

**Investigation of Knowledge Management based on  
Nonaka and Takeuchi Model in Mashhad  
Municipality**

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## **ABSTRACT**

Due to the latest threats and challenges faced by the construction industry today, construction companies must seek new solutions in order to keep ahead of the competition. Knowledge has been identified to be a significant organizational resource, which if used effectively can offer competitive advantage. A lot of attention is being put on how to identify, capture and share knowledge in today's organizations. Fragmented nature of the construction industry and ad-hoc nature of the construction projects capture and reuse of valuable knowledge gathered during a construction project poses a challenge. The first step in deployment of knowledge management practice in company is determining the knowledge level in that organization.

This research will try to determine the knowledge level in the municipality as a main part of the construction industry of each society. It has dealt with a lot of problems in making an integrated information document. For that purpose, the model of Nonaka and Takeuchi (N&T) was used which is a model for determining knowledge level. In contrast to other models, this model concentrates on both explicit and implicit knowledge and on the way they change to each other, and considers how they are produced in all organizational levels (individual, group, and organizational). This is the reason why this model was used.

In order to achieve this aim, after determining the statistical society, questionnaires based on the areas of Nonaka and Takeuchi (N&T) model were distributed, gathered and examined in the offices. Then total score of municipality was assessed based on

the questionnaire survey. At the end, the knowledge level was investigated based on the obtained score.

The municipality of Mashhad-Iran has been chosen as a case study, because of the easy access to information than elsewhere.

**Keywords:** Knowledge, Knowledge Management, Nonaka and Takeuchi Model, Tacit and Explicit Knowledge.

## ÖZ

Günümüzde inşaat sektöründeki tehditler ve zorluklara karşı mücadele edebilmek için, inşaat şirketleri yeni yöntemler araştırmalıdır. Bilgi, çok büyük organize bir kaynak olarak tanımlanmaktadır. Bilgi, efektif bir şekilde kullanıldığında rekabet içerisinde büyük bir avantaj sağlar. Günümüz organizasyonlarında bilginin nasıl tanımlanacağı, ele geçirileceği ve paylaşılacağı ile ilgili konulara çok önem verilmektedir. İnşaat Endüstrisinin parçalı ve amaca özel yapısından dolayı oluşan çok fazla bilgi toplama ve bilgi sahibi olma ihtiyacı büyük bir meydan okumadır. Bir organizasyondaki bilgi yönetim sisteminin ilk adımları o organizasyonun bilgi seviyesini belirtir.

Bu araştırma inşaat sektöründe birçok problemle karşılaşmış olan belediyelerin bu problemlerle ilgili oluşturdukları entegre edilmiş bilgi dokümanlarını saptayacaktır. Bu amaç için bilgi seviyesini belirlemede model olarak kullanılan Nonaka ve Takehuchi (N&T) modeli kullanılmıştır. Diğer modellerin aksine bu model açık ve üstü kapalı bilgiyi kullanmaktadır. Ve bu süreçte bu bilgiler birbirine dönüşmektedir. Bu model ayrıca bu bilgilerin nasıl üretildiğini de sorgulamaktadır (bireysel, grup, organizasyonlu). Bu modelin kullanılmasının nedeni budur.

Elde etmek istediğim amacım, istatistiki toplumu saptadıktan sonra, Nonaka ve Takehuchi (N&T) bölgelerinde anketler yapmaktır. Model ofislerde dağıtılacak, toplanacak ve incelenecektir. Ardından belediyenin toplam skoru anket yöntemine göre değerlendirilecektir. Sonuç olarak bilgi seviyesi elde edilen skora göre incelenecektir.

Örnek bölge olarak Mashhad Belediyesi seçilmiştir. Bu belediyenin seçilmesinin sebebi bilgiye ulaşımın diğer belediyelere göre daha kolay olmasıdır.

**Anahtar Kelimeler:** Açık ve Üstü kapalı Bilgi, Bilgi, Bilgi yönetimi, Nonaka ve Takeuchi Modeli.

**This thesis is dedicated to my lovely family “Dr. Seyed Bagher Ghaffari Oskouei”, “Ferangiz Kalantari Oskouei”, and “Dr. Anita Ghaffari Oskoueir” for their endless love, support, and encouragement.**

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# Chapter 1

## INTRODUCTION

### 1.1 Introduction

Nowadays knowledge management is discussed as a competitive tool, in order to achieve success in the economy based on knowledge area. Therefore, many organizations and corporations especially in the construction industry implement and apply knowledge management as a new concept of management.

Mashhad is the second most populous city in Iran and is the capital of Razavi Khorasan Province in Iran. It is located in north east of the country close to the borders of Afghanistan and Turkmenistan. Its population was about 3,000,000 at the 2011 population census. It was a major oasis along the ancient Silk Road connecting with Merv in the East. As of the importance of managing this kind of grand cities, in this research tried to evaluate Mashhad because of high volume work which is done for constructing the city.

Implementing a comprehensive knowledge influences organization positively. It is beneficial for all three areas, organizational structure, technology and organizational culture.

After understanding these three areas, the most influential practice seems to be understanding of the organization knowledge level. For this aim, all parts of

organization consisting producing, distributing and storing knowledge should be studied (Barth, 2000).

In fact, the organization just achieves the desired results through knowledge management (KM) that occurred by complete and exact understanding of the state of knowledge. The organization should convert the information and knowledge in to each other quickly. At the same time, the organizations should not emphasize too much on their basic knowledge that neglecting effects on converting the information and knowledge into each other. In other words, some knowledge is not acceptable for a long time, so organization should remove it immediately from the knowledge base (Alagheband, 2006). KM is the process of development, verification, delivery, distribution and use of knowledge. KM will shape the models the interaction between technologies, techniques and people. KM in organizations and companies helps to improve decision-making, greater flexibility, increased profits, reduce workload, increase productivity, create new business opportunities, cost reduction, greater market share and improve employee motivation (Darroch, 2003).

## **1.2 Problem Statement**

The municipality of Mashhad -as the second city in a developing country- is the largest and most prestigious organization of the construction industry in the urban society.

Close relationship with citizens, size of construction and cultural projects, the number of employees, variability in projects (civil, traffic, green space) and the

number of affiliated sub organizations of Mashhad municipality are the reasons for this claim.

The high volume of Mashhad municipality activities shows the number of personnel employed in this organization. The new personnel statistics of the municipality of Mashhad stated 3200 persons are working there. Moreover, many young engineers are employed annually as trainee soldiers and new graduates of universities in this organization as the biggest construction corporation of Mashhad (Barth, 2000).

Unfortunately, despite such a high potential and foremost importance, most of the municipality's projects have dealt with some problems and barriers such as delay in performance, delay in operation and debt of the municipality to contractors, and budget deficit in anticipated projects. This could be for various reasons with one important being the lack of a comprehensive system of knowledge management in the organization. High mobility of workers from one area to another area, the existence of the experienced workers after the retirement, completed serving of young and educated troops in the organization and exit from the municipality, working with the contractors at different levels and variability in their field are some reasons which make the necessity of the knowledge management system and recording, keeping and transferring of experience and knowledge. The first step in basing knowledge management system in an organization is the determination of the knowledge level in it (Delaware, 2006).

The goal of this project is to determine the level of knowledge in Mashhad municipality. In this way, the Nonaka and Takeuchi (N&T) Model is used. This model is a kind of cognitive model in knowledge management level determination. Unlike other models, this model focuses on two types of tacit and explicit knowledge and considers how to

convert them to one another and how to make it at all organizational levels (individual, group and organizational) (Darroch, 2003). This is the main reason of using this model for this research.

After identifying the target population, a questionnaire based on the model of Nonaka and Takeuchi (N&T) was designed, and after distribution among selected population, they were collected and examined. Based on respondents' answers, and the value of each question, total score of the organization on knowledge management level was achieved. The amplitude of responses to each question is from 1 to 5 (low to high importance). Also the total score will be between 1 and 5. With regard to the rating and various aspects of the considered model, it is possible to make comment on the level of the knowledge management of the municipality.

### **1.3 The Importance and Necessity of Research**

As described in the previous section, despite the high potential of human resources and importance of the projects, unfortunately most of the municipality's projects have dealt with some problems and barriers such as delay in performance, delay in operation, and debt of the municipality to contractors, budget deficit in anticipated projects. According to the high mobility of workers from one part to another part of organization, the exit of the experienced workers after the retirement, completed serving of young and educated personnel in the organization and exit from the municipality, the usage of knowledge management in order to use the maximum level of knowledge and ability of previous experienced and educated personnel to solve the organization's problems seems necessary. To establish an efficient system of knowledge management, it is necessary to determine the knowledge level of the organization (Eghbal and Esmaili, 2008).

In the recent years, organizations of Khorasan Razavi province have used some models such as Hsyng model to manage their data and knowledge, but they have not used the N&T cognitive model which is the most effective cognitive model in knowledge management. This fact shows the importance of this subject to be investigated.

In recent years, the knowledge has been considered more comparing with past. In project-based organizations and institutions that deal with various groups including consultants and contractors, the role of knowledge management is important. The case study for present research is Mashhad municipality which is the biggest project-driven organization in Mashhad. Also, the other project-based organizations can be as the beneficiaries of this research such as Housing and Urban Development Co, Renovation of schools Co, United Housing Foundation Co, Regional Electric Company and Water Company (Moghadam, 2007).

## **1.4 Research Objectives**

1.4.1. Identifying and being familiar with the concepts of knowledge management and the introduction and explanation of different kinds of the cognitive model of knowledge management.

1.4.2. Full introduction to the cognitive model of Nonaka and Takeuchi (N&T) underlining disadvantages and advantages of this model. Finding an answer for this question: “Is N&T model the effective cognitive model in determining the level of knowledge?”

1.4.3. Determining the level of Mashhad municipality organization's knowledge in each 8 domains of N&T model and the total score of the knowledge level. Generally, evaluating the level of Mashhad municipality's knowledge by using N&T model.

1.4.4. Conclusions about N&T application and comparing the results with the advantages and disadvantages of this model identified with the review of the literature.

## **1.5 Works Done**

In order to achieve the objectives of this research as mentioned in the last section, some works were done as follow:

1.5.1. Reviewing the literature about knowledge management and studying other research related to knowledge management strategies and examining past successful experiences of this subject in other organizations and corporations of Iran.

1.5.2. Performing a literature review about Nonaka and Takeuchi (N&T) and disadvantages and advantages of this model as the beneficial strategy of knowledge management.

1.5.3. Survey among managers of the municipality of Mashhad to find the impact level of N&T model on this organization to determine the level of Mashhad municipality organization's knowledge in each 8 domains of N&T model and the total score of the knowledge level in this organization as the main member of the construction industry of Mashhad.

1.5.4. Reviewing and examining above practices that were done and analyzing their results and outputs.

## **1.6 Thesis Outline**

Below results are achieved by reviewing the literature of investigating and examining all claims and gained data through questionnaire survey.

1.5.1. Knowledge management definition and the cognitive model of knowledge management.

1.5.2. Full explanation of N&T model and effective level of the N&T model using in determining the level of knowledge that was determined.

1.5.3. The Level of Mashhad municipality organization's knowledge in each 8 domains of N&T model and the total score of the knowledge's level were inferred.

1.5.4. A plan and the methods of project's performance according to the documented knowledge of the policies and strategies of the Mashhad municipality as an important organization of construction industry through N&T model.

## **1.7 Research Limitations**

In completing this study, several limitations were confronted. Some of them are mentioned below:



1.7.1. Slow improvement and the long process of the study due to non-cooperation of managers and experts.

1.7.2. Due to the special circumstances in which the questionnaire was developed by administrators and technicians, it was attempted to complete the research in a relatively wide range of time. Obviously, if the process has been done in a compressed form, the investigation would reach the results sooner.

1.7.3. Restrictions on the use of complementary methods such as interviews and observations, due to the complexity and busy times of managers. However, with regard to the nature of knowledge management, quantitative methods will be helpful in achieving real results.

1.7.4. Many managers and experts refused to complete a questionnaire because of involvement and busy working.

## **1.8 Research Assumptions**

1.8.1. The N&T model is an effective cognitive model.

1.8.2. The level of Mashhad municipality's knowledge is in low to moderate range (disturbance of knowledge). The level of knowledge consists of disturbance of knowledge, awareness of knowledge, focus on knowledge and knowledge management.

## **1.9 Definitions**

**Knowledge management:** Making knowledge available in systematic and scientific reserves, in a way when people need them, they can carry out their daily work more efficiently and effectively (Nonaka, 2009).

**Cognitive model:** It is for evaluating and determining the level of knowledge management (Sani, Nezafati and Khadyvar, 2008).

**N&T model:** One of the most effective cognitive models that considers both the tacit and explicit knowledge (Nonaka, 2009).

**Explicit knowledge:** It is a set of processes and techniques, regulations, guidelines that every reader can be familiar with them by studying (Panahi, 2008).

**Tacit knowledge:** Intangible assets in mind which are theoretical and conceptual aspects and are not manifested yet. This type of knowledge is not able to be stored in the database, so others are not familiar with them (Gholizdeh, 2005).

## **1.10 The Research Area**

### **1.10.1 The Date of Research**

The data collection has been done in spring 2013.

### **1.10.2 Case Study**

The field study is some department of Mashhad municipality organization located in the headquarters. These departments include: transportation department, urban

service department, civil and technical department, architecture and urban planning department, social and cultural department, administrative and financial department, planning and development department.

## **1.11 Research Methodology**

### **1.11.1 Research Methods Based on the Aim, Data Collection and Implementation**

The purpose of this study was to investigate and determine the level of knowledge of Mashhad municipality based on the N&T model. For this aim, information on cognitive models was gathered based on library database; particularly the information about N&T model was collected. In the next step, eight kinds of the questionnaires in eight various areas of N&T model were prepared which consist of the quality questions (solutions). According to the questionnaire classification, one type of questionnaire which reflects valuable questions (level determination) was prepared. The questionnaires were distributed in the population studied and field of study (Sarokhani, 2005). With these questionnaires, an educational booklet in the context of knowledge management and N&T model was proposed. After completing the questionnaire and collecting data, analysis was performed on the data. Based on the determined value of responds to each question and the proposed techniques in the chapter 3, overall organization's rate in the field of knowledge management and also in each of the eight domains of the model were determined. Then, according to the obtained score, the level of Mashhad municipality's knowledge was judged. Finally, by results obtained from N&T model, the advantages and disadvantages of this model considered in the literature review were evaluated.

### **1.11.2 Parameters of Study**

The N&T model which supports this investigation is one of the most valuable cognitive models. This model focuses on two types of knowledge, the "explicit" and "tacit" knowledge and how to convert them to each other and also how to make it at all organizational levels: individual, group and institutional.

The eight parts of N&T model are as following: individual tacit knowledge, converting individual tacit knowledge into individual explicit knowledge, individual explicit knowledge, converting individual explicit knowledge into collective explicit knowledge, collective explicit knowledge, converting collective explicit knowledge into collective tacit knowledge, collective tacit knowledge, converting collective tacit knowledge into individual tacit knowledge (Eghbal and Esmaili, 2008). In this research, the level of the organization is evaluated in these eight aspects by using the questionnaire.

### **1.11.3 Data Collection Method**

Firstly, it introduces the KM and cognitive models based on the library database. Research methodology is based on field research method. With eight types of questionnaires based on the N&T model, a questionnaire was prepared by composition of these eight questionnaires and was distributed in the population of the study. One of the best ways of data collection is internet survey which is used in this research (Sarokhani, 2005).

### **1.11.4 Population of Study, Sampling and Sample Volume**

In the research, unit of analysis was staff of departments. The respondents of study were experts with high level education. The sample was selected by using the

stratified method, and Morgan table (Krejcie and Morgan, 1970) determined the sample volume (Delaware, 2006).

#### **1.11.5 Data Analysis Methods and Tools**

In the first part of data analysis by using data that was collected by the questionnaires and the techniques presented in Chapter 3, the level of knowledge in each area of the municipality was evaluated. In this technique, by reviewing the weight of questions in the first questionnaire and the value of the questions in the second one and also the relationships of this model, the level of management was determined.

In the second part, by using the mean, standard deviation and variance, the data obtained from the second questionnaire was addressed. With regard to the results obtained, strategies for promoting knowledge management are presented, in the last chapter

## **Chapter 2**

### **KNOWLEDGE MANAGEMENT**

#### **2.1 Introduction**

Since mass and energy as the most influential sources of information have changed to knowledge, the importance of knowledge management and transferring it in developing programs of organizations and countries are more considered. Systems are known to be efficient and successful which they create and share wisely an appropriate combination of Knowledge, information, entrepreneurship, creativity, capital, materials and energy (Abbasi, 2007).

In knowledge-based economy, intellectual capital is used in order to create and increase enterprise value and the success of an organization depends on its ability to manage this scarce resource. In addition, one of the important features of an organization that can assist in the creation and sharing of knowledge and compared to other organizations creates them sustainable competitive advantage, is the organizational learning capability. (Khayat Moghadam, 2013)

After the establishment of knowledge management and transfer, the methods of proposing knowledge and information are changed and organizational learning will be in dynamic and alive. Knowledge management replaces teaching methods from the traditional mode to interactive and multi-mode to make best connection with its audience. If virtual training are developed more, adopting knowledge management

will be more required as a long-term development needs in public and private corporations and organizations (Foappaolo, 2006).

