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# Technical Shortcomings of Designing and Implementing a Knowledge Management System

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**Abstract**

The purpose of the current research is to recognize technical shortcomings of designing and implementing a knowledge management system. The research population include two companies: Zobahan Esfahan Company and International Automation and Systems Engineering Company (IRISA) in which the staffs work in different departments such as research and development, method and structure, strategic planning, instruction, and information technology. applying a stratified random sampling, 50 samples were selected from totally 5560 ones. The questionnaire is consisted of two parts of demographics data and technical data which are based on the research model. This research will answer the question: "what is the influence of knowledge quality, system quality, and services quality on designing and implementation of a knowledge management system". The research hypotheses include triple areas of pathology (knowledge, system, and services) and its fourteen components which have been analyzed separately. Results of statistical tests show that a total average is high enough, a standard deviation is suitable, and a skewness is positive. Therefore, pathology is a little bit more than average. Generally, system's pathology and services' pathology are higher than average, however, knowledge's pathology is lower than average. Applying a Friedman's test, it was concluded that 14 components of pathology do not have an equal importance in establishing a knowledge management. Three areas of pathology (knowledge, system, and services) did not have an equal importance in design and establishment of a knowledge management system. All of suspected to be effective variables were entered into the model simultaneously, however, only "gender" and "familiarity with knowledge management" variables were recognized to be effective.

**Keywords:** Knowledge Management System, Knowledge quality, System quality, Services quality

## 1. Introduction

Identifying and diagnosing the problems existing in industrial units is crucial for them to improve. There are different solutions to improve and renovate an industrial unit. Identifying suitable solutions requires to recognize the problem which would be solved by each solution. Therefore, it is necessary to diagnose problems and restrictions of industrial units correctly and scientifically in order to improve, grow, and increase their competitiveness. Pathology (fault finding) is a solution for this primary and fundamental need and precedes any improvement activities in an organization. Recognizing the current situation of industrial units in order to find their problems and restrictions, determining their strengths and weaknesses, recommending general solutions to solve the problems, and improving their conditions are important activities for pathology (Neville,1994). The aim of this research is to find technical shortcomings of establishing of a knowledge management system.

In a research performed by Hamidizadeh (Hamidizadeh,2005), advantages of knowledge for an organization have been studied which include improved decision-making, increased responsiveness, increased responsibility, efficiency, innovation, flexibility, improved quality, decreased duplication, and empowerment.(Latifi et al ,2012) state that a key strategic decision for knowledge management is deciding those activities that an organization should carry out by paying attention to its physical characteristics and its perceptual characteristics. In another study, (Ming-Kuen et al,2010) concluded that 49% of companies will have a knowledge management system until the next four years, 21% will have it until the next year, 28% have had this system before, and only 2% will not invest on knowledge management. (Hamidizadeh et al ,2012) studied the influence of direct organizational factors, indirect knowledge citizens, and environmental factors on knowledge management in Iran Public Organizations. They studied infrastructures of knowledge management in Iran and stated that the situation is not desirable because there are not any written macro strategies for a knowledge management in organizations. In addition, they stated that most of the studied organizations assign a little budget for information technology, communication, and knowledge management and there are not any clear organizational arrangements for knowledge management in these organizations. They continued that internal mobility of personnel is poor and is based on job necessity purposes rather than for sharing and attracting a knowledge. There is also a little external mobility of personnel in these organizations.

(Latifi et al,2011) explained and evaluated the strategies of knowledge creation at universities in Iran. First, he explained the knowledge creation process, evaluated the influencing factors on this process, and identified the current situation of these factors. Then he designed some strategies to lead, mobilize, and empower these factors in order to grow and improve knowledge creation at the universities. His research was performed in two parts of quantitative and qualitative. In a qualitative part, the process of knowledge creation at the universities is explained by studying knowledge creation models, observing related case studies, and analyzing experts' viewpoints. Then, using library and field studies, twelve strategic factors that influence the knowledge creation process were identified. In a quantitative part, using a survey method and a questionnaire, the current situation of strategic factors of knowledge creation at the universities was studied. Results show that members of a Delphi Group agreed on 55 strategies of total 57 ones. With regard to results of quantitative and qualitative parts in

Talebnejad's research, a conceptual model is designed in order to improve the knowledge creation at the studied Universities in Iran.

