructs (Sarstedt, Ringle et al. 2014). The blindfolding technique shows both endogenous constructs are well above zero (quantity of knowledge sharing 0.328, quality of knowledge sharing 0.401) which supports the model's predictive relevance.

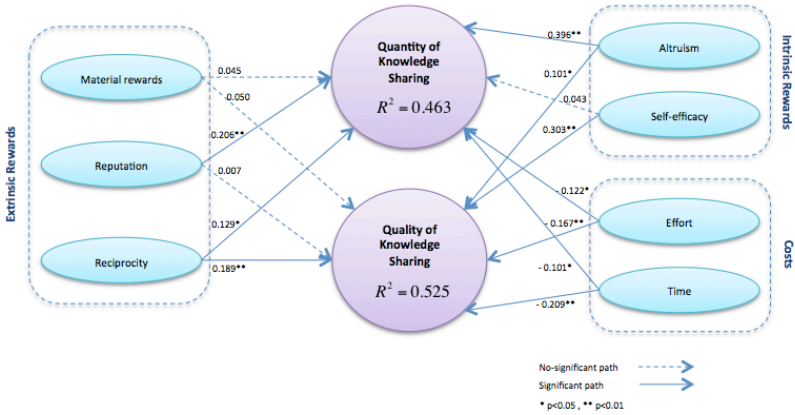


Figure 5.2 Results of SEM-PLS analysis

In the second step, the overall SEM results are calculated by testing the hypothesized relations between the variables. "Beta" is calculated for each relation between the two endogenous variables that signifies relationship between independent and dependent variables. A p-value of 0.05 is used as the cut-off to signify meaningful relations between variables. The results show that material rewards have no direct influence on quantity of knowledge sharing (β = 0.045, p > 0.05) and also have no impact on the quality of knowledge sharing (β = -0.060, p > 0.05), both hypotheses H1a and H1b are not supported. Although, reputation has a significant impact on the quantity of knowledge sharing (β = 0.206, p < 0.01) and supports H2a, there is insufficient evidence to support H2b (β = -0.007, p > 0.05). Reciprocity in knowledge sharing has significant relations to the quantity and quality of knowledge sharing (β = 0.129, p < 0.05; β = 0.189, p < 0.01), hence H3a and H3b are supported. Furthermore, altruism as an important item of intrinsic rewards has positive effects on the quantity and quality of knowledge sharing (β = 0.396, p < 0.01; β = 0.101, p < 0.05), therefore H4a and H4b are supported. Knowledge self-efficacy has no significant relation with quantity of knowledge sharing (β = 0.043, p > 0.05) and does not support H5a, however, this item has a positive relation with quality of knowledge (β = 0.303, p < 0.01), thus H5b is supported. Besides, efforts and time for participation in knowledge sharing have significant negative impacts on participation in knowledge sharing (β = -0.122, p < 0.05; β = -0.167, p < 0.01; β = -0.101, p < 0.05; β = -0.209, p < 0.01), providing support for hypotheses H7a, H7b, H8a and H8b.

5.4 Discussion

The data analysis above finds some evidence for the relations of the comprehensive research model in which perceived benefits, and perceived costs influence participation in knowledge sharing. Although, the beta indexes are not very strong, the R-square results indicate that the research model can interpret an acceptable proportion of the variances. Contrary to our expectations with respect to the resource-constrained economy with a high inflation rate, material (non-monetary) rewards do not show to have a significant effect on the quantity and the quality of participation. This finding is somewhat surprising for a company in the resource-constrained economy. It yields believable explanations for an important line of the KM literature and social studies. Lin (2007) recognizes that employees do not appreciate material rewards, as much as other incentives such as reciprocity in knowledge sharing. Moreover, this finding is consistent with Osterloh and Frey (2000) results that show that intrinsic motivations are more effective for organisational activities than external motivations. In addition, Vuori and Okkonen (2012) have reported that material rewards have shown to have least priority from the employees' viewpoint. This argument is also consistent with Bock and Kim's (2002) findings in which material rewards are shown to have a temporary role but do not show to have lasting impacts on attitudes toward knowledge sharing. A feasible explanation is although our data were collected from Iran as a resource-constrained economy with high inflation rate, all participants were working for a high-tech corporate group. Respondents may not be encouraged by the material rewards, because they are compensated by other extrinsic benefits, such as enhancing reputation in professional communities.

Perceived reputation enhancement has a significant positive effect on the quantity of knowledge sharing. This finding shows that participants are likely to involve in the process of knowledge sharing to gain professional recognition within organisation. The results are similar to Wu and Zhu (2012) and Hsu and Lin (2008) findings that professional reputation has a significant strong effect on workers' attitudes towards sharing knowledge. Wasko and Faraj (2005) also found that professional reputation is a significant factor for individual knowledge sharing in electronic knowledge networks. According Hew and Hara (2007), participants in online environments share their knowledge to make themselves visible and gain recognition through online networks. Nevertheless, the insignificant link between reputational incentives and knowledge sharing quality also illuminates the limitations of recognition benefits.

The statistical results show that reciprocity benefits play a vital role in both quantity and quality of knowledge sharing. The significant impact of perceived reciprocal benefits supports several

insights that participants engage in knowledge sharing if they expect to receive future help or knowledge from others in return. This finding is consistent with the relevant literature. Chang and Chuang show significant impact of reciprocal expectation of participation on the quality and quantity of knowledge sharing behaviour in virtual communities (Chang and Chuang 2011). Besides, Bock et al. (2005) show that participants' attitudes towards knowledge sharing are driven primarily by expectations of reciprocal knowledge exchange.

Our results suggest that altruism has significant influences on both knowledge sharing quantity and quality. This finding is in line with prior studies (Kankanhalli, Tan et al. 2005, Wasko and Faraj 2005, Chang and Chuang 2011, Wu and Zhu 2012, Lou, Fang et al. 2013) testifying to the importance of altruism and enjoyment in helping others as one of the important incentive that support knowledge sharing quantity and quality positively. One reason for the high impact of altruism is that knowledge sharing behaviour is similar to organisational citizenship behaviour (Wu and Zhu 2012). A practical study in Iran shows a significant impact of altruism on sharing knowledge in Iranian universities (Babalhavaeji and Kermani 2011).

The statistical outcomes show a positive influence of self-efficacy on the quality of knowledge sharing; however, there is an insignificant relation between self-efficacy and the quantity of knowledge sharing. Participants intrinsically benefit from confidence in their own ability to create good quality knowledge that is valuable to the firm. This finding is in line with Lin's (2007) findings that self-efficacy is a significant antecedent to participants' knowledge sharing attitudes and knowledge sharing intentions. Yet, the insignificant relationship between self-efficacy and knowledge sharing quantity clarifies the limitation of the self-efficacy to improve knowledge quantity contribution.

5.5 Limitations and Summary

This chapter has several limitations, which provide new opportunities for future research. First, the research scope is restricted to a single company in Iran (i.e. Iranian car industry), limiting its validity to this company. Second, the study uses a self-reported questionnaire for both independent and dependent constructs. Thus, the study does not measure systematic criteria, such as the amount of shared knowledge or systematic quality ranking, to calculate the participants' contributions. Third, this chapter uses different levels of knowledge sharing channels to construct the endogenous factors in the outer model. Therefore, effects of knowledge sharing channels on the perceived benefits, costs and participation are not explored directly in the inner model. Finally, this research concentrates on the relationships of seven factors (Altruism, Knowledge

Self-Efficacy, Material rewards, Reputation, Reciprocity, Time and Effort) that influence individual knowledge sharing. These factors may also influence each other.

This chapter combines several theories and studies from different streams of studies such as social psychology and KM to answer the research question [1c- *How do individual perceived benefits and costs affect participation in knowledge sharing in the Iranian business environment?)*]. This chapter investigates both the quality and the quantity aspect of participation in knowledge sharing using a model of including an exhaustive set of influencing factors in knowledge networks. The outcomes of 283 respondents demonstrate that reputation, reciprocity and altruism are crucial perceived benefits for the quantity of participation, while reciprocity, altruism, trust and knowledge self-efficacy influence the quality of participation in knowledge networks. Both effort and time as two aspects of KM costs have significant negative impacts on both the quantity and the quality of participation in knowledge networks. The results also show that predictors can explain about 46% of the variance in the quantity of participation and 52% of the variance in the quality of participation through knowledge networks. Therefore, this chapter provides following insights:

- The combination of perceived benefits and perceived costs of participation significantly interprets knowledge sharing between participants. The results show that predictors explain 46% of the variance in the quantity of participation and 52% of the variance in the quality of participation.
- The measurement model verifies that perceived benefits and costs are independently influenced by different levels of knowledge sharing visibility (private, group and public)
- Research outcome demonstrates that reputation, reciprocity and altruism stand out as significant perceived benefits for the quantity of participation, while reciprocity, altruism, trust and knowledge self-efficacy have significant impacts on the quality of participation in knowledge networks.
- The structural model results show that intrinsic benefits play an important role in employees' participation in knowledge sharing.
- Contrary to our expectations for a resource-constrained economy such as Iran, material (non-monetary) rewards have no significant effects on both the quantity and the quality of participation. This finding is somewhat surprising.

Chapter 6 The Role of Perceived Benefits in Different Visibility Levels[1]

This chapter elaborates on the role of participation visibility in a case study by exploring relationships between participants' perceived benefits with knowledge contribution quality and quantity for three distinct levels of knowledge sharing visibility (private, group and public levels). This chapter focuses on the research question: [*How do participants' perceived benefits influence participation at different levels of knowledge sharing visibility in the Iranian business environment? (Research question 1d)*]

This chapter uses self-determination theory (SDT) (Deci and Ryan 1985) to explain knowledge contribution. Although several studies have employed the SDT for one visibility level to explain knowledge contribution, this chapter extends existing studies by using the SDT for different levels of knowledge sharing visibility to interpret the quantity and the quality of participation through a knowledge network.

This chapter is organised as follows. Section 6.1 presents a research framework to clarify the relationship between communication visibility and individual perceived benefits. Section 6.2 hypothesizes framework relationships identifying ten hypotheses on the influence of knowledge sharing levels. Section 6.3 describes research design, data analysis and analysis procedure. Section 6.4 presents the results using statistical models. Section 6.5 interprets the results of the statistical model. Section 6.6 summarises the chapter.

6.1 Research Framework of Perceived Benefits in Three Levels of Visibility

This section develops a research framework to explore the relationships between participants' perceived benefits and knowledge contribution in electronic knowledge networks (EKN). The research framework (see Figure 6.1) is structured by extrinsic and intrinsic benefits. This framework shows relationships between perceived benefits and knowledge contribution: three types of extrinsic benefits (reputation, material reward and reciprocity) and two types of intrinsic benefits (altruism and knowledge self-efficacy), as identified in prior chapters. While most KM studies investigate impacts of perceived benefits on the quantity of knowledge sharing (Bock, Zmud et al. 2005, Zhang, Fang et al. 2010), this study develops the framework to explore

[1] A modified version of this chapter is submitted in the Journal of Knowledge Management

relationships between perceived benefits with both the quantity and the quality aspects of shared knowledge on different levels of knowledge sharing.

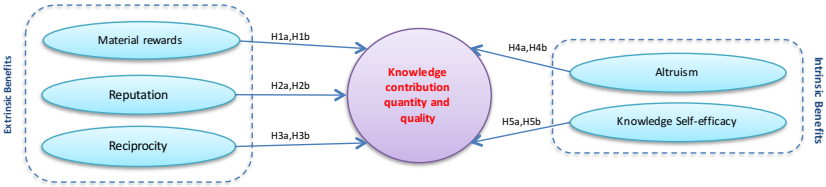


Figure 6.1 Research framework of perceived benefits of knowledge contribution

EKNs have been developed with multi-levels knowledge sharing visibility. The research framework distinguishes three levels of knowledge sharing visibility: private, group and public levels (see Figure 6.2). In private knowledge sharing, a knowledge sender and a knowledge recipient talk in a confidential communication environment (e.g. Instant Messaging). For group level visibility of communication, participants share their knowledge within groups (e.g. Network of Practice). Public level visibility of communication refers to the option to share knowledge with all participants (e.g. Lesson Learned Databases). The research model constructs and hypotheses, used in this chapter are discussed below.

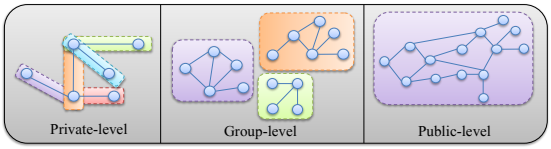


Figure 6.2 Three levels of knowledge sharing visibility

6.2 Hypotheses

From the external regulations perspective, knowledge sharing at different levels of knowledge sharing visibility is affected by material rewards. Material rewards consist of a range of monetary and non-monetary incentives (Hargadon and Sutton 1997). A major part of KM studies criticises monetary benefits because of temporary influences of such rewards on knowledge sharing behaviour (Bartol and Srivastava 2002, Lin 2007). As discussed in Chapter 2, the data are collected from the Iranian companies, which work in an environment of a resources-constrained economy. As a result of such environment (high inflation rate) the value of monetary rewards

attractiveness has been reduced over the time. In contrast, the non-monetary rewards (e.g. job security or job promotion) have been defined as a main motivation for people (Pagès, Busso et al. 2003). Therefore, this chapter considers the non-monetary side of material benefits such as job promotion, job security, flexible work hours, and sabbaticals. Non-monetary material rewards have been examined in studies to improve the knowledge sharing performance (Kankanhalli, Tan et al. 2005). This study explores two hypotheses that relate to this effect of material benefits on the both sides of knowledge sharing behaviour:

H1a- Material rewards (non-monetary benefits) have a positive influence on the quantity of knowledge shared by participants in EKNs.
H1b- Material rewards (non-monetary benefits) have a positive influence on the quality of knowledge contribution in EKNs.

Reputation relates to recognition and position in organisations (Hsu and Lin 2008), influences knowledge sharing (Chang and Chuang 2011). A reputation system can leverage knowledge sharing in organisations (Lou, Fang et al. 2013). Two hypothesizes are proposed to explain the effects of reputation effects on knowledge contribution:

H2a- Reputation has a positive influence on the quantity of knowledge contribution in EKNs.
H2b- Reputation has a positive influence on the quality of knowledge contribution in EKNs.

Reciprocity as a perceived benefit promotes participant engagement in a knowledge exchange process because of expectations to receive knowledge in the future (Gouldner 1960, Davenport and Prusak 1998). Two kinds of reciprocal exchange behaviours have been outlined in the network studies: direct reciprocity and indirect (generalized) reciprocity (Faraj and Johnson 2011). Private knowledge sharing is promoted only by direct reciprocity because the visibility of the knowledge exchange is restricted with a knowledge sender and a knowledge recipient, while both the group and the public levels of knowledge exchange are encouraged by the generalised reciprocal incentives. Therefore, the hypotheses are:

H3a- Direct reciprocity from network participants has a positive influence on the quantity of knowledge contribution in EKNs.
H3b- Generalized reciprocity from network participants has a positive influence on the quality of knowledge contribution in EKNs.

Altruistic behaviours as enjoyment in helping others in knowledge networks have been defined as a voluntarily knowledge sharing behaviour in KM systems (Wasko and Faraj 2000). The SDT theory examines altruism influences participants to perform high-quality activities (Deci and Ryan 1985). Thus participants with the altruistic intention of enjoyment in helping others create

more valuable, useful and helpful knowledge (Wasko and Faraj 2005). Therefore, the following hypotheses are proposed:

H4a- Altruism has a positive influence on the quantity of knowledge contribution in EKNs.
H4b- Altruism has a positive influence on the quality of knowledge contribution in EKNs.

As mentioned before, knowledge self-efficacy as a kind of intrinsic benefits influences knowledge sharing performance (Lin 2007). Indeed, participants with a high level of knowledge self-efficacy make valuable outcomes, while they can be satisfied inherently to show their competences (Bock and Kim 2002, Lin 2007). Therefore participants tend to contribute in the knowledge sharing process regarding the quantity and the quality aspects because participants expect that their capabilities to share valuable knowledge help others (Kankanhalli, Tan et al. 2005).

H5a- Knowledge self-efficacy has a positive influence on the quantity of knowledge contribution in EKNs.
H5b- Knowledge self-efficacy has a positive influence on the quality of knowledge contribution in EKNs.

6.3 Research Design

The research framework categorises perceived benefits for different levels of the knowledge sharing visibility. The framework is tested with conducting two distinct research method procedures to collect data. Independent variables' data are collected using a survey questionnaire for the three levels of knowledge sharing visibility. Content analysis is conducted to measure participants' knowledge contribution within the EKN.

6.3.1 Organisation Context

The data are collected from a high-tech corporate company with a parent and 36-subsidiaries, which operate in the energy industry in Iran. This holding company operates in the area of development of thermal power plants and independent power plants (IPP) under the EPC scheme as well as producing turbines, electrical generators, turbine blades, boilers and control systems. The sample includes electrical engineers, manufacturing engineers, production controllers, power plant staff, and first line managers.

6.3.2 Procedures

Questionnaire

A questionnaire (Appendix D) is devised and distributed in the knowledge network, for all participants to access and respond. The first part of the questionnaire clarifies the research goal, confidentiality conditions and knowledge exchange visibilities with few examples. The second part of the questionnaire measures perceived benefits and costs of knowledge contribution in

three levels of the knowledge sharing visibility with the five-point Likert-type scale (Never, Rarely, Sometimes, Often, Always). The questionnaire items have been translated and adopted on the basis of prior studies. The measuring scales of material rewards and reciprocity are adapted from Lin's (2007) study. Reputation is developed from Kankanhalli et al. (2005) and Wasko et al. (2005) findings. Altruism items are adopted from Kankanhalli et al. (2005) and Yu and Chu (2007) research models. Self-efficacy is developed with respect to Kankanhalli et al. (2005) and Lin (2007) studies. The initial version is reviewed by five KM experts in the energy industry sector. A few items are revised to ensure content validity, readability and understandability. The questionnaire was launched in August 2014.

Content analysis

Dependent variables include the quantity and the quality of knowledge contribution, which are collected for the private, group and public levels of the knowledge sharing. Network's users are not anonymous. Participants' knowledge contributions are collected from the knowledge network dataset during six months (from March 1, 2014 through August 31, 2014). Since, knowledge contribution in the network is not anonymous, the outcome of the completed questionnaires is matched to participants' knowledge contributions. Further, demographic data are prepared by Human Resource Department. The latent content analysis is employed on all posts to clarify meaning of the contents (Babbie 2016). The outcome of the latent content analysis classifies knowledge contributions as knowledge articles, knowledge requests, answers to questions, or other types of contents. Only knowledge articles and response to questions are selected as knowledge objects for quantifying the dependent variables. Thus, questions and other types of message (i.e "*this is useful*" or "*thanks*") are excluded from the dataset. The quantity aspect of the knowledge contribution is measured by the total volume of shared knowledge. The volume of shared knowledge are normalized by transforming the quantity of posts to five-point measure.

The quality aspect of selected knowledge object is evaluated by adopting items from Kulkarni (2006) model. This model examines "*relevancy*", "*accuracy*", "*timeliness*", "*presentation format*" and "*applicability*" as five attributes of the knowledge quality. On request the company provided two independent experts for each knowledge domain (five main knowledge domains). Knowledge domains are defined in relation to the shared knowledge objects. These experts assessed the initial four attributes, while the average of users score is used to evaluate the "applicability" attribute of shared knowledge. All attributes are measured with the average of a five-point Likert scale, ranging very low, low, moderate, high and very high. Participants' scores are measured by assigning the mean of knowledge scores in each level of knowledge sharing.

Data analysis

The partial least squares structural equation modelling (PLS-SEM) method is employed to analyse the results. This method is used when dataset have a non-normal distribution, small sizes and formatively measured constructs (Hair, Sarstedt et al. 2014). Moreover, PLS-SEM is used to analyse results as it is a type of SEM approach that supports formative constructs (Hair, Sarstedt et al. 2014). All results are analysed in three independent PLS-SEM models[1] for 3 different levels of knowledge exchange.

PLS-SEM method includes the two-step analysis method to analyse the research model. The first phase of the PLS-SEM method consists the evaluation of the measurement model (outer model), whereas the second phase includes assessment of the structural relationships of model constructs (inner model) (Hair, Ringle et al. 2011). This approach is used to confirm the reliability and the validity of the research model before exploration of the whole model.

Respondents

During six months (from March to August, 2014), 723 participants used the knowledge network at least for one of the three levels of knowledge sharing. The questionnaire was distributed to all active participants in the knowledge network. With a response rate of 29.5%, 213 questionnaires are collected. Two hundred and five complete questionnaires are analysed (eight incomplete questionnaires are excluded). The number of completed questionnaires is above the minimum sample-size threshold, (defined as five to ten times the largest number of structural relations to latent variables (Chin 1998)). Regarding to the completed questionnaires, the content analysis is employed for respondents' contribution to measure quality and quantity of shared knowledge. The dataset shows 2,154 notes were transferred by respondents in all three levels of knowledge sharing. The outcome of the content analysis categorises 1,881 as knowledge articles and responses to questions. These knowledge objects are evaluated to measure knowledge contribution quality and quantity of respondents.

Table 6.1 represents the demographics of the respondents. As depicted, 31.2% of participants have less or equal than 10 years experience, whereas 68.8% have been in the company more than 11 years. Approximately 50% of participants hold an MSc degree. The χ^2 test is employed on collected data to check non-respondents bias. The results show no significant differences between demographic data of non-response and response participants. The data are also tested for the late and early response bias. The MANOVA is performed to compare demographic data of early 31

[1] R-code "plspm" package (version 0.4.2) is used to analyse the data.

(15%) respondents with last 31 (15%) respondents. The differences of demographics data between two groups are not significant ($p<0.05$).

Table 6.1 Demographics of respondents (N= 205)

Characteristics	Values	Frequency	Percentage %	Characteristics	Values	Frequency	Percentage %
Gender	Male	171	83.4	**Position level**	Managers	34	16.6
	Female	34	16.6		Supervisors	24	11.7
Age	18-28	6	2.9		Experts	131	63.9
	29-35	96	46.8		Technicians	16	7.8
	36-42	85	41.5	**Work Experience**	1-10	64	31.2
	>42	18	8.8		11-15	73	35.6
Education	Bachelor	104	50.7		16-20	33	16.1
	Master	101	49.3		>20	35	17.1

6.4 Results of the Statistical Analysis

The results of this study are explained below. First, results of the measurement model characteristic are elaborated. The second sub-section represents structural model results.

6.4.1 Measurement Model

The composite reliability is used to evaluate the constructs' internal consistency in outer models. As can be seen in Table 6.2, the composite reliabilities well surpass 0.7 which is suggested as the acceptable threshold (Chin 1998). Moreover, outer loadings and average variance extracted (AVE) values are measured to test the convergent validity of the outer model.

Table 6.2 Latent and manifest statistics

Latent construct	Private-level				Group-level				Public-level			
	Items	*Factor Loading*	*CR*	*AVE*	*Items*	*Factor Loading*	*CR*	*AVE*	*Items*	*Factor Loading*	*CR*	*AVE*
Material rewards	IMR01	0.828**	0.867	0.710	GMR01	0.850**	0.888	0.810	OMR01	0.776**	0.766	0.583
	IMR02	0.916**			GMR02	0.870**			OMR02	0.792**		
	IMR03	0.819**			GMR03	0.920**			OMR03	0.700**		
	IMR04	0.804**			GMR04	0.910**			OMR04	0.784**		
Reputation	IRP01	0.808**	0.844	0.744	GRP01	0.858**	0.835	0.751	ORP01	0.889**	0.858	0.778
	IRP02	0.918**			GRP02	0.899**			ORP02	0.886**		
	IRP03	0.741**			GRP03	0.837**			ORP03	0.852**		
Reciprocity	IRC01	0.891**	0.887	0.812	GRC01	0.879**	0.866	0.789	ORC01	0.880**	0.843	0.761
	IRC02	0.901**			GRC02	0.919**			ORC02	0.856**		
	IRC03	0.840**			GRC03	0.864**			ORC03	0.881**		
Altruism	IAL01	0.886**	0.859	0.780	GAL01	0.887**	0.872	0.797	OAL01	0.842**	0.842	0.759
	IAL02	0.889**			GAL02	0.910**			OAL02	0.914**		
	IAL03	0.855**			GAL03	0.863**			OAL03	0.855**		
Knowledge self-efficacy	ISE01	0.891**	0.883	0.741	GSE01	0.788**	0.875	0.727	OSE01	0.841**	0.923	0.813
	ISE02	0.886**			GSE02	0.882**			OSE02	0.936**		
	ISE03	0.850**			GSE03	0.885**			OSE03	0.894**		
	ISE04	0.814**			GSE04	0.837**			OSE04	0.932**		
Quantity of shared knowledge	IQN01	1.000**	1.000	1.000	GQN01	1.000**	1.000	1.000	OQN01	1.000**	1.000	1.000
Quality of shared knowledge	IQL01	0.838**	0.838	0.669	GQL01	0.779**	0.824	0.665	OQL01	0.818**	0.931	0.783
	IQL02	0.772**			GQL02	0.809**			OQL02	0.932**		
	IQL03	0.759**			GQL03	0.832**			OQL03	0.950**		
	IQL04	0.805**			GQL04	0.843**			OQL04	0.926**		
	IQL05	0.766**			GQL05	0.801**			OQL05	0.786**		

Note: CR: Composite Reliability, AVE: Average Variance Extracted

As presented in Table 6.2, all loading factors exceed 0.7 and all AVEs surpass 0.5 as thresholds for accepting the convergent validity of models (Hair, Sarstedt et al. 2014). Furthermore, all

assessed loading factors are significant. Discriminant validities of the proposed model are analysed by comparing the square roots of AVEs and constructs' correlations (Fornell and Larcker 1981). Table 6.3 indicates the model discriminant validity is approved, because correlations of constructs with other latent variables are less than it's AVE's square root.

Table 6.3 Latent and manifest statistics Correlations and AVEs

Construct	Mean	S.D	1	2	3	4	5	6	7
Private-level									
Material rewards (1)	2.121	0.933	**0.842**						
Reputation (2)	3.318	0.941	0.018	**0.862**					
Reciprocity (3)	3.502	1.036	-0.089	0.037	**0.901**				
Altruism (4)	3.791	0.890	-0.396	0.289	0.205	**0.883**			
Knowledge self-efficacy (5)	3.887	0.897	-0.409	0.311	0.245	0.696	**0.860**		
Quantity of shared knowledge (6)	3.009	1.252	-0.217	0.129	0.231	0.555	0.464	**1.000**	
Quality of shared knowledge (7)	3.168	0.913	-0.312	0.191	0.166	0.597	0.498	0.530	**0.817**
Group-level									
Material rewards (1)	2.374	1.149	**0.900**						
Reputation (2)	3.185	1.116	-0.185	**0.866**					
Reciprocity (3)	3.710	0.978	-0.139	0.408	**0.888**				
Altruism (4)	3.713	1.042	-0.224	0.402	0.346	**0.892**			
Knowledge self-efficacy (5)	3.634	1.034	-0.110	0.352	0.550	0.533	**0.852**		
Quantity of shared knowledge (6)	3.414	1.179	-0.115	0.507	0.636	0.581	0.642	**1.000**	
Quality of shared knowledge (7)	3.328	0.969	-0.122	0.316	0.461	0.523	0.553	0.564	**0.815**
Public-level									
Material rewards (1)	2.107	0.992	**0.763**						
Reputation (2)	2.951	1.080	-0.146	**0.882**					
Reciprocity (3)	3.320	1.073	-0.169	0.380	**0.872**				
Altruism (4)	3.588	1.085	-0.086	0.311	0.355	**0.871**			
Knowledge self-efficacy (5)	3.334	1.079	-0.284	0.355	0.397	0.349	**0.901**		
Quantity of shared knowledge (6)	2.659	0.955	-0.225	0.533	0.545	0.395	0.499	**1.000**	
Quality of shared knowledge (7)	2.905	0.999	-0.119	0.360	0.387	0.261	0.534	0.643	**0.884**

Note: the bold diagonal elements are the square root of the AVE

A Paired T-test is used to calculate differences between the quality and the quantity of shared knowledge in three levels of knowledge sharing. The T-test follows a t-distribution with N-1 degree of freedom. The number of data collected was 205; the degrees of freedom are 204 (N-1). As shown in Table 6.3 and Figure 6.3, the quantity and the quality of shared knowledge at the group-level are higher than the private-level. There is a significant difference in the mean of the knowledge quantity for the group-level (M=3.414, SD=1.179) and knowledge quantity for the private-level knowledge sharing (M=3.009, SD=1.252) conditions; t(204)=5.222, P<0.01, as well as the quality of shared knowledge (t(204)=2.302, P<0.05). Likewise, the mean of the shared knowledge volume for the group-level is significantly higher than the mean of the shared knowledge volume in the public-level (t(204)=12.468, P<0.01), as well as the quality of shared knowledge (t(204)=6.777, P<0.01). Hence knowledge contributions are highest for group-level of knowledge exchanges. Content analysis exposes 93% of shared knowledge are created regarding knowledge requests (answering to questions) at the private-level, while 66% of knowledge at the group-level and only 24% of knowledge at the public-level being shared to answer questions.

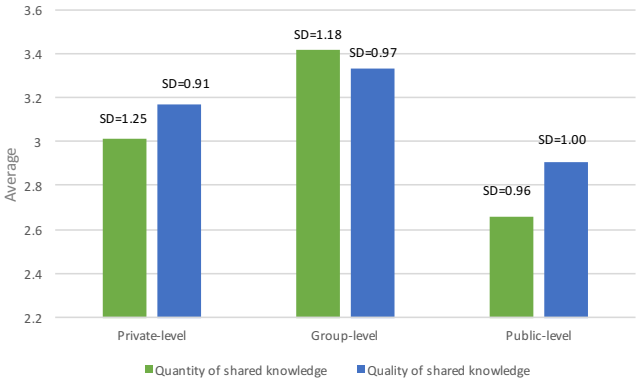


Figure 6.3 Quantity and quality of shared knowledge

6.4.2 Structural Model

The research outcome of the inner models is presented in Figure 6.4. Two main methods have been used to assess inner models in PLS-SEM technique: Coefficient of determination (R^2) and cross-validated redundancy (Q^2) (Hair, Sarstedt et al. 2014). R^2 clarifies the number of variances that are explained with latent constructs. This assessment technique defines the PLS-SEM models' predictive accuracy. As shown in Figure 6.4, the hypothesized significant relations account for 33% of the variance in the volume of shared knowledge and 37% of the variance in the quality of shared knowledge for private-level knowledge sharing. Moreover, the hypothesized paths of the group-level knowledge sharing accounted 62% of the variance in the quantity of shared knowledge and 41% of the variance in the quality of shared knowledge. Finally, perceived benefits for the public-level knowledge sharing accounted for 48% of the variance in the quantity of shared knowledge and 34% of variance in the quality of shared knowledge. These results indicate that the structural model interprets sufficient volumes of variances in the three levels of the knowledge sharing visibility. Thus, the model proves a fit with the collected data. Furthermore, blindfolding procedure (Q^2) is used to evaluate the model's predictive relevancies of latent constructs. Non-zero Q^2 values specify that the model's predictive accuracy is acceptable (Sarstedt, Ringle et al. 2014). The blindfolding technique shows both endogenous constructs in three models are well above zero, which represent model's predictive relevance.