## **2.2 Knowledge Definition and Concept**

Before defining the concepts of knowledge management, knowledge concept and what is in organizations and individuals' minds as intellectual and cognitive content should be expressed. In the following sections, some concepts related to knowledge management will be explained.

### **2.2.1 Hierarchy of Knowledge**

#### **2.2.1.1 Data**

According to Oxford Dictionary, “Data is most often used as a singular mass noun in education”.

Data is often simply raw and objective, and there is not any meaning beyond that. The data can be used in any form, but it does not mean anything individually. In fact, the collection of data is not information. A work is started with data that are meaningless at first. The data is the word with no text that if coming with other data and making significant association, it will mean understanding. Information and knowledge are normally used for overlapping concepts to define data. Considering the main difference in the level of abstraction, data is in the lowest level and information is the next level of abstraction, and knowledge is the highest level among others (Capon, Farley, Lehmann & Hulbert, 1992).

### 2.2.1.2 Information

Information, in its general sense, is "knowledge communicated or received concerning a particular fact or circumstance". Information is a series of data that are meaningful through the relationship with each other. This meaningful can be helpful, but always it is not necessary for using.

Although information is a simple understanding of the relationship between the various parts of data or all other data, it is not basic answer to the "why" and "how". Information consists of a series of data that will be assessed in order to be usable and useful and answer to questions that start with "who", "what", "where" and "when" (Moghadam, 2006). Figure 1 illustrates the relation between information, data, knowledge and wisdom.

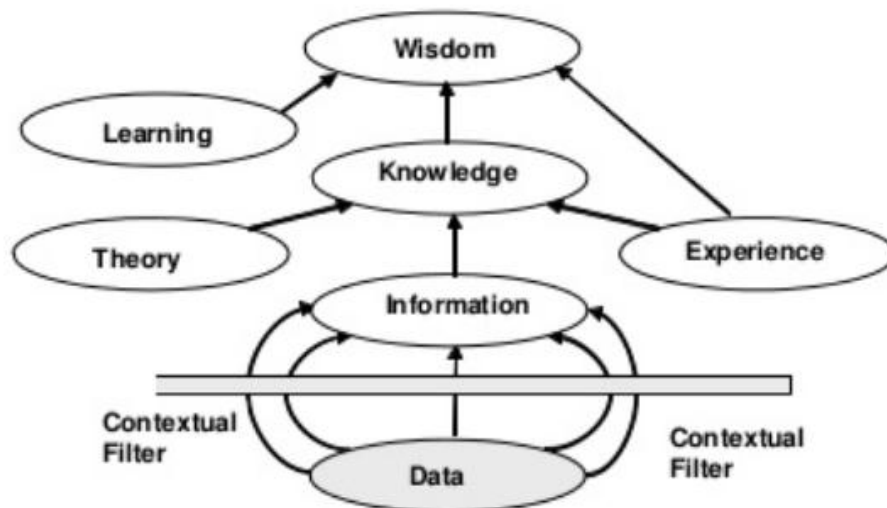


Figure 1. Relations between Information, Data, Knowledge and Wisdom (Moghadam, 2006)



### **2.2.1.3 Knowledge**

Today, knowledge is recognized as the power tool in the corporations. Knowledge is a collection of appropriate data that focus on certain patterns and models. The patterns illustrate knowledge and provide the capability of repeatability and predictability.

Knowledge can include facts, information, descriptions, or skills acquired via experience or education which is inferred by someone or something. Knowledge refers to the theoretic or real understanding of a subject, and it can be formal or systematic. Knowledge acquisition consists of compound cognitive processes: awareness, communication, memory, mental and association; while knowledge is also linked to the acknowledgment capacity in human beings. Knowledge comes understanding a concept and involves the identification and analysis (Foappaolo, 2006). Understanding is upper the pure knowledge, so that in some cases, the ratio of understanding to knowledge is similar to the ratio of learning to memorizing.

It can simply be said that knowledge is as the rich and fertilized information format; also knowledge is about "how" and "why"(Nonaka, 2009). Cooking cake can be mentioned as an example. In order to make the cake, the list of ingredients of staff is data and cooking procedure is the information that describes how the cake should be cooked. Although an experienced or inexperienced chef might cook a cake, another person who has knowledge, skills and experience in cooking can cook a better cake based on the same cake recipes. In order to gain knowledge, information is the base requirement.

In the previous example, knowing how to make cake is not enough and a list of various ingredients and consumer tastes is necessary (Barden, 2008).

Moreover, a reason of this question “why is it very important to make the cake?”, because if the ingredients are not available, knowing the goals and philosophy of cooking recipe can help chief to find other alternatives. In fact, the knowledge is the reason of why it is done; knowing why provides creativity and innovation. As Figure 2 shows, facts and information can access to knowledge through five steps.

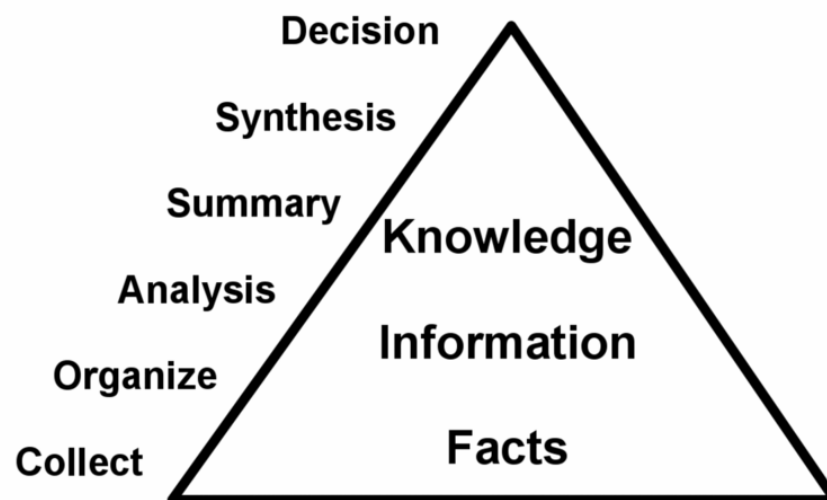


Figure 2. The Required Steps that Information can Access to Knowledge Through them (Barden, 2008)

#### **2.2.1.4 Wisdom**

Wisdom is a deep understanding and realization of people, things, events or situations, resulting in the ability to apply perceptions, judgments and actions in keeping with this understanding. Controlling one's emotional reactions is the requirement of wisdom.

Wisdom involves all levels of awareness and all particular mental programs such as principles, vision, ethics, and main models etc. Wisdom is related to beyond of understanding, philosophical quest and the answers of "why" (Nonaka, 1997).

The different between “True” and “False” is cleared through wisdom; “Good” and “Bad” are justified by wisdom. We can judge about all events via wisdom. It is a condition of unparalleled human and needs of someone with a stronger heart and mind. So the process of converting data into information, information into knowledge and knowledge into wisdom is evolutionary procedure. In other words, while wisdom has all the previous levels, it appears beyond the mere understanding within a person, it comes with clean judgment power and helps to supreme decision making (Jhonson, 1999). Figure 3 shows the hierarchy of mind content.

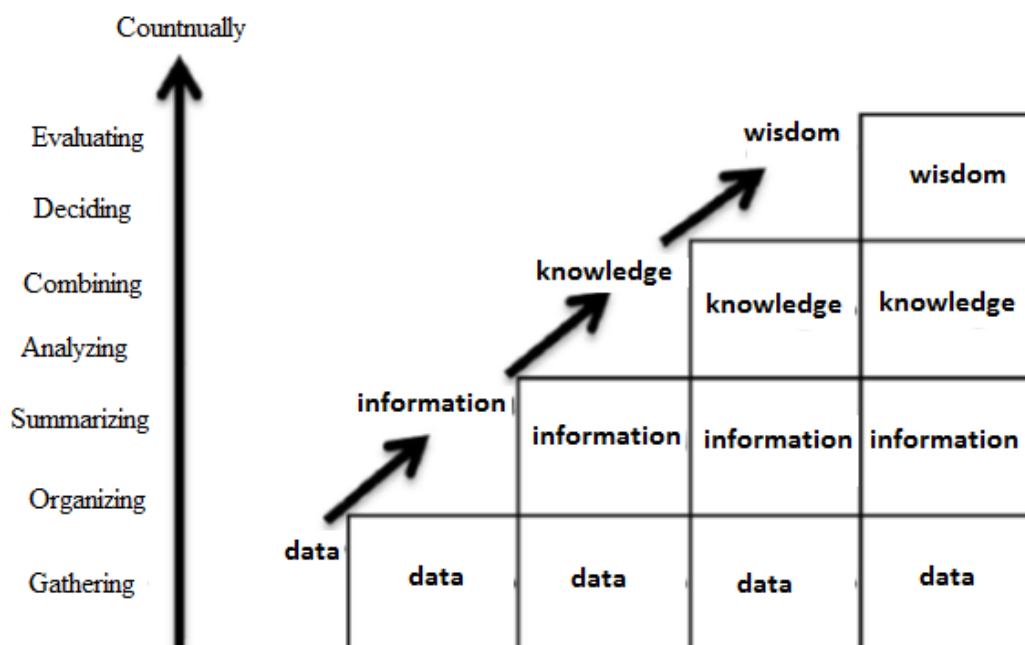


Figure 3. The Hierarchy of Mind Content (Jhonson, 1999)

### **2.2.2 Knowledge Definition in Knowledge Management**

There is a question: Are there any differences between knowledge and knowledge management? Are there obvious differences in appearance, content and intellectual?

The fact reveals all these concepts depend on how the knowledge is used and exploited and for various positions may be one or more is required to interact with other concept. In other words, perhaps it is better to say there are not clear boundaries between them to be distinct from each other (Brooking, 1996). The knowledge of corporations or organizations means all data, information, knowledge and wisdom (Marsh and Jones, 2002). Hence, knowledge in an organization consists of knowing something with facts and understanding through experience, research, and explore the relationship between mental that can be recorded in person's brain or organizational processes, products, facilities, and system documentation.

According to the above definition, the large quantity of raw data does not solve business problems, create value or increase participation and performance, rather it needs to attract and make internal information through mental communication and understanding them and characterized patterns (Nicola, 2004).

There are some various definitions (not different with the mentioned definition) which are presented for better understanding.

- Knowledge includes intellectual and practical information and experience gathered or maintained inside the mind of the person or organization.

- Knowledge consists of data or mental and practical reserve or information that has practical aspect, potentially.

- Knowledge is what people perform or need to know for their job and duties.

- Knowledge is about knowing how the work performed by group or individual based on technical and operational aspects.

Knowledge is not like information, rather is a dynamic and organized, in current and motion, and it is used, experienced made internal, re shared and grown when transmitted from one person to another (Bhatt, 2001).

Knowledge and related concepts about it is as valuable wealth in organizations for business, and it can be referred to as a type of intellectual property. It can be even more powerful than the physical assets of the organization such as land, labor and capital if the possibility distribution and accessibility are provided for all individuals according to the level of their needs.

The mentioned conditions specify the necessity of knowledge management for different levels of the organization. The knowledge of an organization and corporation consists of what is within the brain and the mind of organizational staffs and process in folders and shelves, different databases and knowledge bases and also various websites (Nonaka, 2009).

### **2.2.3 Types of Knowledge**

Every organization has to deal with two kinds of knowledge and rely on them to do their work that is tacit and explicit knowledge (Alagheband, 2006).

#### **2.2.3.1 Tacit Knowledge**

This knowledge refers to specific knowledge, heuristics and intuition that people gain it during working, gradually and evolutionary. Tacit knowledge is rooted in action, and the use of mind. It can be obtained from the mind and body, simultaneously. As long as mental and physical abilities are not used, such knowledge is not being gained. Tacit knowledge is a personal knowledge that making it formulated and separate is extremely hard (Nonaka, 1988).

Transferring tacit knowledge alongside traditional experience and joint through internships and job training will be done over time. Such knowledge ensures the benefits and efficiency of an organization indirectly and makes the activities and tasks to be performed to close work units to their goals (Alagheband, 2006).

Furthermore, such knowledge can also be creative to solve problems and barriers through intuition and exploration that is impossible to be resolved through the routine and popular ways.

#### **2.2.3.2 Explicit Knowledge**

Tacit knowledge is not expressed knowledge, but it is based on rules and regulations of the explicit knowledge in order to compare the activities and measures for the existing situation and laws.

Explicit knowledge guides the actions and activities through answering three questions:

- In what position we have been (What is the current situation)?
- What kind of person (legally) I am? Or what kind of organization we are in?
- What is the guarantee that should be taken by an institutional person like me and an organization like this situation, based on the principles and rules?

Explicit knowledge is used in the current design, standard operating procedures and structure of the data records. Such knowledge enables organizations to have an acceptable level of performance and organizational control (Carneiro, 2000).

Moreover, explicit knowledge is rule-based and makes update responses and organizational non-conflicting and fixed reactions. Table 1 is about comparing the types of knowledge in terms of figure, model and application.

Table 1. Comparison of the Types of Knowledge in Terms of Figure, Model and Application (Nonaka, 2009)

<b>Type</b>	<b>Application</b>	<b>Sample (model)</b>	<b>Figure</b>
Tacit Knowledge	Ensuring the effectiveness of the tasks	<ul style="list-style-type: none"> <li>- Knowing about how the event ensuring the</li> <li>- Exploratory</li> <li>- Intuitively</li> </ul>	<ul style="list-style-type: none"> <li>- The process</li> <li>- Implicit in the act</li> </ul>
Explicit Knowledge	Improving operational effectiveness and control	<ul style="list-style-type: none"> <li>- Current Affairs</li> <li>- Standard Procedures</li> <li>- Recorded and documented structures</li> </ul>	<ul style="list-style-type: none"> <li>- Statements and news</li> <li>- Encoded program</li> </ul>

Both types of knowledge can be found in any organization with various strengths and weaknesses. The smart organizations or corporations are the learners and also instructors that are effective in creating, gaining and transferring both types of knowledge (Nonaka, 2009).

Totally, the most important parts of knowledge management are explicit and tacit knowledge (Panahi, 2008). Figures 4, 5 show the areas of explicit and tacit knowledge and the rate of their acceptability in the organization and corporation.



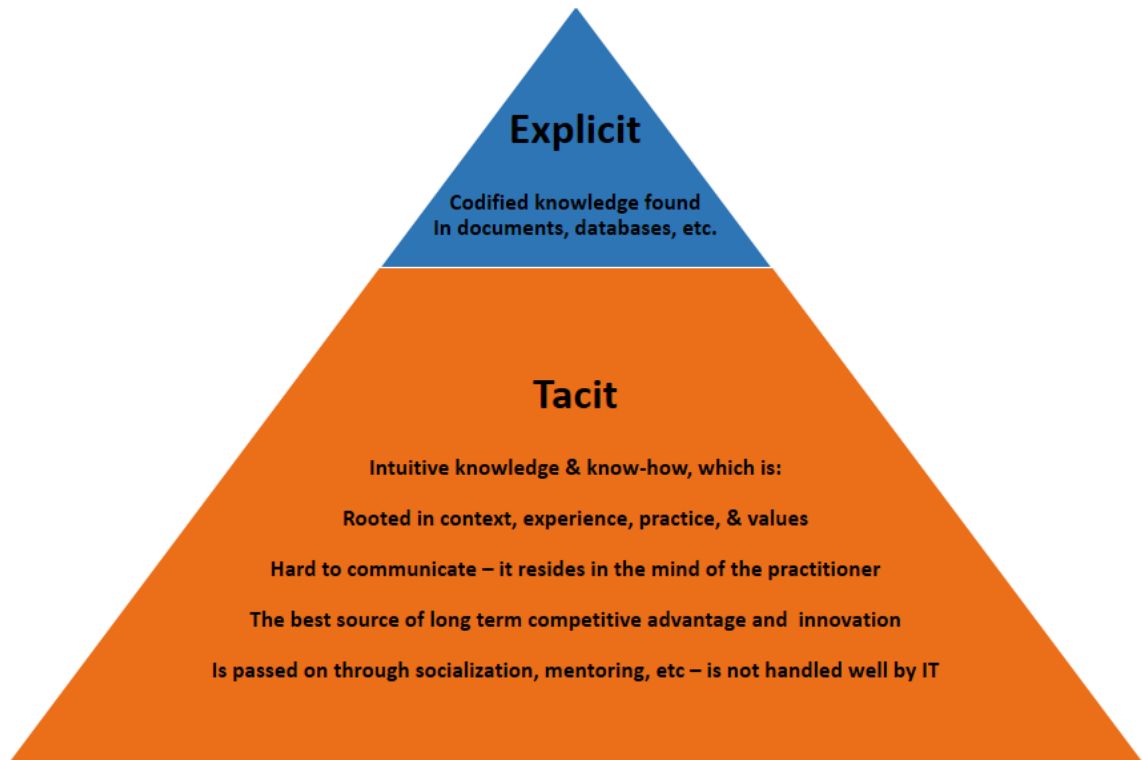


Figure 4. The areas of Explicit and Tacit Knowledge (Nonaka, 2009)

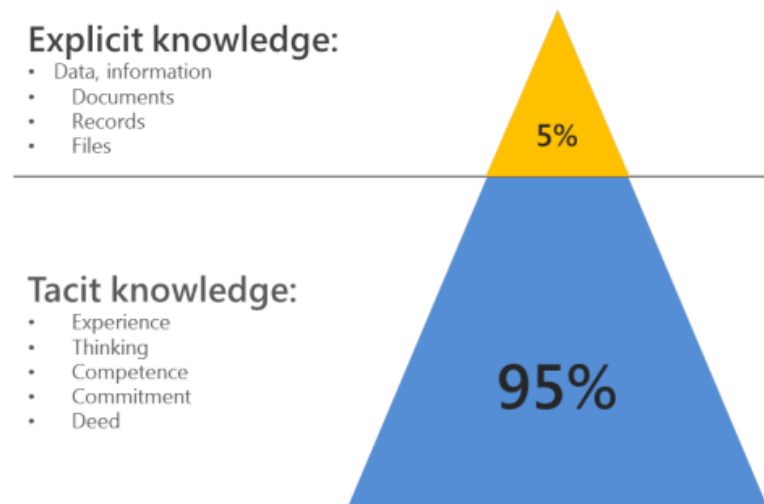


Figure 5. The Acceptability Rate of Tacit Knowledge (Nonaka, 1997)

#### 2.2.4 Dimensions of Knowledge Creation

Considering the literature on the importance and role of knowledge management, many studies have been done about how knowledge is created, and how knowledge

management process is managed. In order to distinguish between different types of knowledge, there are different frameworks.