(Latifi et al ,2012) state that scenarios of knowledge management serve multiple functions. First of all, they present a background for the design and selection of strategies. Since no single strategy can be performed best in each scenario, special selection criteria, such as "bet on the most probable scenario" or "preserve flexibility" are needed

## 2. Research Method

The research method is descriptive and applied; it seeks to recognize the complications of knowledge management establishment in two companies named Zobahan Esfahan and IRISA. The research population consists of the personnel working in different departments such as research and development, method and structure, strategic planning, instruction, and information technology of Zobahan Esfahan Company and International Automation and Systems Engineering Company (IRISA). Using a stratified random sampling, 50 personnel were selected from totally 5560 personnel of these two companies. In order to collect the required data, a questionnaire was designed which had two parts of personal information and specific questions. This questionnaire was used after testing its validity, testing its reliability, and getting viewpoints of academic experts.

### *2.1. Conceptual Model of the Research*

In this model (Figure 1), the complication of knowledge management establishment is examined in three perspectives of knowledge quality, system quality, and services quality. Knowledge quality discusses senior manager's support of the research, learning, instruction, knowledge share, network and infrastructures of information technology, and existence of a reading room in the organization. System quality is examined with regard to human infrastructures of knowledge network, electronic instruction periods, and existence of portal sites in order to access main resources and information experts. Services quality is based on customers' expectations from services, competitive advantage of services, differentiation of services, value of services, and their related expenditures.

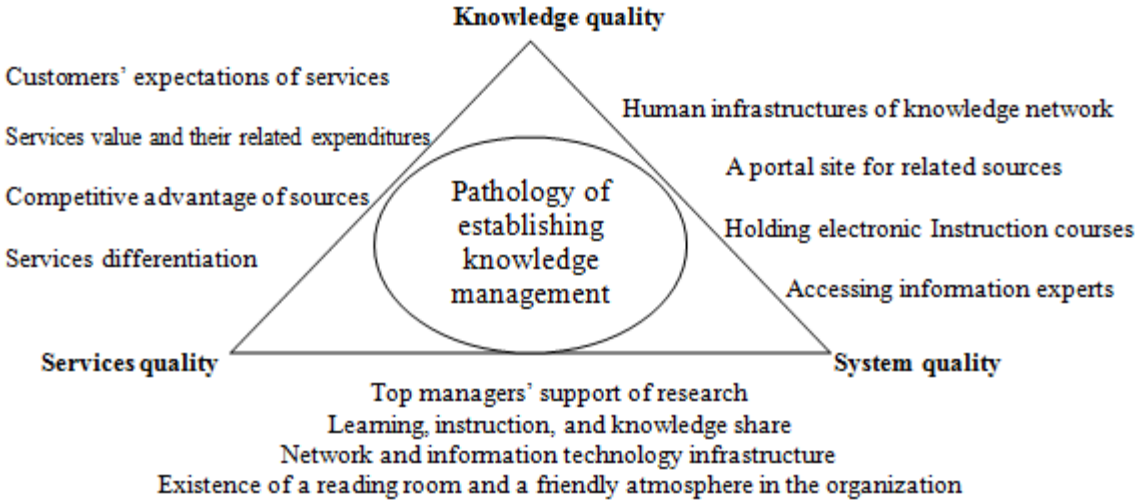


Figure 1: A Knowledge Management Model (Murray E, 2008)

***2.1.1. Knowledge Quality.*** It is necessary for every successful project to have a complete support of the management team. Similarly, establishing a knowledge management needs a complete support of the management team and that is because the organization culturalizing issues in knowledge management and the role of organization's administrators are very important in this process. In other words, knowledge management needs an effective leadership. A prerequisite to gain successful results in performing the knowledge management process is that academic administrators have a motive in this process and accentuate it. In addition, the following procedures should be done in order to achieve good results from the knowledge management process:

- Collecting experts' implicit knowledge and saving all products information and operational processes through various instruments.
- Providing an easy, quick, and personal access to knowledge database for personnel and units in order to reach the opinions and expectations of real/ potential customers as well as their demographic and behavioral characteristics (Latifi et al, 2012).
- Valorizing learning, training, and knowledge share. Putting value on learning means sharing knowledge with organization's research personnel via some processes including improvement, individual developments, and group developments such as using internet and attending seminars, meetings, and modern technology centers (Latifi et al, 2012).
- It is not possible to establish a knowledge management system in a short-term period paying attention to time is crucial for every targeted research. Saving time is very important in comprehensive planning because some plans have to be modified during time. With regard to the mentioned prerequisites, establishing a knowledge management system is applicable in a long-term period (Hamidizadeh,2006).