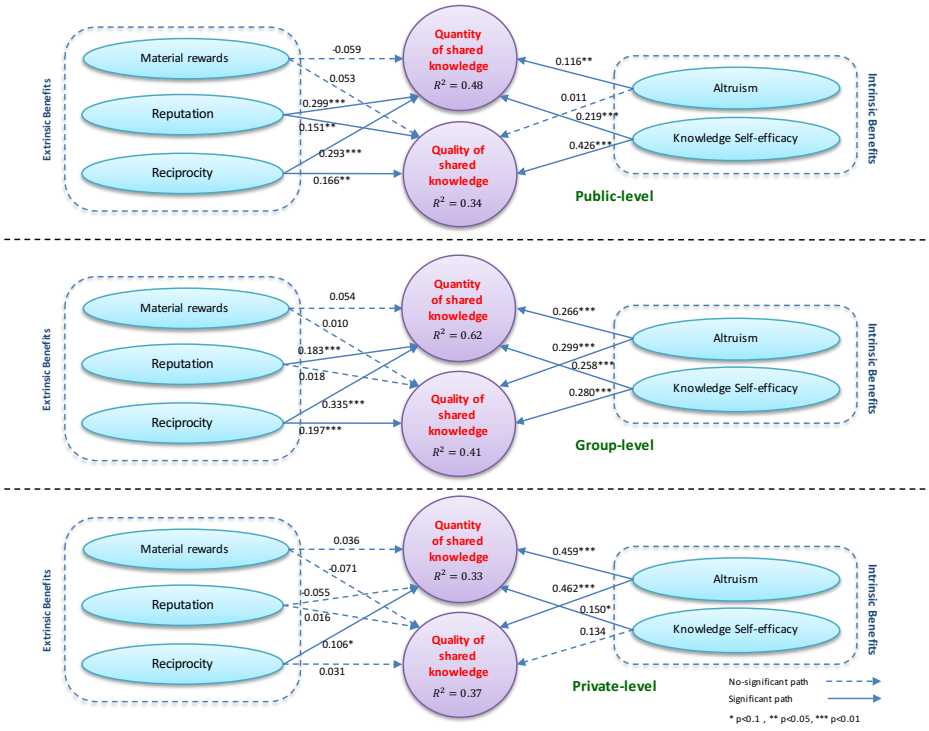


Figure 6.4 Results of structural model

The overall results are analysed by testing the hypothesized relationships between the latent variables. Figure 6.4 indicates significant and non-significant relations between perceived benefits and knowledge contribution at three levels of knowledge sharing visibility. "Beta" is calculated for each relation between the two endogenous variables that signifies the strength of the relation between independent and dependent variables. This variable is measured by a standardised value ranging from -1 to +1. Betas close to +1 signify strong positive relations and Betas close to -1 represent strong negative relations. A p-value of 0.05 is used as the cut-off to signify meaningful (significant) relations between variables. The outcomes of the private-level model show that material rewards have no direct influence on the quantity of shared knowledge ($\beta = 0.036$, $p > 0.1$) and the quality of shared knowledge ($\beta = -0.071$, $p > 0.1$), both hypotheses $H1a_{private}$ and $H1b_{private}$ are rejected. Reputation has no direct influences on the both quantity and quality of shared knowledge ($\beta = -0.055$, $p > 0.1$, $\beta = 0.016$, $p > 0.1$), both hypotheses $H2a_{private}$ and $H2b_{private}$ are rejected in the private-level knowledge sharing. Although, direct

reciprocity has a significant impact on the quantity of the private-level knowledge sharing ($H3a_{private}$) ($\beta = 0.106$, $p < 0.1$), there is insufficient data to prove a relation between direct reciprocity and the quality of shared knowledge ($H3b_{private}$) ($\beta = 0.031$, $p > 0.1$). Altruism has significant relationships with the quantity and the quality of shared knowledge ($\beta = 0.459$, $p < 0.01$; $\beta = 0.462$, $p < 0.01$), hence $H4a_{private}$ and $H4b_{private}$ are supported in the private-level knowledge sharing. Furthermore, knowledge self-efficacy has a significant impact on the volume of shared knowledge ($\beta = 0.150$, $p < 0.1$) and supports $H5a_{private}$, while has no significant relation with the quality of shared knowledge ($\beta = 0.134$, $p > 0.1$) and then $H5b_{private}$ is rejected.

In the group-level knowledge sharing, material rewards have no significant influences on the both quantity and quality of shared knowledge ($\beta = 0.054$, $p > 0.1$; $\beta = 0.01$, $p > 0.1$), thus there is not enough data to support both hypotheses $H1a_{group}$ and $H1b_{group}$ in the group level knowledge sharing. Reputation has a significant effect on the quantity of shared knowledge ($\beta = 0.183$, $p < 0.01$) and it supports $H2a_{group}$, however, this item has no relation with the quality of shared knowledge ($\beta = 0.018$, $p > 0.1$), thus $H2b_{group}$ is rejected. Reciprocity as an important item of internalized extrinsic rewards has positive influences on both the quantity and the quality of shared knowledge ($\beta = 0.335$, $p < 0.01$; $\beta = 0.197$, $p < 0.01$), therefore both $H3a_{group}$, and $H3b_{group}$ are supported. Both intrinsic incentives, altruism ($\beta = 0.266$, $p < 0.01$; $\beta = 0.299$, $p < 0.01$) and knowledge self-efficacy ($\beta = 0.258$, $p < 0.01$; $\beta = 0.280$, $p < 0.01$) have significant impacts on the both sides of knowledge contribution in the group-level knowledge sharing, thus $H4a_{group}$, $H4b_{group}$, $H5a_{group}$ and $H5b_{group}$ are supported.

Results of knowledge sharing in the public-level signify material rewards have no significant effects on both the quantity and the quality aspects of shared knowledge in the public-level ($\beta = -0.059$, $p > 0.1$; $\beta = 0.053$, $p > 0.1$), therefore $H1a_{public}$ and $H1b_{public}$ are rejected. Reputation as an important example of extrinsic rewards has positive effects on the quantity and the quality of shared knowledge in the public-level ($\beta = 0.299$, $p < 0.010$; $\beta = 0.151$, $p < 0.05$), hence $H2a_{public}$ and $H2b_{public}$ are supported. Likewise, reciprocity has significant influences on the both aspects of knowledge contribution ($\beta = 0.293$, $p < 0.01$; $\beta = 0.166$, $p < 0.05$) that support both $H3a_{public}$ and $H3b_{public}$. Altruism has a positive effect on the quantity of shared knowledge ($\beta = 0.116$, $p < 0.05$); but has no significant impact on the quality aspect of shared knowledge in the public-level ($\beta = 0.011$, $p > 0.05$), therefore $H4a_{public}$ is supported but $H4b_{public}$ is rejected. Besides, knowledge self-efficacy has significant relations with the quantity and the quality aspects of

knowledge contribution ($\beta = 0.219$, $p < 0.01$; $\beta = 0.426$, $p < 0.01$), thus $H5a_{public}$ and $H5b_{public}$ are supported.

6.5 Discussion

The analysed data shows different interesting relations for the three levels of knowledge sharing visibility. Knowledge contribution quantity and quality for group-level knowledge sharing are significantly higher than knowledge contribution quantity and quality for both the private and the public levels. Besides, intrinsic incentives play an important role in the private and the group levels of knowledge sharing, while extrinsic rewards (except material rewards) have significant influences on the quality and the quantity of shared knowledge in the public-level knowledge sharing.

Knowledge sharing performance for the 3 different levels indicates that group-level knowledge sharing is most effective. This finding is consistent with theoretical studies (e.g.(Wasko and Faraj 2000, Sie, Aho et al. 2014)), that indicate successful performance of collaboration technologies for group-level knowledge sharing technologies such as communities of practice (CoP). In addition, the quality of shared knowledge for the private-level is higher than for public-level knowledge sharing. This research outcome highlights the role of customisation in knowledge sharing systems. Most of the knowledge in the private-level exchange is created by knowledge requests. To this purpose knowledge providers create customized experiences for the knowledge requests. Customizing knowledge improves the quality of shared knowledge significantly, that represent a type of the virtual experiential knowledge (Matsuo and Easterby-Smith 2008). Additionally, knowledge in the public-level knowledge sharing needs to be shared in general structures in understandable formats for a large size of audiences. This structure reduces the quality of shared knowledge with removing valuable details of practical and complex experiences.

The quantity of shared knowledge in the private-level is significantly higher than the volume of knowledge at the public-level. This finding shows a significant barrier to share knowledge in visible knowledge exchange areas, for which users are not sure whether their contributions are reliable for others. This kind of barrier is identified as the risk of losing face in the KM studies (Vuori and Okkonen 2012). Apart from these findings, comparing participants' contributions between the three levels of knowledge exchange signifies a new direction for KM studies. These results are contrary to the outcomes of existing studies, that show that individuals' knowledge sharing are increased only by transforming private communication to the public knowledge

exchange (Leonardi 2014). A significant part of participants' knowledge contributions is emerged in controlled visibility level of knowledge exchange such as group-level knowledge sharing. Further, the results show KM designers cannot ignore the private-level (invisible) knowledge sharing. Indeed, the results show all knowledge exchange channels are essential to support knowledge sharing.

Contrary to our expectation, the results show material rewards (non-monetary rewards) have no significant influence on knowledge sharing either in the quality or quantity aspect in the three levels of knowledge sharing. This finding is inconsistent with a small part of prior studies in western country, which specifies organisational rewards support the knowledge sharing performance (Kankanhalli, Tan et al. 2005, Lin and Lo 2015). On the other hand, these results are consistent with a major part of the KM studies in western countries, which highlights the insignificant or neutral effects of organisational rewards on knowledge sharing behaviour (Masterson, Lewis et al. 2000, Lin 2007, Lam and Lambermont-Ford 2010). These results are consistent with the outcome of the Chapter 5, which signify no-significant relationships between material rewards and knowledge sharing in a high-tech company in the Iranian car industry. Further, a study in Korea (non-constrained economy) (Hau, Kim et al. 2013) shows negative effects between organisational rewards and participants' intentions to tacit knowledge sharing. A feasible description signifies that although our data were collected from a resource-constrained economy with high inflation rate, all participants were working for a high-tech corporate group. Respondents may not be encouraged by the material rewards, because they are compensated by other perceived benefits, such as enhancing status and reputation in professional communities. In the following sections, the outcome of the research framework's analysis is examined for the three levels of knowledge sharing.

6.5.1 Private-level Knowledge Sharing

The significant influences of intrinsic rewards (altruism and self-efficacy) on the quantity aspect and the quality aspect of shared knowledge demonstrate the importance of intrinsic incentives for private (invisible) knowledge exchange environments. This finding has not been empirically verified in the KM studies, however prior studies highlight the role of altruism and knowledge self-efficacy on knowledge contributions regardless of the visibility aspect (Kankanhalli, Tan et al. 2005, Wasko and Faraj 2005, Lou, Fang et al. 2013).

Form the extrinsic benefits perspective; only reciprocity has a small impact on the volume of shared knowledge. This kind of reciprocal behaviour as a direct reciprocity between knowledge providers and knowledge seekers is highlighted in the social exchange theory (Blau 1964). As

knowledge sharing is promoted by reciprocity in private-level knowledge exchange, it influences the volume of knowledge contribution without affecting the quality aspect. In general, results show intrinsic benefits have more effect on knowledge contribution than extrinsic benefits for private-level knowledge sharing.

6.5.2 Group-level Knowledge Sharing

Intrinsic benefits, such as altruism and self-efficacy improve both the quantity and the quality of shared knowledge for group-level knowledge sharing. These results are consistent with several studies (Wasko and Faraj 2005, Chen and Hung 2010, Lou, Fang et al. 2013), which emphasise the role of intrinsic benefits as important incentives for knowledge sharing.

Reciprocity drastically influences the quantity and the quality of shared knowledge. This finding indicates the importance of generalized reciprocity within the group-level knowledge exchange: the expectation of participants to receive knowledge from a group of participants not necessarily from an individual (Wasko and Faraj 2005). This finding is consistent with several studies (e.g. (Bock, Zmud et al. 2005, Lin 2007)) that show that employees' participation is strongly related to reciprocity.

The results in this chapter indicate that reputation influences the volume of shared knowledge, while it has no significant relation with the quality aspect. On the basis of the scores network users provide for the applicability of knowledge they receive the system creates a list of high rated knowledge in different periods of time (daily, weekly and monthly), boosting these participants' recognition in their community. This outcome is consistent with Chiu, et.al (2006), in which individual identification is shown to have a significant positive relationship with the quantity of shared knowledge in virtual communities. Furthermore, reputation has been identified to clarify the controlling nature of external regulations in the knowledge exchange domain (Ryan and Deci 2000, Lou, Fang et al. 2013).

6.5.3 Public-level Knowledge Sharing

The results of the data analysed for the public-level knowledge sharing show a significant impact of extrinsic benefits (except material rewards) on both aspects of knowledge contribution. Undeniably, relationships between extrinsic benefits and knowledge contribution are significantly higher than relations between intrinsic benefits and knowledge contribution for public-level knowledge sharing. A feasible explanation is the trade-off between intrinsic and extrinsic benefits. Relations between intrinsic and extrinsic benefits has been examined in the "crowding theory" (Osterloh and Frey 2000). This theory indicates that when participants are stimulated

simultaneously by both intrinsic and extrinsic benefits, then external controls win. Hence, extrinsic benefits "*crowd-out*" intrinsic benefits.

Reciprocity as an internalized extrinsic motivation influences both the quantity and the quality of shared knowledge. These findings are consistent with Wasko and Faraj (2000), whom indicate knowledge sharing of online communities' users are motivated by reciprocity at public-level. Further, Oh (2012) examines reciprocity as a perceived benefit of participants to engage in knowledge exchanges.

Public-level knowledge exchange provides an opportunity for participants to enhance status. Further, top-ranked knowledge providers within this network are acknowledged every month. This recognition mechanism promotes participants' reputations within the organisation. This extrinsic benefit significantly promotes both sides of knowledge contribution at the public-level. This outcome is consistent with (Witherspoon, Bergner et al. 2013), which signifies a significant relation between individuals' reputation and individual knowledge sharing.

From the intrinsic benefits perspective, knowledge self-efficacy has positive effects on the quantity and the quality of shared knowledge, while altruism has a significant impact on only the quantity aspect of knowledge contribution. This finding is consistent with Kankanhali et al. (2005), in which they found both enjoyment in helping others and knowledge self-efficacy have significant impacts on knowledge contribution in electronic knowledge repositories. This finding is consistent with Lou et al. (2013), whom indicate enjoyments in helping others has a significant effect on the quantity as compared with the quality of knowledge contribution in online Q&A environments.

6.6 Limitations and Summary

The results of this chapter should be interpreted in the context of certain limitations. First, the sample is restricted by respondents of a high-tech corporate group in Iran, a resource-constrained economy. Form the respondents' perspective; material rewards have no relation with knowledge contribution. This result is not indicative for other Iranian industries. Second, the use of three independent research models does not support comparison of each perceived benefit for the three different levels of visibility, but does support comparisons within each level. Third, Variables such as technological factors, organisational culture and barriers are not considered in the research scope. Fourth, the data are collected from active participants in the knowledge network. Active participants may have different perceptions about the influence of perceived benefits on

knowledge contribution. Hence, the outcome cannot be generalized as knowledge contribution of all participants including non-active participants.

This chapter explores the influences of participants' perceived benefits of knowledge sharing for different levels of knowledge sharing visibility to answer the research question: [*1d- How do participants' perceived benefits influence participation in different levels of knowledge sharing visibility in the Iranian business environment?*]. Results show that intrinsic benefits (i.e., altruism) have significant effects on knowledge contribution comparing with the extrinsic benefits (i.e., reputation) for private knowledge sharing, while extrinsic rewards play an import role for the public-level. In addition, the results indicate that both the quality and quantity of knowledge contribution in the group-level knowledge sharing are significantly higher than the quality and quantity of shared knowledge at private and public levels. Therefore, this chapter provides the following insights:

- The combination of perceived benefits of participation has different impacts on knowledge sharing between the levels of knowledge sharing visibilities.
- Intrinsic benefits are more influential than extrinsic benefits in determining knowledge contribution for private knowledge sharing.
- Extrinsic benefits are more influential than intrinsic benefits in determining participants' contributions for public knowledge sharing.
- Both extrinsic and intrinsic benefits have approximately same impacts on participation for knowledge sharing for the group-level knowledge sharing.
- Both the quality and quantity of employee participation for group-level knowledge sharing (controlled visibility) are significantly higher than the quality and quantity of participation for private and public levels.

Chapter 7 Conceptual Framework

This chapter proposes a conceptual integrated framework that structures and positions the concepts and relations related to knowledge sharing visibility and perceived benefits of participation in knowledge exchange. This chapter focuses on the research question: [*How to design visibility of knowledge sharing to promote participation in the Iranian business environment? (Research question 3a)*] Further, this chapter addresses the research question: [*How does knowledge sharing visibility influence individual perceived benefits? (Research question 2g)*]

The conceptual integrated framework addresses these research questions by clarifying individual perceived benefits as well as the visibility level of knowledge sharing within organisations. Examining perceived benefits regarding the visibility level to understand relations between factors and both the quantity and the quality of participation. Further, structuring visibility levels of knowledge exchange between participants provides insights to design controlled intervention in prevision field-testing of participants' knowledge contribution behaviour. The conceptual framework indicates the level of knowledge contributions at each level is developed with respect to the visibility level.

This chapter structure is as follow: Section 7.1 reflects on the results of the case studies presented in Chapters 4 to 6. Section 7.2 discusses the relationships between the different levels of visibility in these case studies and individuals' participation. Section 7.3 adds results on participants' perceived benefits and costs of knowledge sharing. Section 7.4 presents the integrated conceptual framework that combines these results. Section 7.5 is a summary of this chapter.

7.1 Summary of Case Studies

Chapter 4 provides insights on participation in knowledge exchange by examining perceived benefits and costs of participation from the perspective of the individual. As results, eight perceived benefits and four perceived costs of participation in ENoPs are identified. Altruism and reciprocity are the two main perceived benefits from the knowledge sharing perspective, while problem solving is the main perceived benefit from the knowledge seeking perspective. This case study provides following insights:

- Perceived benefits and costs of participation are the main factors of influence from the knowledge sharing perspective of the individual.

- Perceived benefits of participation are influenced by the visibility of knowledge exchange of different communication channels.
- Perceived costs (time and effort) are not influenced by the visibility level of knowledge sharing.
- Although both knowledge sharing and knowledge seeking are essential to knowledge exchange within organisations, promoting knowledge sharing is a greater challenge than knowledge seeking.
- Five perceived benefits of knowledge sharing are: altruism, reciprocity, professional recognition, knowledge self-efficacy and material rewards.
- Three perceived benefits of knowledge seeking are: problem solving, quick access and being informed.
- Altruism and reciprocity are recognized as two main perceived benefits of participation in knowledge sharing, while problem solving has been introduced as main perceived benefits of knowledge seeking.
- The level of communication visibility influences perceived benefits of knowledge sharing.
- Both knowledge exchange activities (knowledge seeking and knowledge sharing) entail two main perceived costs: time and effort.

Chapter 5 focuses on the contrary influences of perceived benefits and costs on knowledge exchanges. This case study provides following insights:

- The combination of perceived benefits and perceived costs of participation strongly influence knowledge sharing.
- Participation in knowledge sharing includes participants' contributions for the private, the group and the public levels of visibility of knowledge sharing.
- Perceived benefits and costs are independently influenced by different levels of knowledge sharing visibilities (private, group and public)
- Reputation, reciprocity, and altruism stand out as significant perceived benefits for the quantity of participation, while reciprocity, altruism, trust and knowledge self-efficacy significantly influence the quality of participation in knowledge networks.
- Intrinsic benefits play an important role in knowledge sharing.
- Contrary to our expectations, material rewards (non-monetary) do not have a significant effect on the quantity and quality of participation.

The outcome of the case study (Chapter 6) shows how extrinsic and intrinsic perceived benefits influences differ in terms of the knowledge sharing visibility. This case study provides following insights

- Perceived benefits of participation differ for the three levels of knowledge sharing visibility.
- Intrinsic benefits are more influential than extrinsic benefits for private knowledge sharing.
- Extrinsic benefits are more influential than intrinsic benefits for public knowledge sharing.
- Both extrinsic and intrinsic benefits have approximately the same impact on participation for group-level knowledge sharing.
- Both quality and quantity of participation in the group-level knowledge sharing are significantly higher than the quality and the quantity of participation for private and public level sharing.

7.2 Knowledge Sharing Visibility and Participation

Knowledge contribution is defined as the level of participation in KM activities. As discussed in the State-of-the-Art (Chapter 2), the quality and the quantity of knowledge contribution are used to examine participation in knowledge sharing. The measurement model presented in Chapter5 distinguishes three different levels of knowledge sharing visibility: private-level, group-level, and public-level.

Chapter 6 shows that knowledge sharing occurs at all 3 levels, but the amount of knowledge shared differs from one level to the other. Group-level knowledge sharing is significantly higher than private-level knowledge sharing, and private-level knowledge sharing is significantly higher than public-level knowledge sharing. The quality of shared knowledge follows the same order. Thus, the quality of knowledge contribution for group-level knowledge sharing is significantly higher than the quality of shared knowledge for both the private-level and the public-level. In addition, the quality of shared knowledge for the private-level is higher than for public-level knowledge sharing. This finding highlights the role of customisation in knowledge sharing systems. Most of the knowledge in the private-level exchange is created by knowledge requests. To this purpose knowledge providers create customized experiences for the knowledge requests. Additionally, knowledge in the public-level knowledge sharing needs to be shared in general

structures in understandable formats for large audiences. This structure reduces the quality of shared knowledge with removing valuable details of practical and complex experiences.

7.3 Knowledge Sharing Visibility and Perceived Benefits and Costs

Contemporary KM systems (e.g. enterprise social media) enable participants to participate at different levels of knowledge sharing visibility. These technologies empower participants to make their knowledge, behaviours, favourites, and connections visible to other users (Treem and Leonardi 2012). The visibility aspect is construed as a property of KM systems that enable members to observe profiles, contents, activities and knowledge connections. Transparent systems help participants to find knowledge content and experts. Moreover, participants have the autonomy to control the visibility of their knowledge content and their profile information (Aris and Shneiderman 2007). The case studies presented in this thesis show that participants' perceived benefits and costs are influenced by visibility levels of knowledge sharing. The following sub-sections discuss the relationships between knowledge sharing visibilities and perceived benefits of participation in knowledge sharing identified in the previous chapters.

7.3.1 External Regulations

The two main external factors that influence knowledge sharing are: material rewards and reputation. As material rewards do not significant influence on individual participation in knowledge sharing activities (see Chapter 5 and Chapter 6) they are not included in the integrated conceptual framework. Besides, the results of case studies indicate a significant relationship between reputation and knowledge sharing performance however; the impact of reputation in the visible knowledge sharing environments is significantly higher than private levels. The knowledge sharing visibility promotes participants' reputations, providing a transparent platform for knowledge exchange and enhancing recognition within organisations (Kane, Alavi et al. 2014).

Participants gain social recognition by sharing knowledge in visible communication' platforms, and lack of a recognition system discourages employees' sustainable contribution (Treem and Leonardi 2012). Peer-recognition systems promote knowledge sharing behaviours, from which participants gain reputational benefits (Javernick-Will 2011, Kumaraswamy and Chitale 2012). Recognition of users' contributions and expertise can stimulate their participation in expert teams such as ENoP. This is also consistent with social exchange theory, which holds that participants engage in knowledge exchange in the expectation of receiving social rewards (Paroutis and Al Saleh 2009). A social reward may take several forms, such as status, number of "*likes*," and

positive feedback. For instance, Danis and Singer (2008) found that participants can enhance their reputation in organisational wiki pages. Further, Brzozowski et al. (2009) signifies that the number of comments is a visible indicator that has a positive relationship with the quantity of knowledge sharing, whereas the number of bloggers visiting is an invisible factor that has no effect on the quantity of publishing.

7.3.2 Internalized Extrinsic Benefits

The results of case studies identify reciprocity as an internalized extrinsic benefit. Theory of reciprocal exchange categorises two kinds of reciprocal behaviours: direct reciprocity, generalised reciprocity (Wasko and Faraj 2005). Direct reciprocity explains individual knowledge exchanges between two participants which a knowledge provider expects a direct reciprocity in return in the future from the knowledge recipient. Generalised reciprocity interprets knowledge providers' expectations to receive knowledge from the knowledge network members, but not from a single knowledge recipient (Fulk, Flanagin et al. 1996).

The knowledge sharing visibility promotes the generalised reciprocity within organisations, by offering several environments such as wikis and blogs to support collective knowledge. Kosonen and Kianto (2009) remarked that participants are stimulated to engage in the visible KM system, because transparent knowledge sharing eliminates participants' limitations to disseminate ideas within organisations and reduces participants' search costs. Also, the visibility of knowledge sharing reduces free-riding costs by creating a transparent platform for all participants and, hence, reducing fraudulent behaviour (Fulk and Yuan 2013).

7.3.3 Intrinsic Benefits

Exploring impacts of different intrinsic benefits at different levels of knowledge sharing visibility signifies that intrinsic benefits have strong impacts on knowledge sharing however; the impact of the two main intrinsic benefits reduces from the private-level to the public-level. Self-efficacy theory represents participants' self-confidence in their ability to accomplish and succeed in organisational tasks (Gist 1987, Bandura 1994). Furthermore, altruism has been recognised as an important intrinsic benefit in different levels of knowledge sharing visibilities. According to the "*empathy-altruism theory*", if participants feel empathy to others, they will help without expending to gain from it (Batson 2014).

The results of case studies show that both intrinsic benefits' impacts reduce from the private-level to the public-level knowledge sharing. This phenomenon can be defined by the existing extrinsic benefits in the visible knowledge sharing platforms. The trade-off between intrinsic and extrinsic

benefits relates to the "*crowding-effect*" concept in the economic context (Frey and Jegen 2001) and "*motivational synergy*" concept in Social Science. Both "*cognitive evaluation theory*" (Rousseau 1995) and "*crowding theory*" (Osterloh and Frey 2000) have been defined as a theoretical foundation for this phenomenon. Cognitive evaluation theory represents participants' perceptions of intrinsic benefits depend on the individuals' perceptions of controlling behaviours. Controlling participants' behaviour from external sources undermines individuals' cognitive self-determinations (Deci and Ryan 1975). This theory examines if participants are promoted simultaneously by both intrinsic and extrinsic benefits to perform tasks, individuals feel more outside controls and then extrinsic benefits "crowding-out" intrinsic benefits. Further, crowding theory signifies intrinsic benefits are undermined with extrinsic compensation in organisational contexts. This theory interprets individuals' opportunistic behaviours when individuals receive extrinsic benefits (Osterloh and Frey 2000). In general, existing extrinsic perceived benefits indicates the reason of crowding-out intrinsic benefits in the group-level and the public-level knowledge sharing.

Most of the knowledge shared at the private level, however, (Chapter 6) is provided in reply to knowledge seekers' questions, i.e. needs, thus most likely related to altruistic motivation. In this perspective, knowledge providers share knowledge because they see knowledge seekers as potentially in the position of those who need the knowledge. Altruistic behaviours strongly depend on the knowledge requests, which occurred in in-visible environments.

The results of case studies show intrinsic benefits are not influenced directly by knowledge sharing visibility but the visibility level of knowledge contributions makes a set of consequences, which affects intrinsic benefits.

7.3.4 Perceived Costs

Two main perceived costs found in Chapter 4 are time and effort. The results in Chapter 4 show that perceived costs are not influenced by the visibility of participation and thus not depicted in the conceptual model.

7.4 Integrated Conceptual Framework

Based on exploratory research this thesis introduces an integrated conceptual framework in which concepts and relationships between concepts are distinguished, structured and positioned in a network. Figure 7.1 summarises the results of the preceding chapters in an integrated conceptual framework with the relevant knowledge contribution for the three distinct levels of knowledge sharing visibility, together with the factors of influence.

Participants engage in the knowledge sharing process with using private knowledge exchange channels such as email or instant messaging in the private-level knowledge sharing. Group knowledge exchange channels create an environment for users to share knowledge in closed groups. Networks of practices (NoPs) are designed in the group-level knowledge sharing to promote participation among team members. In addition, the public-level knowledge sharing prepares an unrestricted environment for all participants to communicate and share knowledge within an organisation (e.g. ESNs).

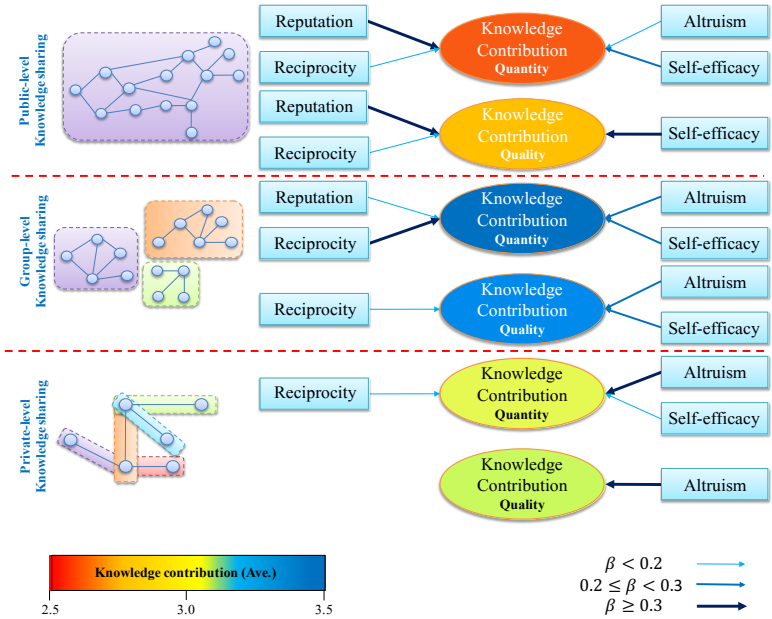


Figure 7.1 Integrated conceptual framework of individual engagement in knowledge sharing

As depicted in Figure 7.1, the dashed lines between communication levels separate the three levels of knowledge sharing visibility. The width of arrows illustrates the factors' influence on the quality and the quantity of knowledge contribution for each level of knowledge sharing. Stronger relationships are depicted by wider arrows. The average level of knowledge contribution for each communication level is illustrated with a colour spectrum from red (low) to blue (high).