According to the Nonaka and Takeuchi (N&T) method, the fundamental framework in the process of knowledge creation in organizations is referring to the “Ontological Knowledge Creation Dimension” and “The Epistemological Knowledge Creation Dimension” (Nonaka, 2009).

In the ontology dimension, there is the basic premise that knowledge is created by only person. It means an organization cannot create knowledge without its staff and the person. Therefore, organizations should support creative individuals or provide the conditions for them to create knowledge (Nonaka, 1997).

Organizational knowledge creation monitors the process that the organization expands created knowledge through it. Then knowledge will be crystallized as organizational knowledge networks across an entire organization or “Interactive community”. In the epistemological knowledge creation dimension, with regard to the distinction which Polanyi (2006) distinguishes between explicit and tacit knowledge, explicit or encrypted knowledge refers to the kind of knowledge that can be expressed and determined through systematic, significant and official language.

Tacit knowledge is for the specific situation and subjective; therefore it is difficult to formulate and exchange.

According to Polanyi (2006), tacit knowledge involves both cognitive and technical elements.

Cognitive element is based on what Johnson (1999) called “Paradigm”, with the assumption that conceptual models, such as the project schema, paradigm, vision, beliefs and viewpoints help people to understand and know the whole world.

On the other hand, technical element of tacit knowledge includes how to do the actual work, characters and skills. It should be noted that the cognitive element of tacit knowledge is based on the perceptions of person about facts and insights of the future.

In other words, “what is and what ought to be” and “mental models of the animation process” are key factors in creating new knowledge (Lopez, 2006).

### **2.2.5 Knowledge Chain**

Knowledge chain is infrastructure of operational definition of the knowledge management concept. There are four links in the knowledge chain that determine the uniqueness and longevity of every organization (Marwick, 2001). These four links are as a following:

- 1 -Internal awareness
- 2 -Internal responsiveness
- 3 -External responsiveness
- 4 -External awareness

Knowledge chain is a series of interactions that make the innovation cycle of each organization. Knowledge management creates permeability between the four links of knowledge chain and adds the pace of innovation in organization. Determining knowledge flow in the organization is done by these four links of knowledge chain. The advantage of knowledge management is the ability to quickly pass among these

four links of knowledge chain (Davenport, 1998). Figure 6 shows how knowledge moves between the four links of knowledge chain.

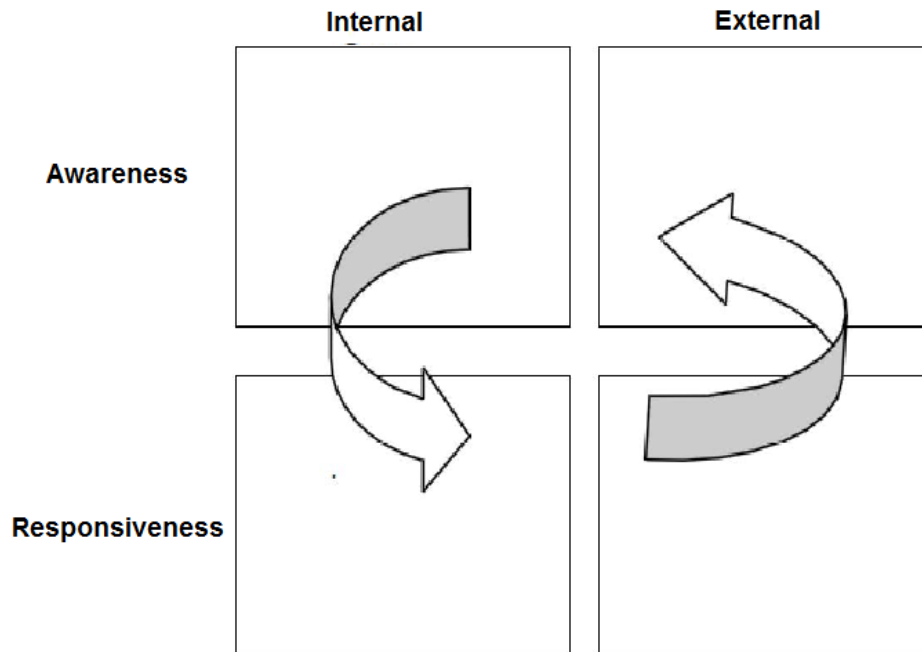


Figure 6. Knowledge Movement between The Four Links of Knowledge Chain (Marwick, 2001)

### 2.2.5.1 Internal Awareness

Self-awareness is the ability to rapidly assess the key skills and competencies. Internal awareness means knowing the history in terms of talent, know on how, the interaction process, groups and teams for thinking. Great emphasis on the functional structure of the organization which is common in traditional companies is the main obstacle to develop internal awareness. The organization or corporations that are based on task structure determine their key competencies in terms of products and services not in terms of skills (Capon, Farley, and Lehmann, 1992). Internal awareness is more formed based on this continuous challenge, what is done and what might be.

#### **2.2.5.2 Internal Responsiveness**

Internal responsiveness is the ability in operating internal awareness. The organization may well be aware of its strengths, advantages and market demand, but if it cannot effect on its internal changes to quickly respond to market demand, key competencies have been debated. Internal responsiveness considers this issue that how fast competencies will be measured in order for the products to enter market or the customer needs are solved (Darroch, 2003).

#### **2.2.5.3 External Responsiveness**

External responsiveness is the ability to meet market demands in the best possible way. The ability of organizations or corporations in this link of knowledge management than other competitors will determine their success or failure (Janeczak, 2001). External responsiveness will be measured based on the ability of organization in an effective and timely responding to external opportunities and threats. In fact, competitive advantage requires that an organization can respond to environmental conditions faster than its competitors (Darroch, 2003).

#### **2.2.5.4 External Awareness**

External awareness is a reflection of internal awareness. External knowledge is the organization's ability to understand, how the market perceps values of organization's goods and services that reveal who are the customers, what customers want, who are the competitors and what is their competencies and finally, market trends, competitors' actions and what are governmental regulations and other external market forces of organization (Barth, 2000).

When the external awareness comes with internal awareness, it may propel the organization into new markets. Internet is one aspect of external awareness that new business models are created through internet rapidly. Internet makes the great chance to provide emergency response to the market for new products (Lundvall and Nilsen, 2007).

### **2.3 Knowledge Management (KM)**

Now, after becoming familiar with the kinds of mental content such as data, information, knowledge, wisdom, and knowledge definition and kinds of knowledge of intelligent organizations, in this section, the definition of knowledge management will be explained.

Knowledge management is a vast and growing subject in project management area. Comprehensive definition of knowledge management is an extraordinarily difficult task and according to the different approaches and applications of knowledge management, it seems to be harder. Knowledge management is the identification, acquisition, extraction, organization, storage and transfer of appropriate knowledge in order to improve the perception and performance of staff at various levels of organization at the right time (Nonaka, 2009).

Actions and activities related to knowledge management help organizations to provide gaining, storage, transmission and utilization of knowledge for solving problem, dynamic learning, strategic planning and centralized decision. Furthermore, the knowledge management protects the organizations against intellectual and mental

property leaving when knowledge perpetrators and expert staffs go outside from organizations and corporations.

Competencies and skills that are among certain groups and people in the organization are developed and transferred among all members of the organization by knowledge management (Darroch, 2003). The majority of organizations do not know their needs because knowledge is within the mind of people.

Knowledge management is systematic effort of organizations or corporations to identifying, obtaining, storage and sharing of knowledge and developing the capacity and competence of individuals and different working groups in the organization. KM is the strategic management which guides mental and intellectual property of organization (recorded knowledge and abilities and also mental capacities of organization's members) in such a way that organizations achieve high efficiency and new values through the development and distribution of the properties among all members proportionally (Davenport, 1998).

Knowledge management discusses for all levels of organization, managers to employees about:

- How and in what way they can provide decent product and service for their customers?
- How and in what way the organization can be fed in terms of knowledge and information?
- How and in what way the skills, required knowledge and data can be provided from various sources and after that transmitted to those sources?

Although in the past organizations were relying on little personal knowledge who had high levels of knowledge, experiences showed those few organizations and corporations that considered to adding knowledge strategies as part of services that offered to their internal customers, benefited from the end of their competitive power in dealing with competitors (Nonaka, 1988). The important point to be considered is that organizational knowledge is not replaced with personal knowledge; and it just makes personal knowledge stronger and broader.

Using fully the knowledge base and potential of personal skills, competencies, ideas, innovations and ideas make the organization to be able to compete effectively in the future if organization knows how to identify its knowledge among its few people and provide required organizational knowledge for them (as internal customers). Hence, KM is important and useful tool for organizations or corporations to access their goals (Abbasi, 2007). Therefore they should try to learn what they do not know. Also, they have to design and implement the systems and appropriate processes given the existed opportunity of facilities and culture conditions.

In every organization, always there are valuable information and knowledge collections that are among individuals or specific groups. Existed knowledge must be identified and be recorded. According to existed evidence, this kind of knowledge is disappeared due to the staff departure or costs relating to the identification, storage and transport of knowledge. As a result, in order to perform tasks better, source of knowledge and information for providing the needs of staff's job can be used through the implementation and deployment of knowledge management. It can be used as a procedure to control the intellectual capital of organizations (Panahi, 2008).



The purpose of knowledge management is knowledge management preparation and control, individual and collective expertise and providing them for the various levels of the organization, systematically so that people who are in each part of organization can easily access them.

In the defend of the importance and necessity of knowledge management projects, managers and experts believe that knowledge management effectively minimizes the errors, eliminates frills, helps to accelerate problem solving, makes better decision, avoids extra research and development costs by reducing duplication in achieving knowledge, enhances customer relationships, improves the quality of goods and services and finally puts the organization multi-step ahead than its competitors (Moghadam, 2007).

However, implementing knowledge management projects in industry such as construction industry and other administrative sections may be different in terms of both form and content. In order to identify, acquire, store, analyze and organize staff's knowledge and expertise and making them available to all in everywhere and anytime, the nature of the measures and activities is same.

It should be mentioned that when it is talked about knowledge management, substantially the entire contents of the mental and intellectual the different levels of data, information, knowledge and wisdom and tacit knowledge and knowledge-based rules and laws should be considered as organizational knowledge. But organization cannot act in the same way for managing each mentioned organizational knowledge because all of them cannot be easily managed; this means identification, acquisition, organization, storage and transport of them are not easy (Nonaka, 1988).

Some of the mental contents especially those which are in the initial levels of cognitive are easy to be acquired, stored and transferred, however high levels of understanding mental structures will not be able to be identified, stored and transferred rather the initial levels.

As previously mentioned, whatever explicit knowledge closer to tacit knowledge, equally managing the knowledge to share will be more difficult and even is impossible in some areas, because when transferring of knowledge and information is discussed such transition is acceptable that after it, transferee finds same mentality (in terms of information and knowledge) that is required and possible within explicit knowledge area (Barden, 2008).

So it is not expected with adopting knowledge management, all existing intellectual property and intellectual capital of organizations, particularly in the areas of cognitive and intuitive as mentioned above, equally among all employees will be promoted according to their understanding and relationships easily and in a short time.

The knowledge management can submit exact information, knowledge and intellectual capacity and experience to people at the right time, using a combination of technology, tools, methodology and philosophy through storing them. Hence it can be recognized that two views of knowledge management exist that were mentioned above. The first view believes that information and knowledge as an object or thing which can be acquired and stored and transported (explicit knowledge and information) that this vision led to develop systems which encourage operating, collecting, storing and distributing knowledge (Marwick, 2001).

The second view considers knowledge as a process that is unique for each individual collection, storage and distribution (tacit knowledge), but what must be remembered about knowledge management is that the knowledge management is not an independent scheme; rather, a combination of various schemes that guarantee the knowledge acquisition, storage and distribution and the issue of how it should be done for each organization is unique and special.

Despite the variation in how operating the organization which can lead to different interpretations of knowledge management, there are two areas of knowledge management:

- **Learning:** This implies the vertical transmission of knowledge from top-down (especially when moving from one to other person), this means the transition from one person who has a lot knowledge to another one who does not have enough knowledge in specific job. Therefore in this area knowledge management is as a tool of learning.
  
- **Decision support:** making exact and real decision that needs true and correct information and knowledge. Knowledge management systems allow the organization to make the best decision and guide and support the organization in this way through making available information and knowledge in the required areas.

However, in order for decisions to be supported by knowledge management, all organizational information and knowledge should be filtered and purified (Carneiro,2000).

### 2.3.1 Knowledge Management Models

Knowledge management models imply a range of views that has been described in the literature. The models description can be used in structural and functional research of knowledge management. Also, models of knowledge management should be used with caution.

Selected models have been examined from different aspects and perspectives. In some sources of KM, three types of models have been introduced in this field: classification models of knowledge, intellectual capital model and model of social structures (Moghadam, 2007).

#### 2.3.1.1 Models of Knowledge Classification

These models consider knowledge as a separate element. As an example, Nonaka and Takeuchi (N&T) models are a representation of the high level of conceptual knowledge. Figure 7 shows the Nonaka and Takeuchi (N&T) models schematically (Nonaka, 2009).

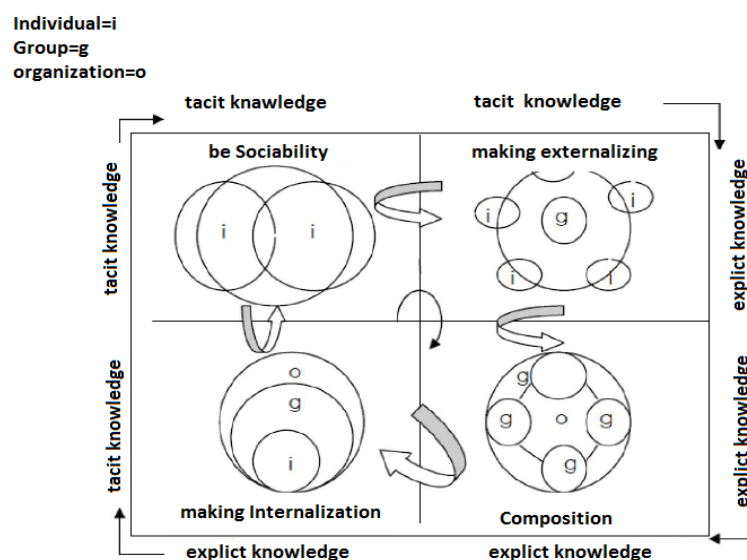


Figure 7. The Nonaka and Takeuchi (N&T) Models (Nonaka, 2009)

Based on this model, knowledge includes explicit and tacit elements. According to Polany (2006) description, tacit knowledge is the non-verbal expression and is not essential. Explicit knowledge is knowledge that is stated through writings, drawings, and paintings, computer programs, etc.

In this model, it is assumed that tacit knowledge can be transferred to tacit knowledge of the other person via community oriented process and then be turned to explicit knowledge through externalizing knowledge process (Gholizdeh, 2005). Also based on explicit knowledge, it can be changed to tacit knowledge through the process of internalization and can be turned to other explicit knowledge by compositing and distributing. However, transferring knowledge is much more complex than the simple matrix that proposed by Nonaka and is not easily interpreted by the new paradigm of knowledge management. An optimized version of this model is shown in Hedland & Nonaka model (H&M) (Nonaka, 2009).

According to H&M, four different levels of carriers or agents of knowledge exist in organizations (ontology-based) that include individuals, small groups within the organization or outside of it (customers, suppliers, competitors, etc.). Based on another model (Boisot model) organizational knowledge is divided to codified knowledge, developed, published and unpublished knowledge (Gholizdeh, 2005). Codified knowledge is created in order to transfer something such as financial data, knowledge and codified knowledge that is not easily transferable. Published knowledge is the same experience and is ready to be shared. Sharing unpublished knowledge is not easy.

If knowledge is not being codified and is not published, it will be considered as individual knowledge (personal perception, perspective, experience). Codified and unpublished knowledge is transmitted in small groups just based on “the need to knowing”. Codified and unpublished knowledge can be achieved through magazines, books, and the library.

According to Boisot, knowledge that is not codified and published are created during slow process of socialization, habits and intuition. There are many similarities between the model of Nonaka and Boisot (Sani, Nezafati, and Khadyvar, 2008).

Perhaps the newest model in this way is last model. This model states that personal knowledge is the starting point of organizational knowledge creation. Information is the raw material for individual knowledge which will form the basis of organizational knowledge.

As Davenport (1998) stated, personal knowledge emerges from the combination of information, interpretation, reflection and experience in a particular situation. In order to create organizational knowledge, individual knowledge (explicit and tacit knowledge) must be external. Organizational knowledge is created through the combination of these two dimensions of knowledge. Personal knowledge should be transferred to other individuals and groups to improve organizational knowledge. Transferring individual knowledge to the organizational knowledge is occurred by socialization, externalization, combination and internalization. This process can be occurred from person to person, from individuals to groups or within groups (Delaware, 2006).

Two later cases can be more effective for transferring knowledge. This conceptual model has six steps (Panahi, 2008):

- 1 - Creating a common vision about the meaning or purpose of knowledge development.
- 2 - Providing information.
- 3 - Creating an internal process for making personal knowledge.
- 4 - Transforming individual knowledge into group learning.
- 5 - Disseminating knowledge to other organizational levels.
- 6 - Practical aspects of knowledge.

Generally, these processes are examined transformation of knowledge, although some of the mentioned processes within it are mechanical and schematic.

### **2.3.1.2 Model of Intellectual Capital**

A number of models of knowledge management are classified in this category; the most popular model is the model presented by company Skandia. This model suggests a default with the scientific approach related to knowledge that could be a link between capital organizations (Eghbal and Esmaeili, 2008).

Skandia was the first company that considered activities and philosophy of the company's intellectual capital, in its annual report. Social aspects of knowledge management are ignored in this model. This model has a mechanical nature, and it assumes that knowledge can be same as other assets and with them as Figure 8 illustrates (Eghbal and Esmaeili, 2008).

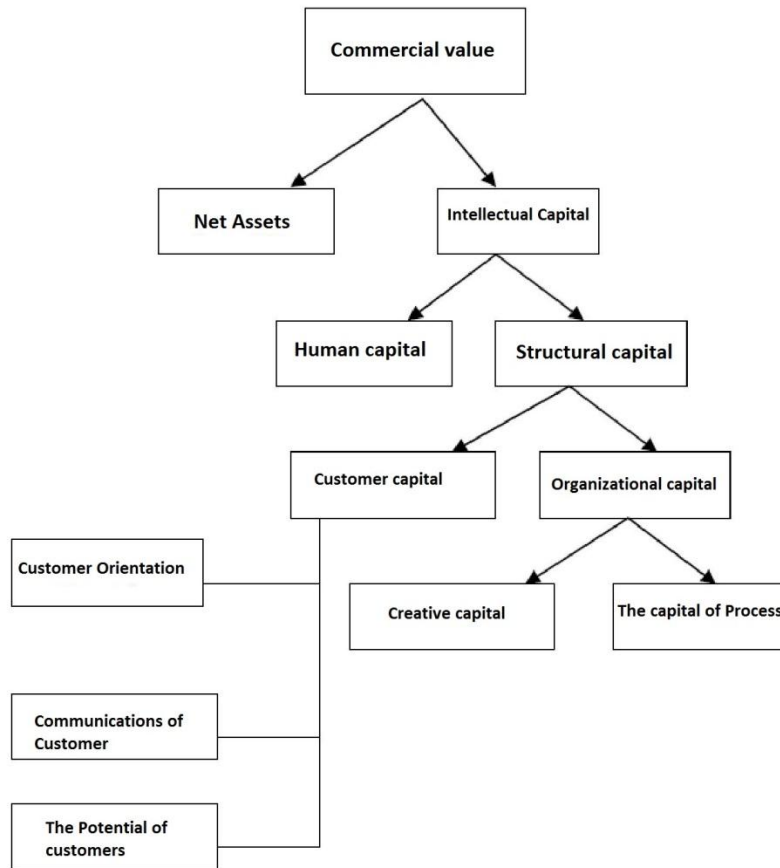


Figure 8 Model of Intellectual Capital of Knowledge Management Skandia (Eghbal and Esmaeili, 2008)

### 2.3.1.3 Models of Social Structure

These models are intrinsically linked with social and learning processes in organizations. Despite these models are extremely similar, they are trying to find the concept of the learning organization or organizational learning. Damerest's model (1997) is the type of these models. This model is focused on four keys of knowledge management as shown in Figure 9 (Moghadam, 2006).



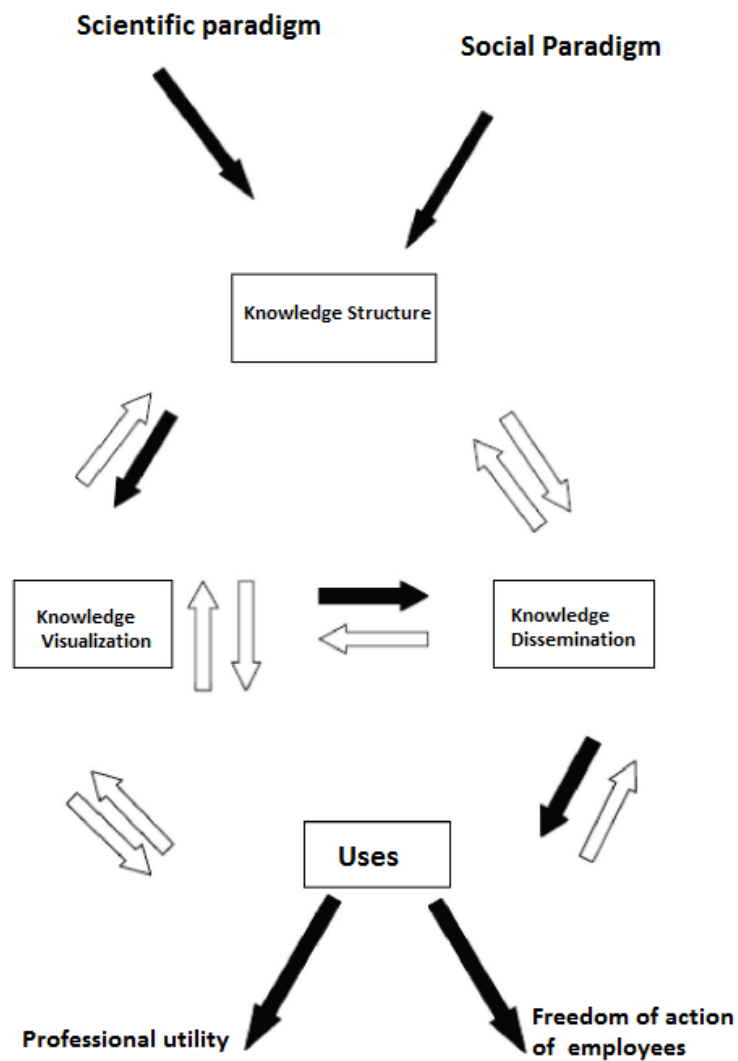


Figure 9. Damerest Knowledge Management Model (Moghadam, 2006)

Knowledge structure of the organization is not limited to just explicit scientific knowledge of organization; it also includes social structure of knowledge management. The default of this model states that knowledge structures in the organization are not provided through explicit and objective programs; it can also be the result of social exchange process (Foappalo, 2006).

There is the process of supporting the dissemination of knowledge and organizational environment. Economical uses of knowledge from organizational outcomes are other

keys. Black arrows indicate the direction of the main flow while white arrows in the back show periodic returns and repeatable flows (Foappaolo, 2006).

This model does not cover all the concepts of knowledge, but it has the general approach to the structure of knowledge. The section related to "Use" of this model is limited to the organization outputs. This factor can be considered as complementary, it is not considered mutually exclusive. Double arrows indicate the knowledge management process is not simple and linear (Marwick, 2001).

Social structure of knowledge is an essential part of knowledge management. Success in this area is identifying what is known as knowledge in the organization and how the growth of knowledge and employees. N & T called this part of knowledge management "organizational knowledge creation".

First paradigm reveals practical perspective of knowledge or "view of the fact" that is here as rational and wisely facts and rules (Marwick, 2001).

Second is about what related to social paradigm of knowledge structure that can be formed based on interactions between staffs in terms of social structure. Knowledge structure in terms of scientific and social paradigm should be considered as part of the organization's knowledge management in visualization and dissemination of knowledge area. Many organizations may fail in visualization and dissemination of knowledge because they just consider the approach of scientific paradigms and the paradigm of social knowledge structures (Bhatt, 2001).

In this model, the main goal of knowledge management is "use". Damerest described the use as "Generate commercial value for the customer " while Wilkinson and Willmott (W&W) stated that the method of improving trade should be developed to achieve mutual supporting goals related to developed business and productivity of employees (Marsh and Jones, 2002).

Creativity and innovation are the key benefits of using knowledge management. Henry and Walker (H&W) made the link between creativity and innovation to the "new knowledge" or "knowledge of the new structure" (Bhatt, 2001).

New knowledge can be scientific, technical or social. Profit and benefit of employees can be included to give them dignity. Peters (2007) has spoken about "professional standing" of workers. Also in this case, increasing autonomy (freedom of action), inherent advantage and learning are the results of implementing knowledge management. Modified version of Damerest as a useful model for the study of representation and implementation of knowledge management is in the public and private sectors. Key areas of the model indicate knowledge management approaches in both the public and private sectors.

## **2.4 Nonaka and Takeuchi (N&T) Model**

N&T model is one of the most cognitive models (Nonaka, 1997). Japanese researchers of N&T model have a significant impact on knowledge management topics. The concept of tacit knowledge and explicit knowledge by N&T for planning organizational learning theory is classified.

Using this classification, considering the convergence between different forms of knowledge, they have established a model that is presented to their name. This model focuses on both implicit and explicit knowledge and how to convert them to each other and also how to make them at all organizational levels (individual, group and organizational), unlike other models of knowledge management. In this dynamic model, how to convert these two types of knowledge and how knowledge managing in this relationship is assumed in the form of the spiral (helical) an ongoing process (Nonaka, 2009). Figure 10 shows the spiral science that is used within N&T model.

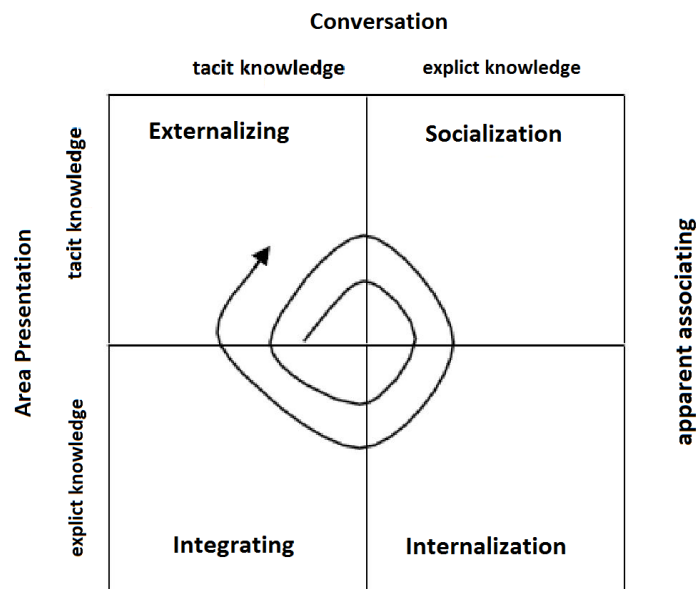


Figure 10.Spiral Science (Barth, 2000)

It is assumed in this thinking that only people can create knowledge Therefore, the process of creating organizational knowledge should be a continuous process where the knowledge created be strengthened and guided by individuals, organizationally (Barth, 2000).

## **2.4.1 The Trends of Creating Knowledge in N&T**

According to N&T, in order to transfer two types of knowledge, following steps must be done in different levels of the organization including socialization, externalization, combination and internalization (Nonaka, 1997).

### **2.4.1.1 Socialization-Tacit to Tacit**

In order to transfer knowledge of non-visible individual to the other one (How to solve the problem of the program – designed unusually), common culture and teamwork abilities should be created between individuals. This is possible using the theory of social cooperation. Meeting for a group to explain and discuss their experiences is a common activity which sharing tacit knowledge can be occurred (Polany, 2006).

### **2.4.1.2 Externalization-Tacit to Explicit**

It is non-observable to observable knowledge process. In this case, person can provide his knowledge to others in the form of ordered materials (seminar - workshop) and usual activities, such as conversations between members of a group in order to ask questions or withdraw from the event (Lopez, 2006).

### **2.4.1.3 Combination-Explicit to Explicit**

Integrating is the process to formulate concepts in the form of knowledge systems. This way of knowledge conversion covers issues such as the integration of various forms of explicit knowledge. People can exchange and combine knowledge by tools such as documents, meetings, telephone conversations or computer-based communication networks. With reconfigurable available information and data by

regulation, collect, collate and classify tacit knowledge - in the same way that is done by a computer database - new knowledge can be gained (Davenport, 1998).

The creation of knowledge that is applied in formal education in schools usually looks this trend. In the business context, often the trend of knowledge integration can be achieved that middle managers examined and assessed their common view, business concepts or generating hypotheses and then implementing them (Lopez, 2006).

Middle management plays the main role in the introduction of new concepts with coding information and networking knowledge. Effective use of computer networks and information databases with large-scale allows this kind of knowledge to be happened. At senior management level, incorporation trend can be achieved when the medium-range concepts (such as hypothesis generating) in terms of general concepts (such as organization view) are consolidated and integrated to infer that new meanings of the second case (Alagheband, 2006).

#### **2.4.1.4 Internalization-Explicit to Tacit**

Internalization is a process in which tacit knowledge is embodied in the form of explicit knowledge. When experiences are made internalization based on shared mental models or technical expertise through socialization processes, they will become valuable inventories. For converting the explicit knowledge to tacit, formation or speech knowledge is extremely effective in the form of documents, leaflets or oral method. Documentation of explicit knowledge makes people internalize their experiences and improve their tacit knowledge (Darroch, 2003).

In addition, documents or handouts make easy transferring explicit knowledge to other people and assist them in gaining directly experience of others. Experiences of other people can be realized through the socialization process. For example, when reading a novel makes some of the members understand the reality and nature of the story, experience may be converted to tacit mental model (Foappaolo, 2006). When many members of the organization have such a model in their mind, tacit knowledge becomes as a part of the organizational culture.

The previous four steps continue in forms of spiral trend continually. So that, each step completes previous step and creation of knowledge will be done while knowledge becoming institutionalization. It should be noted that each of these two kinds of knowledge should be managed; interactions, uses and converting to each other should be identified and used. Each of this knowledge can be the origin of creating other one and be spread at the individual/group/organizational levels. Another key point is that when people are involved in this process, organizational learning will be occurred. Because of people's knowledge sharing, describing and providing; the new knowledge will be generated. Examples of different forms of knowledge conversion process to each other are given in Table 2 (Alagheband, 2006).

Table 2. Different Forms of Knowledge Conversion Processes to Each Other (Alagheband, 2006)

<p>Tacit to Tacit (socialization)</p> <p>As meetings and discussions as a group</p>	<p>Tacit to Explicit (exterior making)</p> <p>As discussion within the group, answer questions</p>
<p>Explicit the Tacit (internalization)</p> <p>As learning to read, hearing a report</p>	<p>Explicit to Explicit (compound)</p> <p>As sending a report via the e-mail</p>

It should be noted that this process is taken place in various combinations and in position between people who work together. Knowledge creation is the result of interaction between individuals and tacit and explicit knowledge (Moghadam, 2007). Tacit knowledge will be externalized and shared through interaction between people. In this process, people create, disseminate and internalize knowledge while gaining organizational insight and experience.

#### 2.4.2 Advantages of N&T Model

Unlike other knowledge management models, this model focuses on both tacit and explicit knowledge and how to convert to each other and also how to make it at all organizational levels (individual and organizational). Perhaps the most significant advantage of this model is knowledge management. In this model, how to use these two types of knowledge and convert in to each other and how to manage the knowledge have been imagined as a spiral (helical) action and a continuous process. The N&T model does not just create the knowledge but also transfers the knowledge; hence, among all existing models for knowledge creation, N&T model has been considered more (Nonaka, 2009).



## **2.5 KM Applications**

KM applications are based on the model which believes that the primary role of KM is the knowledge sharing in the organization so that each individual and group understand the depth and content of knowledge to use it effectively in decision making and innovation. Four applications of KM are (Foappaolo, 2006):

1. Intermediation
2. Externalization
3. Internalization
4. Cognition

Each of these applications emphasizes on a specific subject, but if it is integrated with other applications, it will be in the best situation.

### **2.5.1 Intermediation**

Intermediation is the link between knowledge and people. Intermediation is the bridge between those seeking certain sectors of knowledge and those who can provide that sectors of knowledge. It is an essential step in the internal and external responding, and its role is connecting the researcher to the optimized personally source or sources of knowledge. There are two kinds of intermediation: synchronous intermediation and asynchronous intermediation (Alagheband, 2006).