7.5 Discussion

The integrated conceptual framework of individual engagement in knowledge sharing provides a frame of reference for organisational challenges in promoting individuals' participation in

knowledge sharing activities. This conceptual outcome fulfils the Design Science requirement to develop "*field-tested and grounded technological rules to be used as design exemplars*" (van Aken 2004). The grounded technological rules propose two different practical strategies to improve knowledge sharing performance:

1. The first rule is that participants need to be able to share knowledge at different levels of visibility. This rule proposes that before designing an incentive strategy for knowledge sharing or before just encouraging participants to share knowledge, a more fruitful approach may be to create an opportunity for participants to select the most appropriate communication channel with private, group or public level visibility.
2. The second rule focuses on creation of incentive strategies for the different visibility levels of knowledge sharing. Given that knowledge sharing is implemented for different visibility levels, organisations should make an incentive plan to address extrinsic benefits for the public-level and intrinsic benefits for the private-level. The combination incentive strategy can be used for group-level knowledge sharing to address both intrinsic and extrinsic benefits.

7.6 Summary

This chapter proposes an integrated conceptual framework to answer two research questions: [*3a- How to design visibility of knowledge sharing to promote participations in the Iranian business environment? 2g- How does knowledge sharing visibility influence individual perceived benefits?*]. The integrated conceptual framework examines the role of the visibility level of knowledge sharing and perceived benefits of participation in knowledge contribution. The results of case studies in Chapter 4, Chapter 5 and Chapter 6 are employed to develop the integrated conceptual framework of individual engagement in knowledge sharing.

Both intrinsic and extrinsic benefits influence knowledge contribution in transparent (public-level) and semi-transparent (group-level) environments, but extrinsic benefits have a greater impact. Moreover, intrinsic benefits influence knowledge contribution in invisible (private-level) knowledge sharing environments. Both quantity and quality of participation in group-level knowledge sharing is significantly higher than private-level and public-level knowledge sharing.

Chapter 8 Field-experiment[1]

This chapter explores the role of the visibility of knowledge sharing in participation in a field experiment in Iran addressing the research question: [*Can visibility of knowledge sharing be designed to promote participations in the Iranian business environment? (Research question 3b)*]

The field-experiment is designed regarding to the first grounded technological rule to test a part of the proposed framework in Chapter 7. Accordingly, this chapter conducts a field-experiment to compare the performance of individuals' participation in knowledge sharing in the private-level with the performance of individuals' participation in knowledge sharing in the group-level, which both groups perform in a similar field. The visibility level of knowledge sharing is changed in the experiment to measure the impact of visibility on knowledge contribution. Relationships between the visibility level of knowledge sharing and individual perceived benefits are clarified with post-experiment interviews.

This chapter is structured as follow: Section 8.1 explains the field-experiment design in an ICT holding company. Section 8.2 introduces the procedure of the experiment. Section 8.3 indicates the analysis strategy of the field-experiment. Section 8.4 provides the results of the field - experiment in different sub sections. Section 8.5 discusses the outcome of the field-experiment, and Section 8.6 prepares a summary of the chapter.

8.1 Experimental Design

A field experiment (Cooper and Schindler 2011) is designed to explore the effects of knowledge sharing visibility on the quantity and the quality of knowledge contribution as well as perceived benefits and costs of knowledge sharing in Iran, a resource-constrained economy. The field-experiment involves two different groups in a corporate group: An experimental group, and a control group. One group is situated in the same city (but in two different locations), while the offices of the second group are dispersed between two cities. The effects of manipulated factors on dependent variables are explored by comparing the results of the experimental group with the control group (Neuman 2005). The performance of these two groups is compared except for the following factors: limited (controlled) visibility versus invisible knowledge sharing. Post-experiment interviews explore the consequences of increasing the level of visibility (group-level) on perceived benefits and costs of participation. This method is used to evaluate the external

[1] A modified version of this chapter is submitted in the Journal of Knowledge Management, Research & Practice

validity of previous case studies (Chapters 4, 5 and 6) and to test the proposed the integrated conceptual framework of individual engagement in knowledge sharing (Chapter 7).

8.1.1 Participants

The field experiment is conducted in a large corporate Iranian ICT group. This high-tech company includes 11 subsidiaries with over 2100 employees. The company provides ICT services and solutions; ranging from financial enterprise solutions, transaction processing engines, e-payment networks, core banking, ICT platforms, and mobile communication. The company is selected for the field-experiment because they had introduced a new KM system 5 months prior to the experiment. This offers an opportunity to design a controlled intervention in the system to understand the role of knowledge exchange visibility. The field-experiment compares two project teams in the corporate company. One team is completely based in the same city (but in two different workplaces), while another team is distributed across two different cities, but both working in the same domain to design and implement a core banking system. Table 8.1 summarizes attributes of the control and experimental groups.

Table 8.1 Summary of experimental and control groups attributes

Attributes	Project A (Experimental group)	Project B (Control group)
Total Employees	81	110
Participants (randomly selected)	50	50
Projects	Project A Core Banking software	Project B Core Banking software
Distributions	2 different workplaces (Placed in one city)	2 different workplaces (Placed in two cities)
Similarity	Core banking software domain Demographic data Organisational culture	

The control and experimental group work as software team in the same organisation, but they are unaware of the experiment conditions in other team. All participants are randomly selected from the team members. Participants have access to an integrated intra-organisational knowledge sharing system with their desktops. This system provides private communication technologies such as email, an instant messaging for all participants. The sample includes 100 participants, randomly selected from total 191 employees within two projects. There are no significant differences between demographic data for the two projects in age, gender, educational level and professional experience. Table 8.2 depicted demographic data of participants, which are collected from the Human Resource Department of the organisation.

Table 8.2 Participants' demographic data (N=100)

Experimental group (Project A)				Control group (Project B)			
Characteristics	**Values**	**Frequency**	**Percentage %**	**Characteristics**	**Values**	**Frequency**	**Percentage %**
Gender	Male	36	72%	Gender	Male	32	64%
	Female	14	28%		Female	18	36%
Age	21-25	2	4%	Age	21-25	3	6%
	25-30	17	34%		25-30	14	28%
	30-35	15	30%		30-35	18	36%
	35-40	9	18%		35-40	10	20%
	>40	7	14%		>40	5	10%
Education	Bachelor	38	76%	Education	Bachelor	35	70%
	Master	12	24%		Master	15	30%

8.1.2 Internal and External Validity

Both projects are executed in same company; but team members are unaware of the experiment's conditions. Neuman (2005) identified 10 major threats of internal validity during an experiment. Table 8.3 indicates these threats and relevant strategies to counter these threats.

Table 8.3 How to diminish the major threats to internal validity

Threats	Descriptions (Source: Neuman (2005))	Our Solutions
Selection bias	"Selection bias is the threat that subjects will not form equivalent groups."	Both groups are randomly assigned
History	"*History effect* is a threat that an event unrelated to the treatment will occur during the experiment and influence the independent variables. This threat is more likely in experiments that continue over the long time period."	The field experiment is designed for a short-term experiment; therefore, this threat is not applicable.
Maturation	"This is the threat that some biological, psychological, or emotional process within the subjects and separate from the treatment will change over time." (Neuman 2005)	Experiment is planned for a short-term period Both teams work on a same ICT project subject Post-experiment interviews support us to reduce the risk of the maturation bias
Testing	"Testing effect threatens internal validity by affecting the depended variables with pre-test measuring."	The pre-test results are collected from the observed data in the system. Therefore, participants' behaviours are not affected by the pre-test measurement process.
Instrumentation	"Instrumentation occurs when the instrument or dependent variable measure changes during the experiment."	The measures of dependent variable are not changed during the experiment. This threat is not applicable for the experiment.
Mortality	"Mortality or attrition arises when some subjects do not continue throughout the experiment."	The experiment subjects including the two groups of participants are not changed during the experiment period.
Statistical Regression	"Statistical regression is a problem of extreme values or tendency for random group result toward the average"	The controlled intervention is not an extreme change for participants, thus the threat is not applicable.
Diffusion of Treatment or Contamination.	"Diffusion of treatment is the threat that subjects in different groups will communicate with each other and lean about the other's treatment."	Which subjects are part of the experiment is not revealed to the group members during the experiment Post-experiment interviews support us to reduce the risk of the this bias
Compensatory behaviour	"Experiments provide something of value to one group of subjects but not to another, and the difference becomes known."	The experiment introduces a new system for both groups
Experimenter Expectancy	"A researcher may threaten internal validity, not by purposefully unethical behaviour but by indirectly communicating experimenter expectancy to subjects."	The experiment strategy to measure dependent variables includes two directions: For measuring the quantity of participation, the observed data are collected from the system, thus the threat is not applicable. For measuring the quality of knowledge contribution, the experiment uses the "*Double-Blind Experiment*" method by using a group of experts to evaluate the quality of participation.

External validity is defined as "*an ability to generalize experimental findings to events and settings outside the experiment itself*" (Lin 2010). The field experiment is an appropriate research method to support external validity, because researchers have less control on the experimental conditions in real settings (Neuman 2005). The Hawthorne effect can be defined as a reaction in which participants modify their behaviours because of awareness of being seen by experiment designers (Adair 1984). This effect cannot be a threat for the experiment, because both groups use the KM system as a routine system in projects. Further, both groups were not aware of the experimental procedure. Thus, the behaviour of the experiment subjects cannot be revealed by their awareness of the experiment.

8.1.3 Experiment Procedure

The initial step of the experiment in December 2015 is to develop new communication features for the experimental group. The experiment focuses on the impact of visible knowledge exchange between participants. During two meetings, both project managers are informed about the goal of the experiment. The company's management team encourages the project managers to contribute to discover how to improve knowledge exchange performance. In the experimental group an intervention is performed, while the control group, no further intervention is given. The dependent variables are analysed for a period of 40 days. Further, the pre-test lunched to measure the quality and the quantity of shared knowledge over the 40 days before the experiment for both the experimental group and the control group.

8.1.4 Measures

Measuring the quality and the quantity of shared knowledge is used to assess both the volume amount of participant involvement and the value of knowledge contribution (Cabrera and Cabrera 2002, Lou, Fang et al. 2013). Knowledge contribution (quality and quantity) is determined in both the pre-test period and the experiment period to compare the dependent variables before and after the intervention. The volume of knowledge contribution is assessed by the quantity of shared knowledge, measured by the summation of the number of knowledge objects and number of comments.

The quality aspect of knowledge contribution is evaluated for the five attributes of knowledge quality distinguished by (Kulkarni, Ravindran et al. 2006): relevance, accuracy, timeliness, presentation format and applicability. Two independent experts in each project assess the quality of shared knowledge using a five-point Likert scale (*very low, low, moderate, high and very high*). Employees' names are replaced with anonymous codes for avoiding potential assessment

biases. Moreover, all posts are analysed to examine knowledge contributions. Content analysis is used to evaluate knowledge contributions. Quality grades are measured by the mean scores for each participant.

8.1.5 Controlled Intervention

The visibility level of knowledge sharing among team members differs between the two groups. Both control and experimental groups have the opportunity to share their knowledge at the private (one-to-one) level, but the experimental group has additional access to visible group knowledge sharing. As can be seen in the left diagram of Figure 8.1 the visibility level of shared knowledge is restricted to the knowledge provider and the knowledge recipient. The right diagram represents participants in the experimental group whom share knowledge at the group-level for which knowledge contents and profiles are visible for the rest of the project team.

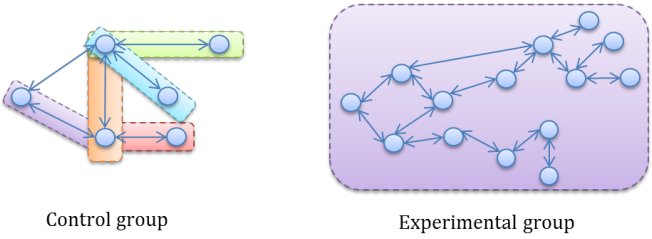


Figure 8.1 Visibility levels in the field-experiment

8.1.6 Timeline

The field-experiment starts 21 December 2015. The preparation phase includes 2 weeks in which software developers work on software bugs. The bugs include software codes that are relevant to users' ability to share knowledge. The participants' performance levels are analysed from 2 January 2016 for a period of 40 days. Semi-structured interviews after the experiment period are used to clarify the purpose of the experiment for participants in the experimental group.

Figure 8.2 summarizes the field-experiment's time line. The pre-test stage includes analysis of shared knowledge over the 40 days before introducing changes for the experimental group. The quantity and the quality aspects of shared knowledge are measured for both the experimental group and the control group. Further, for interpreting the results of the experiment and exploring the perceived benefits, post-experiment interviews (semi-structured) are conducted just after the experiment. The post-experiment interviews are designed to explore: 1- understanding the

influence of dependent variables (participation for knowledge sharing) on independent variables (visible knowledge exchange). 2- Clarifying participants' descriptions about their behaviours, which are affected (e.g. visibility and perceived benefits and costs). 3- presents the disclosure of confidentiality of the experiment condition for the second experiment.

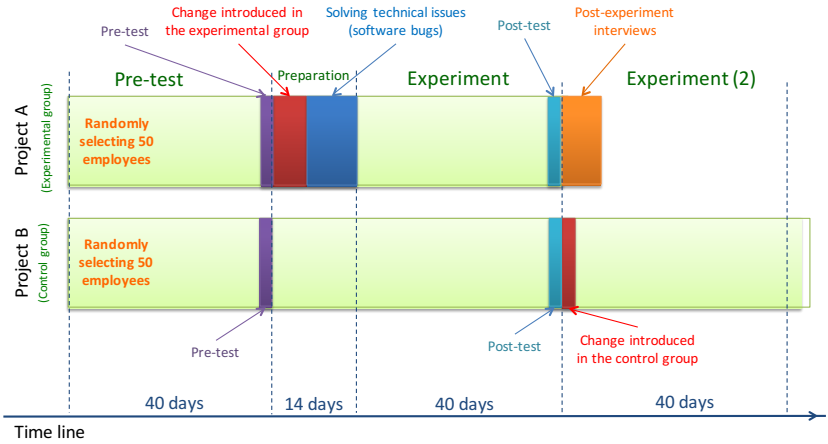


Figure 8.2 Timeline of the field-experiment

As finding exact same groups is one of the limitations for all field-experiments, the first experiment is followed by a second experiment. In the second experiment, the control group can use the same knowledge sharing functionality as the experimental group in the first experiment for the same period of 40 days (second experiment). With the second experiment, we can determine, if dependent variables are truly affected by the intervention. According to (Cooper and Schindler 2011), the second experiment also allows us to check the internal validity of the designed experiment.

8.2 Analysis Strategy

This section identifies analysis methods to compare results in the different phases of the field-experiment.

8.2.1 Comparing Means

Statistical analysis is used to explore differences in means of the quantity and the quality of shared knowledge between the two groups. Two hypotheses are tested to explore dissimilarity between the groups: [*H0- There is no difference in mean*] [*H1- There is a difference in mean*]. The quantity of knowledge (the number of knowledge objects being shared) is not fitted to the

normal distribution. Besides the sample size is restricted to 50 participants in the experiment. Thus, a non-parametric method (Wilcoxon signed-rank test) is used to compare the quantity of shared knowledge in both groups (experimental or control groups). This method is an appropriate test for comparing two related (dependent) samples (observing same participants over the time) with non-normal distribution (Rey and Neuhäuser 2011). Further, another non-parametric method (Mann-Whitney U test) is used to clarify differences between two independent groups (experimental and control groups). This statistical test is an appropriate approach for comparing the means of two independent groups that do not fit with a specific distribution (McKnight and Najab 2010).

The quality of shared knowledge is fitted with the normal distribution. Therefore, parametric methods (dependent and independent t-tests) are used to analyse results. Domain experts' ratings are used to measure the quality of shared knowledge. Cases with missing data are excluded from the dataset. Further, the content analysis is performed for all knowledge objects to examine whether the object is a question, general statement (e.g. thank you) or pure knowledge. Since both question and general statement categories are not categorised as participants' knowledge contribution, they are removed form the datasets.

8.2.2 Post-experiment Interviews

Semi-structured interviews after the experiment period are used to clarify the purpose of the experiment for participants in the experimental group. The interviews focus on participants' reactions to the changes. The participants are asked to verbally make their perceptions and experiences explicit as well as perceived benefit or costs received in both the visible (group) and the invisible (private) knowledge sharing. The participants are given time to ask questions about the research, but are asked not to share the experiment goals with others until after the period of experimentation. The control group in the second experiment was thus not aware of the first experiment. Qualitative outcomes of the post-experiment interviews are used to interpret statistical results.

The 17 post-experiment interviews are analysed to interpret knowledge sharing behaviours in the visible environment. This phase contains detailed questions for clarifying reasons of participation in the new system. Questions such as, "*What kind of changes do you encounter when participating in the new system?*". Further, the next part relates to barrier of participation in knowledge. Question such as "*What kinds of barrier do you receive when using the new system?*". Twelve pages of interview contents are obtained as raw data. The results are analysed and coded by the author using the qualitative data analysis method (Miles, Huberman et al. 2013)

to identify initial codes. Axial coding is used on the initial codes to create a new structure by integrating categories (Corbin and Strauss 2014). Domain experts in the company validate the outcome of the axial coding method. Table 8.4 indicates analysis procedure of the post-experiment interviews' results.

Table 8.4 Analysis procedure of the results of post-experiment interviews

Data Analysis Level	Data collection / procedure
1. Creating initial codes	17 semi-structured post-experiment interviews (face-to-face / telephone)
2. Axial Coding procedure	Reassembling codes in different clusters of perceived benefits and costs
3. Subject-matter experts validation	Validating codes with two domain experts in the company

8.3 Results

This section presents the results of the field-experiment. Two knowledge experts evaluate all comments. A number of comments (39 posts) are removed from the dataset: general statements, questions and comments such as "*Great, thank you!*" or "*That's useful*". These posts do not contribute knowledge. The removed posts include general statements, thanks sentences and questions. 19 (7.2%) comments are removed from knowledge dataset of the experimental group, while 20 (32.7%) knowledge objects are eliminated from knowledge dataset of the control group. Table 8.5 represents the eliminated data from the dataset.

Table 8.5 Removed comments from the dataset

Categories	Experimental group	Control group
Thanks phrases / General sentences	4 (1.5%)	18 (29.5%)
Questions	15 (5.7%)	2 (3.2%)

Figure 8.3 depicts an overview of the quantity of knowledge contribution (knowledge objects and comments) in both control and treatment groups, comparing the pre-test experiment (the blue bar) and the post-test experiment (the orange bar). Besides, Figure 8.4 shows the differences of the quality of knowledge contribution between the pre-test period and the post-test period.

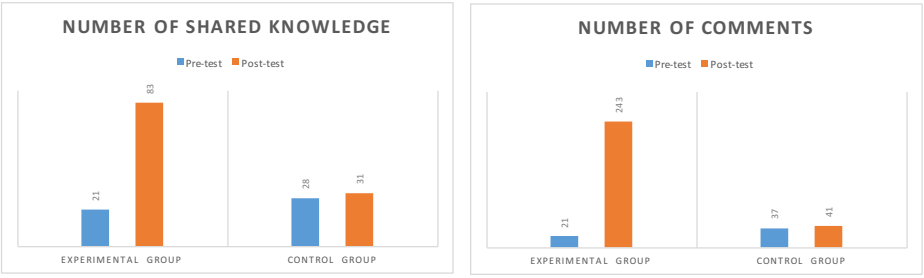


Figure 8.3 Quantity of shared knowledge

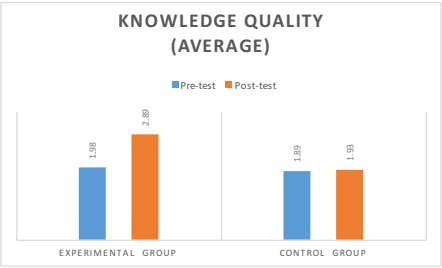


Figure 8.4 Quality of shared knowledge

Tracking participants' behaviours in the experiment period highlights several interesting behavioural reactions to the visible knowledge exchange feature. Although, the experimental group can use both the private and the public channels, 75 (90.36%) knowledge objects are exchanged on the public-level, whereas only eight knowledge objects remained in the private channels. Besides, the result indicates most part of knowledge objects (85.71%) in the pre-test period of experimental group are created by questions (pull system), while only 30 knowledge objects (36.14%) are created regarding questions in the post-test period. Likewise, the results show 27 knowledge objects (87.09%) are created to answer questions in the control group in the experiment time.

8.3.1 Quantity of knowledge (Pre-test/Post-test Analysis)

The field-experiment measures the number of knowledge objects in both pre-test and post-test (experiment) periods for both groups. The quantity of shared knowledge (knowledge objects) is not fitted to the normal distribution. Therefore, the Wilcoxon signed-rank test (non-parametric statistics) is used to compare dissimilarities. This analysis attempts to find an answer to this question: [*Is there a difference in the quantity (knowledge objects and comments) of shared knowledge of the experimental group before and after the intervention?*]. Table 8.6 depicts the results of the Wilcoxon signed-rank test for the results of the quantity aspect of participation during experiment period for the experimental group.

Table 8.6 Pre-test/Post-test analysis of volume of knowledge (experimental group)

	Knowledge objects		**Comments**	
	Pre-test	**Post-test**	**Pre-test**	**Post-test**
N	50	50	50	50
Mean	0.42	1.66	0.42	4.86
Std. Deviation	0.609	1.648	0.81	2.983
Negative ranks§	N:2, Mean rank:13.00, Sum of rank: 26.00		N:3, Mean rank:4.00, Sum of rank: 12.00	
Positive ranks	N:36, Mean rank:19.86, Sum of rank: 715.00		N:43, Mean rank:24.86, Sum of rank: 1069.00	
Wilcoxon signed rank test	z: 5.179, p-value: <0.001		z: -5.789, p-value: <0.001	

The Wilcoxon rank-sum Test is statistically significant, thus the volume of shared knowledge in the experimental group increases in the experiment period. The p-value is below the critical significance level (0.05). Therefore, the alternative hypothesis is accepted (mean difference of the number of knowledge objects: 1.24, mean difference of the number of comments: 4.44).

To ensure the internal validity during the experiment period, Pre-test/Post-test analysis is applied for the control group to clarify differences of the quantity of shared knowledge before and after the manipulation. Thus, this analysis addresses the question: [*Is there a difference in the quantity of knowledge of the control group during experiment?*]. The quantity of shared knowledge is not formfitting with the normal distribution. Therefore, the Wilcoxon signed-rank test (non-parametric statistics) is used to compare dissimilarities. This method is an appropriate method to compare two related samples. Table 8.7 represents results of the Wilcoxon signed-rank test.

Table 8.7 Pre-test/Post-test analysis of volume of knowledge (control group)

	Knowledge objects		**Comments**	
	Pre-test	Post-test	Pre-test	Post-test
N	50	50	50	50
Mean	0.56	0.62	0.82	0.74
Std. Deviation	0.675	0.878	0.873	0.899
Negative ranks	N:12, Mean rank:13.54, Sum of rank: 162.50		N:16, Mean rank:16.06, Sum of rank: 257.00	
Positive ranks	N:12, Mean rank:11.46, Sum of rank: 137.50		N:14, Mean rank:14.86, Sum of rank: 208.00	
Wilcoxon signed rank test	Z: 0.384, p-value: 0.701		Z: 0.524, p-value: 0.600	

The test results show a non-significant p-value. The exact p-value (0.701 and 0.6) is greater than the critical level (0.05) and the null hypothesis is not supported. Thus, the outcome represents no sufficient evidence to determine decreasing or increasing the volume of knowledge during the experiment period.

8.3.2 Quality of knowledge (Pre-test/Post-test Analysis)

The results of the quality of shared knowledge are collected in both the pre-test and the post-test periods. Thus, the paired sample t-test is used to compare the means of the quality of shared knowledge during the experiment period. The statistical test is conducted for treatment to ascertain whether the average of the quality of shared knowledge does or does not change over the experiment period. The sample size is reduced to 16 participants who participate in both periods (pre-test and post-test), because missing data are excluded from the dataset. There is a significant difference in the pre-test (M=1.98, SD=0.35) and the post-test (M=2.9, SD=0.41) conditions; t (15)=8.403, p <0.001. The results (Table 8.8) indicate a significant difference between the post-test and the pre-test that show a significant effect on the quality of shared knowledge after the intervention. Specifically, the results propose that visible knowledge exchange increases the quality of shared knowledge.

Table 8.8 Pre-test/Post-test analysis of the quality of knowledge (experimental group)

	Experimental group		Control group	
	Pre-test	Post-test	Pre-test	Post-test
N	16	16	14	14
Mean	1.98	2.89	1.91	1.90
Std. Deviation	0.346	0.413	0.241	0.585
Std. Error Mean	0.086	0.103	0.064	0.15
(Posttest – Pretests)	Mean: 0.91 Std deviation: 0.541		Mean: 0.014 Std deviation: 0.527	
t-test	t: 8.403, df: 15, p-value < 0.001		T:0.101 df:13 P-value: 0.921	

Likewise, the paired sample t-test is used to analyse the quality aspect of shared knowledge of control group participants. The statistical test is used to analyse of the average of the quality of shared knowledge. The sample size is reduced to 14 participants who share knowledge in both periods (pre-test and post-test). The t-test indicates the quality of shred knowledge is not changed significantly during the experiment period.

8.3.3 Post-experiment Interviews

This section presents the results of interviews in the post-experiment phase. Overall, 17 users of experimental group are individually asked to express their thoughts about their participation (Appendix E). 13 interviews occur face-to-face at company facilities, for between 30-45 minutes each. Due to geographical distance between two workplaces, four interviews are held via telephone, for between 35-45 minutes each[1]. Users are given sufficient time to ask questions. Moreover, participants are asked to never talk about the experiment with the control group until the end of the experiment. The interview results show that most individual perceived benefits are affected by the visibility of communication. In total, 7 initial codes (influential factors) are distinguished. Axial coding is employed twice (level two and three) on the initial codes to create a new classification with combining similar categories (Corbin and Strauss 2014). The axial coding procedure distinguishes 5 factors in the second level and 3 factors in the third level. The coding results are shown in Table 8.9.

Table 8.9 Coding results in post-experiment interviews

First Level	Second Level	Third Level
Professional recognition	Helping others	Altruism
Enjoyment helping colleagues	Helping organisation	Reciprocity
Enjoyment helping company	Reciprocity	Professional recognition
Religious status	Professional	
Receiving knowledge in future	Recognition	
Connecting with experts		
Connecting with managers		

Quantitative evidences demonstrate that though the same knowledge sharing technologies are used in both groups, the individual level of participation is extremely different. In general, 15

[1] The quality of the collected information by telephone is equal to that of the face-to-face interviews Sturges, J. E. and K. J. Hanrahan (2004). "Comparing telephone and face-to-face qualitative interviewing: a research note." Qualitative Research **4**(1): 107-118..

participants (88.23%) mention the visibility of knowledge sharing as a technical feature that supports them to gain more perceived benefits from knowledge sharing.

Fourteen (82.35%) participants mention that the new knowledge sharing environment supports them to present themselves to others in prestigious positions. In other words, during interviews, respondents confirm that they contribute to the system to gain professional recognition.

Generalized reciprocity as a type of perceived benefits is indicated by twelve (70.58%) participants. They mention that increasing the number of knowledge recipients in the visible environment improves the chance of receiving knowledge from teammates in the future. Hence, they are motivated to share their knowledge. Further, six (35.29%) respondents indicate that enjoyment to help others as a form of the altruistic behaviour stimulates their knowledge sharing behaviour in the new environment.

There is no evidence that shows the influence of the experiment on knowledge self-efficacy. Likewise, there are no results that confirm/deny a relationship between taking time and expending efforts with the knowledge sharing performance for the group-level knowledge sharing. Therefore individuals perceived costs (time and efforts) of participation in the group-level knowledge sharing are same as the private-level knowledge sharing.

8.3.4 Experiment 2

The validity of the experiment (external validity) is evaluated by introducing a same intervention for the control group as for the experimental group. This procedure helps to ensure that changing knowledge contribution level is effective. Pre-test/Post-test analysis is applied for the control group to clarify differences in the quality and the quantity of participation in knowledge sharing after the controlled intervention. The pre-test data is collected from the experiment period, while the experiment data is collected in the second experiment (Experiment 2) period. This to address the following question: [*Is there a difference in the quality and the quality of shared knowledge during the experiment 2?*] Table 8.10 represents the results of the Wilcoxon signed-rank test (non-parametric statistics) to measure quantity aspects of shared knowledge during the experiment and Table 8.11 signifies the paired-sample t-test in the second experiment period to measure quality aspect of shared knowledge.

Table 8.10 Pre-test/Post-test analysis of participation quantity (control group)

	Knowledge objects		Comments	
	Pre-test	**Post-test**	**Pre-test**	**Post-test**
N	50	50	50	50
Mean	0.62	1.94	0.82	4.24
Std. Deviation	0.878	1.557	0.873	2.896
Negative ranks	N:3 Mean rank:6.00, Sum of rank: 18.00		N:4 Mean rank:6.25, Sum of rank: 25.00	
Positive ranks	N:30, Mean rank:18.10, Sum of rank: 543.00		N:40, Mean rank:24.13, Sum of rank: 965.00	
Wilcoxon signed rank test	z: 4.735, p-value <0		z: 5.502, p-value <0	

Table 8.11 Pre-test/Post-test analysis of participation quality (control group)

	Pre-test	**Post-test**
N	20	20
Mean	1.92	2.55
Std. Deviation	0.505	0.348
Std. Error Mean	0.113	0.77
(Posttest – Pretests)	Mean: 0.63 Std deviation: 0.642	
t-test	t: 4.385, df: 19, p-value < 0.001	

Both parametric and non-parametric statistical tests indicate that both the quality and the quantity of knowledge contribution have increased significantly in the second experiment. The analysis results confirm the relation between the visibility levels of knowledge sharing and participation in knowledge sharing. The results for the control group for the quantity and the quality of knowledge contribution are very similar to the experimental group. This approach increases the internal validity of the experiment.

8.4 Discussion

The field experiment explores the influence of the visibility level of knowledge exchange in group-level on the quality and the quantity aspects of participation. Both aspects of knowledge contribution have increased significantly. With respect to the outcome of the post-experiment interviews, an increasing level of knowledge contribution has a relationship with three main participants' perceived benefits: reputation, reciprocity and altruism.

The results indicate that increasing the visibility level of knowledge sharing from private-level to group-level improves individuals' participation by influencing individual perceived benefits. This finding is consistent with Zhang et al. (2013). Specifically, the results show that visible knowledge exchange influences participants' recognition within the project. The results show that a visible communication platform is needed to acquire professional recognition.

These results confirm the results of the case studies in the prior chapters participants contribute to the knowledge sharing activities to obtain professional recognitions. This finding is consistent

with Kane et al. (2014) who show that transparent platforms for knowledge exchange promote enhancing recognition. Further, peer-recognition systems promote knowledge sharing behaviours, from which participants derive reputational benefits (Javernick-Will 2011, Kumaraswamy and Chitale 2012). Brzozowski et al. (2009) show that the number of comments as a visible indicator has a positive relation with the quantity of knowledge sharing, whereas the number of bloggers visiting is an invisible indicator and has no effect on the quantity of contribution.

The interviews indicate that knowledge sharing in a visible environment increases the chance of receiving help from teammates in the future. This kind of reciprocity is identified as generalized reciprocity which participants do not expect to collect knowledge from a specified person, but from a whole group (Wasko and Faraj 2000). This finding is consistent with van Baalen et.al (2005) who found that interactive environments positively influence generalized reciprocity and emergence of knowledge networks.

The results show that few participants in the experimental group are stimulated by altruism. Increasing the visibility level of knowledge exchange among participants provides a new opportunity for participants to donate their knowledge with a larger group of knowledge recipients. This opportunity supports participants who enjoy assisting others by sharing their knowledge. Therefore, visible knowledge sharing increases participants' altruistic behaviours (helping colleagues without presuming rewards in return (Stewart and Gosain 2006)). This finding is consistent with van den Hooft et al. (2004) who indicate that increasing the size of the knowledge recipients group in visible areas positively influences the number of knowledge contributors to donate and share knowledge. Furthermore, the results are consistent with Kankanhali et al. (2005) who identify that enjoying to help others has a meaningful impact on knowledge sharing behaviour.

8.5 Experiment Limitations

The field experiment has some limitations. It has been conducted in a high-tech ICT holding company with a limited sample size. Therefore, the findings may not be generalized to further industries in Iran. The experiment's subjects include skilful software engineers. Participants are familiar with IT features and KM technologies. This may limit the generalizability of the results in other branches. Further, this experiment is designed to manipulate the visibility level of knowledge sharing and explore the variations of participation in knowledge sharing.

8.6 Summary

This chapter designs a knowledge sharing platform to investigate the differences between knowledge contribution in the private-level and group-level knowledge sharing to answer research question *3b* [*Can visibility of knowledge sharing be designed to promote participations in the Iranian business environment?*]

The key conclusion of this chapter is that increasing the visibility level of knowledge sharing within a group, significantly improves the quality and the quantity aspects of participants' knowledge contribution. The results of the field-experiment in an ICT holding company show that designing the visible knowledge sharing for the group-level (in addition to the private level) influences the perceived benefits including reputation, reciprocity and altruism. Further, there is no evidence to show significant relationships between perceived costs (taking time or expending efforts for knowledge contributions) with increasing the visibility level of knowledge exchange.

Chapter 9 Summary, Conclusion and Future Research

This chapter presents a summary, concussion, limitations, and suggestions for future research. The main contribution of this thesis is summarized in section 9.1 by addressing the main research question. Section 9.2 identifies research limitations whereas section 9.3 focuses on future research opportunities. Section 9.4 concludes the chapter.

9.1 Thesis Contribution

This thesis develops an integrated conceptual framework of individual engagement in knowledge sharing. The thesis employs a combined qualitative and quantitative research design approach rooted in design science, to answer the main research question:

Can engagement for knowledge sharing within organisations in the Iranian business environment be fostered?

The sub questions related to the main question are mapped to the model of design science research:

Relevance Cycle

1a. How to rank priority of critical success factors (CSF) for successful knowledge management systems in the Iranian business environment? (Chapter 3)
1b. What are important factors that influencing participants' engagement in knowledge exchange in the Iranian business environment? (Chapter 4)
1c. How do individual perceived benefits and costs affect participation in knowledge sharing in the Iranian business environment? (Chapter 5)
1d. How do participants' perceived benefits influence participation at different levels of knowledge sharing visibility in the Iranian business environment? (Chapter 6)

Rigour Cycle

2a. What are critical success factors (CSF) for successful knowledge management systems? (Chapter 2)
2b. Why are participants willing to share knowledge and participate for knowledge exchange? (Chapters 2)
2c. Which Key Performance Indicators (KPIs) are identified for evaluating participation in knowledge exchange? (Chapter 2)
2d. Which perceived benefits and costs have been identified for knowledge exchange? (Chapters 2)
2e. How does knowledge exchange visibility interact with knowledge exchange? (Chapters 2)
2f. Which KM systems have been recognized to support participation in knowledge exchanges? (Chapter 3)
2g. How does knowledge sharing visibility influence individual perceived benefits? (Chapter 7)

Design Cycle

3a. How to design visibility of knowledge sharing to promote participations in the Iranian business environment? (Chapters 7)

3b. Can visibility of knowledge sharing be designed to promote participations in the Iranian business environment? (Chapter 8)

Outcome of different case studies in Iran, with its resource-constrained economy, indicates the role of the visibility in knowledge sharing as well as perceived benefits and costs of knowledge sharing in participation for knowledge exchange. The summary of the case studies' results is presented in the below:

- Perceived benefits and costs of participation are the main factors of influence from the knowledge sharing perspective of the individual.
- Perceived benefits of participation are influenced by the visibility of knowledge exchange of different communication channels.
- Perceived costs (time and effort) are not influenced by the visibility level of knowledge sharing.
- Although both knowledge sharing and knowledge seeking are essential to knowledge exchange within organisations, promoting knowledge sharing requires more investment.
- Both knowledge exchange activities (knowledge seeking and knowledge sharing) entail two main perceived costs: time and effort.
- The combination of perceived benefits and perceived costs of participation strongly influence knowledge sharing.
- Participation in knowledge sharing includes participants' contributions for the private, the group and the public levels of visibility of knowledge sharing.
- Perceived benefits are independently influenced by different levels of knowledge sharing visibilities (private, group and public).
- Reputation, reciprocity, and altruism stand out as significant perceived benefits for the quantity of participation, while reciprocity, altruism, trust and knowledge self-efficacy significantly influence the quality of participation in knowledge networks.
- Intrinsic benefits play an important role in knowledge sharing.
- Contrary to our expectations, material rewards (non-monetary) do not have a significant effect on the quantity and quality of participation.
- Intrinsic benefits are more influential than extrinsic benefits for private knowledge sharing.

- Extrinsic benefits are more influential than intrinsic benefits for public knowledge sharing.
- Both extrinsic and intrinsic benefits have approximately the same impact on participation for group-level knowledge sharing.
- Both quality and quantity of participation in the group-level knowledge sharing are significantly higher than the quality and the quantity of participation for private and public level sharing.

These results relate to the three cycles of the design science research model. The scientific contribution is presented below, followed by the practical contribution and the design contribution.

9.1.1 Theoretical Contribution (Rigor cycle)

This thesis has several theoretical contributions for the KM literature as well as communication visibility and motivational theories. This thesis contributes to scientific understanding on individual perceived benefits, knowledge sharing visibility and participation in knowledge sharing in Iran, a resource-constrained economy. These factors influence participants from the interpersonal viewpoint. In addition, the thesis outcome extends understanding of knowledge sharing in Iran by exploring both quantity and quality of participation. The following paragraphs describe the theoretical contribution in detail.

Table 9.1 Effects of perceived benefits on knowledge contribution quantity and quality

Visibility level	Quantity of shared knowledge	Quality of shared knowledge
Public-level	Reputation (0.3) Reciprocity (0.29) Knowledge self-efficacy (0.22) Altruism (0.11)	Knowledge self-efficacy (0.42) Reciprocity (0.17) Reputation (0.15)
Group-level	Reciprocity (0.33) Altruism (0.26) Knowledge self-efficacy (0.25) Reputation (0.18)	Altruism (0.29) Knowledge self-efficacy (0.28) Reciprocity (0.15)
Private-level	Knowledge self-efficacy (0.46) Altruism (0.45) Reciprocity (0.11)	Altruism (0.46)

This thesis has provided theoretical contributions for the emerging theory of communication visibility (Leonardi 2014), by adding perceived benefits of participants in the integrated conceptual framework of individual engagement in knowledge sharing. Table 9.1 shows the effects of perceived benefits on knowledge contribution quality versus knowledge contribution quantity for the three levels of visibility (numbers show the significant relations between factors

with two aspects of knowledge contribution). As shown in Table 9.1, the identified perceived benefits of knowledge contribution differ for different levels of visibility. Intrinsic benefits (altruism and self-efficacy) are more influential than extrinsic benefits (reciprocity and reputation) in determining knowledge contribution for private knowledge sharing, while extrinsic perceived benefits are more influential for the public-level. These results provide new insights for the current literature of KM (e.g (Zhang, De Pablos et al. 2014)), which emphasise the role of intrinsic rewards in knowledge sharing. The outcome shows that extrinsic benefits have complementary effects with intrinsic benefits to explain knowledge sharing behaviours.

This thesis advances understanding of knowledge contribution in Iran by constructing the integrated conceptual framework that contains both quantity and quality of knowledge contribution for three levels of knowledge sharing visibility (private, group and public). Prior research classifies influencing factors; while this thesis goes beyond conceptualizing and identifying perceived benefits and costs in the different levels of knowledge sharing. The outcome of this thesis shows that all visibility levels are necessary to design participation for knowledge contribution within organisations. Although prior research (e.g. (Zhang, De Pablos et al. 2013, Leonardi 2014)) indicate the role of knowledge sharing visibility to improve knowledge contribution, the case studies' results show a high-level of transparency reduces the value of shared knowledge as well as the frequency of shared knowledge. The quality and the quantity of knowledge contribution for the group-level are significantly higher than the quality and the quantity of individual participation for public-level contributions. Customisation of shared knowledge in controlled visibility environments (group-level) improves the knowledge contribution level. Although Matsuo and Easterby-Smith (2008) focuses on the role of employees' customisation for their own benefit, this thesis outcome presents a more complex picture by the role of knowledge provides' customisation for knowledge recipients. This outcome indicates that customisation can improve the level of knowledge quality in non-public knowledge sharing. Further, this outcome indicates that influencing both types of perceived benefits (extrinsic and intrinsic) can influence knowledge contribution for the group-level.

This thesis develops a novel approach to explore perceived benefits in relation to quality and the quantity of participation in knowledge sharing. Three main identified clusters of individual perceived benefits are assessed in the integrated conceptual framework of individual engagement in knowledge sharing. Results show that intrinsic benefits have an important role on the quality of participation. Altruism, an intrinsic benefit, exerts a greater influence on the quantity of participation compared to the quality. This result challenges the SDT, that indicates that intrinsic

benefits have a stronger impact on human performance when performing high quality activities, than extrinsic benefits due to the influence of internal enjoyment (Deci and Ryan 1975). This finding advances theoretical research with examining different roles of intrinsic benefits on the quality side of individuals' participation.

The thesis outcome shows material rewards (non-monetary rewards) have no relation with knowledge sharing either in the quality or quantity aspect in the three levels of knowledge sharing. This finding is somewhat surprising for a company, which is functioning, in the resource-constrained economy. This is similar with other studies (e.g. (Lin 2007))in non-constrained economies which emphasize employees do not appreciate material rewards, as much as other perceived benefits. Therefore, high inflation rate or high employment rate of an economy are not good reasons to invest on material rewards for knowledge sharing. Participants are not encouraged by the material rewards, because they are compensated by other perceived benefits, such as enhancing status and reputation in professional communities.

The outcome of this thesis shows the altruistic incentive for knowledge sharing includes two main dimensions in Iran. The first dimension shows that "*enjoy helping*" is related to doing the right thing and enjoyment from helping people. In comparing with research in western countries (Hsu and Lin 2008), this evidence is an equal outcome that can be observed in the Iranian business context. The second dimension of the altruistic behaviour relates to the organisational commitment, which is identified as the participants' commitment to organisational values. Participants' altruistic behaviour is promoted with willingness to contribute to organisational success.

9.1.2 Practical Contribution (Relevance cycle)

This research has postulated several practical contributions and practical implications to foster sustainable participation in knowledge sharing. The thesis outcomes show that the quantity and quality of participation are promoted by a combination of both intrinsic and extrinsic perceived benefits for the 3 different levels of knowledge sharing visibility explored in this thesis. Adapting private communication channels as well as public and group communication channels improves the quality and quantity aspects of knowledge contribution.

The results show that both knowledge sharing and knowledge seeking are essential to emergence of knowledge exchange from the individual perspective. However, improving knowledge sharing needs more resources. Since knowledge seekers are motivated to find solutions in the KM systems, organisations need to encourage participants to share knowledge in KM systems by

providing a social environment between employees. For example, Blue Shop, a famous Taiwanese virtual community, provides different knowledge exchange channels for enhancing online interaction between participants (Chiu, Hsu et al. 2006).

As discussed in the theoretical contribution, contrary to our expectations, material rewards (non-monetary rewards) have no significant influence on knowledge sharing either in the quality or quantity aspect in the three levels of knowledge sharing, however data are collected from Iran as a resource-constrained economy,. In comparison with non-constrained economies, our results are consistent with most studies in European and western countries. These results show KM practitioners in Iran like westerns countries should not design material rewards to motivate knowledge sharing behaviour within organisations.

Knowledge sharing visibility as an influential factor promotes the quality and quantity of knowledge contribution. From the quantity aspect of participation, transparent environments influence employees' participation levels to contribute knowledge because of both reputation and reciprocity. Further, intrinsic benefits (altruism and knowledge self-efficacy) are more influential than extrinsic benefits in determining knowledge contribution for private knowledge sharing. From the quality aspect of participation, direct reciprocity as well as generalized reciprocity influences the quality of participants' contribution. Altruism is a unique perceived benefit, which can influence the quality aspect of knowledge contribution. In the group-level knowledge sharing as controlled-transparent environments, a combination of intrinsic and extrinsic benefits determines knowledge sharing performance. Practitioners interested in designing and sustaining participation for sharing high quality knowledge within organisations should address the roles of reciprocity and altruism among participants, in their designs.

This outcome has important implications for practitioners who attempt to design an incentive strategy for knowledge sharing. These findings guide designers to develop a comprehensive, integrated, all-inclusive and combined incentive plan for all visibility levels of knowledge exchange. Certainly, the incentive plan needs to be designed by a set of mechanisms to promote intrinsic benefits for knowledge sharing in invisible knowledge exchange environments. These mechanisms include multi-pronged and cultural strategies within organisations to stimulate individuals' intrinsic motivations such as altruism. Further, KM designers need to spend more effort in developing incentive mechanisms to align with the extrinsic benefits in visible knowledge exchange channels.

The next practical contribution refers to the use of different knowledge exchange channels within organisations. Although all knowledge exchange levels are necessary for knowledge exchange, a big volume of high-quality knowledge is generated in the group-level communications. Therefore, the main concern of KM developers in high-tech companies should be focused on designing efficient group-level knowledge exchange platforms (such as Network of Practices) to improve knowledge sharing performance.

The integrated conceptual framework of individual engagement in knowledge sharing assists KM practitioners to design an integrated communication structure. Demonstrating three visibility levels of knowledge exchanges in the integrated conceptual framework postulates a general guideline for structuring private, group and public communication levels among participants. Further, three levels of knowledge exchange provide a strategic knowledge map for organisations to develop knowledge sharing mechanisms.

9.1.3 Design Contribution (Design cycle)

This thesis provides several contributions from the design perspective. The importance of the inclusion of different levels of the knowledge sharing visibility for a platform for participation in knowledge sharing is shown in the field-experiment in Chapter 8. The ability to collect and distribute organisational knowledge, using a platform is, however, not sufficient to create commitment to knowledge sharing within an organisation. The results show that an incentive strategy that supports participants to "*be part of a specific larger whole*" by creating "*reciprocal relations with a specific larger whole*" (Brazier and Nevejan 2014), is essential.

The field experiment empirically confirms relationships between knowledge sharing visibilities and participants' perceived benefits as well as participation for knowledge sharing. Results of designing KM system indicate developing new opportunities for participation by adapting visible knowledge exchange channels support organisations to improve knowledge contribution. Moreover, the results show controlled visible knowledge sharing channels (group-level knowledge exchange) improve both aspects of participation for knowledge sharing.

9.2 Research Limitations

The specific limitations of each case study in this thesis are presented above in the relevant chapters. This section describes the limitations of the research approach taken in the thesis as a whole.

- All case studies are situated in high-tech businesses. Thus, the research scope is restricted to high-tech companies, which decreases the generalizability of the research outcome to other corporations.
- All data are collected from active participants. Active participants compare with non-active participants might have different perceptions about the influence of perceived benefits on knowledge contribution.
- The participants in the case studies in this thesis are experts both in their field, with considerable experience in knowledge sharing within their company, familiar with IT features and KM technologies.
- The integrated conceptual framework of individual engagement in knowledge sharing is evaluated only for private-level and group-level visibility, and not for public-level knowledge sharing in the field-experiment, due to practical feasibility of this case study.
- This thesis focuses on knowledge sharing within organisational boundaries. Influential factors of individual participation in knowledge sharing in cross-bounded systems might be different from that of intra-organisational KM systems. Further research need to consider knowledge sharing between organisations.

9.3 New Directions for Future Research

This thesis identifies new opportunities and directions for future research. The integrated conceptual framework concentrates on the relationships of five perceived benefits for three levels of knowledge sharing visibility. These factors may also influence each other. Future research should focus on the interdependency between these factors. Moreover, future research should examine changes in participants' perceived benefits over time and the impacts of these changes on participation.

All data are collected from active participants. The results should be generalized to non-active participants by future studies.

This thesis investigates the role of perceived benefits and costs of participation in knowledge sharing. Future research should focus on other critical factors of participation in knowledge sharing influenced by experiential, social, economic and cultural factors.

Since all data are collected from intra-organisational knowledge networks, the results should be evaluated for inter-organisational knowledge networks in additional studies.

9.4 Conclusion

This thesis provides several contributions to design of participation for knowledge exchange within organisations in a resource-constrained economy. These contributions not only improve the understanding of participation in knowledge exchange but also suggest several messages to KM designers. Practitioners in the KM domain can leverage the thesis outcome to improve participation in knowledge exchange in the resource-constrained economy; with a better interpreting of the relations between perceived benefits and the visibility level of knowledge sharing. Many unanswered questions remain for the future research to explore participation in knowledge exchange.

References

Abili, K., F. N. Thani, F. Mokhtarian and M. M. Rashidi (2011). "The role of effective factors on organizational knowledge sharing." Procedia-Social and Behavioral Sciences **29**: 1701-1706.

Adair, J. G. (1984). "The Hawthorne effect: A reconsideration of the methodological artifact." Journal of applied psychology **69**(2): 334.

Agichtein, E., C. Castillo, D. Donato, A. Gionis and G. Mishne (2008). Finding high-quality content in social media. Proceedings of the 2008 International Conference on Web Search and Data Mining, ACM.

Ajmal, M., P. Helo and T. Kekäle (2010). "Critical factors for knowledge management in project business." Journal of Knowledge Management **14**(1): 156-168.

Akhavan, P. and M. Jafari (2006). "Critical issues for knowledge management implementation at a national level." VINE: J. Info. Knowl. Manage. Syst. **36**(1): 52-66.

Akhavan, P., M. Jafari and M. Fathian (2006). "Critical success factors of knowledge management systems: a multi-case analysis." European Business Review **18**(2): 97-113.

Akhavan, P. and A. Pezeshkan (2014). "Knowledge management critical failure factors: a multi-case study." VINE **44**(1): 2-2.

Al-Alawi, A. I., N. Y. Al-Marzooqi and Y. F. Mohammed (2007). "Organizational culture and knowledge sharing: critical success factors." Journal of knowledge management **11**(2): 22-42.

Alavi, M., T. R. Kayworth and D. E. Leidner (2006). "An empirical examination of the influence of organizational culture on knowledge management practices." Journal of management information systems **22**(3): 191-224.

Alavi, M. and D. E. Leidner (2001). "Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues." MIS Quarterly **25**(1): 107-136.

Alazmi, M. and M. Zairi (2003). "Knowledge management critical success factors." Total Quality Management & Business Excellence **14**(2): 199-204.

Allameh, S. M., S. M. Zare and S. m. r. davoodi (2011). "Examining the impact of KM enablers on knowledge management processes." Procedia Computer Science **3**(0): 1211-1223.

Appleyard, M. M. (1996). "How does knowledge flow? Interfirm patterns in the semiconductor industry." Strategic Management Journal **17**(S2): 137-154.

Ardichvili, A., M. Maurer, W. Li, T. Wentling and R. Stuedemann (2006). "Cultural influences on knowledge sharing through online communities of practice." Journal of knowledge management **10**(1): 94-107.

Ardichvili, A., V. Page and T. Wentling (2003). "Motivation and barriers to participation in virtual knowledge-sharing communities of practice." Journal of Knowledge Management **7**(1): 64-77.

Aris, A. and B. Shneiderman (2007). "Designing semantic substrates for visual network exploration." Information Visualization **6**(4): 281-300.

Asrar-ul-Haq, M., S. Anwar and T. Nisar (2016). "A systematic review of knowledge management and knowledge sharing: Trends, issues, and challenges." Cogent Business & Management **3**(1): 1127744.

Babalhavaeji, F. and Z. J. Kermani (2011). "Knowledge sharing behaviour influences: a case of Library and Information Science faculties in Iran." Malaysian Journal of Library & Information Science **16**(1): 1-14.

Babbie, E. R. (2016). The practice of social research. Boston, USA, Cengage Learning.

Bandura, A. (1986). Social foundations of thought and action. The Health Psychology Reader. D. Marks. London, SAGE. **1986**.
Bandura, A. (1994). Self-efficacy. New York: Wiley, Wiley Online Library.
Bandura, A. and E. A. Locke (2003). "Negative self-efficacy and goal effects revisited." Journal of applied psychology **88**(1): 87.
Barclay, D., C. Higgins and R. Thompson (1995). "The partial least squares (PLS) approach to causal modeling: Personal computer adoption and use as an illustration." Technology studies **2**(2): 285-309.
Bartol, K. M. and A. Srivastava (2002). "Encouraging knowledge sharing: the role of organizational reward systems." Journal of Leadership & Organizational Studies **9**(1): 64-76.
Batson, C. D. (2014). The altruism question: Toward a social-psychological answer, Psychology Press.
Becerra-Fernandez, I., A. Gonzalez and R. Sabherwal (2004). Knowledge Management, Challenges, Solutions and Technologies. New Jersey, Pearson Prentice Hall.
Benbya, H. (2015). Exploring the design and effects of internal knowledge markets. New York, Springer.
Bennett, R. and H. Gabriel (1999). "Organisational factors and knowledge management within large marketing departments: an empirical study." Journal of Knowledge Management **3**(3): 212 - 225.
Benyon, D., P. Turner and S. Turner (2005). Designing interactive systems: People, activities, contexts, technologies, Pearson Education.
Bhatt, G. D. (2001). "Knowledge management in organizations: examining the interaction between technologies, techniques, and people." Journal of Knowledge Management **5**(1): 68 - 75.
Blau, P. M. (1964). Exchange and Power in Social Life. New York, Wiley.
Bloom, N., A. Mahajan, D. McKenzie and J. Roberts (2010). "Why do firms in developing countries have low productivity?" The American Economic Review **100**(2): 619-623.
Bock, G.-W. and Y.-G. Kim (2002). "Breaking the myths of rewards: An exploratory study of attitudes about knowledge sharing." Information Resources Management Journal **15**(2): 14-21.
Bock, G.-W., R. W. Zmud, Y.-G. Kim and J.-N. Lee (2005). "Behavioral intention formation in knowledge sharing: examining the roles of extrinsic motivators, social-psychological forces, and organizational climate." MIS Quarterly **29**(1): 87-111.
Boer, N.-I., H. Berends and P. van Baalen (2011). "Relational models for knowledge sharing behavior." European Management Journal **29**(2): 85-97.
Bolisani, E. and E. Scarso (2014). "The place of communities of practice in knowledge management studies: a critical review." Journal of Knowledge Management **18**(2).
Bose, R. (2004). "Knowledge management metrics." Industrial Management & Data Systems **104**(6): 457- 468.
Bose, R. (2004). "Knowledge management metrics." Industrial management & data systems **104**(6): 457-468.
Bozorgmehr, N. (2012). Iran develops 'economy of resistance'. Financial Times. Isfahan, FT.
Brandzaeg, P. and J. Heim (2009). Explaining participation in online communities. Handbook of Research on Socio-Technical Design and Social Networking. B. Whitworth and A. d. Moor. New York, NY, IGI Global**:** 167-182.
Bratianu, C. and I. Orzea (2012). "Knowledge Strategies Analysis by Using the Analytic Hierarchy Process." The IUP Journal of Knowledge Management **10**(2): 7-21.
Brazier, F. and C. Nevejan (2014). Vision for Participatory Systems Design. 4th International Engineering Systems Symposium (CESUN 2014). New York.

Brush, T. H. and K. W. Artz (1999). "Toward a contingent resource-based theory: The impact of information asymmetry on the value of capabilities in veterinary medicine." Strategic Management Journal **20**(3): 223-250.
Brydon, M. and A. R. Vining (2006). "Understanding the failure of internal knowledge markets: A framework for diagnosis and improvement." Information & Management Journal **43**(8): 964-974.
Brzozowski, M. J., T. Sandholm and T. Hogg (2009). Effects of feedback and peer pressure on contributions to enterprise social media. Proceedings of the ACM 2009 international conference on Supporting group work, ACM.
Burley, D. L. and G. Pandit (2008). "Lesson learned: organizational realities influence KMS implementation." VINE **38**(4): 476-489.
Cabrera, A. and E. F. Cabrera (2002). "Knowledge-Sharing Dilemmas." Organization Studies **23**(5): 687-710.
Cabrera, A., W. C. Collins and J. F. Salgado (2006). "Determinants of individual engagement in knowledge sharing." The International Journal of Human Resource Management **17**(2): 245-264.
CBI. (2015). " Inflation Rate." Central Bank of Iran, 2015, from http://www.cbi.ir/Inflation/Inflation_en.aspx.
Cepeda, G. and D. Vera (2007). "Dynamic capabilities and operational capabilities: A knowledge management perspective." Journal of Business Research **60**(5): 426-437.
Cham, T. H., Y. M. Lim, B. L. Cheng, T. H. Lee, F. Burstein and W. Lee (2016). "An Empirical Study on the Determinants of Knowledge Management Systems Success-Evidence from the Banking Industry of Malaysia." VINE Journal of Information and Knowledge Management Systems **46**(1).
Chang, H. H. and S.-S. Chuang (2011). "Social capital and individual motivations on knowledge sharing: Participant involvement as a moderator." Information & Management **48**(1): 9-18.
Chang, M.-Y., Y.-C. Hung, D. C. Yen and P. T. Tseng (2009). "The research on the critical success factors of knowledge management and classification framework project in the Executive Yuan of Taiwan Government." Expert Systems with Applications **36**(3): 5376-5386.
Chang, M.-Y., Y.-C. Hung, D. C. Yen and P. T. Y. Tseng (2009). "The research on the critical success factors of knowledge management and classification framework project in the Executive Yuan of Taiwan Government." Expert Systems with Applications **36**(3, Part 1): 5376-5386.
Chen, C.-J. and S.-W. Hung (2010). "To give or to receive? Factors influencing members' knowledge sharing and community promotion in professional virtual communities." Information & Management **47**(4): 226-236.
Chen, S.-S., Y.-W. Chuang and P.-Y. Chen (2012). "Behavioral intention formation in knowledge sharing: Examining the roles of KMS quality, KMS self-efficacy, and organizational climate." Knowledge-Based Systems **31**(1): 106-118.
Chen, Y., T. H. HO and Y. M. KIM (2010). "Knowledge market design: A field experiment at Google Answers." Journal of Public Economic Theory **12**(4): 641-664.
Chin, W. W. (1998). "The partial least squares approach to structural equation modeling." Modern Methods for Business Research **295**(2): 295-336.
Chin, W. W., A. Gopal and W. D. Salisbury (1997). "Advancing the theory of adaptive structuration: The development of a scale to measure faithfulness of appropriation." Information Systems Research **8**(4): 342-367.