Asynchronous intermediation is accrued when the externalization and internalization do not take place in a same time. In this case, an external tank saves the knowledge during its transferring. Most of the time knowledge is stored in the knowledge base before is needed in a part of the organization. When a seeker of knowledge needs it,

the knowledge base will be searched, and knowledge will be mind. Such an approach is more suitable for explicit knowledge. Synchronous intermediation is accrued when the externalization and internalization take place in a same time. While transferring, knowledge is not stored so the knowledge provider and knowledge seeker will engage in a direct communication. The main challenge is to coordinate the seeker with the provider of knowledge at the right time (Foappalo, 2006). This approach is used in the transfer of tacit knowledge.

### **2.5.2 Externalization**

Externalization is the connection between knowledge and knowledge. Externalization is the process of knowledge storing in an external tank and its organizing. Having a map or structure of knowledge can facilitate knowledge discovery. In most organizations, their efforts have focused on how to obtain knowledge from knowledge management systems, and only a few of them consider how to enter the knowledge in to these systems. A knowledge management system is such as an eco-system, it cannot be operated continuously without continuous refueling. Externalization consists of two main parts: gathering and storing the knowledge in a proper storage and classification and organization of knowledge (Jhonson, 1999). The gathering and storing of knowledge can be as a database, a video or a document. The storage should be appropriate for the type of knowledge. The classification and organization of knowledge is more difficult than two previous steps because the knowledge classification in the most effective way depends on the knowledge of the provider. Its objective is making the knowledge understandable for the knowledge seeker in the most efficient way.

### **2.5.3 Internalization**

Internalization is the link between knowledge and searching. The internalization method consists of extracting knowledge from an external tank and adjusting it with the knowledge of seeker. The internalization has a close relationship with the external knowledge storage and base on the seeker's question, the knowledge base is transformed (Barden, 2008).

### **2.5.4 Cognition**

The cognition is the connection of knowledge to the process. Recognition is the process of taking decisions based on existing knowledge. This application of knowledge is exchanged through three previous ones. In its simplest form, the cognition is achieved in dealing with an unconventional event, opportunity or challenge and also through the use of experience to reach the best possible outcome (Marwick, 2001).

## **2.6 Summarizing Other Related Articles**

Carneiro (2000) has considered the relationship between knowledge and innovation. The study tested the role of KM's capacity in relation between human resource practices and innovation from the perspective of KM. This research used the regression analysis to test the hypotheses in 146 industrial companies (Carneiro, 2000).

Knowledge management involves three stages: acquisition, sharing and application of knowledge in relation to innovation which includes administrative and technological innovation. Results indicate that strategic human resource practices

impact positively on knowledge management and ultimately knowledge management has a positive impact on firm innovative performance. The results provide evidence for the KM's capacity to have a mediating role in the relationship between strategic human resources and innovation (Marsh and Jones, 2002).

The application of this paper's results is that managers should manage the human investments of the organization actively through various strategic human resources management in order to encourage the organization to acquisition, sharing and application of knowledge. In addition, higher levels of KM can make creative and innovative thinking which ultimately lead to better innovative performance (Carneiro, 2000).

Darroch (2003) in other study examined the impacts of the individual factors (enjoyment in helping others), technical factors (the use of technology and communication information), and organizational factors (top management supports and organizational rewards) on the process of knowledge sharing and whether they are transformed to the company's innovation ability.

Based on the investigation in 172 staffs of 50 huge organizations in Taiwan (this study used structural equation modeling (SEM) to examine the research model), two personal factors (pleasure in helping others and enjoy the ability of knowledge for others) and one organizational factor (top managers' supports) effectively have an impact on the process of knowledge sharing. Also, it showed that the employee will be able to improve the company's ability to innovate through distributing and collecting the knowledge. Feeling competence and self-confidence is another need of the employee to make them eager to share their knowledge. Finally, this research

suggested that innovation involves an extensive process of knowledge sharing which helps the organization to use the ideas, procedures, processes or services. This research considered the positive role of organizational culture in improving the innovative abilities (Darroch, 2003).

Bhatt (2001) tested the relationship between organizational competition and innovation improvement of KM, and provided a set of attachments presenting how these relations influence on strategic management and the setting of competition's strategies. In order to show how knowledge improvement relates to the personal features and individual improvement, this essay created a professional view of the relationship between innovation and competition. These attachments show the importance of knowledge management in ensuring the competitive advantage. In other words, KM is ensuring the competitive advantage, and these competitive activities cause some innovative improvements in organization. The research suggested the conceptual model of the relationship between KM, competitive advantage and innovation. Also, it focused on the importance of the employees as an effective factor in promoting innovation goals. In this article, KM had influences on innovation through two ways: creating competition and the information obtained from the markets (Bhatt, 2001).

In another study, Lundvall (2007) provided a model which claimed that organizational insight would offer an instruction to create knowledge that finally support the organizational innovation. This model causes the organization to be able in integration and usage of knowledge. This model is a cyclical and algorithmic model which is different with other linear ones, and all of its components are connected to each other. The aim of the relevance of the insight in this model is

making the sense of belonging in employees to identify themselves as a part of larger group during their performance and daily duty. This encourages employees to perform tasks more motivated. Having the shared insight unifies the various identities of organization and combines the different actions of business and provides guidelines for necessary actions. Insight sets an instruction for KM which includes facilitating development, integration and application of knowledge (Darroch, 2003).

Establishment of such networks needs establishing new information and new communication structures. The new informational structures are such as, Internet, Intranet and Extranet. Because these systems are limited in transmitting the explicit knowledge, creating the communication structures such as internal and external meeting areas which make the face to face communication possible, is so necessary. It also helps to make the commitment and constructive attitude which ultimately will strengthen the organizational insight.

In this model, in addition, all the steps mentioned such as insight, KM, making networks and communication structures, new information, commitment and constructive attitude of employees are relating to each other rotationally, each one directly relates to the innovation which is the heart of this model (Lundvall and Nilsen, 2007).

Nicolas (2004) in his survey sought to determine what extent KM influences on the decisions which are effective in strategic situations. In order to find out how companies use the KM method, KM strategies of 49 companies were considered. According to the results of Hans and coworkers (1999) knowledge management

strategies used in this study consisted of technical strategies, identify integration and socialization.

Also to evaluate the impact of these strategies on the decision-making process, 14 types of decision-making were analyzed. This process is based on Simon's model which consists of three phases: knowledge, perception and selection. The results of this study suggested that different types of knowledge and KM strategies in various steps of decision-making play different roles. So the technical strategies are more effective in providing timely information. In fact, this approach is the presenter of the organization's role in information processing (Carneiro, 2000). Based on this approach, the capability of the information processing in the organization is majorly dependent on the ability to overcome the uncertainties. In contrast to it, the socialization helps people to have the common perception of strategies and decision-making. The communication networks development throughout the organization helps the innovation and collective consciousness to be expanded. This collective consciousness is the result of ethical divergent that effects on the decision-making process in providing the strategic options. This strategy in the perception of the decision-making process is so considerable. In fact, perception is the result of collective consciousness.

The characterization strategy not only creates the collective consciousness for judgment in decisions but also creates a collective vision or insight. This insight comes from sharing experiences and tacit knowledge through direct exchanging. As the result of this process, members can achieve the collective understanding of informal decision making process that could be the basis of "knowledge". This strategy suggests that setting the strategy and its implementation are not considered

separate from each other. Based on the results, 82 percent of the company to share ideas about the problem and its definition use the face to face meetings (informal) (Nicolas, 2004).

Marsh and Jones (2002) asked 60 volunteer companies to give their views on the organization of knowledge, how it is created, organized and made available, shared and used. Volunteer interpretations were categorized as cultural, organizational, technological and learning. In the cultural aspect, resistance to change was introduced as the major obstacle for implementation of KM (Marsh and Jones, 2002).

According to the volunteer's observations, the appropriate practical suggestions include preparation programs to support change, inclusion of beliefs and values related to knowledge as an educational program, survey on transferring of knowledge in communication networks rather than hierarchies in order to improve the cultural aspect in the implementation of KM strategies (Capon, Farley, and Lehmann, 1992).

In structural aspect, the employment strategy development was planned based on the expertise and skill in career and also the long-term consequences of financing from abroad. In learning aspect also the volunteers emphasized on the informal learning promotion as a tool for KM development, providing the advice program and creating some systems to access the expertise as a learning environment facilitator. In the technological aspect, the use of technology in the cultural context and institutional processes was suggested in order to implement KM programs and create the dialogue rooms and discussion groups with clear objectives (Marsh and Jones, 2002).



Janeczak (2001) analyzed 59 examples of projects that had been undertaken by 41 middle managers. All activities of middle managers in integration of knowledge were analyzed by qualitative methods. The results of this research indicated that middle managers play three principal roles such as problem solver, the entrepreneur and negotiator while implementing projects. The middle managers deal with three steps to reach their goals:

**Start stage:** At this stage, middle managers identify the key factors while considering awareness of needs and issues.

**Development:** In this step, in addition to interact with members, the middle managers provide the necessary resources for the development and identify the various solutions for the problem.

**Final stage:** In this stage, the middle managers implement the decisions taken in the previous step and evaluate the results. The middle managers play three main roles in these steps such as analysis, innovative management and pragmatic management (Janeczak, 2001).

Totally, the considering to the study and investigation on knowledge management indicates the importance of this part of management in organizations. As the construction industry is one of the main industries, in this study the application, situation and importance of knowledge management in construction industry are considered.

According to the lack of the knowledge management in developing countries such as Iran, this study focuses on the municipality of Mashhad as one of the greatest construction organizations of Mashhad. Also based on the literature review, the advantages of Nonaka and Takeuchi (N&T) Model are more considerable than the other models in governmental organizations so in this research the impact of the Nonaka and Takeuchi (N&T) Model in Municipality of Mashhad is considered.

## **Chapter 3**

### **RESEARCH METHODOLOGY**

#### **3.1 Introduction**

History of the last century shows the countries which have paid more attention to the survey and research and have done it more seriously are successful in dealing with the problems in management. They also have considerable economic and industrial improvement and have been able to provide the relative prosperity to their community members. Study is a group of processes in order to create a new link between experience and theory, so it requires an understanding of the origins of the methodology.

#### **3.2 Type of Research**

In general, research can be divided into two categories, fundamental and functional. The fundamental research deals with the knowledge production for more understanding and the functional research deals with the knowledge production for more acts. In other words, the fundamental research is associated with theoretical subjects and the functional research is related to the social and practical topics (Gholizdeh, 2005).

According to this definition, this research is also functional research because it reviews the level of KM and focuses on the knowledge in some parts of Mashhad

municipality. Since this investigation tries to study the attitudes of employees and managers through the questionnaires, it is a survey research.

### **3.3 Definition of the Study Population**

Sampling is the selection of a number of people, events and objects as representative of a defined population. The definition of the population study –according to most scientists- is the selection of the real or imagined members that the research is interested in applying his data to them (Lopez, 2006). The advantage of selecting a sample from a population is to avoid wasting time and saving financial resources. Through the study of a relatively small sample and the correct implementation and acceptance of small sampling errors, the results achieved will be approximately correct. The first step in sampling is to define the target population. In most cases, the set of points such as the importance of the ability of generalization, research interests and availability of resources affect population selection (Delaware, 2006).

So with regard to spatial and temporal scope of the research survey, the study population consists of all managers and employees in Mashhad municipality's departments such as transportation department, urban services department, civil and technical department, architecture and urban planning department, social and cultural department, administrative and financial department, planning and development department. According to the received list of the Mashhad municipality's personnel, there were 292 managers and experts in the organization in spring 2013. Study population was selected based on the nobility about the issues of organization and seeing events with a systematic view and also be able to spend time for this aim. The questionnaires were distributed among the managers and experts of the municipality.

### 3.4 Sampling Method and Volume of Sample

A further problem faced by researcher in planning the study was the size or volume of the sample. Generally, in this case determines the maximum size of the sample. The purpose of this study is data collection about the selected sample, so the larger size of the selected sample, the statistical indicators will cause more accurate estimation of population's parameters. But very large sample requires spending a lot of time, high cost and having skilled human resources. Hence, in many cases, it is hard to have such a choice of sample (Delaware, 2006). In this investigation, the study sample size was determined by using the method of Morgan (Krejcie and Morgan, 1970); so according to the 292 members of the population, the sample consists of 165 members. After determining the minimum size of the required sample, the random sampling with classification and proportional allocation was used to select samples. The Table 3 shows the results of this part.

Table 3. The Sample Size and Target Population

	Area	Population size	Sample size
1	Municipal services department	27	15
2	Cultural and social department	16	9
3	Planning department	37	21
4	Engineering and Construction department	41	23
5	Transportation department	10	5
6	Administration and Finance department	113	64
7	Architecture and Urbanism department	48	28
	Total	292	165

### **3.5 Research Variables**

The variable is a concept which has two or more numbers or value. In other words, the variable refers to a feature that can be observed or measured with a value or number and also more data can be replaced with them. Number or value assigned to each variable represents a change from one person to another or from one state to another state (Marwick, 2001).

The variable has been divided into two categories according to its role in the research: independent variable and dependent variable. Independent variable is a variable that is measured, manipulated and chosen by the researcher to determine the influence of its relationship with other variables. The dependent variable is observed or measured to determine the effect of the independent variable. The independent variable can predict the dependent variable. It can be said that the independent variable is the default of the dependent variable. In other words, the independent variable is the introduction and dependent variable is the result (Delaware, 2006).

The independent variable of this survey is the eight levels of the N&T model such as individual tacit knowledge, converting individual tacit knowledge into individual explicit knowledge, individual explicit knowledge, converting individual explicit knowledge into collective explicit knowledge, collective explicit knowledge, converting collective explicit knowledge into collective tacit knowledge, collective tacit knowledge, converting collective tacit knowledge into individual tacit knowledge. The dependent variable of this research is the state of the organization in KM (Sani, Nezafati and Khadyvar, 2008).

### **3.6 Data Collection Methods**

Most of researches in the humanities field were done by graduate students uses two methods for data collection. The first method is the procedure library which provides the second-hand information. It means, the researchers refer to books, magazines and websites to achieve data acquired earlier by other researchers. The second method is the field method that is the process which the researchers achieve the first-hand information through the proper tools. This information is specific to the researcher's investigation (Sarokhani, 2005). Obviously, in the current research both of these two methods were used.

#### **3.6.1 Data Collection Tool – Questionnaire**

Question is the basis of questionnaires. The questionnaires must indicate the aim of research by converting the objectives into questions. Answers to such questions will provide the necessary information to examine the researcher's hypothesis. Questions should be able to encourage the respondents to give the necessary information. All types of questions (closed, open or contingency) should be prepared according to the hypothesis because the hypothesis is the basis of the questions. The close questions provide a set of answer and ask the respondent to select which is more matched to his view.

##### **3.6.1.1 Components of Questionnaire**

The questionnaire of this research consists of three parts:

**The letter:** in this part, in addition to the introduction of research and topic, the researcher's intention was presented. Also, the researcher appreciated the good assistance and cooperation of respondents.

**Personal information:** this part was designed to collect the personal characteristics of the respondents and mostly it was used for descriptive statistics. These questions include the name, age, gender, educational level, organizational unit, organizational position and work experience in the municipality of Mashhad. It is obvious that the completion of this section was optional.

**Technical questions:** the final section of the questionnaire includes technical questions which were designed to collect data for testing hypotheses, and hence mainly deals with inferential statistics. A sample questionnaire is included in the appendix.

The questionnaire consists of two types; one is about the level determination (value) and the other one is offering solutions (weight). The level determination questions examined the state of an indicator in the municipality which finally showed the total status of the organization based on the indicators. The solutions offering questions determine the importance of each indicator in improving the knowledge management's status. It is noteworthy that the aim of this study is to determine the level of knowledge management in Mashhad municipality; also the second part indicates the criteria which effect on the improvement of status of knowledge and knowledge management in this organization.



### **3.6.1.2 The Level Determination Questionnaire (value) in the Organization Based on Eight Levels of N&T Model**

Regarding to the effective factors and indicators in each level of the N&T model, some questions were analyzed to identify the state of the case study in these levels. This questionnaire consisted of 63 questions and is provided in Appendix.

### **3.6.1.3 The Solution Offered Questionnaire (weight) in the Organization Based on Eight Levels of N&T Model**

The solution offered questionnaire determines the importance of the indicators of each level of the N&T model in organization. Therefore, by this questionnaire, the level of the importance of various factors in each of eight levels of the N&T model was classified. Clearly, investment on the high weight indicators is more effective than others.

This questionnaire was prepared for each eight parts of the N&T model and consists of 50 questions on value. In this survey, questionnaire was prepared to collect data. The closed questions were used based on Likert format. Particularly, the Likert format uses the basis of extremely low, low, medium, high and very high. Respondents present their level of agreement or disagreement with various statements, and then the responses are summed. Table 4 shows the analysis of the responses to each of the above cases which get the specific score. Likert spectrum is classified levels in surveying and is shown in Table 4.

Table 4. Likert Spectrum in Classified Levels in Surveying

Options	Very High	High	Average	Few	Very Low
Score	5	4	3	2	1

#### 3.6.1.4 Reliability of the Questionnaire

Reliability is an index which identifies the amount of the errors variability of the measurement tool. The error variability means the lack of ability of measurement tool to calculate the facts in different times and recognize the similar facts at one time and measure the transformations. Even if the changes in responses are due to the absence of respondent's mind, the performance of measurement tools is still being questioned.

In the present study, Cronbach's Alpha method was used to assess the reliability of research. For this aim, based on the gathered data and using the SPSS software, the Alpha was measured. Since the value of Alpha was 91.46 % and the standard is 92.57%, it can be argued that the questionnaire has high reliability. In other words, if the mentioned questionnaire is considered by other researchers in different times and places, the same results will be gained.

### 3.7 Analysis Method

In order to analyze the survey, both manual way and software were used. All steps done to analyze the output of questionnaire survey are described in the following sections.

#### 3.7.1 Software Used

In this research, the Microsoft Office Excel 2011 was used to display the frequency of data, and SPSS software was used to measure other statistical parameters.

### 3.8 Tools for Analyzing the Results of the Questionnaires

This section describes the general tools and methods to analyze the results of the questionnaires.

#### 3.8.1 Techniques to Determine the Overall Status of Society

A- In this technique, each question was calculated by the following values (Delaware, 2006):

$$\bar{X}_i = \frac{\sum_j X_{ij}}{n} \quad \text{Eq. 1}$$

$$\bar{W}_i = \frac{\sum_j \bar{W}_i}{n}, \quad i = 1, 2, \dots, m, j = 1, 2, \dots, n \quad \text{Eq. 2}$$

B- The normal points gained from the organization were calculated as following:

$$V_k = \frac{\sum_i \bar{X}_i * \bar{W}_i}{\sum_i \bar{W}_i} \quad \text{Eq. 3}$$

The amount of “V” is between 1 and 5.

Variables used in these tools are as following:

$X_{ij}$ : the value of the question “i” in view of person “j”

$W_{ij}$ : the weight of the question “i” in view of person “j”

M: the number of questions

N: the number of samples

C- The state of the organization was determined by focusing on the knowledge as following:

Score 1-2: Knowledge turbulence

Score 2-3: Knowledge awareness

Score 3-4: Focus on knowledge

Score 4-5: Knowledge management

### **3.8.2 The Techniques to Determine the Status of N&T Model’s Levels**

A- All questions were classified in various groups in this technique:

1. Markers for interpersonal skills’ knowledge level.
2. Markers for detection level of individual tacit knowledge.
3. Markers for individual explicit knowledge level.
4. Markers for how to convert the individual explicit knowledge into organizational explicit knowledge.
5. Markers for organizational explicit knowledge.

6. Markers for how to convert the organizational explicit knowledge into organizational tacit knowledge.
7. Markers for organizational tacit knowledge level.
8. Markers for how to convert the organizational tacit knowledge into individual tacit knowledge (Sarokhani, 2005).

B- For each mentioned group, the normal score was calculated as following:

$$V_k = \frac{\sum_i \bar{X}_i * \bar{W}_i}{\sum_i \bar{W}_i}, \quad i \in k, k = a, b, c, d, e, f, g, h \quad \text{Eq.4}$$

The amount of “V” is between 1 and 5

C- According to the scores, groups were prioritized as follows:

Score 1-2: Knowledge turbulence

Score 2-3: Knowledge awareness

Score 3-4: Focus on knowledge

Score 4-5: Knowledge management

### **3.8.3 Techniques to Determine the Problems**

A- According to the priorities of technique 3.8.2, there are some tables for each group. The problems are identified, as Figure 11 illustrates.

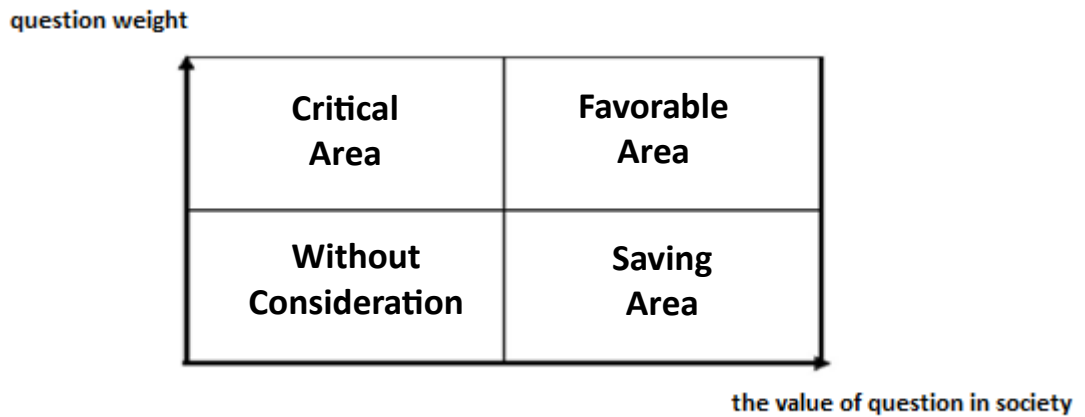


Figure 11. Identifying Problems (Sarokhani, 2005)

In each table's cell, a question is located corresponding to each group. The above vertical axis indicates the weight of each question and the horizontal axis refers the value of each question. For example, the points located in the critical area of the above table are the points with high weight and impact in the organization.

B- Regarding to the status of various points in the above table, improvement projects in the organization can be defined. In the solutions offered section, the relations of the average standard deviation is used in order to use the results of the study and commented on the variables of interest (Delaware, 2006).

## **Chapter 4**

### **DATA ANALYSIS**

#### **4.1 Introduction**

In this chapter, the data collected by questionnaires have been analyzed. After submitting the questionnaire to be completed by seven different departments of Mashhad municipality, it is commented about each hypothesis through appropriate tests.

#### **4.2 An Analysis of Results**

According to the 292 members of the case study, the survey population was decided to be 165 respondents based on the Morgan's method (Krejcie and Morgan, 1970). The sample size was shown in Table 3 based on the population of each of the seven departments. The questionnaires were distributed among experts in the field randomly. Unfortunately, the returned questionnaire rate was lower than the specified rate of sample size in Morgan's procedure. Table 5 shows the relation between distributed questionnaires and rate of the returned questionnaires by the related departments which has been analyzed by the researcher. The statistical results based on departments are shown in Table 5 and Figure 12.

Table 5 Statistical Results of the Distributed Questionnaires

Row	Department	Population statistical society	The sample size	Abundance	The percent of abundance	The rate of return
1	Municipal services	27	15	13	11%	86.67%
2	Cultural and Social	16	9	5	4%	55.56%
3	planning	37	21	16	14%	76.19%
4	Engineering and Construction	41	23	15	13%	65.22%
5	Transportation	10	5	5	4%	100%
6	Administration and Finance	113	64	47	40%	73.44
7	Architecture and Urbanism	48	28	17	14%	60.71%
Total		292	165	118	100%	71.52 %

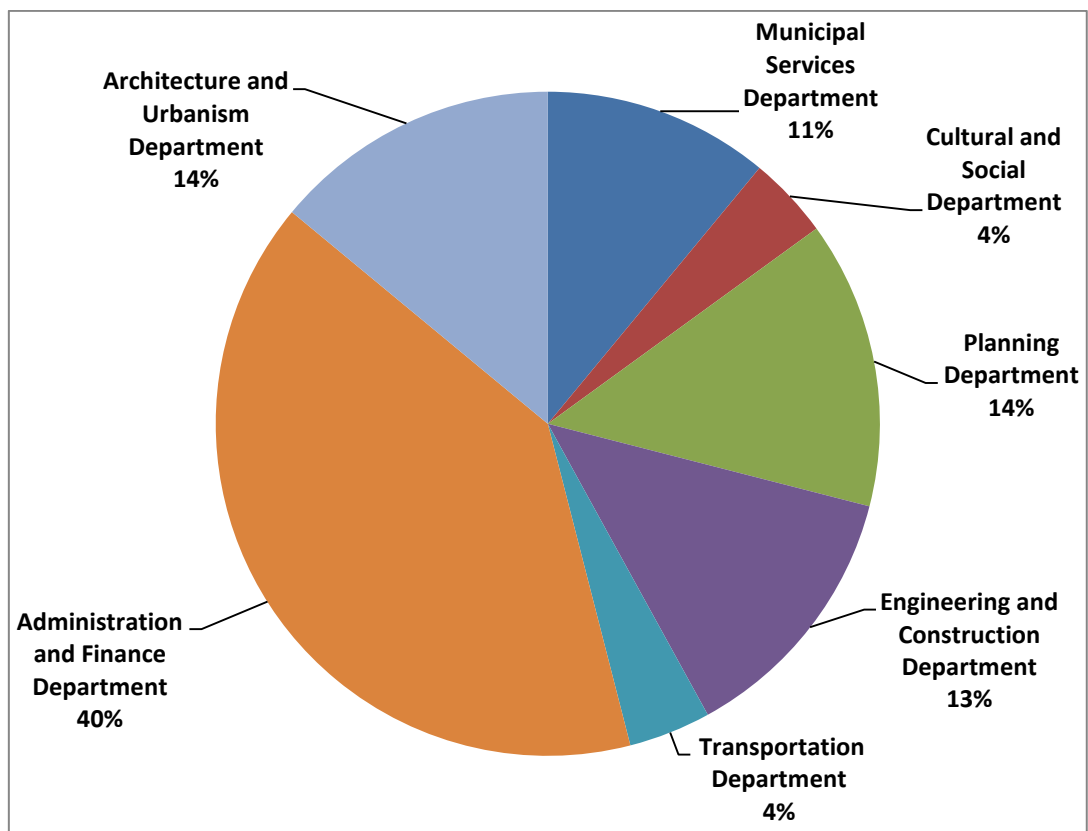


Figure 12 The Survey Participation of Different Departments



### 4.3 The Result of Level Determination of Questionnaire

In order to assess the state of knowledge of Mashhad municipality, the members of seven departments have answered to the value and weight questions. After collecting the questionnaires, the results have been analyzed based on the three techniques presented in the third chapter. The state of organizational knowledge is determined in Figure 13.

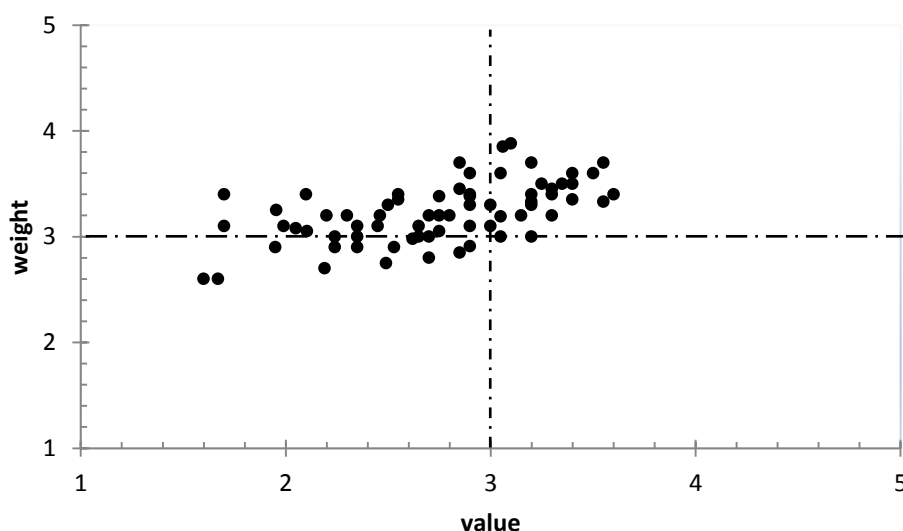


Figure 13. The State of Organizational Knowledge

Based on the technique 3.8.1 in chapter three, the case study succeeded in gaining a point about 2.77. This rating reflects the overall status of society in perspective of knowledge-based and taking advantage of investment knowledge is below average (between the middle and weak). As it is observed in the overall graph, most of the points are in the critical region and a few places are in the favorable region. Thus, in order to move towards a knowledge-based organization, the KM project should be implemented in that. This part of the survey consists of the analysis of the

questionnaires based on the eight parts of the N&T model and technique in 3.8.2 section.

### 4.3.1 Individual Tacit Knowledge

The organization could achieve to the 3.02 points as individual tacit knowledge, and this indicates that the organization gains higher score than the average level according to the individual tacit knowledge. The level of individual tacit and implicit knowledge is shown in Figure 14.

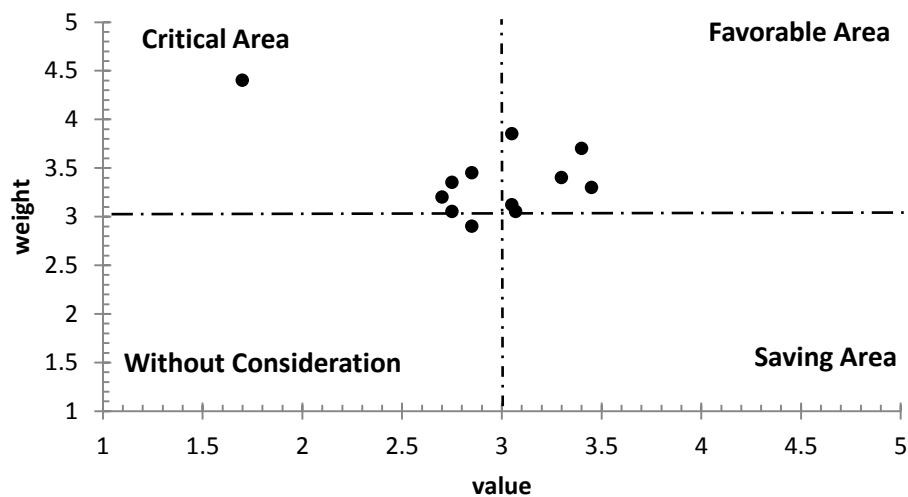


Figure 14. The Level of Individual Tacit and Implicit Knowledge

### 4.3.2 The Detection of the Individual Tacit Knowledge to Individual Explicit Knowledge

Regarding to the detection of individual tacit knowledge, organization gained 2.41 points. It can indicate that the state of the organization in converting the individual tacit knowledge into individual explicit knowledge is less than average level, also among levels of the knowledge conversion, where N&T model allocates the lowest rating. The level of detecting individual tacit knowledge to individual explicit knowledge is determined in Figure 15.

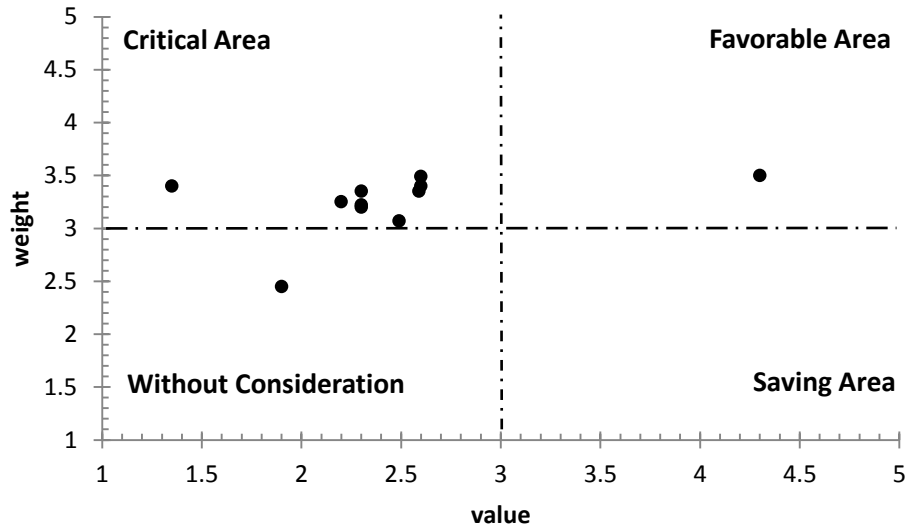


Figure 15 The level of Detecting Individual Tacit Knowledge to Individual Explicit Knowledge

### 4.3.3 Individual Explicit Knowledge

The case study got 2.90 rate in the individual explicit knowledge which seems the state of the organization is poor. The state of detecting individual knowledge level is shown in Figure 16.

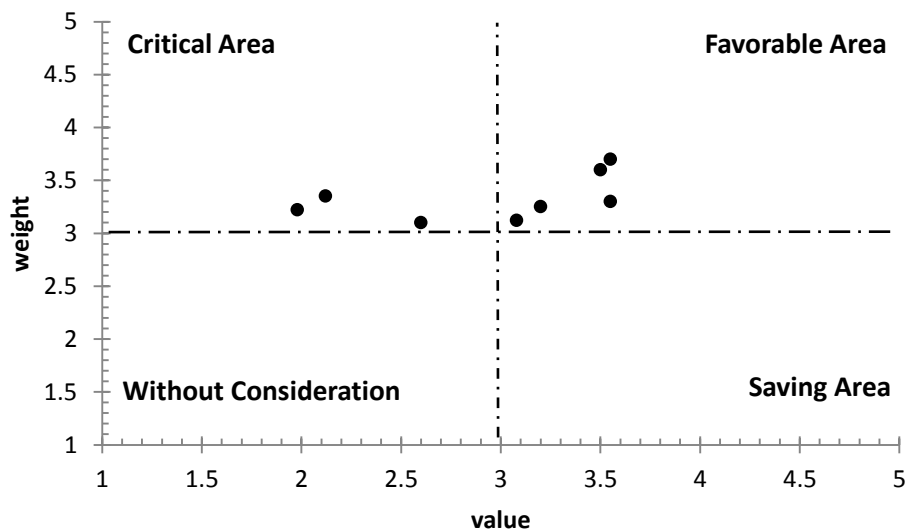


Figure 16. The State of Detecting Individual Knowledge Level

#### 4.3.4 Converting Individual Explicit Knowledge into Collective Explicit Knowledge

In terms of the population studied, the conversion of individual explicit knowledge into collective explicit knowledge could not gain a score better than 2.62 which is considered as a low level of knowledge conversion rating. The state of converting individual explicit knowledge to organizational knowledge is shown in Figure 17.