Chiu, C.-M., M.-H. Hsu and E. T. Wang (2006). "Understanding knowledge sharing in virtual communities: an integration of social capital and social cognitive theories." Decision Support Systems **42**(3): 1872-1888.
Choi, B., S. K. Poon and J. G. Davis (2008). "Effects of knowledge management strategy on organizational performance: A complementarity theory-based approach." Omega **36**(2): 235-251.
Choi, J. H., B. Lev and H.-L. Kim (2014). Exploring determinants of knowledge sharing in a social network of practice. Proceedings of the Seventh International Conference on Management Science and Engineering Management, Springer.
Choi, Y. S. (2000). An empirical study of factors affecting successful implementation of knowledge management. PhD Dissertation Doctor of Philosophy, University of Nebraska.
Chong, S. C. (2006). "KM critical success factors: A comparison of perceived importance versus implementation in Malaysian ICT companies." Learning Organization **13**(3): 230-256.
Chong, S. C. (2006). "KM critical success factors: a comparison of perceived importance versus implementation in Malaysian ICT companies." Learning Organization, The **13**(3): 230-256.
Chong, S. C. and Y. S. Choi (2005). "Critical factors in the successful implementation of knowledge management." Journal of Knowledge Management Practice **6**.
Chua, A. and W. Lam (2005). "Why KM projects fail: a multi-case analysis." Journal of Knowledge Management **9**(3): 6-17.
Cohen, S. (1980). "Aftereffects of stress on human performance and social behavior: a review of research and theory." Psychological bulletin **88**(1): 82.
Cohen, S. and J. Lambie (1978). Environmental load and the allocation of attention. Advnaces in environmental research. A. Baum and S. Vallins. Hilsdale, NJ, Erlbaum.
Connelly, C. E., D. P. Ford, O. Turel, B. Gallupe and D. Zweig (2014). "'I'm busy (and competitive)!'Antecedents of knowledge sharing under pressure." Knowledge Management Research & Practice **12**(1): 74-85.
Connelly, C. E. and E. K. Kelloway (2003). "Predictors of employees' perceptions of knowledge sharing cultures." Leadership & Organization Development Journal **24**(5): 294-301.
Cooper, D. R. and P. S. Schindler (2011). Business research methods, McGraw-Hill.
Cross, N. (2001). "Designerly Ways of Knowing: Design Discipline vs. Design Science." Design Issues **17**(3): 49-55.
Cyr, S. and C. W. Choo (2010). "The individual and social dynamics of knowledge sharing: an exploratory study." Journal of Documentation **66**(6): 824-846.
Cyr, S. and C. Wei Choo (2010). "The individual and social dynamics of knowledge sharing: an exploratory study." Journal of Documentation **66**(6): 824-846.
Dalkir, K. (2013). Knowledge management in theory and practice, Routledge.
Danis, C. and D. Singer (2008). A wiki instance in the enterprise: opportunities, concerns and reality. Proceedings of the 2008 ACM conference on Computer supported cooperative work, ACM.
Darroch, J. (2003). "Developing a measure of knowledge management behaviors and practices." Journal of Knowledge Management **7**(5): 41-54.
Davenport, T. H., D. W. D. Long and M. C. Beers (1998). "Successful Knowledge Management Projects." Sloan Management Review **39**(2): 43-57.
Davenport, T. H. and L. Prusak (1998). Woking Knowledge, How organizations manage what they know. Cambridge, Harvard Business Press.
Davison, R. M., C. X. Ou and M. G. Martinsons (2013). "Information technology to support informal knowledge sharing." Information Systems Journal **23**(1): 89-109.

Deci, E. L. and R. Ryan (2002). Overview of self-determination theory: An organismic dialectical perspective. Handbook of self-determination research. E. L. Deci and R. Ryan. NY, USA, The University pf Rochester Press: 3-33.
Deci, E. L. and R. M. Ryan (1975). Intrinsic motivation, Wiley Online Library.
Deci, E. L. and R. M. Ryan (1985). Intrinsic motivation and self-determination in human behavior. New York, Plenum.
Denyer, D., D. Tranfield and J. E. Van Aken (2008). "Developing design propositions through research synthesis." Organization studies **29**(3): 393-413.
Desouza, K. C. and Y. Awazu (2005). Engaged Knowledge Management, Engagement with New Realities, PALGRAVE MACMILLAN.
Donate, M. J. and J. D. S. de Pablo (2015). "The role of knowledge-oriented leadership in knowledge management practices and innovation." Journal of Business Research **68**(2): 360-370.
Ellison, N. B., J. L. Gibbs and M. S. Weber (2014). "The Use of Enterprise Social Network Sites for Knowledge Sharing in Distributed Organizations The Role of Organizational Affordances." American Behavioral Scientist **1**(1): 1-21.
Eschenfelder, E., R. Heckman and S. Sawyer (1998). "The distribution of computing: the knowledge markets of distributed technical support specialists." Information Technology and People **11**(2): 84-103.
Fan, J., P. Zhang and D. C. Yen (2014). "G2G information sharing among government agencies." Information & Management **51**(1): 120-128.
Faraj, S. and S. L. Johnson (2011). "Network exchange patterns in online communities." Organization Science **22**(6): 1464-1480.
Firestone, J. M. and M. W. McElroy (2003). Key issues in the new knowledge management, Routledge.
Fornell, C. and D. F. Larcker (1981). "Structural equation models with unobservable variables and measurement error: Algebra and statistics." Journal of Marketing Research **8**(3): 382-388.
Frey, B. S. and R. Jegen (2001). "Motivation crowding theory." Journal of economic surveys **15**(5): 589-611.
Frey, B. S. and F. Oberholzer-Gee (1997). "The Cost of Price Incentives: An Empirical Analysis of Motivation Crowding- Out." The American Economic Review **87**(4): 746-755.
Frost, A. (2014). "A synthesis of knowledge management failure factors." Retrieved January **5**: 2015.
Fulk, J., A. J. Flanagin, M. E. Kalman, P. R. Monge and T. Ryan (1996). "Connective and Communal Public Goods in Interactive Communication Systems." Communication Theory **6**(1): 60-87.
Fulk, J. and Y. C. Yuan (2013). "Location, Motivation, and Social Capitalization via Enterprise Social Networking." Journal of Computer-Mediated Communication **19**(1): 20-37.
Gefen, D. and M. Keil (1998). "The impact of developer responsiveness on perceptions of usefulness and ease of use: an extension of the technology acceptance model." Acm Sigmis Database **29**(2): 35-49.
Gherardi, S., D. Nicolini and F. Odella (1998). "Toward a social understanding of how people learn in organizations: The notion of situated curriculum." Management learning **29**(3): 273-297.
Gist, M. E. (1987). "Self-efficacy: Implications for organizational behavior and human resource management." Academy of management review **12**(3): 472-485.
Gold, A. H., A. Malhotra and A. H. Segars (2001). "Knowledge Management: An Organizational Capabilities Perspective." Journal of Management Information Systems **18**(1): 185-214.

Gouldner, A. W. (1960). "The norm of reciprocity: A preliminary statement." American Sociological Review: 161-178.
Grimaldi, M. and P. Rippa (2011). "An AHP-based framework for selecting knowledge management tools to sustain innovation process." Knowledge and Process Management **18**(1): 45-55.
Gupta, B., L. S. Iyer and J. E. Aronson (2000). "Knowledge management: practices and challenges." Industrial Management & Data Systems **100**(1): 17-21.
Hair, J. F., C. M. Ringle and M. Sarstedt (2011). "PLS-SEM: Indeed a silver bullet." The Journal of Marketing Theory and Practice **19**(2): 139-152.
Hair, J. F., M. Sarstedt, L. Hopkins and V. G. Kuppelwieser (2014). "Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research." European Business Review **26**(2): 106-121.
Hall, H. (2001). "Input-friendliness: motivating knowledge sharing across intranets." Journal of information science **27**(3): 139-146.
Hall, H., G. Widén and L. Paterson (2010). "Not what you know, nor who you know, but who you know already: examining online information sharing behaviours in a blogging environment through the lens of social exchange theory." Libri **60**(2): 117-128.
Hanel, P. (2006). "Intellectual property rights business management practices: A survey of the literature." Technovation **26**(8): 895-931.
Hansen, M., N. Nohria and T. Tierney (2000). "What's your strategy for managing knowledge." The knowledge management yearbook **2001**: 55-69.
Hara, N. (2007). "Information technology support for communities of practice: How public defenders learn about winning and losing in court." Journal of the American Society for Information Science and Technology **58**(1): 76-87.
Hargadon, A. and R. I. Sutton (1997). "Technology brokering and innovation in a product development firm." Administrative Science Quarterly **42**(4): 716-749.
Harper, F. M., D. Moy and J. A. Konstan (2009). Facts or friends?: distinguishing informational and conversational questions in social Q&A sites. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, ACM.
Hau, Y. S., B. Kim, H. Lee and Y.-G. Kim (2013). "The effects of individual motivations and social capital on employees' tacit and explicit knowledge sharing intentions." International Journal of Information Management **33**(2): 356-366.
He, W., Y. Fang and K. K. Wei (2009). "The role of trust in promoting organizational knowledge seeking using knowledge management systems: An empirical investigation." Journal of the American Society for Information Science and Technology **60**(3): 526-537.
He, W. and K.-K. Wei (2009). "What drives continued knowledge sharing? An investigation of knowledge-contribution and-seeking beliefs." Decision Support Systems **46**(4): 826-838.
Hevner, A. and S. Chatterjee (2010). Design Research in Information Systems. New York, Springer.
Hevner, A., S. March, J. Park and S. Ram (2004). "Design science in information systems research." MIS Quarterly **28**(1): 75-105.
Hew, K. F. and N. Hara (2007). "Knowledge sharing in online environments: A qualitative case study." Journal of the American Society for Information Science and Technology **58**(14): 2310-2324.
Himmelberg, C. P. and B. C. Petersen (1994). "R & D and internal finance: A panel study of small firms in high-tech industries." The Review of Economics and Statistics: 38-51.
Holsapple, C. W. and K. D. Joshi (1999). Description and analysis of existing knowledge management frameworks. System Sciences, 1999. HICSS-32. Proceedings of the 32nd Annual Hawaii International Conference on.

Holsapple, C. W. and K. D. Joshi (2000). "An investigation of factors that influence the management of knowledge in organizations." The Journal of Strategic Information Systems **9**(2–3): 235-261.
Howells, J. R. (2002). "Tacit knowledge, innovation and economic geography." Urban studies **39**(5-6): 871-884.
Hsu, C.-L. and J. C.-C. Lin (2008). "Acceptance of blog usage: The roles of technology acceptance, social influence and knowledge sharing motivation." Information & Management **45**(1): 65-74.
Huang, L.-S. and C.-P. Lai (2012). "An investigation on critical success factors for knowledge management using structural equation modeling." Procedia - Social and Behavioral Sciences **40**(0): 24-30.
Huang, Q., R. M. Davison and J. Gu (2008). "Impact of personal and cultural factors on knowledge sharing in China." Asia Pacific Journal of Management **25**(3): 451-471.
Huber, G. P. (1991). "Organizational learning: The contributing processes and the literatures." Organization science **2**(1): 88-115.
Hung, S.-Y., A. Durcikova, H.-M. Lai and W.-M. Lin (2011). "The influence of intrinsic and extrinsic motivation on individuals' knowledge sharing behavior." International Journal of Human-Computer Studies **69**(6): 415-427.
Hung, Y.-C., S.-M. Huang, Q.-P. Lin and M.-L. -Tsai (2005). "Critical factors in adopting a knowledge management system for the pharmaceutical industry." Industrial Management & Data Systems **105**(2): 164-183.
Huysman, M. and D. d. Wit (2004). "Practices of Managing Knowledge Sharing: Towards a Second Wave of Knowledge Management." Knowledge and Process Management **11**(2): 81-92.
Huysman, M. and V. Wulf (2006). "IT to support knowledge sharing in communities, towards a social capital analysis." Journal of Information Technology **21**: 40-51.
Hwang, E. H., P. V. Singh and L. Argote (2015). "Knowledge Sharing in Online Communities: Learning to Cross Geographic and Hierarchical Boundaries." Organization Science **26**(6): 1593-1611.
Ipe, M. (2003). "Knowledge sharing in organizations: A conceptual framework." Human Resource Development Review **2**(4): 337-359.
Iske, P. and W. Boersma (2005). "Connected brains: Question and answer systems for knowledge sharing: concepts, implementation and return on investment." Journal of knowledge management **9**(1): 126-145.
Jafari, M., P. Akhavan and E. Nouranipour (2009). "Developing an architecture model for enterprise knowledge: an empirical study based on the Zachman framework in Iran." Management Decision **47**(5): 730-759.
Jafari, M., P. Akhavan, J. Rezaee Nour and M. N. Fesharaki (2007). "Knowledge management in Iran aerospace industries: a study on critical factors." Aircraft Engineering and Aerospace Technology **79**(4): 375-389.
Jafari, M., M. Fathian, P. Akhavan and R. Hosnavi (2007). "Exploring KM features and learning in Iranian SMEs." VINE: J. Info. Knowl. Manage. Syst. **37**(2): 207-218.
Javernick-Will, A. (2011). "Motivating knowledge sharing in engineering and construction organizations: Power of social motivations." Journal of Management in Engineering **28**(2): 193-202.
Jennex, M. and L. Olfman (2005). "Assessing knowledge management success." International Journal of Knowledge Management (IJKM) **1**(2): 33-49.
Jennex, M. E. and L. Olfman (2006). "A model of knowledge management success." International Journal of Knowledge Management (IJKM) **2**(3): 51-68.

Jeong, S., J. Ahn and B. Rhee (2012). A Study of Knowledge Management System Activation Methods Based on Knowledge Market Theory. Convergence and Hybrid Information Technology. G. Lee, D. Howard, D. Ślęzak and Y. Hong, Springer Berlin Heidelberg. **310:** 103-110.
Kaae, S., B. Søndergaard, L. S. Haugbølle and J. M. Traulsen (2010). "Development of a qualitative exploratory case study research method to explore sustained delivery of cognitive services." Pharmacy world & science **32**(1): 36-42.
Kahraman, C. and F. Tunc Bozbura (2007). "Knowledge management practices in Turkish SMEs." Journal of Enterprise Information Management **20**(2): 209-221.
Kane, G. C., M. Alavi, G. Labianca and S. P. Borgatti (2014). "What's different about social media networks? A framework and research agenda." Mis Quarterly **38**(1): 275-304.
Kankanhalli, A., B. C. Tan and K.-K. Wei (2005). "Contributing knowledge to electronic knowledge repositories: an empirical investigation." MIS Quarterly **29**(1): 113-143.
Katzman, K. (2016). Iran Sanctions, Congressional Research Service. **1**.
Kaufmann, D. and A. Kraay (2017). The Worldwide Governance Indicators (WGI) project, The World-Bank.
Kazadi, K., A. Lievens and D. Mahr (2016). "Stakeholder co-creation during the innovation process: Identifying capabilities for knowledge creation among multiple stakeholders." Journal of Business Research **69**(2): 525-540.
Khalid, A.-M. (2006). Critical Success Factors Affecting Knowledge Management Adoption: A Review of the Literature. Innovations in Information Technology.
King, W. R. and P. V. Marks (2008). "Motivating knowledge sharing through a knowledge management system." Omega **36**(1): 131-146.
Kosonen, M. and A. Kianto (2009). "Applying wikis to managing knowledge—A socio-technical approach." Knowledge and Process Management **16**(1): 23-29.
Kulkarni, U. R., S. Ravindran and R. Freeze (2006). "A Knowledge Management Success Model: Theoretical Development and Empirical Validation." Journal of Management Information Systems **23**(3): 309-347.
Kulkarni, U. R., S. Ravindran and R. Freeze (2007). "A knowledge management success model: theoretical development and empirical validation." Journal of management information systems **23**(3): 309-347.
Kumaraswamy, K. S. N. and C. Chitale (2012). "Collaborative knowledge sharing strategy to enhance organizational learning." Journal of Management Development **31**(3): 308-322.
Kwahk, K.-Y. and D.-H. Park (2016). "The effects of network sharing on knowledge-sharing activities and job performance in enterprise social media environments." Computers in Human Behavior **55**(1): 826-839.
Lam, A. and J.-P. Lambermont-Ford (2010). "Knowledge sharing in organisational contexts: a motivation-based perspective." Journal of Knowledge Management **14**(1): 51-66.
Laudon, K. C. and J. P. Laudon (2004). Management Information Systems: managing the digital firm. New Jersey, Pearson Prentice Hall.
Lave, J. and E. Wenger (1991). Situated Learning: Legitimate Peripheral Participation. New York, Cambridge University Press.
Lee, H., Y. Chang and B. Choi (1999). "Analysis of effects of knowledge management strategies on corporate performance." Korea Intelligent Information Journal **5**(2): 99-120.
Lee, H. and B. Choi (2003). "Knowledge Management Enablers, Processes, and Organizational Performance: An Integrative View and Empirical Examination." Journal of Management Information Systems **20**(1): 179-228.
Lee, K. C., S. Lee and I. W. Kang (2005). "KMPI: measuring knowledge management performance." Information & Management Journal **42**(3): 469-482.

Leonard-Barton, D. (1995). Wellsprings of Knowledge. Boston, Harvard Business School Press.
Leonardi, P. M. (2014). "Social media, knowledge sharing, and innovation: Toward a theory of communication visibility." Information Systems Research **25**(4): 796-816.
Leonardi, P. M., M. Huysman and C. Steinfield (2013). "Enterprise social media: Definition, history, and prospects for the study of social technologies in organizations." Journal of Computer-Mediated Communication **19**(1): 1-19.
Li, S. M. and W. W. Ma (2014). Exploring Interpersonal Relationship and Growth Need Strength on Knowledge Sharing in Social Media. Hybrid Learning. Theory and Practice, Springer**:** 288-299.
Liao, C., S.-H. Chuang and P.-L. To (2011). "How knowledge management mediates the relationship between environment and organizational structure." Journal of Business Research **64**(7): 728-736.
Liebowitz, J. (1999). "Key ingredients to the success of an organization's knowledge management strategy." Knowledge and process management **6**(1): 37-40.
Lin, C.-P. (2007). "To share or not to share: Modeling tacit knowledge sharing, its mediators and antecedents." Journal of Business Ethics **70**(4): 411-428.
Lin, C.-P. (2010). "Learning task effectiveness and social interdependence through the mediating mechanisms of sharing and helping: A survey of online knowledge workers." Group & Organization Management **35**(3): 299-328.
Lin, H.-F. (2007). "Effects of extrinsic and intrinsic motivation on employee knowledge sharing intentions." Journal of Information Science **33**(2): 135-149.
Lin, S.-W. and L. Y.-S. Lo (2015). "Mechanisms to motivate knowledge sharing: integrating the reward systems and social network perspectives." Journal of Knowledge Management **19**(2): 212-235.
Lin, T.-C. and C.-C. Huang (2008). "Understanding knowledge management system usage antecedents: An integration of social cognitive theory and task technology fit." Information & Management **45**(6): 410-417.
Lindner, F. and A. Wald (2011). "Success factors of knowledge management in temporary organizations." International Journal of Project Management **29**(7): 877-888.
Liu, R., J.-x. Yu, H.-c. Sun and P. TIAN (2003). "Introduction to the ANP Super Decisions software and its application [J]." Systems Engineering-theory & Practice **8**: 024.
Liu, Y., R. T. Keller and H. A. Shih (2011). "The impact of team-member exchange, differentiation, team commitment, and knowledge sharing on R&D project team performance." R&D Management **41**(3): 274-287.
Llopis, O. and N. J. Foss (2016). "Understanding the climate-knowledge sharing relation: The moderating roles of intrinsic motivation and job autonomy." European Management Journal **34**(2): 135-144.
López, C. and J. Salmeron (2011). "Exploring risk factors in ERP maintenance projects." Scientific Journal of Riga Technical University. Computer Sciences **43**(1): 50-56.
López, S. P., J. M. M. Peón and C. J. V. Ordás (2004). "Managing knowledge: the link between culture and organizational learning." Journal of knowledge management **8**(6): 93-104.
Lou, J., Y. Fang, K. H. Lim and J. Z. Peng (2013). "Contributing high quantity and quality knowledge to online Q&A communities." Journal of the American Society for Information Science and Technology **64**(2): 356-371.
Lu, H.-P. and K.-L. Hsiao (2007). "Understanding intention to continuously share information on weblogs." Internet Research **17**(4): 345-361.
Ma, W. W. and A. Chan (2014). "Knowledge sharing and social media: Altruism, perceived online attachment motivation, and perceived online relationship commitment." Computers in Human Behavior **39**: 51-58.

Majchrzak, A., S. Faraj, G. C. Kane and B. Azad (2013). "The Contradictory Influence of Social Media Affordances on Online Knowledge Sharing." **19**(1): 38-55.
Markus, L. M. (2001). "Toward a theory of knowledge reuse: Types of knowledge reuse situations and factors in reuse success." Journal of Management Information Systems **18**(1): 57-93.
Massa, S. and S. Testa (2009). "A knowledge management approach to organizational competitive advantage: Evidence from the food sector." European Management Journal **27**(2): 129-141.
Masterson, S. S., K. Lewis, B. M. Goldman and M. S. Taylor (2000). "Integrating justice and social exchange: The differing effects of fair procedures and treatment on work relationships." Academy of Management Journal **43**(4): 738-748.
Matsuo, M. and M. Easterby-Smith (2008). "Beyond the knowledge sharing dilemma: the role of customisation." Journal of Knowledge Management **12**(4): 30-43.
McAdam, R., S. Moffett and J. Peng (2012). "Knowledge sharing in Chinese service organizations: a multi case cultural perspective." Journal of Knowledge Management **16**(1): 129-147.
McElroy, M. W. (2000). "Integrating complexity theory, knowledge management and organizational learning." Journal of knowledge management **4**(3): 195-203.
McKnight, P. E. and J. Najab (2010). "Mann-Whitney U Test." Corsini Encyclopedia of Psychology.
Mergel, I., D. Lazer and M. C. Binz-Scharf (2008). "Lending a helping hand: voluntary engagement in knowledge sharing." International Journal of Learning and Change **3**(1): 5-22.
Mesmer-Magnus, J. R. and L. A. DeChurch (2009). "Information sharing and team performance: A meta-analysis." Journal of Applied Psychology **94**(2): 535.
Miles, M. B., A. M. Huberman and J. Saldana (2013). Qualitative data analysis: A methods sourcebook. USA, SAGE Publications, Incorporated.
Moffett, S., R. McAdam and S. Parkinson (2003). "An empirical analysis of knowledge management applications." Journal of Knowledge Management **7**(3): 6-26.
Montero, B., F. Watts and A. García-Carbonell (2007). "Discussion forum interactions: Text and context." System **35**(4): 566-582.
Murray, P. and A. Myers (1997). "The facts about knowledge." Information Strategy **2**(7): 29-33.
Neuman, W. L. (2005). Social research methods: Quantitative and qualitative approaches, Allyn and bacon Boston, MA.
Nevejan, C. and F. Brazier (2012). "Granularity in reciprocity." AI & SOCIETY **27**(1): 129-147.
Nowak, M. A. and K. Sigmund (2000). "Shrewd investments." Science **288**(5467): 819-820.
O'Dell, C. and C. Jackson (1998). If only we know what we know: the transfer of internal knowledge and best peractice. New York, Free Press.
Oh, S. (2012). "The characteristics and motivations of health answerers for sharing information, knowledge, and experiences in online environments." Journal of the American Society for Information Science and Technology **63**(3): 543-557.
Oostervink, N., M. Agterberg and M. Huysman (2016). "Knowledge sharing on enterprise social media: Practices to cope with institutional complexity." Journal of Computer-Mediated Communication.
Osterloh, M. and B. S. Frey (2000). "Motivation, Knowledge Transfer, and Organizational Forms." Organization Science **11**(5): 538-550.
Overby, E. (2012). Migrating Processes from Physical to Virtual Environments: Process Virtualization Theory. Information Systems Theory, Springer**:** 107-124.

Oyemomi, O., S. Liu, I. Neaga and A. Alkhuraiji (2016). "How knowledge sharing and business process contribute to organizational performance: Using the fsQCA approach." Journal of Business Research **69**(11): 5222-5227.
Pagès, C., M. Busso, A. Micco, E. Lora, U. Panizza, A. Rodriguez and G. Marquez (2003). Good Jobs Wanted: Labor Markets in Latin America. Washington DC, Inter-American Development Bank.
Pandey, S. C. and A. Dutta (2013). "Role of knowledge infrastructure capabilities in knowledge management." Journal of Knowledge Management **17**(3): 435-453.
Pang-Lo, L. (2011). "Empirical study on influence of critical success factors on ERP knowledge management on management performance in high-tech industries in Taiwan." Expert Systems with Applications **38**(8): 10696-10704.
Papadopoulos, T., T. Stamati and P. Nopparuch (2013). "Exploring the determinants of knowledge sharing via employee weblogs." International Journal of Information Management **33**(1): 133-146.
Paroutis, S. and A. Al Saleh (2009). "Determinants of knowledge sharing using Web 2.0 technologies." Journal of Knowledge Management **13**(4): 52-63.
Phang, C. W., A. Kankanhalli and R. Sabherwal (2009). "Usability and sociability in online communities: A comparative study of knowledge seeking and contribution." Journal of the Association for Information Systems **10**(10): 721.
Plessis, M. d. (2007). "Knowledge management: what makes complex implementations successful?" Journal of Knowledge Management **11**(2): 91-101.
Raman, M., T. Ryan and L. Olfman (2005). "Designing knowledge management systems for teaching and learning with wiki technology." Journal of Information Systems Education **16**(3): 311.
Ranft, A. L. and M. D. Lord (2000). "Acquiring new knowledge: The role of retaining human capital in acquisitions of high-tech firms." The Journal of High Technology Management Research **11**(2): 295-319.
Rey, D. and M. Neuhäuser (2011). Wilcoxon-signed-rank test. International Encyclopedia of Statistical Science, Springer**:** 1658-1659.
Riggs, E. (1985). Managing high-tech companies. NY, Van Nostrano Reinhold.
Riva, G., J. A. Waterworth, E. L. Waterworth and F. Mantovani (2011). "From intention to action: The role of presence." New Ideas in Psychology **29**(1): 24-37.
Rogers, E. M. and J. K. Larsen (1984). Silicon Valley fever: Growth of high-technology culture. NY, Basic Books (AZ).
Rousseau, D. (1995). Psychological contracts in organizations: Understanding written and unwritten agreements, Sage Publications.
Ryan, R. M. and E. L. Deci (2000). "Intrinsic and extrinsic motivations: Classic definitions and new directions." Contemporary Educational Psychology **25**(1): 54-67.
Saaty, T. (1980). The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation. New York, McGraw-Hill.
Saaty, T. L. (1977). "A scaling method for priorities in hierarchical structures." Journal of Mathematical Psychology **15**(3): 234–281.
Saaty, T. L. (1996). "Decision making with dependence and feedback: The analytic network process."
Saaty, T. L. and L. G. Vargas (1994). Decision making in economic, political, social, and technological environments with the analytic hierarchy process, RWS publications Pittsburgh.
Sage, A. P. and W. B. Rouse (1999). "Information Systems Frontiers in Knowledge Management." Information Systems Frontiers **1**(3): 205-219.

Salmeron, J. L. and I. Herrero (2005). "An AHP-based methodology to rank critical success factors of executive information systems." Computer Standards & Interfaces **28**(1): 1-12.
Sanchez, G., L. Trinchera and G. Russolillo (2015). plspm: Partial Least Squares data analysis methods. R package version 0-4-2, available at: http://cran.r-project.org/web/packages/plspm/plspm.pdf.
Santos, M. J., R. Wane and O. Lopes (2014). "Knowledge sharing: social, cultural and structural enabling factors." Transfer and Management of Knowledge: 81-125.
Sarstedt, M., C. M. Ringle, D. Smith, R. Reams and J. F. Hair (2014). "Partial least squares structural equation modeling (PLS-SEM): A useful tool for family business researchers." Journal of Family Business Strategy **5**(1): 105-115.
Sedighi, M., S. v. Splunter, F. Brazier, C. v. Beers and S. Lukosch (2016). "Exploration of multi-layered knowledge sharing participation: the roles of perceived benefits and costs." Journal of Knowledge Management **20**(6): 1247-1267.
Sedighi, M., S. van Splunter, F. Zand and F. Brazier (2015). "Evaluating critical success factors model of knowledge management: An analytic hierarchy process (AHP) approach." International Journal of Knowledge Management **11**(3): 17-36.
Sedighi, M. and F. Zand (2012). Knowledge management: Review of the Critical Success Factors and development of a conceptual classification model. 10th International Conference of ICT and Knowledge Engineering, Bangkok, IEEE Explore.
Sekaran, U. (2006). Research methods for business: A skill building approach, John Wiley & Sons.
Sharma, R., P. Yetton and J. Crawford (2009). "Estimating the effect of common method variance: the method-method pair technique with an illustration from TAM research." Management Information Systems Quarterly **33**(3): 5.
Sher, P. J. and V. C. Lee (2004). "Information technology as a facilitator for enhancing dynamic capabilities through knowledge management." Information & Management **41**(8): 933-945.
Shiau, W.-L. and M. M. Luo (2012). "Factors affecting online group buying intention and satisfaction: A social exchange theory perspective." Computers in Human Behavior **28**(6): 2431-2444.
Shin, M., T. Holden and A. Ruth (2001). "From knowledge theory to management practice: towards an integrated approach." Information Processing & Management **37**(2): 335-355.
Sie, A. B., A.-M. Aho and L. Uden (2014). Community of practice for knowledge sharing in higher education: Analysing community of practice through the lens of activity theory. Learning Technology for Education in Cloud: MOOC and Big Data. L. Uden, J. Sinclair, Y.-H. Tao and D. Liberona. New York, NY, Springer**:** 135-148.
Skyrme, D. and D. Amidon (1997). "The Knowledge Agenda." Journal of Knowledge Management **1**(1): 27-37.
Slater, S. F. and J. C. Narver (1995). "Market orientation and the learning organization." Journal of Marketing **59**: 63-74.
Snyder, J. and J. Eng Lee-Partridge (2013). "Understanding communication channel choices in team knowledge sharing." Corporate Communications: An International Journal **18**(4): 417-431.
Solomon, J. (2015). Shift clouds Iran nuclear deal. Wall Street Journal.
Spende, J. (1996). "Making knowledge the basis of a dynamic theory of the firm." Strategic management journal **17**(Winter Special): 45-62.
Stamford , C. (2013). "Gartner says 80 percent of social business efforts will not achieve intended benefits through 2015." 2014, from http://www.gartner.com/newsroom/id/2319215.

Stebbins, R. A. (2001). Exploratory research in the social sciences, Sage.
Stewart, K. J. and S. Gosain (2006). "The impact of ideology on effectiveness in open source software development teams." Mis Quarterly: 291-314.
Sturges, J. E. and K. J. Hanrahan (2004). "Comparing telephone and face-to-face qualitative interviewing: a research note." Qualitative Research **4**(1): 107-118.
Sun, Y., Y. Fang and K. H. Lim (2012). "Understanding sustained participation in transactional virtual communities." Decision Support Systems **53**(1): 12-22.
Sun, Y., Y. Fang and K. H. Lim (2014). "Understanding knowledge contributors' satisfaction in transactional virtual communities: A cost–benefit trade-off perspective." Information & Management **51**(4): 441-450.
Syed-Ikhsan, S. O. S. and F. Rowland (2004). "Knowledge management in a public organization: a study on the relationship between organizational elements and the performance of knowledge transfer." Journal of knowledge management **8**(2): 95-111.
Szulanski, G. (1996). "Exploring internal stickiness: Impediments to the transfer of best practice within the firm." Strategic Management Journal **17**(Special): 27-43.
Tenenhaus, M., V. E. Vinzi, Y.-M. Chatelin and C. Lauro (2005). "PLS path modeling." Computational statistics & data analysis **48**(1): 159-205.
Tohidinia, Z. and M. Mosakhani (2010). "Knowledge sharing behaviour and its predictors." Industrial Management & Data Systems **110**(4): 611-631.
Torchia, A., P. Blenkinsop, D. Milliken and D. Zhdannikov (2016). Iranian banks reconnected to SWIFT network after four-year hiatus. K. Weir and D. Holmes, Reuters.
Treem, J. W. and P. M. Leonardi (2012). Social Media Use in Organizations: Exploring the Affordances of Visibility, Editability, Persistence, and Association. Communication Yearbook. **36:** 143-189.
Tseng, F.-C. and F.-Y. Kuo (2014). "A study of social participation and knowledge sharing in the teachers' online professional community of practice." Computers & Education **72**: 37-47.
UN, S. C. (2006). Security Council demands Iran suspend uranium enrichment by 31 august, or face possible economic, diplomatic sanctions, UN.
Vaast, E. (2004). "O brother, where are thou? From communities to networks of practice through intranet use." Management Communication Quarterly **18**(1): 5-44.
Vallerand, R. J. (2000). "Deci and Ryan's self-determination theory: A view from the hierarchical model of intrinsic and extrinsic motivation." Psychological Inquiry: 312-318.
Valmohammadi, C. (2010). "Identification and prioritization of critical success factors of knowledge management in Iranian SMEs: An experts' view." African Journal of Business Management **4**(6): 915.
van Aken, J. E. (2004). "Management research based on the paradigm of the design sciences: the quest for field-tested and grounded technological rules." Journal of management studies **41**(2): 219-246.
van Baalen, P., J. Bloemhof-Ruwaard and E. van Heck (2005). "Knowledge Sharing in an Emerging Network of Practice:: The Role of a Knowledge Portal." European Management Journal **23**(3): 300-314.
Van den Hooff, B. and F. de Leeuw van Weenen (2004). "Committed to share: commitment and CMC use as antecedents of knowledge sharing." Knowledge and Process Management **11**(1): 13-24.
van den Hooff, B. and M. Huysman (2009). "Managing knowledge sharing: Emergent and engineering approaches." Information & Management **46**(1): 1-8.
Von Krogh, G. (2012). "How does social software change knowledge management? Toward a strategic research agenda." The Journal of Strategic Information Systems **21**(2): 154-164.

Vuori, V. and J. Okkonen (2012). "Knowledge sharing motivational factors of using an intra-organizational social media platform." Journal of Knowledge Management **16**(4): 592-603.
Wang, S. and R. A. Noe (2010). "Knowledge sharing: A review and directions for future research." Human Resource Management Review **20**(2): 115-131.
Wang, S., R. A. Noe and Z.-M. Wang (2014). "Motivating Knowledge Sharing in Knowledge Management Systems A Quasi–Field Experiment." Journal of Management **40**(4): 978-1009.
Wang, Z., P. N. Sharma and J. Cao (2016). "From knowledge sharing to firm performance: A predictive model comparison." Journal of Business Research **69**(10): 4650-4658.
Wang, Z., N. Wang and H. Liang (2014). "Knowledge sharing, intellectual capital and firm performance." Management decision **52**(2): 230-258.
Wasko, M. M. and S. Faraj (2000). ""It is what one does": why people participate and help others in electronic communities of practice." The Journal of Strategic Information Systems **9**(2–3): 155-173.
Wasko, M. M. and S. Faraj (2005). "Why should I share? Examining social capital and knowledge contribution in electronic networks of practice." MIS Quarterly **29**(1): 35-57.
Wasko, M. M., R. Teigland and S. Faraj (2009). "The provision of online public goods: Examining social structure in an electronic network of practice." Decision support systems **47**(3): 254-265.
Wenger, E. (1998). Communities of practice: Learning, meaning, and identity, Cambridge university press.
Wiertz, C. and K. de Ruyter (2007). "Beyond the call of duty: why customers contribute to firm-hosted commercial online communities." Organization studies **28**(3): 347-376.
Witherspoon, C. L., J. Bergner, C. Cockrell and D. N. Stone (2013). "Antecedents of organizational knowledge sharing: a meta-analysis and critique." Journal of Knowledge Management **17**(2): 250-277.
Wong, K. Y. (2005). "Critical success factors for implementing knowledge management in small and medium enterprises." Industrial Management & Data Systems **105**(3): 261-279.
Wong, K. Y. and E. Aspinwall (2005). "An empirical study of the important factors for knowledge-management adoption in the SME sector." Journal of Knowledge Management **9**(3): 64-82.
World-Bank, T. (2015). Iran in the World Today.
Wu, W.-L., C.-H. Lin, B.-F. Hsu and R.-S. Yeh (2009). "Interpersonal trust and knowledge sharing: Moderating effects of individual altruism and a social interaction environment." Social Behavior and Personality: an international journal **37**(1): 83-93.
Wu, W.-W. and Y.-T. Lee (2007). "Selecting knowledge management strategies by using the analytic network process." Expert Systems with Applications **32**(3): 841-847.
Wu, Y. and W. Zhu (2012). "An integrated theoretical model for determinants of knowledge sharing behaviours." Kybernetes **41**(10): 1462-1482.
Yan, Z., T. Wang, Y. Chen and H. Zhang (2016). "Knowledge sharing in online health communities: A social exchange theory perspective." Information & Management **53**(5): 643-653.
Yang, J.-T. (2007). "Knowledge sharing: Investigating appropriate leadership roles and collaborative culture." Tourism Management **28**(2): 530-543.
Yeh, Y.-J., S.-Q. Lai and C.-T. Ho (2006). "Knowledge management enablers: a case study." Industrial Management & Data Systems **106**(6): 793 - 810.
Yin, R. K. (2013). Case study research: Design and methods, Sage publications.
Yu, C.-P. and T.-H. Chu (2007). "Exploring knowledge contribution from an OCB perspective." Information & Management **44**(3): 321-331.

Yue Wah, C., T. Menkhoff, B. Loh and H.-D. Evers (2007). "Social capital and knowledge sharing in knowledge-based organizations: an empirical study." International Journal of Knowledge Management (IJKM) **3**(1): 29-48.
Zack, M. H. (1999). "Developing a knowledge strategy." California Management Review **41**(3): 125-145.
Zack, M. H. (1999). "Managing Codified Knowledge." Sloan Management Review **40**(4): 45-58.
Zhang, X., P. O. De Pablos and Q. Xu (2014). "Culture effects on the knowledge sharing in multi-national virtual classes: A mixed method." Computers in Human Behavior **31**: 491-498.
Zhang, X., P. O. De Pablos and Z. Zhou (2013). "Effect of knowledge sharing visibility on incentive-based relationship in Electronic Knowledge Management Systems: An empirical investigation." Computers in Human Behavior **29**(2): 307-313.
Zhang, Y., Y. Fang, K.-K. Wei and H. Chen (2010). "Exploring the role of psychological safety in promoting the intention to continue sharing knowledge in virtual communities." International Journal of Information Management **30**(5): 425-436.
Zhang, Z. and S. M. Jasimuddin (2012). "Knowledge market in organizations: incentive alignment and IT support." Industrial Management & Data Systems **112**(7): 1101-1122.
Zheng, W., B. Yang and G. N. McLean (2010). "Linking organizational culture, structure, strategy, and organizational effectiveness: Mediating role of knowledge management." Journal of Business Research **63**(7): 763-771.
Zhou, Z. and Z. Chen (2011). "Formation mechanism of knowledge rigidity in firms." Journal of Knowledge Management **15**(5): 820-835.
Zohoori, M., S. Mohseni, B. Samadi and O. Attarnezhad (2013). "The relationship between knowledge sharing and innovation in electronic industry of Iran." Journal of Small Business and Entrepreneurship Development **1**(1): 26-33.

Summary

Knowledge sharing is an organisational process that is essential to create and maintain sustained competitive advantage by organisations to react quickly to changing external circumstances. Participation of employees is a major challenge to facilitate knowledge sharing within organisations. Knowledge exchange channels have been developed in knowledge management (KM) systems to support the emergent social nature of knowledge sharing. Establishing communication channels between participants does not assure that knowledge sharing will actually take place within or between organisations. Knowledge sharing performance depends on how participants use the technologies provided.

A critical challenge of fostering participation for knowledge contribution is individual engagement, which relates to the participants' propensity to share knowledge with others. This thesis focuses on the Iranian business context, a resource-constrained economy. Organisations operating in resource-constrained environment are confronted with high transaction costs, and therefore a different, more flexible internal organisation is required as compared with other organisations in resource efficient economies. For instance, information and communication technologies (ICT) provide a great opportunity for Iranian companies to use KM systems, but they have not used these systems in an efficient way. KM can play a significant role in accelerating the economy to overcome the consequences of the period of restricted resources. Specifically sharing of tacit and experiential knowledge among employees is expected to improve the situation. While organisational knowledge sharing is identified as one of the critical factors in dominating resource-constrained problems in Iran, there is a lack of research to explore its role in the Iranian company performance. The motivation of this thesis is to design individual engagement for knowledge sharing in the Iranian business context. The main research question is as follow: **Can engagement for knowledge sharing within organisations in the Iranian business environment be fostered?**

To address the main research question, this thesis explores knowledge management in different high-tech companies in Iran to design an integrated framework of individual engagement using a design science research approach. This research integrates theoretical and empirical research method to this purpose. First, the theoretical foundation is formed by a literature review of relevant and related studies. Second, a qualitative survey is employed to identify influential factors to be included in the integrated conceptual framework. Two different case studies empirically examine the effect of influential factors on individual engagement. Third, the result of

theoretical and practical insights of individual engagement in knowledge sharing have been collected, analysed, integrated and synthesised to develop an integrated conceptual framework of individual engagement in knowledge sharing at three levels. The developed integrated framework is validated by a field-experiment in the last part of the research. All research outcomes in each part of this thesis are compared with the existing KM literature in non-constrained economies. Different parts of this study are explained below.

This thesis explores different critical success factor (CSF) by ranking them an Iranian business context. The results of an analytic hierarchy process (AHP) analysis show that soft factors such as participants' collaboration and participation in knowledge sharing have scored higher than hard factors such as technological infrastructure. Further, a qualitative case study shows employees' participation in knowledge exchange strongly depends on participants' engagement in knowledge sharing activities within organisations.

In order to understand the importance of individual engagement in KM systems, Social Exchange Theory is employed to identify critical factors that influence participants' engagement in knowledge exchange. Several perceived benefits and costs of participation are identified. The perceived benefits are: altruism, reciprocity, professional recognition, knowledge self-efficacy and material rewards. Two main perceived costs of participation in knowledge sharing (time and effort needed) have been identified. Further, the results show that the level of knowledge sharing visibility influences participants' perceived benefits.

A research framework has been used to investigate the impact of both perceived benefits and perceived costs on knowledge sharing in the Iranian business context. The outcome of the SEM-PLS statistical analysis demonstrates that reputation, reciprocity and altruism are significant perceived benefits for the quantity of individual engagement performance, while reciprocity, altruism, trust and knowledge self-efficacy influence the quality aspect. Both effort and time as two aspects of individual costs have significant negative impacts on both the quantity and quality of participation in knowledge sharing.

The role of individual engagement is elaborated in a case study by exploring relationships between participants' perceived benefits with knowledge contribution quality and quantity for three distinct levels of knowledge sharing visibility (private, group and public levels). Results show that intrinsic benefits of knowledge sharing are more influential than extrinsic benefits to explain individual knowledge contribution for private knowledge sharing, while extrinsic rewards play an import role for the public-level. In addition, the results indicate that knowledge

contribution quality and quantity of knowledge contribution in the group-level knowledge sharing are significantly higher than the quality and quantity of shared knowledge at private and public levels.

This thesis explores different high-tech companies in Iran to design a framework of individual engagement in different levels of knowledge sharing. The research framework is developed for private, group and public levels of knowledge sharing among participants. The framework shows the level of the knowledge sharing visibility as a predictor of individual engagement influences the quality and quantity of knowledge contribution. Further, a field-experiment is designed to test a part of the proposed framework. Accordingly, this field-experiment compares the performance of the individual's participation in knowledge sharing at the private-level with the performance at the group-level, in which both groups work in a similar field. The results show that designing visible knowledge sharing for the group-level (in addition to the private level) influences the perceived benefits including reputation, reciprocity and altruism. Further, there is no evidence to show significant relationships between perceived costs (taking time or expending efforts for knowledge contributions) with increasing the visibility level.

This thesis provides several contributions to the design of participants' engagement for knowledge exchange within organisations in a resource-constrained economy. From the theoretical perspective, this thesis contributes to scientific understanding on individual perceived benefits, knowledge sharing visibility and participation in knowledge sharing in Iran, a resource-constrained economy. These factors influence participants from the interpersonal viewpoint. In addition, the thesis outcome extends understanding of knowledge sharing by exploring both quantity and quality of participation.

These contributions not only improve the understanding of participation in knowledge exchange but also contain insights for KM designers. Practitioners in the KM domain can leverage the thesis outcomes to improve participation in knowledge exchange in resource-constrained economies with a better understanding of the relations between perceived benefits and visibility level of knowledge sharing. This thesis shows that participant engagement is promoted by a combination of both intrinsic and extrinsic perceived benefits for the three different levels of knowledge sharing visibility explored in this thesis. These findings can guide designers to develop a comprehensive, integrated, all-inclusive and combined incentive plan for all visibility levels of knowledge exchange.

The thesis outcome shows that material (non-monetary) rewards have no relation with knowledge sharing either in the quality or quantity aspect for the three levels of knowledge sharing. This finding is at odds what could be expected from current literature. However, the resource-constrained context of the Iranian business environment during the period within which this research was conducted provides an explanation. This finding is in line with other studies that show that employees do not appreciate material rewards, as much as other perceived benefits in uncertain business environments characterized by high inflation rate or high unemployment rates.

Samenvatting

Het delen van kennis is een organisatorisch proces dat voor bedrijven essentieel is voor het creëren en het behouden van een duurzaam concurrentievoordeel om snel te kunnen inspelen op veranderende externe omstandigheden. Participatie van werknemers is hierbij een van de grootste uitdagingen. Kennismanagement-systemen hebben vaak aparte kanalen voor kennisuitwisseling om emergente sociale vormen van kennisdeling te ondersteunen. Echter, het alleen aanbieden van de kanalen voor kennisuitwisseling biedt geen garantie dat werknemers ook daadwerkelijk kennis gaan delen. De mate van kennisdeling is afhankelijk van hoe en in welke mate deelnemers gebruik maken van de aangeboden technologieën.

Een van de grootste uitdagingen bij kennisdelen is persoonlijke engagement, welke sterk gerelateerd is aan de bereidheid van deelnemers om kennis met anderen te delen. Dit proefschrift focust op kennisdeling binnen Iraanse bedrijfscontexten, in een "resource-constrained" economie. Organisaties die opereren in zulke economieën hebben te maken met hoge transactiekosten, die een meer flexibele, interne organisatie nodig hebben in vergelijking met organisaties die in "resource-efficient" economieën opereren. Hoewel, bijvoorbeeld, informatie- en communicatietechnologieën (ICT) ook voor Iraanse bedrijven mogelijkheden bieden om kennismanagement-systemen in te zetten, worden deze systemen echter niet op een efficiënte wijze ingezet. Kennismanagement kan een significante rol spelen in het versneld herstel van de economie, om de gevolgen van een periode van economische resource beperkingen te boven te komen. Het delen van impliciete kennis en van wordt gezien als oplossing om de problemen gerelateerd aan de resource beperkingen in Iran te overwinnen. Dit wordt dit niet gestaafd door onderzoek over het functioneren van Iraanse bedrijven. De focus van dit proefschrift is juist het ontwerp van persoonlijke engagement voor kennisdeling binnen een Iraanse bedrijfscontext. De hoofdvraag van dit onderzoek is: **Kan engagement voor kennisdeling binnen organisaties in een Iraanse bedrijfsmatige context worden bevorderd?**

Om deze vraag te beantwoorden, wordt in dit proefschrift onderzoek gedaan naar kennisdelen in een aantal high-tech bedrijven in Iran om een geïntegreerd conceptueel raamwerk voor persoonlijke engagement te ontwerpen op basis van een "design science" benadering. Hiertoe maakt dit onderzoek gebruik van zowel theoretische als empirische onderzoeksmethoden . Als eerste het theoretische, gebaseerd op literatuurstudie over relevant en gerelateerd onderzoek. Ten tweede worden de meest invloedrijke factoren die voor het geïntegreerde conceptuele raamwerk van belang zijn geïdentificeerd met behulp van een kwalitatieve enquête. Twee verschillende

casestudies geven inzicht in het effect van deze factoren op persoonlijke engagement vanuit de empirie. Ten derde, worden deze theoretische en empirische inzichten verzameld, geanalyseerd, geïntegreerd en gesynthetiseerd tot een geïntegreerd conceptueel raamwerk voor persoonlijke engagement voor kennisdeling op drie niveau's (private, group en public). Dit geïntegreerde conceptueel raamwerk wordt gevalideerd in het afsluitende deel van het onderzoek in een laatste casestudy. Binnen elk onderdeel van dit proefschrift worden de wetenschappelijk resultaten vergeleken met bestaande kennismanagement-literatuur over niet resource constrained economieën. De verschillende bijdragen van dit proefschrift worden hieronder verder toegelicht.

Dit proefschrift levert een aantal bijdragen aan inzichten over engagement van deelnemers voor kennisdeling binnen organisaties in resource-constrained economieën. Vanuit een theoretisch perspectief draagt dit proefschrift bij aan wetenschappelijk inzicht in door "individual perceived benefits (i.e. individuen ervaren voordelen), in visibility of knowledge exchange (i.e. "zichtbaarheid van kennisdeling) en in deelname in kennisdeling in Iran, een resource constrained economie. Deze factoren beïnvloeden deelnemers vanuit een interpersoonlijk standpunt. Verder biedt dit proefschrift een dieper begrip over kennisdeling, door het verkennen van participatie in kennisuitwisseling op zowel kwantitatieve als op kwalitatieve wijze.

Naast de verdieping in begrip van participatie in kennisuitwisseling, biedt dit proefschrift ook inzichten voor ontwerpers van kennismanagement-systemen. Beroepsbeoefenaars uit het kennismanagement-domein kunnen de resultaten uit dit proefschrift gebruiken om participatie in kennisuitwisseling te verbeteren binnen resource constrained economieën; met verbeterde mogelijkheden om relatie te duiden tussen perceived benefits en visibility of knowledge exchange. De resultaten van dit proefschrift tonen aan dat engagement van deelnemers wordt bevorderd door een combinatie van zowel intrinsiek als extrinsiek percieved benefits. Dit speelt een rol op drie verschillende niveaus van visibility of knowledge exchange, zoals binnen dit proefschrift wordt verkend. Deze bevindingen kunnen ontwerpers als leidraad gebruiken om brede, geïntegreerde, inclusieve en gecombineerde "incentive plan" te creëren voor elk niveau van zichtbaarheid van kennisdeling binnen een organisatie.

Verder tonen de resultaten van dit proefschrift aan dat materiele (niet-monetaire) beloningen geen relatie hebben met kennisdeling, noch in kwaliteit, noch in kwantiteit van kennis. Dit geldt voor elk van de drie niveaus van kennisdeling. Deze bevinding lijkt in contrast te staan met wat er in de huidige kennismanagement-literatuur naar voren komt. Echter, de resource constrained context van het Iraanse bedrijfsleven, die zich voordeed in de periode waarin dit onderzoek werd

uitgevoerd, biedt hiervoor een verklaring. Deze bevinding komt namelijk overeen met bevindingen van andere studies die aantonen dat werknemers, materiële beloningen minder belangrijk vinden dan andere perceived benefits in situaties gekenmerkt door onzekerheid met een hoge inflatie en/of een hoge werkeloosheid.

Appendices

Appendix A: AHP-Questionnaire (Chapter 3)

We would like to invite you to participate in a research study, to collect data for designing and identifying priority of critical success factor in implementing knowledge management in the energy industry. Before you begin, take a few minutes to read what will be done with the information you provide. Your individual privacy and confidentiality of the information you provide will be maintained in all published and written data analysis resulting from the study. The study is strictly anonymous and will be saved in the TUDelft repository. If you have any questions, please ask by email: m.sedighi@tudelft.nl. Thank you for your time.

The questionnaire follows the analytic hierarchy process (AHP). The AHP is a powerful decision-making procedure to create priorities among different factors. AHP is a method that uses a hierarchic structure to present a multifaceted assessment problem by decomposing it into several small problems. AHP has been widely used to create the importance, or weights, of the factors related to priorities. In order to study the priority of CSF with implementing a knowledge management project, the conceptual classification model identifies eight categories. The calculation of the importance degree associated to the CSF can be determined by decomposing it into sub-factor within a hierarchy structure. The top level of the entire hierarchy represents the goal of the problem and the intermediate levels represent the factor categorises of factors and the last level represents sub factors to be considered to achieve the goal.

CSF:

The knowledge management literature has identified a broad range of factors that can influence KM implementation. Although, several KM critical success factors have been suggested by researchers, no systematic researches exist for classifying a collective set of CSFs for executing KM in the firms and relationship between CSFs.

Factors' descriptions are adopted regarding relevant studies. The below table represents relevant KM studies, which are used to define CSFs.

Aspects	Categories	Factors	Sources
External (Environmental) Factors	**Macro factors**	Legal factor	(Holsapple and Joshi 2000)
		Economic factor	(Holsapple and Joshi 2000)
		Policy factor	(Holsapple and Joshi 2000)
		Social relations	(Holsapple and Joshi 2000)
		Educational system	(Holsapple and Joshi 2000)
		Technological factor	(Moffett, McAdam et al. 2003)

		Globalization process	(Moffett, McAdam et al. 2003)
	Meso factors	Supply chain	(Moffett, McAdam et al. 2003)
		Commercial competitors	(Chong 2006); (Choi 2000); (Chong and Choi 2005)
Internal (Organizational) Factors	**Corporate Culture**	Knowledge sharing	(Ajmal, Helo et al. 2010); (Yeh, Lai et al. 2006); (Bose 2004); (Lindner and Wald 2011); (Zheng, Yang et al. 2010); (Wong and Aspinwall 2005); (Akhavan, Jafari et al. 2006); (Chong and Choi 2005, Akhavan and Jafari 2006); (Khalid 2006); (Chong 2006); (Plessis 2007);
		Collaboration culture	(Lee and Choi 2003) ;(Gold, Malhotra et al. 2001); (Akhavan, Jafari et al. 2006); (Alavi, Kayworth et al. 2006);(Alavi, Kayworth et al. 2006); (López, Peón et al. 2004); (Yang 2007); (Akhavan and Pezeshkan 2014); (Jennex and Olfman 2005)
		Pro-social culture	(Cyr and Choo 2010); (Wasko and Faraj 2000); (Yue Wah, Menkhoff et al. 2007); (Chong 2006)
	Structures & Procedures	Organizational structural	(Chua and Lam 2005); (Moffett, McAdam et al. 2003); (Zheng, Yang et al. 2010); (Akhavan, Jafari et al. 2006); (Jafari, Fathian et al. 2007); (Plessis 2007); (Chang, Hung et al. 2009); (Ajmal, Helo et al. 2010); (Wong and Aspinwall 2005); (Al-Alawi, Al-Marzooqi et al. 2007); (Santos, Wane et al.)
		Incentive system	(Ajmal, Helo et al. 2010); (Wong 2005); (Davenport, Long et al. 1998); (Leonard-Barton 1995); (Szulanski 1996); (Wong and Aspinwall 2005); (Plessis 2007); (Kulkarni, Ravindran et al. 2006); (Akhavan and Pezeshkan 2014);(Al-Alawi, Al-Marzooqi et al. 2007); (Jennex and Olfman 2005)
		Channels for knowledge transfer	(Davenport, Long et al. 1998); (Plessis 2007); (Jennex and Olfman 2006)
		Organization Size	(Connelly and Kelloway 2003); (Bennett and Gabriel 1999)
		Network/Community of practice	(Skyrme and Amidon 1997)
	Human & Financial Resources	Human resource management	(Lee and Choi 2003); (Yeh, Lai et al. 2006); (Holsapple and Joshi 2000); (Bose 2004); (Wong 2005); (Wong and Aspinwall 2005); (Akhavan and Jafari 2006); (Chang, Hung et al. 2009); (Moffett, McAdam et al. 2003); (Kulkarni, Ravindran et al. 2006); (Khalid 2006)
		Employee training	(Chua and Lam 2005); (Hung, Huang et al. 2005); (Wong 2005); (Moffett, McAdam et al. 2003); (Leonard-Barton 1995); (Pang-Lo 2011); (Chong 2006); (Akhavan, Jafari et al. 2006, Jafari, Fathian et al. 2007); (Plessis 2007); (Khalid 2006); (Wong and Aspinwall 2005); (Chong 2006); (Akhavan and Pezeshkan 2014); (Jennex and Olfman 2005)
		Teamwork skill	(Hung, Huang et al. 2005); (Chong 2006); (Choi 2000); (Chong and Choi 2005); (Chong 2006)
		Empowerment program	(Moffett, McAdam et al. 2003); (Chong 2006); (Choi 2000); (Chong and Choi 2005); (Chong 2006)
		Financial investment	(Wong 2005); (Akhavan and Jafari 2006)
	Technology & Infrastructure	Communication system	(Moffett, McAdam et al. 2003); (Plessis 2007); (Lee and Choi 2003); (Yeh, Lai et al. 2006); (Pang-Lo 2011); (Chong 2006); (Plessis 2007); (Chong and Choi 2005); (Chang, Hung et al. 2009); (Khalid 2006); (Chong 2006); (Al-Alawi, Al-Marzooqi et al. 2007); (Santos, Wane et al.); (Jennex and Olfman 2006)
		System usability	(Chua and Lam 2005); (Moffett, McAdam et al. 2003)
		Access to communication technology	(Liebowitz 1999); (Lindner and Wald 2011)
		Information security system	(Plessis 2007); (Jennex and Olfman 2005); (Jennex and Olfman 2006)
		Search engine	(Plessis 2007); (Sher and Lee 2004); (Wong 2005); (Cepeda and Vera 2007); (Kulkarni, Ravindran et al. 2007); (Syed-Ikhsan and Rowland 2004); (Jennex and Olfman 2005); (Chang, Hung et al. 2009); (Jennex and Olfman 2006)
		Intellectual property	(Bose 2004); (Hanel 2006)
	Strategy & Leadership	KM Strategy	(Hung, Huang et al. 2005); (Yeh, Lai et al. 2006); (Wong 2005); (Moffett, McAdam et al. 2003); (Lindner and Wald 2011); (Zheng, Yang et al. 2010); (Chong 2006); (Akhavan, Jafari et al. 2006); (Akhavan and Jafari 2006); (Plessis 2007); (Kulkarni, Ravindran et al. 2006); (Khalid 2006); (Jennex and Olfman 2005); (Jennex and Olfman 2006)
		Top management commitment	(Chua and Lam 2005); (Hung, Huang et al. 2005); (Pang-Lo 2011);

			(Chong 2006); (Akhavan, Jafari et al. 2006); (Jafari, Fathian et al. 2007); (Plessis 2007); (Chong 2006); (Lindner and Wald 2011); (Akhavan and Pezeshkan 2014); (Jennex and Olfman 2005)
		Change management	(Moffett, McAdam et al. 2003); (Akhavan and Jafari 2006); (Plessis 2007)
	KM processes	KM Measurement tool	(Chua and Lam 2005); (Wong 2005); (Wong and Aspinwall 2005); (Chong 2006); (Plessis 2007); (Chong and Choi 2005); (Chang, Hung et al. 2009); (Khalid 2006); (Chong 2006); (Akhavan and Pezeshkan 2014); (Jennex and Olfman 2005)
		KM processes	(Wong 2005); (Alazmi and Zairi 2003); (Lindner and Wald 2011); (Plessis 2007); (Chang, Hung et al. 2009); (Khalid 2006); (Akhavan and Pezeshkan 2014); (Jennex and Olfman 2006)

Corporate Culture: all values and basic assumptions that influence KM members' participation in all KM processes. This factor includes three different cluster sub-factors:

- **Sharing knowledge:** A set of values, which promotes people share their valuable experience and knowledge within an organization.
- **Collaboration culture:** A set of values, which promotes individuals to come together interacts, discusses and communicates for solving problems within an organization.
- **Pro-social culture:** A set of values, which promotes employees to behave pro-socially and contributing to the voluntary task (knowledge sharing) without apparent compensation.

Structures & Procedures: Organizational structures and procedures consist of activities and procedures such as task allocation, coordination, standards and supervision, which are directed towards the achievement of KM objectives. This factor includes five different cluster sub-factors:

- **Organizational structure:** An organizational structure defines how activities such as task allocation, coordination and supervision are directed towards the achievement of organizational aims.
- **Incentive system:** An incentive system represents a comprehensive mechanism (both monetary and non-monetary rewards) that stimulates individuals to participate in KM activities.
- **Channels for knowledge transfer:** All technological tools and informal channels, which make connections between domain experts with KM systems.
- **Organization Size:** A number of organizational employees.
- **Network/Community of practice:** A CoP is defined as an informal group that share a common work/practice/experience.

Human & Financial Resources:

- **Human resource management:** HRM is an organizational function designed to maximize employees' performance. This factor concerns the procedure of recruitment, empowerment and development. (The training factor will be evaluated by the next factor)

- **Employee training:** A training program is a process of teaching the KM concept and KM skills within organizations to support individuals' participation in KM activities. Moreover, this program refers to a process that creates a common language about knowledge and KM.
- **Teamwork skill:** Teamwork is an action performed by a team towards a common goal in the KM system.
- **Empowerment program:** An employee empowerment program represents a set of plans that helps employees to make decisions and take responsibility for their work results.
- **Financial investment:** Financial investment represents monetary resources consumed for KM activities within organizations. It can be used for developing technological infrastructures or training programs.