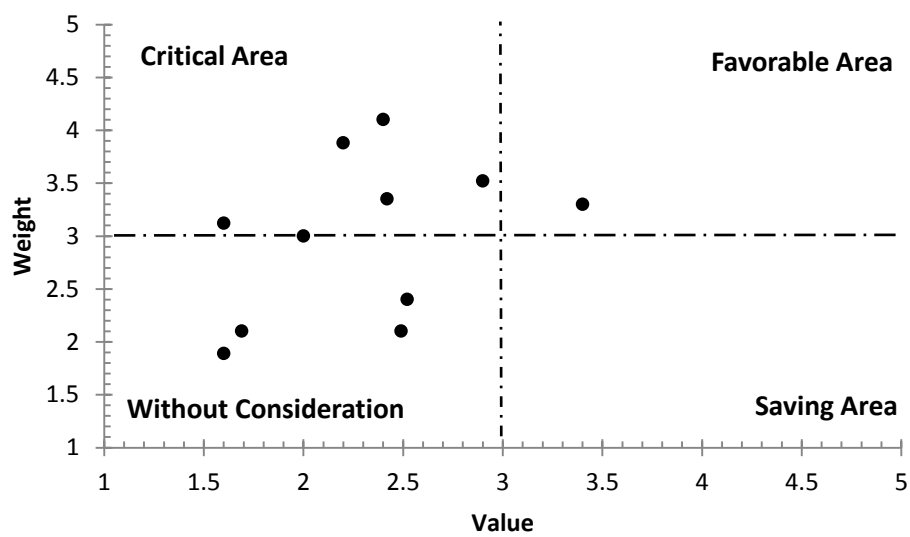


Figure 17. The State of Converting Individual Explicit Knowledge to Organizational Knowledge

#### 4.3.5 Collective Explicit Knowledge

The collective explicit knowledge level was 2.34 which is the lowest point among other knowledge levels. The state of organizational explicit knowledge level is in Figure 18.

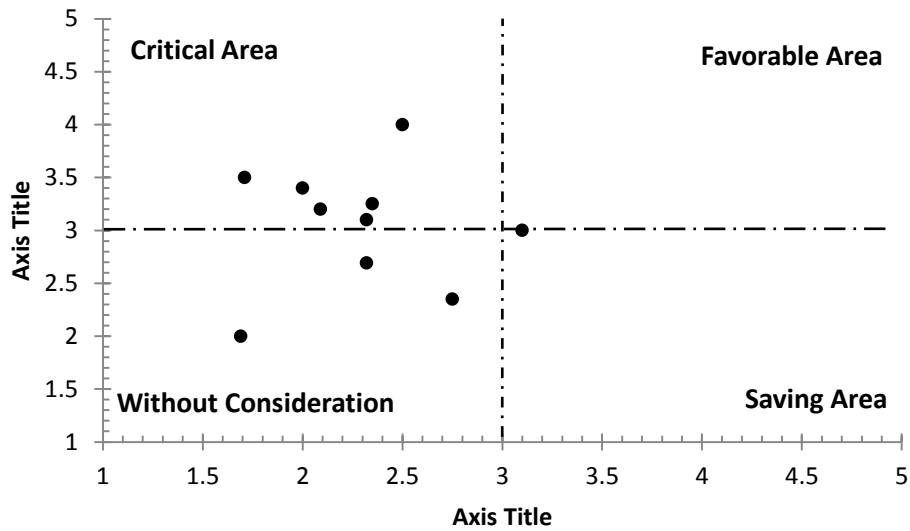


Figure 18. The State of Organizational Explicit Knowledge Level

#### 4.3.6 Converting Collective Explicit Knowledge into Collective Tacit Knowledge

This case could achieve 2.58 score which in comparison to other levels is in an average situation. The levels of converting collective explicit knowledge to organizational institutionalized knowledge are shown in Figure 19.

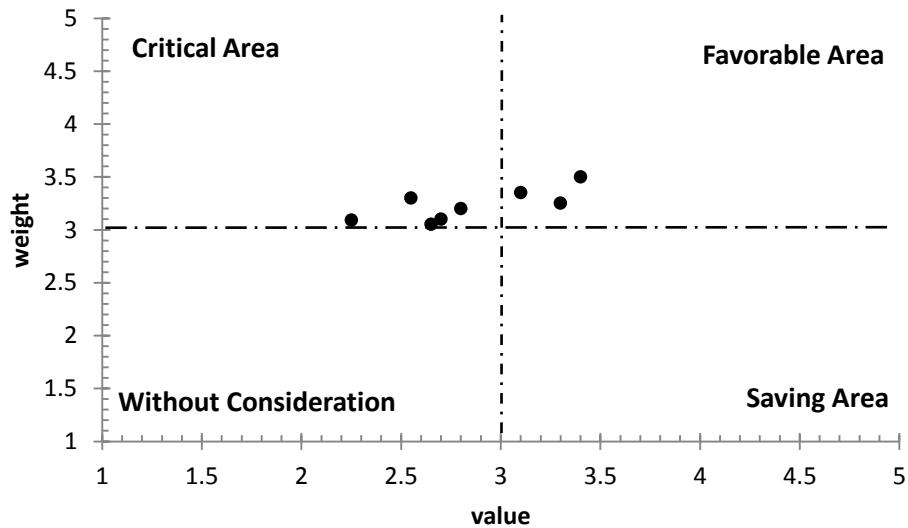


Figure 19. The Levels of Converting Collective Explicit Knowledge to Organizational Institutionalized Knowledge

### 4.3.7 Collective Tacit Knowledge

This level of knowledge got 3.28 and this point is the highest score among knowledge levels and conversions levels. The state of organizational institutionalized knowledge level is shown in Figure 20.

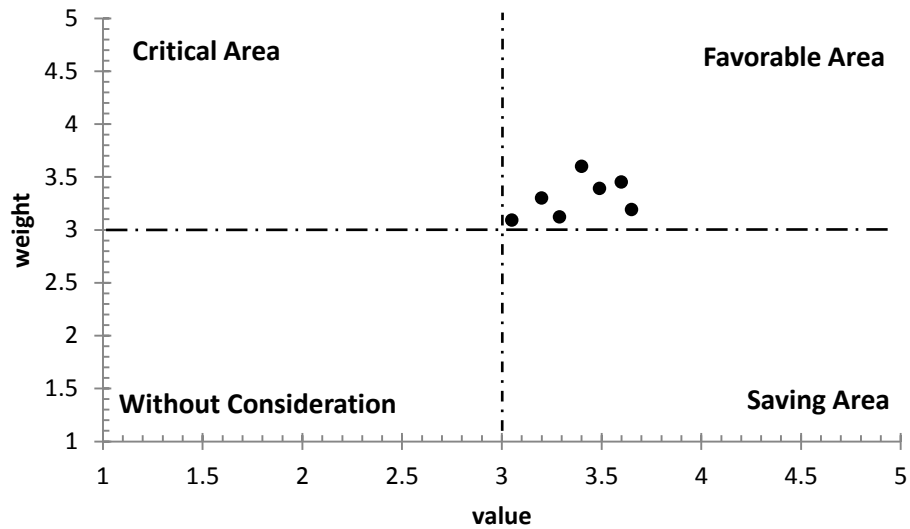


Figure 20. The State of Organizational Institutionalized Knowledge Level

### 4.3.8 Converting Collective Tacit Knowledge into Individual Tacit Knowledge

The score of this level conversion was almost 2.93 which is the highest level among other levels of conversions. The state of the institutional knowledge of the organization into individual tacit knowledge is presented in Figure 21.

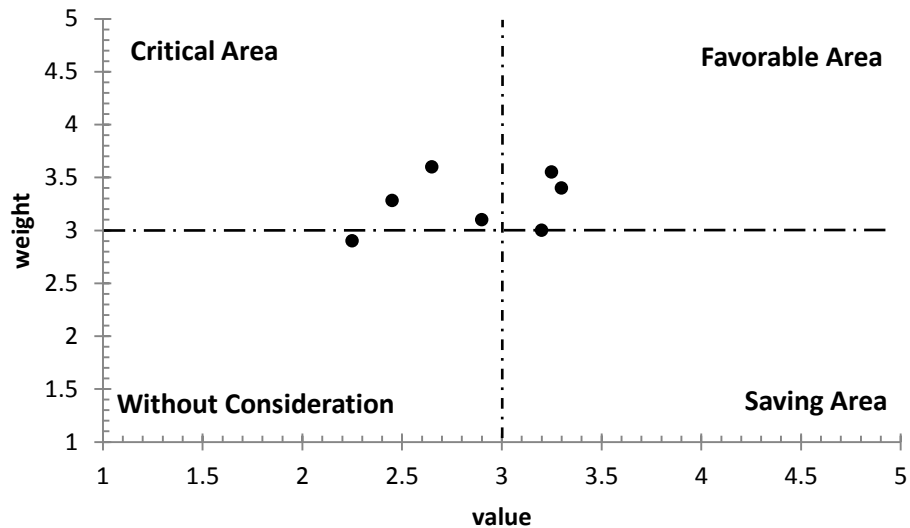


Figure 21 The State of the Institutional Knowledge of the Organization into Individual Tacit Knowledge

#### 4.4 The Result of Solution Questionnaire

In section 4.2., the weight questionnaire which consisted of eight parts in N&T model and the techniques provided in Chapter 3 was used to determine the level of the organization and the levels of the N&T model.

In addition, according to the weight determination in each part of the management model, it can be possible to suggest some solutions to increase and improve the level of KM in organization with regard to the questionnaires. For this aim, after determining the abundance of each indicator in the municipality of Mashhad, by using the existing relations, the mean and standard deviation parameters were calculated. The average and standard deviation of the questionnaire's results of solution presentation are shown in Table 6.

Table 6. Average and Standard Deviation of the Questionnaire's Results of Solution Presentation

Department	Factor	Individual tacit knowledge Level	The Detection level of tacit knowledge	Individual explicit knowledge level	Conversion level of individual explicit knowledge to organizational explicit knowledge	Organizational explicit knowledge level	Conversion level of organizational Explicit to organizational tacit knowledge	Organizational tacit knowledge level	Conversion level of organizational tacit knowledge to individual tacit knowledge
		$S$	$\bar{X}$	$S$	$\bar{X}$	$S$	$\bar{X}$	$S$	$\bar{X}$
Municipal services	$S$	2.96	2.87	2.88	3.09	2.62	2.76	2.86	2.84
	$\bar{X}$	0.57	0.75	0.62	0.51	0.77	0.48	0.37	0.46
Administration and finance	$S$	3.19	2.57	3.02	2.86	3.01	2.86	2.62	2.9
	$\bar{X}$	0.48	0.5	0.43	0.3	0.74	0.43	0.35	0.33
Technical assistance and civil	$S$	3.01	3.16	3.41	3.08	3.19	3.22	3.04	3.93
	$\bar{X}$	0.61	0.53	0.79	0.55	0.72	0.75	0.27	0.46
Cultural and social	$S$	2.45	3.35	2.33	3.33	3.13	2.48	2.57	2.31
	$\bar{X}$	0.71	1.31	1.07	1.26	1.19	1.26	1.25	0.85
planning	$S$	2.9	3.11	3.16	3.3	3.02	2.98	3.41	2.91
	$\bar{X}$	0.4	0.56	0.72	0.34	0.53	0.3	0.65	0.36
Architecture and urbanism	$S$	3.08	2.98	3.12	2.97	2.94	3.11	2.94	2.94
	$\bar{X}$	0.75	0.41	0.36	0.63	0.64	0.47	0.52	0.47
Transportation	$S$	3.22	2.45	3.08	3.3	2.9	3.30	2.49	3.09
	$\bar{X}$	0.51	0.74	0.85	0.95	0.44	0.68	0.86	1.03
Municipality organization of Mashhad	$S$	3.06	2.87	3.06	3.03	2.98	2.95	2.84	2.95
	$\bar{X}$	0.31	0.27	0.28	0.18	0.29	0.18	0.25	0.16

#### 4.5 Interview with the Organization Experts

After analyzing the data collected from the questionnaires, weight and value, to evaluate the effectiveness of the model used, some experts of Mashhad's municipality were interviewed. The obtained results about the level of knowledge in the organization through the survey were given to the experts. The experts were asked to comment on the results of the survey to analyze the responses. The results of the interviews are shown in Table 7.



Table 7.Result of Interviews with Experts

Expert	The Level of							
	Individual tacit knowledge	detecting tacit knowledge	individual explicit knowledge	converting individual explicit knowledge to organizational explicit knowledge	organizational explicit knowledge	level of converting organizational explicit knowledge to organizational tacit knowledge	organizational tacit knowledge	converting organizational tacit to Individual tacit knowledge
First	Medium	Medium	Weak	Medium	Weak	Medium	Good	Good
Second	Medium	weak	Medium	Medium	Weak	Medium	Medium	Medium
Third	Good	Medium	Weak	Medium	Medium	Medium	Good	Good
Fourth	Medium	Weak	Medium	Weak	Medium	Weak	Medium	Medium
Fifth	Medium	Medium	Medium	Weak	Weak	Weak	Medium	Medium

## **Chapter 5**

### **RESULTS AND DISCUSSIONS**

#### **5.1 Introduction**

Based on what have been done in previous chapters, the results of examination are stated and also the limitations of the study and the research are determined in following, then by offering some practical recommendations to managers and experts, the study will be completed.

#### **5.2 Results and Discussions**

According to the assumptions of Nonaka's theory, the main objective of this investigation is the identification of KM in Mashhad municipality. The experts of Mashhad municipality's departments are asked to analysis the level of knowledge in organization. Then using the techniques presented in Chapter III data were analyzed and the following results were obtained:

##### **5.2.1 Hypothesis I**

N&T model is the efficient cognitive model.

##### **5.2.1.1 Result of Hypothesis I**

Interviews were conducted with five experts of the organization. Due to the results of the survey, it seems that the results are too close to the data analysis. Based on the literature review, the most significant points of this model rely on two types of

knowledge, explicit and tacit knowledge management and it can be said that these results are evidence of this. With this explanation, the first theory which introduces N&K model as an efficient cognitive model is correct.

### **5.2.2 Hypothesis II**

How is the level of Mashhad municipality's knowledge by using N&T model?

#### **5.2.2.1 Result of Hypothesis II**

Based on the first technique, the case study succeeded to gain a score around 2.77. This rating reflects the overall society's status of being knowledge-based and taking advantage of knowledge investments below average (between the middle and low - turbulence knowledge). The overall chart of this organization (Mashhad municipality) presents that most of the points are in the critical region and a few places in the region are favorable. So in order to move towards a knowledge-based organization, KM project should be implemented in the organization basically. These results indicate that the hypothesis which knows the level of knowledge management in the low to moderate range (turbulence knowledge) is true.

### **5.3 Review the Organizational Areas and Proposing the Solutions to Improve the KM's Level**

In this section, based on the results obtained from descriptive statistics, seven departments of Mashhad municipality were reviewed based on N&T model in each of the eight parts. Then some strategies were proposed to improve the level of knowledge.

### **5.3.1 Individual Tacit Knowledge Level**

Among the seven departments of organization, department of administrative and financial and department of transportation were in the better level; against the social and cultural department which is located in the lower level. According to descriptive statistics, the highest rating belonged to the "self-studies of experts".

Due to the results, it is suggested that:

- Incentive policies should be developed to increase the capital of experts' study such as some competitions to encourage them to read more and set some appropriate awards.
- Making culture and explanation about the benefits of study with mid-career's training, brochures and etc.

### **5.3.2 The Level of Tacit Knowledge Detection**

In this state, the level of the cultural and social department is at the best situation and the level of transportation department is at the lowest level. The highest average level is about the "rules and standard procedures for documenting the experiences by people". According to the results, it is suggested:

- Explain the mechanism for obtaining and recording the experiences of successful and unsuccessful managers, experts and etc.
- Establish an electronically system with issue separation to keep the experience and easy access to the results.

### **5.3.3 Individual Explicit Knowledge Level**

The highest score among all areas was related to "training programs attended by staff within the organization". According to the results the following suggestion is made:

- The use of motivational incentives to encourage employees to participate in training courses with financial incentives (the mission of education, overtime training) and job incentives.

### **5.3.4 Conversion of Individual Explicit Knowledge to Organizational Explicit Knowledge**

Among all departments, the cultural and social department and transportation department had the highest score and administrative and financial department had the lowest rank. The highest average level returns to "culture of employee interest in providing their knowledge to others". Based on the result it is suggested:

- -Financial and career incentives for the expertise employees to encourage them to transfer their knowledge and experience to other staff.

### **5.3.5 Organizational Explicit Knowledge Level**

According to the statistics, the department of technic and civil engineering was in the best level and department of urban service affairs was in the lowest. At this level, the highest rating was assigned to "membership in related knowledge bank (data libraries, webs, etc.)". So, regarding to what gained, it is suggested:

- Providing some loans to employees to join the knowledge bank (free membership, offering facilities to other family members, etc).