Technology & Infrastructure: This factor represents all information technologies and communication systems for the purpose of KM. This factor includes six different cluster sub-factors:

- **Communication system:** A part of information technology infrastructure that connect participants with each other through KM systems.
- **System usability:** Usability is an attribute of the KM system quality, which is provided by a set of techniques during the design of KM technology.
- **Access to communication technology:** Access to relevant communication technology to support KM activities.
- **Information security system:** A security system is information protection applied to technology to protect knowledge assets from unauthorized access, use, disclosure, disruption, modification, perusal, inspection, recording or destruction.
- **Search engine:** A search engine is a set of computer programs that search for knowledge in KM systems.
- **Intellectual property:** Intellectual property rights grant certain exclusive rights to a variety of intangible assets, such as discoveries and inventions in a KM system.

Strategy & Leadership: All strategic and leadership procedures which support KM. This factor includes three different cluster sub-factors:

- **KM Strategy:** Strategic planning in KM includes defining objectives and goals clearly and trying to make the connection between the KM strategy and the business strategy of the firm.
- **Top management commitment:** supporting and committing to implement KM by the top manager as a person or group of people who directs and controls your organization at the highest level.
- **Change management:** Change management is an approach to transitioning employees, teams, and organizations to a desired future state in the KM domain.

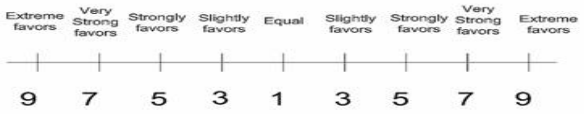
KM processes: A KM process introduces something that can be done with knowledge in the firm. This factor includes two different cluster sub-factors:

- **KM Measurement tool:** Measurement mechanisms identify the gap between the performance of KM and KM objectives.
- **KM processes:** A KM process introduces something that can be done with knowledge in the firm like creating, sharing and using knowledge.

Macro Factors: The macro environment imposes opportunities and threats for implementing KM in organizations. These include legal, economic, political, technological, social, educational, and globalization factors, which affect the internal organizational factors of KM system.

Meso Factors: The Meso environment refers to the market segment and industry in which the firm operates and competes. The meso factors include, among others, supply chain, strategic partnerships and competitors in the same industry.

Please fill the below from by comparing two factors with each other by using the below diagram (compare it that the share and importance of these factors on the making successful KM in your organization).



M.Sedighi

PhD candidate at TUDelft

Comparing CSFs										
Corporate culture										
Sharing knowledge	9	7	5	3	1	3	5	7	9	Coordination culture
Pro-social culture	9	7	5	3	1	3	5	7	9	Coordination culture
Pro-social culture	9	7	5	3	1	3	5	7	9	Sharing knowledge
Structure & Procedures										
Structural complexity	9	7	5	3	1	3	5	7	9	Incentive system
Structural complexity	9	7	5	3	1	3	5	7	9	Channels for knowledge transfer
Structural complexity	9	7	5	3	1	3	5	7	9	Organization Size
Structural complexity	9	7	5	3	1	3	5	7	9	Network/Community of practice
Incentive system	9	7	5	3	1	3	5	7	9	Channels for knowledge transfer
Incentive system	9	7	5	3	1	3	5	7	9	Organization Size
Incentive system	9	7	5	3	1	3	5	7	9	Network/Community of practice
Channels for knowledge transfer	9	7	5	3	1	3	5	7	9	Organization Size
Channels for knowledge transfer	9	7	5	3	1	3	5	7	9	Network/Community of practice
Organization Size	9	7	5	3	1	3	5	7	9	Network/Community of practice
Human & Financial Resources										
Human resource management	9	7	5	3	1	3	5	7	9	Employee training
Human resource management	9	7	5	3	1	3	5	7	9	Teamwork skill
Human resource management	9	7	5	3	1	3	5	7	9	Empowerment program
Human resource management	9	7	5	3	1	3	5	7	9	Financial investment
Employee training	9	7	5	3	1	3	5	7	9	Teamwork skill
Employee training	9	7	5	3	1	3	5	7	9	Empowerment program
Employee training	9	7	5	3	1	3	5	7	9	Financial investment
Teamwork skill	9	7	5	3	1	3	5	7	9	Empowerment program
Teamwork skill	9	7	5	3	1	3	5	7	9	Financial investment
Empowerment program	9	7	5	3	1	3	5	7	9	Financial investment

					Technology & Infrastructure					
Communication system	9	7	5	3	1	3	5	7	9	System usability
Communication system	9	7	5	3	1	3	5	7	9	Access to communication technology
Communication system	9	7	5	3	1	3	5	7	9	Information Security system
Communication system	9	7	5	3	1	3	5	7	9	Search engine
Communication system	9	7	5	3	1	3	5	7	9	Intellectual property
System usability	9	7	5	3	1	3	5	7	9	Access to communication technology
System usability	9	7	5	3	1	3	5	7	9	Information Security system
System usability	9	7	5	3	1	3	5	7	9	Search engine
System usability	9	7	5	3	1	3	5	7	9	Intellectual property
Access to communication technology	9	7	5	3	1	3	5	7	9	Information Security system
Access to communication technology	9	7	5	3	1	3	5	7	9	Search engine
Access to communication technology	9	7	5	3	1	3	5	7	9	Intellectual property
Information Security system	9	7	5	3	1	3	5	7	9	Search engine
Information Security system	9	7	5	3	1	3	5	7	9	Intellectual property
Search engine	9	7	5	3	1	3	5	7	9	Intellectual property
					Strategy & Leadership					
KM Strategy	9	7	5	3	1	3	5	7	9	Top management commitment
KM Strategy	9	7	5	3	1	3	5	7	9	Change management
Top management commitment	9	7	5	3	1	3	5	7	9	Change management
					KM processes					
KM Measurement tool	9	7	5	3	1	3	5	7	9	KM processes
					Macro factors					
Legal factor	9	7	5	3	1	3	5	7	9	Economic factor
Legal factor	9	7	5	3	1	3	5	7	9	Policy factor
Legal factor	9	7	5	3	1	3	5	7	9	Social relations
Legal factor	9	7	5	3	1	3	5	7	9	Educational system
Legal factor	9	7	5	3	1	3	5	7	9	Technological factor
Legal factor	9	7	5	3	1	3	5	7	9	Globalization process
Economic factor	9	7	5	3	1	3	5	7	9	Policy factor
Economic factor	9	7	5	3	1	3	5	7	9	Social relations
Economic factor	9	7	5	3	1	3	5	7	9	Educational system
Economic factor	9	7	5	3	1	3	5	7	9	Technological factor
Economic factor	9	7	5	3	1	3	5	7	9	Globalization process
Policy factor	9	7	5	3	1	3	5	7	9	Social relations
Policy factor	9	7	5	3	1	3	5	7	9	Educational system
Policy factor	9	7	5	3	1	3	5	7	9	Technological factor
Policy factor	9	7	5	3	1	3	5	7	9	Globalization process
Social relations	9	7	5	3	1	3	5	7	9	Educational system
Social relations	9	7	5	3	1	3	5	7	9	Technological factor
Social relations	9	7	5	3	1	3	5	7	9	Globalization process
Educational system	9	7	5	3	1	3	5	7	9	Technological factor
Educational system	9	7	5	3	1	3	5	7	9	Globalization process
Technological factor	9	7	5	3	1	3	5	7	9	Globalization process
					Meso factors					
Supply chain	9	7	5	3	1	3	5	7	9	Commercial competitors
					Categories					
Corporate Culture	9	7	5	3	1	3	5	7	9	
Corporate Culture	9	7	5	3	1	3	5	7	9	Human & Financial Resources
Corporate Culture	9	7	5	3	1	3	5	7	9	Technology & Infrastructure
Corporate Culture	9	7	5	3	1	3	5	7	9	Strategy & Leadership
Corporate Culture	9	7	5	3	1	3	5	7	9	KM processes
Corporate Culture	9	7	5	3	1	3	5	7	9	Macro factors
Corporate Culture	9	7	5	3	1	3	5	7	9	Meso factors
Structures & Procedures	9	7	5	3	1	3	5	7	9	Human & Financial Resources
Structures & Procedures	9	7	5	3	1	3	5	7	9	Technology & Infrastructure
Structures & Procedures	9	7	5	3	1	3	5	7	9	Strategy & Leadership
Structures & Procedures	9	7	5	3	1	3	5	7	9	KM processes
Structures & Procedures	9	7	5	3	1	3	5	7	9	Macro factors
Structures & Procedures	9	7	5	3	1	3	5	7	9	Meso factors
Human & Financial Resources	9	7	5	3	1	3	5	7	9	Technology & Infrastructure
Human & Financial Resources	9	7	5	3	1	3	5	7	9	Strategy & Leadership
Human & Financial Resources	9	7	5	3	1	3	5	7	9	KM processes
Human & Financial Resources	9	7	5	3	1	3	5	7	9	Macro factors
Human & Financial Resources	9	7	5	3	1	3	5	7	9	Meso factors
Technology & Infrastructure	9	7	5	3	1	3	5	7	9	Strategy & Leadership
Technology & Infrastructure	9	7	5	3	1	3	5	7	9	KM processes
Technology & Infrastructure	9	7	5	3	1	3	5	7	9	Macro factors
Technology & Infrastructure	9	7	5	3	1	3	5	7	9	Meso factors
Strategy & Leadership	9	7	5	3	1	3	5	7	9	KM processes
Strategy & Leadership	9	7	5	3	1	3	5	7	9	Macro factors
Strategy & Leadership	9	7	5	3	1	3	5	7	9	Meso factors
KM processes	9	7	5	3	1	3	5	7	9	Macro factors
KM processes	9	7	5	3	1	3	5	7	9	Meso factors
Macro factors	9	7	5	3	1	3	5	7	9	Macro factors

Appendix B: Semi-Structured Interview Protocol (Chapter 4)

Introduction:

- Stating appreciation for taking time to participate
- Introducing the interviewer as a PhD candidate at TUDelft.
- Introducing the goal of the semi structured interviews
- Introducing the confidentiality agreement between the company and TUDelft.
- Asking from the participants for permission of recording

Part 1- Demographic data:

- How old are you?
- How long have you been in your present position?
- How long have you been at this company?
- What is your highest educational degree?
- What is your domain of your study (background)?

Part 2-percived benefits of participation in knowledge exchange

- What types of individual incentives or perceived benefits do you experience when participating for knowledge sharing in the ENoPs?".
- What types of individual incentives or perceived benefits do you experience when participating for knowledge seeking in the ENoPs?".

Part 3-percived costs of participation in knowledge exchange

- What kinds of individual perceived costs do you receive when participating for knowledge sharing in the ENoPs?
- What kinds of individual perceived costs do you receive when participating for knowledge seeking in the ENoPs?

Appendix C: Questionnaire (Chapter 5)

This questionnaire is a part of a research project with Delft University of Technology that you are asked to complete. This questionnaire aims to understand the drivers and barriers behind your decision to participate in knowledge sharing within your organization. Thus this questionnaire asks you about perceived benefits and perceived costs of knowledge sharing in your organization. The results also are used to design a new knowledge management system in your Company. The questionnaire consists of three parts: private, group and public levels of knowledge sharing.

Your answers will not be released to anyone and will remain anonymous. Your name will not be written on the questionnaire or be linked to answer in our records. The responses provided by you for this study will be treated confidentially. Your participation is voluntary and you may withdraw from this questionnaire any time you wish or skip questions you don't wish to answer. The research intends to abide by commonly acknowledged ethical codes, as specified in the Code of Ethics TU Delft version 23/10/2012. You agree to participate in this research project by filling the following questionnaire. If you have any questions, please ask by email mentioned below. Thank you for your time.

m.sedighi@tudelft.nl

Personal information:

Age: ○18-25 ○26-35 ○36-45 ○46-55 ○>55

Work Experiences: ○<8 ○8-16 ○>17

Education:

○Less than high school diploma
○High school diploma or equivalent
○Bachelor degree or equivalent
○Master degree or equivalent
○PhD degree or equivalent

Gender:

○ Female
○ Male

Organizational position:

○ Manager ○Supervisor ○Expert ○Technician

The questionnaire is designed in three levels:

Private knowledge sharing: This part represents sharing knowledge between individual employees within organization. For instance, e-mail is a common sharing tool for the individual knowledge sharing.

Private level
How many times do you share knowledge in the individual layer?
□daily □several times a week □several times a month □ more than one per quarter □ less than once per quarter
I think knowledge I contributed help my colleagues to solve their problems in the individual layer?
□always □often □sometimes □rarely □never
I share my knowledge with another employee, because she/he will share knowledge if I need it.
□always □often □sometimes □rarely □never
I share my knowledge with another employee, because I enjoy helping another employee by sharing knowledge.
□always □often □sometimes □rarely □never
I share my knowledge with another employee, because I have confidence about my ability and experience to share knowledge.
□always □often □sometimes □rarely □never
I share my knowledge with another employee, because I enjoy sharing my knowledge.
□always □often □sometimes □rarely □never
I share my knowledge with another employee, because I can enhance my reputation in my professional field.
□always □often □sometimes □rarely □never
I share my knowledge with another employee, because I receive material rewards (Material rewards is non-monetary rewards, development career, job security)
□always □often □sometimes □rarely □never
If I want to share my knowledge with someone else, I am concerning about the enjoyment rather than material rewards
□ I do always for enjoyment □ I do often for enjoyment □ equally between enjoyment and material rewards □ I do often for material rewards □ I do always for material rewards
I share my knowledge with another employee, because I receive monetary rewards
□always □often □sometimes □rarely □never
I don't share my knowledge with another employee, because I should takes too much time for sharing knowledge (I have no enough time)
□always □often □sometimes □rarely □never
I don't share my knowledge with another employee, because I should takes too much effort for sharing knowledge
□always □often □sometimes □rarely □never
If I want to share my knowledge with someone else, I am concerning more about the feedbacks rather than reputation.
□ I do always for feedbacks □ I do often for feedbacks □ equally between feedbacks and material reputation □ I do often for material reputation □ I do always for material reputation
What are the other most important incentives for knowledge sharing at the individual level?

Group knowledge sharing: This part represents sharing knowledge within a group of employees. Community of practice and meetings are important sharing environments for group knowledge sharing.

Group level
How many times do you share knowledge in the group layer?
□daily □several times a week □several times a month □ more than one per quarter □ less than once per quarter
I think knowledge I contributed help my colleagues to solve their problems in the group / community?
□always □often □sometimes □rarely □never
I share my knowledge with a community, because they will share knowledge if I need it.
□always □often □sometimes □rarely □never
I share my knowledge within a group of employees, because they want to help them.
□always □often □sometimes □rarely □never
I share my knowledge within a group of employees, because I want to show that I have abilities to complete tasks and reach goals
□always □often □sometimes □rarely □never
I share my knowledge within a group of employees, because I enjoy sharing my knowledge.
□always □often □sometimes □rarely □never
I share my knowledge within a group of employees, because it can improve my reputation and recognition within the group.
□always □often □sometimes □rarely □never
I share my knowledge within a group of employees, because I receive material rewards (Material rewards like as money, travel package, and compensation system)
□always □often □sometimes □rarely □never
If I want to share my knowledge with a group, I am concerning more about the enjoyment rather than material rewards
□ I do always for enjoyment □ I do often for enjoyment □ equally between enjoyment and material rewards □ I do often for material rewards □ I do always for material rewards
I share my knowledge with a group, because I receive monetary rewards
□always □often □sometimes □rarely □never
I don't share my knowledge with a group, because I should takes too much time for sharing knowledge (I have no enough time)
□always □often □sometimes □rarely □never
I don't share my knowledge with a group, because I should takes too much effort for sharing knowledge
□always □often □sometimes □rarely □never
If I want to share my knowledge with someone else, I am concerning more about the feedbacks rather than reputation.
□ I do always for feedbacks □ I do often for feedbacks □ equally between feedbacks and material reputation □ I do often for material reputation □ I do always for material reputation
What are the other most important incentives for knowledge sharing in the group level?

Public knowledge sharing: This layer represents sharing knowledge in the whole of the organization. Public intranet is an important tool for organizational knowledge sharing. For instance intranet web-based knowledge management system is an organizational knowledge-sharing tool.

Public level
How many times do you share knowledge in the organization layer?
□daily □several times a week □several times a month □ more than one per quarter □ less than once per quarter
I think the quality of my shared knowledge helps my colleagues to solve their problems in organization?
□always □often □sometimes □rarely □never
I share my knowledge in the organization, because all employees will share knowledge with me in the near future or get feedback from organizational members.
□always □often □sometimes □rarely □never
I share my knowledge in the organization, because they want to help them.
□always □often □sometimes □rarely □never
I share my knowledge in the organization, because I want to show that I have abilities to complete tasks and reach goals
□always □often □sometimes □rarely □never
I share my knowledge in the organization, because I enjoy sharing my knowledge.
□always □often □sometimes □rarely □never
I share my knowledge in the organization, because it can improve my reputation and recognition in the organization.
□always □often □sometimes □rarely □never
I share my knowledge in the organization, because I receive material rewards (Material rewards like as money, travel package, and compensation system)
□always □often □sometimes □rarely □never
If I want to share my knowledge within the organization, I am concerning more about the enjoyment rather than material rewards
□ I do always for enjoyment □ I do often for enjoyment □ equally between enjoyment and material rewards □ I do often for material rewards □ I do always for material rewards
I don't share my knowledge in the organization because I have no enough time for sharing knowledge
I share my knowledge within my organization, because I receive monetary rewards
□always □often □sometimes □rarely □never
I don't share my knowledge within my organization, because I should takes too much time for sharing knowledge (I have no enough time)
□always □often □sometimes □rarely □never
I don't share my knowledge within my organization, because I should takes too much effort for sharing knowledge
□always □often □sometimes □rarely □never
□ I do always for feedbacks □ I do often for feedbacks □ equally between feedbacks and material reputation □ I do often for material reputation □ I do always for material reputation
What are the other most important incentives for knowledge sharing in the organizational level?

Appendix D: Questionnaire (Chapter 6)

This questionnaire is a part of a research project with Delft University of Technology that you are asked to complete. This questionnaire aims to understand the drivers behind your decision to participate in knowledge sharing in different levels of knowledge exchange visibility. Thus this questionnaire asks you about perceived benefits and perceived costs of knowledge sharing in your organization. The results also are used to design a new knowledge management system in your Company. The questionnaire consists of three parts: private, group and public levels.

Your answers will not be released to anyone and will remain anonymous. Your name will not be written on the questionnaire or be linked to answer in our records. The responses provided by you for this study will be treated confidentially. Your participation is voluntary and you may withdraw from this questionnaire any time you wish or skip questions you don't wish to answer. The research intends to abide by commonly acknowledged ethical codes, as specified in the Code of Ethics TU Delft version 23/10/2012. You agree to participate in this research project by filling the following questionnaire. If you have any questions, please ask by email mentioned below. Thank you for your time.

System engineering section,
Faculty of Technology, Policy and Management,
Delft University of Technology
m.sedighi@tudelft.nl

Personal information:

Age: ○18-25 ○26-35 ○36-45 ○46-55 ○>55

Work Experiences: ○<5 ○5-10 ○11-15 ○16-20 ○>20

Education:

○High school diploma or equivalent
○Bachelor degree or equivalent
○Master degree or equivalent
○PhD degree or equivalent

Gender:

○ Female
○ Male

Organizational position:

○ Manager ○Supervisor ○Expert ○Technician

Private knowledge sharing: This part represents sharing knowledge between individual employees within organization, which is invisible for third parties. For instance, instant messaging or e-mail are two main examples for the private-level knowledge sharing.

Private level
I share my knowledge in the private-level of the knowledge network to gain career promotions opportunities.
□always □often □sometimes □rarely □never
I share my knowledge in the private-level of the knowledge network to improve my job security.
□always □often □sometimes □rarely □never
I share my knowledge in the private-level of the knowledge network to get flexible work hours.
□always □often □sometimes □rarely □never
I share my knowledge in the private-level of the knowledge network to get sabbaticals.
□always □often □sometimes □rarely □never
I share my knowledge in the private-level of the knowledge network to increase my position in organization.
□always □often □sometimes □rarely □never
I share my knowledge in the private-level of the knowledge network to improve my reputation in the organizational professional field.
□always □often □sometimes □rarely □never
I share my knowledge in the private-level of the knowledge network to earn respect from employees.
□always □often □sometimes □rarely □never
I share my knowledge in the private-level of the knowledge network to receive knowledge in return in the future knowledge from the knowledge recipient.
□always □often □sometimes □rarely □never
I share my knowledge in the private-level of the knowledge network because I believe my question will be answered in the future.
□always □often □sometimes □rarely □never
I share my knowledge in the private-level of the knowledge network to receive helpful knowledge from the knowledge recipient.
□always □often □sometimes □rarely □never
I share my knowledge in the private-level of the knowledge network, because I like to assist participants.
□always □often □sometimes □rarely □never
I share my knowledge in the private-level of the knowledge network, because I feel happy to assist participants to solve their problems.
□always □often □sometimes □rarely □never
I share my knowledge in the private-level of the knowledge network, because I enjoy helping other participants by sharing knowledge.
□always □often □sometimes □rarely □never
I share my knowledge in the private-level of the knowledge network, because I am confident in my capability to create knowledge that participants consider helpful.
□always □often □sometimes □rarely □never
I share my knowledge in the private-level of the knowledge network, because I have the expertise necessitated to create valuable knowledge for participants
□always □often □sometimes □rarely □never
It does not really make any difference whether I share my knowledge with others in the private-level of the knowledge network.
□always □often □sometimes □rarely □never
Most other participants can create valuable knowledge than I can in the private-level of the knowledge network.
□always □often □sometimes □rarely □never
What are the other most important incentives for knowledge sharing at the private-level?

Group knowledge sharing: This part represents sharing knowledge within a group of employees. Community of Practice and Networks of Practice are two main examples for group knowledge sharing. As you know, eight electronic communities of practice are defined for knowledge sharing in your company.

Group level				
I share my knowledge in the group-level of the knowledge network to gain career promotions opportunities.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the group-level of the knowledge network to improve my job security.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the group-level of the knowledge network to get flexible work hours.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the group-level of the knowledge network to get sabbaticals.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the group-level of the knowledge network to increase my position in organization.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the group-level of the knowledge network to improve my reputation in the organizational professional field.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the group-level of the knowledge network to earn respect from employees.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the group-level of the knowledge network to receive knowledge in return in the future knowledge from the knowledge recipient.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the group-level of the knowledge network because I believe my question will be answered in the future.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the group-level of the knowledge network to receive helpful knowledge from the knowledge recipient.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the group-level of the knowledge network, because I like to assist participants.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the group-level of the knowledge network, because I feel happy to assist participants to solve their problems.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the group-level of the knowledge network, because I enjoy helping other participants by sharing knowledge.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the group-level of the knowledge network, because I am confident in my capability to create knowledge that participants consider helpful.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the group-level of the knowledge network, because I have the expertise necessitated to create valuable knowledge for participants				
□always	□often	□sometimes	□rarely	□never
It does not really make any difference whether I share my knowledge with others in the group-level of the knowledge network.				
□always	□often	□sometimes	□rarely	□never
Most other participants can create valuable knowledge than I can in the group-level of the knowledge network.				
□always	□often	□sometimes	□rarely	□never
What are the other most important incentives for knowledge sharing at the group-level?				

Public knowledge sharing: This level represents sharing knowledge in the whole of the organization. Organizational intranet is an example for sharing knowledge in the public-level. As you know your company uses intranet web-based knowledge management system.

Public level				
I share my knowledge in the public-level of the knowledge network to gain career promotions opportunities.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the public-level of the knowledge network to improve my job security.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the public-level of the knowledge network to get flexible work hours.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the public-level of the knowledge network to get sabbaticals.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the public-level of the knowledge network to increase my position in organization.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the public-level of the knowledge network to improve my reputation in the organizational professional field.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the public-level of the knowledge network to earn respect from employees.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the public-level of the knowledge network to receive knowledge in return in the future knowledge from the knowledge recipient.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the public-level of the knowledge network because I believe my question will be answered in the future.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the public-level of the knowledge network to receive helpful knowledge from the knowledge recipient.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the public-level of the knowledge network, because I like to assist participants.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the public-level of the knowledge network, because I feel happy to assist participants to solve their problems.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the public-level of the knowledge network, because I enjoy helping other participants by sharing knowledge.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the group-level of the knowledge network, because I am confident in my capability to create knowledge that participants consider helpful.				
□always	□often	□sometimes	□rarely	□never
I share my knowledge in the group-level of the knowledge network, because I have the expertise necessitated to create valuable knowledge for participants				
□always	□often	□sometimes	□rarely	□never
It does not really make any difference whether I share my knowledge with others in the public-level of the knowledge network.				
□always	□often	□sometimes	□rarely	□never
Most other participants can create valuable knowledge than I can in the public-level of the knowledge network.				
□always	□often	□sometimes	□rarely	□never
What are the other most important incentives for knowledge sharing at the public-level?				

Appendix E: Post-Experiment Interview Protocol (Chapter 8)

Introduction:

- Stating appreciation for taking time to participate
- Introducing the interviewer as a PhD candidate at TUDelft.
- Introducing the experiment procedure and experiment goal
- Introducing the goal of the post-experiment interview
- Introducing the disclosing policy until the end of the experiment
- Asking from the participants for permission of recording

Part 1- Demographic data:

- How old are you?
- How long have you been in your present position?
- How long have you been at this company?
- What is your highest educational degree?
- What is your domain of your study (background)?

Part 2- General questions

- What types of changes do you experience during the field-experiment?
- What types of individual incentives or perceived benefits do you experience during the field-experiment?
- What kinds of individual perceived costs do you receive during the field-experiment?

SIKS-Dissertation Series

2011
2011-01 Botond Cseke (RUN)
Variational Algorithms for Bayesian Inference in Latent Gaussian Models
2011-02 Nick Tinnemeier(UU)
Organizing Agent Organizations. Syntax and Operational Semantics of an Organization-Oriented Programming Language
2011-03 Jan Martijn van der Werf (TUE)
Compositional Design and Verification of Component-Based Information Systems
2011-04 Hado van Hasselt (UU)
Insights in Reinforcement Learning; Formal analysis and empirical evaluation of temporal-difference learning algorithms
2011-05 Base van der Raadt (VU)
Enterprise Architecture Coming of Age - Increasing the Performance of an Emerging Discipline.
2011-06 Yiwen Wang (TUE)
Semantically-Enhanced Recommendations in Cultural Heritage
2011-07 Yujia Cao (UT)
Multimodal Information Presentation for High Load Human Computer Interaction
2011-08 Nieske Vergunst (UU)
BDI-based Generation of Robust Task-Oriented Dialogues
2011-09 Tim de Jong (OU)
Contextualised Mobile Media for Learning
2011-10 Bart Bogaert (UvT)
Cloud Content Contention
2011-11 Dhaval Vyas (UT)
Designing for Awareness: An Experience-focused HCI Perspective
2011-12 Carmen Bratosin (TUE)
Grid Architecture for Distributed Process Mining
2011-13 Xiaoyu Mao (UvT)
Airport under Control. Multiagent Scheduling for Airport Ground Handling
2011-14 Milan Lovric (EUR)
Behavioral Finance and Agent-Based Artificial Markets
2011-15 Marijn Koolen (UvA)
The Meaning of Structure: the Value of Link Evidence for Information Retrieval
2011-16 Maarten Schadd (UM)
Selective Search in Games of Different Complexity
2011-17 Jiyin He (UVA)
Exploring Topic Structure: Coherence, Diversity and Relatedness
2011-18 Mark Ponsen (UM)
Strategic Decision-Making in complex games
2011-19 Ellen Rusman (OU)
The Mind ' s Eye on Personal Profiles
2011-20 Qing Gu (VU)
Guiding service-oriented software engineering - A view-based approach
2011-21 Linda Terlouw (TUD)
Modularization and Specification of Service-Oriented Systems
2011-22 Junte Zhang (UVA)
System Evaluation of Archival Description and Access
2011-23 Wouter Weerkamp (UVA)
Finding People and their Utterances in Social Media
2011-24 Herwin van Welbergen (UT)
Behavior Generation for Interpersonal Coordination with Virtual Humans On Specifying, Scheduling and Realizing Multimodal Virtual Human Behavior
2011-25 Syed Waqar ul Qounain Jaffry (VU))
Analysis and Validation of Models for Trust Dynamics
2011-26 Matthijs Aart Pontier (VU)
Virtual Agents for Human Communication - Emotion Regulation and Involvement-Distance Trade-Offs in Embodied Conversational Agents and Robots
2011-27 Aniel Bhulai (VU)
Dynamic website optimization through autonomous management of design patterns
2011-28 Rianne Kaptein(UVA)
Effective Focused Retrieval by Exploiting Query Context and Document Structure
2011-29 Faisal Kamiran (TUE)
Discrimination-aware Classification
2011-30 Egon van den Broek (UT)
Affective Signal Processing (ASP): Unraveling the mystery of emotions
2011-31 Ludo Waltman (EUR)
Computational and Game-Theoretic Approaches for Modeling Bounded Rationality
2011-32 Nees-Jan van Eck (EUR)
Methodological Advances in Bibliometric Mapping of Science
2011-33 Tom van der Weide (UU)
Arguing to Motivate Decisions
2011-34 Paolo Turrini (UU)
Strategic Reasoning in Interdependence: Logical and Game-theoretical Investigations
2011-35 Maaike Harbers (UU)
Explaining Agent Behavior in Virtual Training
2011-36 Erik van der Spek (UU)
Experiments in serious game design: a cognitive approach
2011-37 Adriana Burlutiu (RUN)
Machine Learning for Pairwise Data, Applications for Preference Learning and Supervised Network Inference
2011-38 Nyree Lemmens (UM)
Bee-inspired Distributed Optimization
2011-39 Joost Westra (UU)
Organizing Adaptation using Agents in Serious Games
2011-40 Viktor Clerc (VU)
Architectural Knowledge Management in Global Software Development
2011-41 Luan Ibraimi (UT)
Cryptographically Enforced Distributed Data Access Control
2011-42 Michal Sindlar (UU)
Explaining Behavior through Mental State Attribution
2011-43 Henk van der Schuur (UU)
Process Improvement through Software Operation Knowledge
2011-44 Boris Reuderink (UT)
Robust Brain-Computer Interfaces
2011-45 Herman Stehouwer (UvT)
Statistical Language Models for Alternative Sequence Selection
2011-46 Beibei Hu (TUD)
Towards Contextualized Information Delivery: A Rule-based Architecture for the Domain of Mobile Police Work
2011-47 Azizi Bin Ab Aziz(VU)
Exploring Computational Models for Intelligent Support of Persons with Depression
2011-48 Mark Ter Maat (UT)
Response Selection and Turn-taking for a Sensitive Artificial Listening Agent
2011-49 Andreea Niculescu (UT)
Conversational interfaces for task-oriented spoken dialogues: design aspects influencing interaction quality

2012
2012-01 Terry Kakeeto (UvT)
Relationship Marketing for SMEs in Uganda
2012-02 Muhammad Umair(VU)
Adaptivity, emotion, and Rationality in Human and Ambient Agent Models
2012-03 Adam Vanya (VU)
Supporting Architecture Evolution by Mining Software Repositories
2012-04 Jurriaan Souer (UU)
Development of Content Management System-based Web Applications
2012-05 Marijn Plomp (UU)
Maturing Interorganisational Information Systems
2012-06 Wolfgang Reinhardt (OU)
Awareness Support for Knowledge Workers in Research Networks
2012-07 Rianne van Lambalgen (VU)
When the Going Gets Tough: Exploring Agent-based Models of Human Performance under Demanding Conditions
2012-08 Gerben de Vries (UVA)
Kernel Methods for Vessel Trajectories
2012-09 Ricardo Neisse (UT)
Trust and Privacy Management Support for Context-Aware Service Platforms
2012-10 David Smits (TUE)
Towards a Generic Distributed Adaptive Hypermedia Environment
2012-11 J.C.B. Rantham Prabhakara (TUE)
Process Mining in the Large: Preprocessing, Discovery, and Diagnostics
2012-12
Kees van der Sluijs (TUE)
Model Driven Design and Data Integration in Semantic Web Information Systems
2012-13 Suleman Shahid (UvT)
Fun and Face: Exploring non-verbal expressions of emotion during playful interactions
2012-14 Evgeny Knutov(TUE)
Generic Adaptation Framework for Unifying Adaptive Web-based Systems
2012-15 Natalie van der Wal (VU)
Social Agents. Agent-Based Modelling of Integrated Internal and Social Dynamics of Cognitive and Affective Processes.
2012-16 Fiemke Both (VU)
Helping people by understanding them - Ambient Agents supporting task execution and depression treatment
2012-17 Amal Elgammal (UvT)
Towards a Comprehensive Framework for Business Process Compliance
2012-18 Eltjo Poort (VU)
Improving Solution Architecting Practices
2012-19
Helen Schonenberg (TUE)
What's Next? Operational Support for Business Process Execution
2012-20 Ali Bahramisharif (RUN)
Covert Visual Spatial Attention, a Robust Paradigm for Brain-Computer Interfacing
2012-21 Roberto Cornacchia (TUD)
Querying Sparse Matrices for Information Retrieval
2012-22 Thijs Vis (UvT)
Intelligence, politie en veiligheidsdienst: verenigbare grootheden?
2012-23 Christian Muehl (UT)
Toward Affective Brain-Computer Interfaces: Exploring the Neurophysiology of Affect during Human Media Interaction
2012-24 Laurens van der Werff (UT)
Evaluation of Noisy Transcripts for Spoken Document Retrieval
2012-25 Silja Eckartz (UT)
Managing the Business Case Development in Inter-Organizational IT Projects: A Methodology and its Application
2012-26 Emile de Maat (UVA)
Making Sense of Legal Text
2012-27 Hayrettin Gurkok (UT)
Mind the Sheep! User Experience Evaluation & Brain-Computer Interface Games
2012-28 Nancy Pascall (UvT)
Engendering Technology Empowering Women
2012-29 Almer Tigelaar (UT)
Peer-to-Peer Information Retrieval
2012-30 Alina Pommeranz (TUD)
Designing Human-Centered Systems for Reflective Decision Making
2012-31 Emily Bagarukayo (RUN)
A Learning by Construction Approach for Higher Order Cognitive Skills Improvement, Building Capacity and Infrastructure
2012-32 Wietske Visser (TUD)
Qualitative multi-criteria preference representation and reasoning
2012-33 Rory Sie (OUN)
Coalitions in Cooperation Networks (COCOON)
2012-34 Pavol Jancura (RUN)
Evolutionary analysis in PPI networks and applications
2012-35 Evert Haasdijk (VU)
Never Too Old To Learn -- On-line Evolution of Controllers in Swarm- and Modular Robotics
2012-36 Denis Ssebugwawo (RUN)
Analysis and Evaluation of Collaborative Modeling Processes
2012-37 Agnes Nakakawa (RUN)
A Collaboration Process for Enterprise Architecture Creation
2012-38 Selmar Smit (VU)
Parameter Tuning and Scientific Testing in Evolutionary Algorithms
2012-39 Hassan Fatemi (UT)
Risk-aware design of value and coordination networks
2012-40 Agus Gunawan (UvT)
Information Access for SMEs in Indonesia
2012-41 Sebastian Kelle (OU)
Game Design Patterns for Learning
2012-42 Dominique Verpoorten (OU)
Reflection Amplifiers in self-regulated Learning
2012-43 Withdrawn
2012-44 Anna Tordai (VU)
On Combining Alignment Techniques
2012-45 Benedikt Kratz (UvT)
A Model and Language for Business-aware Transactions
2012-46 Simon Carter (UVA)
Exploration and Exploitation of Multilingual Data for Statistical Machine Translation
2012-47 Manos Tsagkias (UVA)
Mining Social Media: Tracking Content and Predicting Behavior
2012-48 Jorn Bakker (TUE)
Handling Abrupt Changes in Evolving Time-series Data
2012-49 Michael Kaisers (UM)
Learning against Learning - Evolutionary dynamics of reinforcement learning algorithms in strategic interactions
2012-50 Steven van Kervel (TUD)
Ontologogy driven Enterprise Information Systems Engineering
2012-51 Jeroen de Jong (TUD)
Heuristics in Dynamic Sceduling; a practical framework with a case study in elevator dispatching

2013
2013-01 Viorel Milea (EUR)
News Analytics for Financial Decision Support
2013-02 Erietta Liarou (CWI)
MonetDB/DataCell: Leveraging the Column-store Database Technology for Efficient and Scalable Stream Processing
2013-03 Szymon Klarman (VU)
Reasoning with Contexts in Description Logics
2013-04 Chetan Yadati(TUD)
Coordinating autonomous planning and scheduling
2013-05 Dulce Pumareja (UT)
Groupware Requirements Evolutions Patterns
2013-06 Romulo Goncalves(CWI)
The Data Cyclotron: Juggling Data and Queries for a Data Warehouse Audience
2013-07 Giel van Lankveld (UvT)
Quantifying Individual Player Differences
2013-08 Robbert-Jan Merk(VU)
Making enemies: cognitive modeling for opponent agents in fighter pilot simulators
2013-09 Fabio Gori (RUN)
Metagenomic Data Analysis: Computational Methods and Applications
2013-10 Jeewanie Jayasinghe Arachchige(UvT)
A Unified Modeling Framework for Service Design.
2013-11 Evangelos Pournaras(TUD)
Multi-level Reconfigurable Self-organization in Overlay Services
2013-12 Marian Razavian(VU)
Knowledge-driven Migration to Services
2013-13 Mohammad Safiri(UT)
Service Tailoring: User-centric creation of integrated IT-based homecare services to support independent living of elderly
2013-14 Jafar Tanha (UVA)
Ensemble Approaches to Semi-Supervised Learning Learning
2013-15 Daniel Hennes (UM)
Multiagent Learning - Dynamic Games and Applications
2013-16 Eric Kok (UU)
Exploring the practical benefits of argumentation in multi-agent deliberation
2013-17 Koen Kok (VU)
The PowerMatcher: Smart Coordination for the Smart Electricity Grid
2013-18 Jeroen Janssens (UvT)
Outlier Selection and One-Class Classification
2013-19 Renze Steenhuizen (TUD)
Coordinated Multi-Agent Planning and Scheduling
2013-20 Katja Hofmann (UvA)
Fast and Reliable Online Learning to Rank for Information Retrieval
2013-21 Sander Wubben (UvT)
Text-to-text generation by monolingual machine translation
2013-22 Tom Claassen (RUN)
Causal Discovery and Logic
2013-23 Patricio de Alencar Silva(UvT)
Value Activity Monitoring
2013-24 Haitham Bou Ammar (UM)
Automated Transfer in Reinforcement Learning
2013-25 Agnieszka Anna Latoszek-Berendsen (UM)
Intention-based Decision Support. A new way of representing and implementing clinical guidelines in a Decision Support System
2013-26 Alireza Zarghami (UT)
Architectural Support for Dynamic Homecare Service Provisioning
2013-27 Mohammad Huq (UT)
Inference-based Framework Managing Data Provenance
2013-28 Frans van der Sluis (UT)
When Complexity becomes Interesting: An Inquiry into the Information eXperience
2013-29 Iwan de Kok (UT)
Listening Heads
2013-30 Joyce Nakatumba (TUE)
Resource-Aware Business Process Management: Analysis and Support
2013-31 Dinh Khoa Nguyen (UvT)
Blueprint Model and Language for Engineering Cloud Applications
2013-32 Kamakshi Rajagopal (OUN)
Networking For Learning; The role of Networking in a Lifelong Learner's Professional Development
2013-33 Qi Gao (TUD)
User Modeling and Personalization in the Microblogging Sphere
2013-34 Kien Tjin-Kam-Jet (UT)
Distributed Deep Web Search
2013-35 Abdallah El Ali (UvA)
Minimal Mobile Human Computer Interaction
2013-36 Than Lam Hoang (TUe)
Pattern Mining in Data Streams
2013-37 Dirk Borner (OUN)
Ambient Learning Displays
2013-38 Eelco den Heijer (VU)
Autonomous Evolutionary Art
2013-39 Joop de Jong (TUD)
A Method for Enterprise Ontology based Design of Enterprise Information Systems
2013-40 Pim Nijssen (UM)
Monte-Carlo Tree Search for Multi-Player Games
2013-41 Jochem Liem (UVA)
Supporting the Conceptual Modelling of Dynamic Systems: A Knowledge Engineering Perspective on Qualitative Reasoning
2013-42 Lon Planken (TUD)
Algorithms for Simple Temporal Reasoning
2013-43 Marc Bron (UVA)
Exploration and Contextualization through Interaction and Concepts

2014
2014-01 Nicola Barile (UU)
Studies in Learning Monotone Models from Data
2014-02 Fiona Tuliyano (RUN)
Combining System Dynamics with a Domain Modeling Method
2014-03 Sergio Raul Duarte Torres (UT)
Information Retrieval for Children: Search Behavior and Solutions
2014-04 Hanna Jochmann-Mannak (UT)
Websites for children: search strategies and interface design - Three studies on children's search performance and evaluation
2014-05 Jurriaan van Reijsen (UU)
Knowledge Perspectives on Advancing Dynamic Capability
2014-06 Damian Tamburri (VU)
Supporting Networked Software Development
2014-07 Arya Adriansyah (TUE)
Aligning Observed and Modeled Behavior
2014-08 Samur Araujo (TUD)
Data Integration over Distributed and Heterogeneous Data Endpoints
2014-09 Philip Jackson (UvT)
Toward Human-Level Artificial Intelligence: Representation and Computation of Meaning in Natural Language

2014-10 Ivan Salvador Razo Zapata (VU)

Service Value Networks
2014-11 Janneke van der Zwaan (TUD)
An Empathic Virtual Buddy for Social Support
2014-12 Willem van Willigen (VU)
Look Ma, No Hands: Aspects of Autonomous Vehicle Control
2014-13 Arlette van Wissen (VU)
Agent-Based Support for Behavior Change: Models and Applications in Health and Safety Domains
2014-14
Yangyang Shi (TUD)
Language Models With Meta-information
2014-15 Natalya Mogles (VU)
Agent-Based Analysis and Support of Human Functioning in Complex Socio-Technical Systems: Applications in Safety and Healthcare
2014-16 Krystyna Milian (VU)
Supporting trial recruitment and design by automatically interpreting eligibility criteria
2014-17 Kathrin Dentler (VU)
Computing healthcare quality indicators automatically: Secondary Use of Patient Data and Semantic Interoperability
2014-18 Mattijs Ghijsen (UVA)
Methods and Models for the Design and Study of Dynamic Agent Organizations
2014-19 Vinicius Ramos (TUE)
Adaptive Hypermedia Courses: Qualitative and Quantitative Evaluation and Tool Support
2014-20 Mena Habib (UT)
Named Entity Extraction and Disambiguation for Informal Text: The Missing Link
2014-21 Kassidy Clark (TUD)
Negotiation and Monitoring in Open Environments
2014-22 Marieke Peeters (UU)
Personalized Educational Games - Developing agent-supported scenario-based training
2014-23 Eleftherios Sidirourgos (UvA/CWI)
Space Efficient Indexes for the Big Data Era
2014-24 Davide Ceolin (VU)
Trusting Semi-structured Web Data
2014-25 Martijn Lappenschaar (RUN)
New network models for the analysis of disease interaction
2014-26 Tim Baarslag (TUD)
What to Bid and When to Stop
2014-27 Rui Jorge Almeida (EUR)
Conditional Density Models Integrating Fuzzy and Probabilistic Representations of Uncertainty
2014-28 Anna Chmielowiec (VU)
Decentralized k-Clique Matching
2014-29 Jaap Kabbedijk (UU)
Variability in Multi-Tenant Enterprise Software
2014-30 Peter de Cock (UvT)
Anticipating Criminal Behaviour
2014-31 Leo van Moergestel (UU)
Agent Technology in Agile Multiparallel Manufacturing and Product Support
2014-32 Naser Ayat (UvA)
On Entity Resolution in Probabilistic Data
2014-33 Tesfa Tegegne (RUN)
Service Discovery in eHealth
2014-34 Christina Manteli(VU)
The Effect of Governance in Global Software Development: Analyzing Transactive Memory Systems.
2014-35 Joost van Ooijen (UU)
Cognitive Agents in Virtual Worlds: A Middleware Design Approach
2014-36 Joos Buijs (TUE)
Flexible Evolutionary Algorithms for Mining Structured Process Models
2014-37 Maral Dadvar (UT)
Experts and Machines United Against Cyberbullying
2014-38 Danny Plass-Oude Bos (UT)
Making brain-computer interfaces better: improving usability through post-processing.
2014-39 Jasmina Maric (UvT)
Web Communities, Immigration, and Social Capital
2014-40 Walter Omona (RUN)
A Framework for Knowledge Management Using ICT in Higher Education
2014-41 Frederic Hogenboom (EUR)
Automated Detection of Financial Events in News Text
2014-42 Carsten Eijckhof (CWI/TUD)
Contextual Multidimensional Relevance Models
2014-43 Kevin Vlaanderen (UU)
Supporting Process Improvement using Method Increments
2014-44 Paulien Meesters (UvT)
Intelligent Blauw. Met als ondertitel: Intelligence-gestuurde politiezorg in gebiedsgebonden eenheden.
2014-45 Birgit Schmitz (OUN)
Mobile Games for Learning: A Pattern-Based Approach
2014-46 Ke Tao (TUD)
Social Web Data Analytics: Relevance, Redundancy, Diversity
2014-47 Shangsong Liang (UVA)
Fusion and Diversification in Information Retrieval

2015
2015-01 Niels Netten (UvA)
Machine Learning for Relevance of Information in Crisis Response
2015-02 Faiza Bukhsh (UvT)
Smart auditing: Innovative Compliance Checking in Customs Controls
2015-03 Twan van Laarhoven (RUN)
Machine learning for network data
2015-04 Howard Spoelstra (OUN)
Collaborations in Open Learning Environments
2015-05 Christoph Bosch(UT)
Cryptographically Enforced Search Pattern Hiding
2015-06 Farideh Heidari (TUD)
Business Process Quality Computation - Computing Non-Functional Requirements to Improve Business Processes
2015-07 Maria-Hendrike Peetz(UvA)
Time-Aware Online Reputation Analysis
2015-08 Jie Jiang (TUD)
Organizational Compliance: An agent-based model for designing and evaluating organizational interactions
2015-09 Randy Klaassen(UT)
HCI Perspectives on Behavior Change Support Systems
2015-10 Henry Hermans (OUN)
OpenU: design of an integrated system to support lifelong learning
2015-11 Yongming Luo(TUE)
Designing algorithms for big graph datasets: A study of computing bisimulation and joins
2015-12 Julie M. Birkholz (VU)
Modi Operandi of Social Network Dynamics: The Effect of Context on Scientific Collaboration Networks
2015-13 Giuseppe Procaccianti(VU)
Energy-Efficient Software
2015-14 Bart van Straalen (UT)
A cognitive approach to modeling bad news conversations
2015-15 Klaas Andries de Graaf (VU)
Ontology-based Software Architecture Documentation
2015-16 Changyun Wei (UT)
Cognitive Coordination for Cooperative Multi-Robot Teamwork
2015-17 Andre van Cleeff (UT)

Physical and Digital Security Mechanisms: Properties, Combinations and Trade-offs
2015-18 Holger Pirk (CWI)
Waste Not, Want Not! - Managing Relational Data in Asymmetric Memories
2015-19 Bernardo Tabuenca (OUN)
Ubiquitous Technology for Lifelong Learners
2015-20 Loes Vanhe(UU)
Using Culture and Values to Support Flexible Coordination
2015-21 Sibren Fetter (OUN)
Using Peer-Support to Expand and Stabilize Online Learning
015-22 Zhemin Zhu(UT)
Co-occurrence Rate Networks
2015-23 Luit Gazendam (VU)
Cataloguer Support in Cultural Heritage
2015-24 Richard Berendsen (UVA)
Finding People, Papers, and Posts: Vertical Search Algorithms and Evaluation
2015-25 Steven Woudenberg (UU)
Bayesian Tools for Early Disease Detection
2015-26 Alexander Hogenboom (EUR)
Sentiment Analysis of Text Guided by Semantics and Structure
2015-27 Sandor Heman (CWI)
Updating compressed colomn stores
2015-28 Janet Bagorogoza(TiU)
Knowledge Management and High Performance; The Uganda Financial Institutions Model for HPO
2015-29
Hendrik Baier (UM)
Monte-Carlo Tree Search Enhancements for One-Player and Two-Player Domains
2015-30 Kiavash Bahreini(OU)
Real-time Multimodal Emotion Recognition in E-Learning
2015-31 Yakup Koc (TUD)
On the robustness of Power Grids
2015-32 Jerome Gard(UL)
Corporate Venture Management in SMEs
2015-33 Frederik Schadd (TUD)
Ontology Mapping with Auxiliary Resources
2015-34 Victor de Graaf(UT)
Gesocial Recommender Systems
2015-35 Jungxao Xu (TUD)
Affective Body Language of Humanoid Robots: Perception and Effects in Human Robot Interaction

2016

2016-01 Syed Saiden Abbas (RUN)
Recognition of Shapes by Humans and Machines
2016-02 Michiel Christiaan Meulendijk (UU)
Optimizing medication reviews through decision support: prescribing a better pill to swallow
2016-03 Maya Sappelli (RUN)
Knowledge Work in Context: User Centered Knowledge Worker Support
2016-04 Laurens Rietveld (VU)
Publishing and Consuming Linked Data
2016-05 Evgeny Sherkhonov (UVA)
Expanded Acyclic Queries: Containment and an Application in Explaining Missing Answers
2016-06 Michel Wilson (TUD)
Robust scheduling in an uncertain environment
2016-07 Jeroen de Man (VU)
Measuring and modeling negative emotions for virtual training
2016-08 Matje van de Camp (TiU)
A Link to the Past: Constructing Historical Social Networks from Unstructured Data
2016-09 Archana Nottamkandath (VU)
Trusting Crowdsourced Information on Cultural Artefacts
2016-10 George Karafotias (VUA)
Parameter Control for Evolutionary Algorithms
2016-11 Anne Schuth (UVA)
Search Engines that Learn from Their Users
2016-12 Max Knobbout (UU)
Logics for Modelling and Verifying Normative Multi-Agent Systems
2016-13 Nana Baah Gyan (VU)
The Web, Speech Technologies and Rural Development in West Africa - An ICT4D Approach
2016-14 Ravi Khadka (UU)
Revisiting Legacy Software System Modernization
2016-15 Steffen Michels (RUN)
Hybrid Probabilistic Logics - Theoretical Aspects, Algorithms and Experiments
2016-16 Guangliang Li (UVA)
Socially Intelligent Autonomous Agents that Learn from Human Reward
2016-17 Berend Weel (VU)
Towards Embodied Evolution of Robot Organisms
2016-18 Albert Meroco Pecuela (VU)
Refining Statistical Data on the Web
2016-19 Julia Efremova (Tu/e)
Mining Social Structures from Genealogical Data
2016-20 Daan Odijk (UVA)
Context & Semantics in News & Web Search
2016-21 Alejandro Moreno Calleri (UT)
From Traditional to Interactive Playspaces: Automatic Analysis of Player Behavior in the Interactive Tag Playground
2016-22 Grace Lewis (VU)
Software Architecture Strategies for Cyber-Foraging Systems
2016-23 Fei Cai (UVA)
Query Auto Completion in Information Retrieval
2016-24 Brend Wanders (UT)
Repurposing and Probabilistic Integration of Data; An Iterative and data model independent approach
2016-25 Julia Kiseleva (TU/e)
Using Contextual Information to Understand Searching and Browsing Behavior
2016-26 Dilhan Thilakarathne (VU)
In or Out of Control: Exploring Computational Models to Study the Role of Human Awareness and Control in Behavioural Choices, with Applications in Aviation and Energy Management Domains
2016-27 Wen Li (TUD)
Understanding Geo-spatial Information on Social Media
2016-28 Mingxin Zhang (TUD)
Large-scale Agent-based Social Simulation - A study on epidemic prediction and control
2016-29 Nicolas Haning (TUD)
Peak reduction in decentralised electricity systems -Markets and prices for flexible planning
2016-30 Ruud Mattheij (UvT)
The Eyes Have It
2016-31 Mohammad Khelghati (UT)
Deep web content monitoring
2016-32 Eelco Vriezekolk (UT)
Assessing Telecommunication Service Availability Risks for Crisis Organisations
2016-33 Peter Bloem (UVA)
Single Sample Statistics, exercises in learning from just one example
2016-34 Dennis Schunselaar (TUE)
Configurable Process Trees: Elicitation, Analysis, and Enactment
2016-35 Zhaochun Ren (UVA)

Monitoring Social Media: Summarization, Classification and Recommendation
2016-36 Daphne Karreman (UT)
Beyond R2D2: The design of nonverbal interaction behavior optimized for robot-specific morphologies
2016-37 Giovanni Sileno (UvA)
Aligning Law and Action - a conceptual and computational inquiry
2016-38 Andrea Minuto (UT)
MATERIALS THAT MATTER - Smart Materials meet Art & Interaction Design
2016-39 Merijn Bruijnes (UT)
Believable Suspect Agents; Response and Interpersonal Style Selection for an Artificial Suspect
2016-40 Christian Detweiler (TUD)
Accounting for Values in Design
2016-41 Thomas King (TUD)
Governing Governance: A Formal Framework for Analysing Institutional Design and Enactment Governance
2016-42 Spyros Martzoukos (UVA)
Combinatorial and Compositional Aspects of Bilingual Aligned Corpora
2016-43 Saskia Koldijk (RUN)
Context-Aware Support for Stress Self-Management: From Theory to Practice
2016-44 Thibault Sellam (UVA)
Automatic Assistants for Database Exploration
2016-45 Bram van de Laar (UT)
Experiencing Brain-Computer Interface Control
2016-46 Jorge Gallego Perez (UT)
Robots to Make you Happy
2016-47 Christina Weber (UL)
Real-time foresight - Preparedness for dynamic innovation networks
2016-48 Tanja Buttler (TUD)
Collecting Lessons Learned
2016-49 Gleb Polevoy (TUD)
Participation and Interaction in Projects. A Game-Theoretic Analysis
2016-50 Yan Wang (UVT)
The Bridge of Dreams: Towards a Method for Operational Performance Alignment in IT-enabled Service Supply Chains

2017
2017-01 Jan-Jaap Oerlemans (UL)
Investigating Cybercrime
2017-02 Sjoerd Timmer (UU)
Designing and Understanding Forensic Bayesian Networks using Argumentation
2017-03 Daniel Harold Telgen (UU)
Grid Manufacturing; A Cyber-Physical Approach with Autonomous Products and Reconfigurable Manufacturing Machines
2017-04 Mrunal Gawade (CWI)
Multi-core Parallelism in a Column-store
2017-05 Mahdieh Shadi (UVA)
Collaboration Behavior
2017-06 Damir Vandic (EUR)
Intelligent Information Systems for Web Product Search
2017-07 Roel Bertens (UU)
Insight in Information: from Abstract to Anomaly
2017-08 Rob Konijn (VU)
Detecting Interesting Differences:Data Mining in Health Insurance Data using Outlier Detection and Subgroup Discovery
2017-09 Dong Nguyen (UT)
Text as Social and Cultural Data: A Computational Perspective on Variation in Text
2017-10 Robby van Delden (UT)
(Steering) Interactive Play Behavior
2017-11 Florian Kunneman (RUN)
Modelling patterns of time and emotion in Twitter #anticipointment
2017-12 Sander Leemans (UT)
Robust Process Mining with Guarantees
2017-13 Gijs Huisman (UT)
Social Touch Technology - Extending the reach of social touch through haptic technology
2017-14 Shoshannah Tekofsky (UvT)
You Are Who You Play You Are: Modelling Player Traits from Video Game Behavior
2017-15 Peter Berck, Radboud University (RUN)
Memory-Based Text Correction
2017-16 Aleksandr Chuklin (UVA)
Understanding and Modeling Users of Modern Search Engines
2017-17 Daniel Dimov (UL)
Crowdsourced Online Dispute Resolution
2017-18 Ridho Reinanda (UVA)
Entity Associations for Search
2017-19 Jeroen Vuurens (TUD)
Proximity of Terms, Texts and Semantic Vectors in Information Retrieval
2017-20 Mohammadbashir Sedighi (TUD)
Fostering Engagement in Knowledge Sharing: The Role of Perceived Benefits, Costs and Visibility
2017-21 Jeroen Linssen (UT)
Meta Matters in Interactive Storytelling and Serious Gaming (A Play on Worlds)
2017-22 Sara Magliacane (VU)
Logics for causal inference under uncertainty
2017-23 David Graus (UVA)
Entities of Interest--- Discovery in Digital Traces

List of Publications

- Sedighi, M., van Splunter, S., Brazier, F., van Beers, C., Lukosch, S. (2016). Exploration of multi-layered knowledge sharing participation: the roles of perceived benefits and costs. *Journal of Knowledge Management*, 20(6).
- Sedighi, M., Lukosch, S., van Splunter, S., Brazier, F., Hamedi, M., van Beers, C., (2016). Employees' Participation in Electronic Networks of Practice within A Corporate Group: Perceived Benefits and Costs. *Journal of Knowledge Management, Research and Practice*, Submitted.
- Sedighi, M., Lukosch, S., Brazier, F., Hamedi, M., van Beers, C., (2017). Multi-level Knowledge Sharing: The Role of Perceived Benefits in Different Visibility Levels of Knowledge Exchange. *Journal of Knowledge Management*, Submitted.
- Sedighi, M., Lukosch, S., Brazier, F., Hamedi, M., van Beers, C., (2017). Transparent knowledge sharing platforms: A field experiment measuring effects of visibility on knowledge contribution. *Journal of Knowledge Management, Research and Practice*, Submitted.
- Sedighi, M., van Splunter, S., Zand, F., Brazier, F. (2015). Evaluating Critical Success Factors Model of Knowledge Management: An Analytic Hierarchy Process (AHP) Approach. *International Journal of Knowledge Management (IJKM)*, *11*(3), 17-36.
- Sedighi, M., Isaai, M.T, (2016) Transformation of Knowledge Sharing Motivations in the Presence of Social Media, *Social Knowledge Management in Action*, Springer, 2017.
- Sedighi, M., Lukosch, S., van Splunter, S., Brazier, F., van Beers, C., (2016). Exploring Participants Engagement in Organizational Knowledge Sharing, *8th international Conference on Knowedge Management and Information Sharing*, Porto, Portugal.
- Sedighi, M., Hamedi, M. (2016). Knowledge Contribution in Knowledge Networks: Effects of Participants' Central Positions on Contribution Quality, *ICICKM, 13th International Conference on Intellectual Capital, Knowledge Management & Organizational Learning*, 14-15 October 2016, Ithaca, New York, USA
- Rahimi, S Tampinongkol, M Sedighi, J Van den Berg, W Veen, (2014) Investigating relationship between self-and co-regulatory learning processes in a workplace e-learning system. *E-Learning at Work and the Workplace: Proceedings of the European Distance and E-Learning Network 2014 Annual Conference*, Zagreb, Croatia, 10-13 June 2014. EDEN, 2014.
- Sedighi, M., (2013) An Agent-mediated Approach to Promote Knowledge Sharing Through Enterprise Social Networks. *EASSS 2013: 15th European Agent Systems Summer School*, London, UK, 1-5 July 2013. 2013.
- Sedighi, M., Zand F., Knowledge management: Review of the Critical Success Factors and development of a conceptual classification model. *ICT and Knowledge Engineering (ICT & Knowledge Engineering), 2012 10th International Conference,* Bangkok, IEEE, 2012.

About the Author

Mohammadbashir Sedighi (1985) was born in Tehran, Iran. He holds a bachelor degree in Industrial Engineering from Amirkabir University of Technology (Tehran Polytechnic). Mohammad holds an MBA degree from Sharif University of Technology (International Campus) in Iran, where he was involved in several managerial projects in the Iranian car industry. Mohammad graduated Cum Laude for his MBA degree and gained second place among MBA graduates. Mohammad also won the industrial champion prize for developing success competitive strategies to achieve superior financial performance and market leadership in the simulation strategy program by GLO-BUS (McGraw-Hill Education, Inc.) in 2010.

During his PhD research, he has been involved in some Iranian and European projects in the Knowledge Management field where he applied his research outcome in the real field. His results have been published as journal articles, book chapters and conference proceedings. Mohammad has been a guest university lecturer in Tehran Polytechnic. Besides research, Mohammad has more than five years experiences in the car industry in different roles such as Human Resource Development manager, System Engineering manager, Human Resource consultant, etc. Moreover, he has been involved in several projects related to designing health policies in different domains such as Ministry of Health and Medical Education.