- Set up agreements and deploy the web-based system with other project-driven organizations to use their libraries.

### **5.3.6 The Conversion of Explicit Knowledge to Tacit Knowledge**

In this indicator, the transportation department was at the highest level and on the other side, the cultural and social department reached the lowest point. The highest rating was related to "embrace the new knowledge-based projects by managers and invest in them". So it can be concluded that:

- Training managers and making them aware of the techniques and knowledge of the world.
- Provide some examples of successful knowledge-based plans to managers to prepare them mentally and intellectually, and the managers' investment and support of new introduced designs.

### **5.3.7 Tacit Knowledge Level of Organization**

The planning department was located on the top of the other departments. The transportation department was in the lowest level. Best score in this level was about the "risk of the organization". Therefore, it is offered to:

- Delegate authority and responsibility to employees, giving them the possibility to share power.

### **5.3.8 The Conversion of Organizational Tacit Knowledge to Individual Tacit Knowledge**

In this case, the technical and civil department was in the best situation and the cultural and social department was in the worst situation. The highest point in these areas referred to “the level of personnel’s satisfaction of scientific levels improvement”. Based on the result, it is suggested:

- Increasing the confidence of staff to organizational level improvement (salary and benefits, group, organizational post, etc.) pursuant to improve staff’s knowledge.
- Increasing confidence in the knowledge-based employees and organizational devolution and supporting them.

### **5.4 The Strengths and Weaknesses of Organization Based on the Results of the Questionnaires’ Analysis**

According to an analysis done on the responses to the questionnaire and the calculated rates of the different parts of the N&T model in the organization, it is tried to consider the organization’s strengths and weaknesses according to the results of the questionnaires. These data in the implementation of KM phase should be used to improve the level of the organization. This part is set based on the results of the third technique (which was described in chapter three).

Based on previous parts, some of the strengths of Mashhad municipality in KM are described as follows:

- The high level of experts' education.
- Working in jobs related to their education and skills.
- People's tendency to share their knowledge.
- Appropriate amount of knowledge production in organization.
- Proper activities of managers and researchers in scientific issues and projects.
- Good relationship with the universities.
- Having advanced labs.

And weaknesses of the organization:

- Lack of knowledge and experience documented in the organization.
- Lack of knowledge sharing facilities in the organization.
- Lack of knowledge exchange meetings.
- Lack of specialized seminars in the organization.
- Lack of internal magazines published in collaboration with press.
- The low prevalence of documented experience relevant to the project.
- Low company's interaction with customers.
- Lack of discussion meetings.
- Lack of the training class during the job in the organization.
- Neglect of the strategic plan based on the growing role of knowledge.
- Length of time required to achieve the project's data.



## **Chapter 6**

### **CONCLUSIONS AND RECOMMENDATIONS**

#### **6.1 Introduction**

Based on the questionnaire survey's results and the analysis of case study and discussions in previous Chapter, overall evaluation of this survey and concluding from results will be reported in this Chapter.

In following chapter, initially overall conclusion of this investigation's results with mentioning distinguished findings is represented then in other sections; research limitations and recommendations for construction industry experts about knowledge management in their organization are made. Finally, some suggestions are offered for researchers who tend to study on this topic in their future works.

#### **6.2 Conclusion**

This study tries to investigate the level of knowledge and knowledge management in the municipality of Mashhad. For this aim, a questionnaire was administered which is able to represent the eight parts of N&T model. Based on the data gathered by questionnaire and also by using the three techniques presented in chapter three, this hypothetical relationship was examined in order to investigate the main hypotheses and then present some claims.

In contrast to other models, N&T model concentrates on both explicit and implicit knowledge and on the way they change to each other, and considers how they are

produced in all organizational levels (individual, group, and organizational). This is the reason why this model was used.

In order to achieve the above purpose, 118 practitioners of Mashhad's municipality were asked about the knowledge level and all aspect of knowledge management in their organization and totally seven departments of Mashhad municipality were reviewed based on N&T model in each of the eight parts. Then some strategies were proposed to improve the level of knowledge. Also two theories assumed to continue this study.

According to respondents' opinion about first theory (Is N&T model the efficient cognitive model?) and literature review that presented the most significant points of N&T model rely on two types of knowledge, explicit and tacit, N&T model as an efficient cognitive model is correct.

In theory II (How is the level of Mashhad municipality's knowledge by using N&T model?), the overall society's status of being knowledge-based and taking advantage of knowledge investments below average (between the middle and low - turbulence knowledge) , therefore KM project should be implemented in the organization basically.

As a conclusion, understanding the state of knowledge management in the organizations is one of the most important principles of success in implementing knowledge management. Therefore, organizations which want to implement a knowledge management process, they have to take steps in this direction more carefully. The algorithm of N&T model that is used in this study has the skill of examining the state of knowledge management. After presenting the results, it is

possible to make the plan and identify the methods of project's performance according to the documented knowledge of the policies and strategies of the organization.

### **6.3 Research Limitations**

In completing this study, the researcher was confronted with several limitations, some of them are mentioned below:

1. Slow improvement and the long process of the study due to non-cooperation of managers and experts.
2. Due to the special circumstances in which the questionnaire was developed by administrators and technicians, the researcher has attempted to complete the research in a relatively wide range of time. Obviously, if the process has been done in a compressed form, the investigation would reach the results sooner.
3. Restrictions on the use of complementary methods such as interviews and observation, due to the complexity and busy business of managers. However, with regard to the nature of knowledge management, quantitative methods will be helpful in achieving real results.
4. Many managers and experts refused to complete a questionnaire because of involvement and busy working.

### **6.4 Recommendations for Further Studies**

As previously mentioned, knowledge management is an emerging field that has attracted much attention at the global level. Many experts believe that attention to

knowledge management can have major positive implications for organizations. But because of the novelty of this topic, there are some doubts on these claims about this field. While the existing researchers forecast the serious consequences of KM, but the reality is that this area is seriously needed to verify the allegations made by the researchers with the help of experimental data. In recent years, academic circles have considered to KM in Iran specially, and those of teachers and students, who are interested in new topics, have been fascinated. But it is necessary that each researcher before entering the field of research in this area is due to the fact that KM and similar items are topics that are extremely subjective understanding, even not very deep level, are required reading multiple sources.

On the other hand, scholars and authors who have written about knowledge management, consider it in various points of view. As a result, there is no same perceived of KM. Thus, the researcher who does research in the area of knowledge management should know that just having the article or book title with Knowledge Management term is not necessarily closely related to the subject of his study.

According to what is mentioned, there are some recommendations for future researchers to overcome the limitations of this research work.

1. Investigating on the eight parts of N&T model based on three main factors (culture, structure and information technology) and providing the model for the evaluation of the organization based on the perspective of N&T model.
2. Investigating on the other parts of the Mashhad municipality.

3. Survey on the impact of information and communication technologies (Internet, email, phone, etc.) On the willingness of managers and experts to participate in knowledge management processes.
4. Survey of top managers' support in the implementation of knowledge management planning's.
5. Study on the relationship between organizational structure of Mashhad Municipality and KM processes.
6. Survey on the effect of reward systems in the municipality of Mashhad on the managers and experts' willing to share and exchange knowledge.
7. Study of KM's level in construction projects of Mashhad Municipality.

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## **APPENDIX**

## Appendix A

No	Personal information			
1	<b>Name &amp; Surname</b>			
2	<b>Age</b>			
3	<b>Gender</b>	Male		Female
4	<b>Education</b>			
5	<b>Organizational department</b>	Transportation department		
		urban service department		
		civil and technical department		
		Architecture and urban planning department		
		social and cultural department		
		Administrative and Financial department		
		Planning and Development department		
6	<b>Organizational position</b>	Associate		
		Manager		
		Expert		
7	<b>Work experience in the municipality of Mashhad</b>			

No	Questions	Response 1-5
1	How much are your personnel able to solve the issues dealt in their works?	
2	How much are your personnel innovative and creative in their projects?	
3	How much does your personnel's ability to react quickly to the issues?	
4	How much do this department's experts do personal study and survey on their field?	
5	How much do the organization's personnel solve their work's problems themselves to avoid of crisis?	
6	What is the level of personnel's awareness of formal and informal communications?	
7	How long do the personnel stay at their position?	
8	How much does personnel's skill effect on their promotion?	
9	How much does personnel's skill effect on their promotion?	
10	Does your department employ new personnel often?	
11	What is the level of personnel's awareness of the process that they do part of it?	
12	What is the average of the work experience in your department?	
13	What is the average of the work experience in your department?	
14	What is your level of organization belonging of your personnel to the center?	
15	How interested employees to give their knowledge to others?	
16	How standards documentation procedures are implemented in your department?	
17	How much reward is granted to employees regarding to experiences?	
18	How much does your department make rules encourage employees to reveal their tacit knowledge?	
19	How is your center for the exchange of ideas and experiences, formal and informal meeting facility uses?	

20	What is the level of employee involvement in all publications center? (Both within the center of the magazine, brochure, etc.)	
21	Does your department have some laws for retaining knowledge ownerships?	
22	To what extent does your department use the electronic systems to make the knowledge practical?	
23	To what extent are some processes available to extract personnel's knowledge?	
24	What is the level of participation in the training program of the organization?	
25	How much are your personnel eager to make student and teacher relationship in your department?	
26	How much are the training programs common in the organization?	
27	What is the average level of your personnel's education?	
28	What is the level of impact of staff education on the process of hiring?	
29	What percentage of people is working in jobs related to their studies?	
30	Do you have access to the organization's library and technical documentation via electronic systems?	
31	How much is the personnel's study in their fields? (Studies Book, Internet, scientific journals)	
32	How is the skill of the employees on the professional softwares?	
33	To what extent are the experiences documented and retained during the project?	

<b>Level determination questionnaire</b>		
<b>No</b>	<b>Questions</b>	<b>Response 1-5</b>
34	What extent communication skills in terms of infrastructure, computer networks, and so is ideal for exchanging information in your center?	
35	Are there any certain procedures documented in your department?	
36	Do your employees have a tendency to produce paper and publish it?	
37	Is there any book entitled “book of experience” in your department?	
38	Is there any magazine published regularly in your center?	
39	What extent is the administrative your center?	
40	How much are your managers interested in documenting knowledge of the projects at the end of them?	
41	To what extent does your department publish by personnel involving?	
42	How much does the organization invest on the research area to support the changes required by people?	
43	How is the research center’s interaction with other sectors?	
44	Do the experts use the results of the research in their activities?	
45	To what extent does the organization by the technical knowledge?	
46	How much do you access to the database related to your expertise?	
47	Are there any scheduled series of lessons and project experiences in your department?	
48	How many instructions and procedures are in your sector to standardize the projects?	
49	How many books or articles are published in the organization?	
50	To what extent is your department famous in terms of knowledge basement, innovation and technology among others?	

51	How much is the change of procedures and work processes of new knowledge acquired?	
52	To what extent are personnel adhered to the instructions and guidelines?	
53	What is the level of organization's attention to design of strategic programs based on the growing of knowledge role in product?	
54	To what extent do employees resist using the new methods and knowledge?	
55	How is the organization in interaction with customers?	
56	How is the organization in interaction with competitors?	
57	How often does your center take part meeting and discussion?	
58	How people interact with new working groups on technical issues and knowledge?	
59	To what extent are organizational relationships formed based on trust and friendship?	
60	What is the level of the tendency of employees to work as a team?	
61	How much does your department use the previous projects experiences and documents?	
62	To what extent has been the organization successful in dealing with the changing environment?	
63	To what extent do the employees believe to the slogans and values of the organization?	



<b>Solution offered questionnaire</b>						
<ul style="list-style-type: none"> <li>How much does each of the following factors influence on knowledge and skills of employees?</li> </ul>						
<b>No.</b>	<b>Individual Tacit knowledge</b>	<b>Too Low</b>	<b>Low</b>	<b>Average</b>	<b>Much</b>	<b>Too Much</b>
1	Problem solving ability					
2	Personnel creativity and innovation					
3	Individual studies of experts					
4	Work experience of personnel					
5	Organization Recognition rate by personnel					
6	Organizational belonging of personnel					
7	Retention of staff in post					
8	Considering to personnel's skill to improve their positions					
9	Considering to personnel's skill and performance in the reward system					
10	New staff employment					
11	Task-oriented rather than process-oriented structure in the center					
12	Rapid response in dealing with issues					

<b>Solution offered questionnaire</b>						
<ul style="list-style-type: none"> <li>How much does each of the following factors influence on converting Individual Tacit knowledge into individual explicit knowledge?</li> </ul>						
<b>No.</b>	<b>Factors of converting Individual Tacit knowledge into individual explicit knowledge</b>	<b>Too Low</b>	<b>Low</b>	<b>Average</b>	<b>Much</b>	<b>Too Much</b>
1	The interest in giving knowledge to others					
2	Rules and standard procedures for documenting the experiences of staff					
3	Technology existed to document the experiences and practices					
4	Rules of keeping ownership					
5	Identifying methods for experts					
6	Processes for extracting knowledge and personal experiences					
7	Existence of formal and informal knowledge group					
8	Reward system to provide documentation of personnel					
9	Employee participation in the training center					
10	Rules to encourage individuals to detect					
11	The tendency to making the student-teacher relationship					

<b>Solution offered questionnaire</b>						
<ul style="list-style-type: none"> <li>▪ How much does each of the following factors influence on growing of personnel's knowledge level?</li> </ul>						
<b>No.</b>	<b>Factors of Individual explicit knowledge</b>	<b>Too Low</b>	<b>Low</b>	<b>Average</b>	<b>Much</b>	<b>Too Much</b>
1	Training class for employees (outside of organization)					
2	Training class for employees (inside the organization)					
3	Level of education of employees					
4	Study of personnel in their field					
5	The importance of education in employment					
6	The related field of study to the position in the organization					
7	Usage of technology in access to library resources					
8	The software skill related to job					

<b>Solution offered questionnaire</b>						
<ul style="list-style-type: none"> <li>How much does each of the following factors influence on growing of personnel's knowledge level?</li> </ul>						
<b>No.</b>	<b>Factors of Converting individual explicit knowledge into collective explicit knowledge</b>	<b>Too Low</b>	<b>Low</b>	<b>Average</b>	<b>Much</b>	<b>Too Much</b>
1	System for documenting the experience of experts					
2	Documenting procedures					
3	Administrative structure					
4	Interest of employees to share their knowledge to others					
5	Informal meetings and discussions					
6	The desire to write and publish articles					
7	Optimal reward system (material and spiritual) to exchange knowledge					
8	Appropriate infrastructure for knowledge converting					

<b>Solution offered questionnaire</b>						
<ul style="list-style-type: none"> <li>How much does each of the following factors influence on growing of personnel's knowledge level?</li> </ul>						
<b>No.</b>	<b>Factors of Collective explicit knowledge</b>	<b>Too Low</b>	<b>Low</b>	<b>Average</b>	<b>Much</b>	<b>Too Much</b>
1	Publishing some journals by the organizational employees					
2	Investment in the research center					
3	Set of instructions of prior projects with retrieval ability					
4	The amount of publications in the organization					
5	Existing level of product knowledge					
6	Join the associated knowledge banks					
7	Documented procedures for staff to use					
8	Being a pioneer in the center in terms of knowledge level among competitors					

<b>Solution offered questionnaire</b>						
<ul style="list-style-type: none"> <li>How much does each of the following factors influence on growing of personnel's knowledge level?</li> </ul>						
<b>No.</b>	<b>Factors of Converting collective explicit knowledge into collective Tacit knowledge</b>	<b>Too Low</b>	<b>Low</b>	<b>Average</b>	<b>Much</b>	<b>Too Much</b>
1	Acceptance of new knowledge-based projects by managers and invest on them					
2	Implementing product-related conferences					
3	Contributing to the growth of knowledge in the formulation of strategic plans and programs					
4	Changes in procedures and work processes of the knowledge obtained					
5	Product development programs					
6	Enforcement of personnel to the rules of organization					
7	Usage of documentation of the experiences of last projects					

<b>Solution offered questionnaire</b>						
<ul style="list-style-type: none"> <li>How much does each of the following factors influence on growing of personnel's knowledge level?</li> </ul>						
<b>No.</b>	<b>Factors of Collective Tacit knowledge</b>	<b>Too Low</b>	<b>Low</b>	<b>Average</b>	<b>Much</b>	<b>Too Much</b>
1	The experience of organization in production and current services					
2	Embedding Slogans and values in the minds of the center staff					
3	Attention to the intangible assets					
4	Benefit from excellent communication with the audience					
5	Enjoying convenient communications with competitors					
6	The flexibility of center					
7	Risking					

<b>Solution offered questionnaire</b>						
<ul style="list-style-type: none"> <li>How much does each of the following factors influence on growing of personnel's knowledge level?</li> </ul>						
<b>No.</b>	<b>Factors of Converting collective Tacit knowledge in to individual Tacit knowledge</b>	<b>Too Low</b>	<b>Low</b>	<b>Average</b>	<b>Much</b>	<b>Too Much</b>
1	Being pleased with the staff to improve the level of scientific					
2	Tendency to team working					
3	Level meetings to discuss					
4	The existence of an infrastructure for remote communication					
5	Relationships between staff					
6	Usage of documentation of the experiences of last projects					
7	The speed of Being familiar with the scope by the newcomers					