- Using a reading room in the organization. Elements that are common in factors involved in knowledge creation include spending time and creating different facilities such as a suitable working site and expositing special tasks for entrepreneurs (Hamidizadeh, 2006).
- Creating a friendly climate that results in understanding visitors' needs.
- Showing the mobility degree of workforce, Informal relations can explain the real structure of the work place better and richer. In informal relations, personnel have more freedom of action than in formal relations. Therefore, they have captured most of the main organizational activities (Hamidizadeh et al,2012).
- Existence of networks and infrastructures of information technology.
- Many factors make the organizations successful in applying a knowledge management strategy. Nevertheless, one of the most important factors here is improving suitable infrastructures of information technology. Using internet, intranet, and emails are examples of information and communication technologies that are applied in knowledge-based organizations and make them become electronic organizations. Using these technologies results in that hierarchical levels will not be able to restrict organizational relations any more. In addition, organization's personnel can communicate with everybody and everywhere instantly: these technologies suitably empower knowledge-based organizations and are the most effective ways of collecting, saving, transferring, and distributing knowledge(Latifi et al,2010).

***2.1.2. System Quality.*** This item includes the following indices:

- Human infrastructures of knowledge network exist. Organizations should create a set of responsibilities, roles, and skills to receive, analyze, distribute, and use the knowledge in order to strengthen knowledge management. Therefore, knowing knowledge management components, it would possible to organize them. The set of knowledge management responsibilities should be in their framework of creation, saving, and distribution process (Hamidizadeh,2009a; Hamidizadeh, 2009b).
- There is access to information experts. Although organizations possess intangible assets during time, they do not have any direct possession on personnel's knowledge. Actually, the main source of intangible assets is personnel's knowledge. If an organization does not possess the personnel's knowledge, it would be possible that their knowledge be abolished as soon as they leave the organization (Gough et al,2000).
- Holding electronic instruction courses. Electronic instruction is an active learning that results in a teaching- learning process. It plays an important role in creating a culture of information and communication technology. Electronic learning is an instructive innovation that can be provided in CDs, local networks, and internet. It includes computer-based and web-based instructions. Knowledge management is different from electronic learning. Electronic learning is potentially a basis for knowledge management (Shelbourn et al,2004).
- Creating a portal site to access the main sources. It is not possible to implement a knowledge management system only with one technology; rather different technologies are required for its implementation. This is a necessary condition but is not sufficient. Technologies can play important roles in implementing knowledge management processes in an organization. By creating knowledge ports, it would be possible to access the electronic system of documents, searching tools, and other related technologies easily (France et al,2005).

***2.1.3. Services Quality.*** This item includes the following indices:

- Customers expect services to be in a good quality. It is necessary to service each customer in his/her favorite way in order to make a good relationship with him/her. Therefore, a customer's knowledge management is required. Knowledge management system is an important system that should be spread all over the organization. Accessing customers' knowledge not only includes recognition of them, but also includes the behavior and patters they follow. Accessing customers' knowledge should be implemented continuously and dynamically in order to collect information about current customers, lost customers, and new customers (Rezaienoor et al, 2008).
- Competitive advantage for services which includes:

I. Creating a central knowledge base to collect, use, and distribute the organization's knowledge
II. Utilizing the technical knowledge of organization's business partners in order to eliminate the gap between strategic plans and operational plans; and adjusting operational processes with products.
III. Providing an easy, quick, and personal access to knowledge database for everybody and every unit in order to identify expectations of real and potential customers, their demographic characteristics, and their behavior.
IV. Making formal structures of products and processes flexible in order to gain a greater share of the market and use the customers' knowledge to offer better services.

- Differentiation of services which include:

I. Creating a coherent knowledge base to combine the implicit knowledge in knowledge bases of business partners and explicit knowledge of the organization.
II. Creating routes to gain information about interaction with customers through knowing the types of interactions and the usage of information technologies in order to facilitate that interaction.
III. Using the current knowledge to predict the feasibility of innovation in products, processes, structures, and methods
IV. Designing and creating a participatory management structure and developing idea management.
V. Creating a suitable framework for the rewarding system and motivational Incentives in order to increase experts' participation in offering specialized knowledge (Rezaienoor et al,2008).

Services quality has been based on their value and expenditure.Knowledge management performance is measured both financially and non-financially. Measuring financial performance is based on indexes such as returns on investment, total sales, amount of investment, Costs of accessing to technology, flowing capital and supporting costs. Measuring the non-financial performance, however, is based on learning and operational indexes. Direct learning indexes are based on the number of courses, the number of participants, quality of courses, and learning quality of participants. Indirect learning indexes, however, include expert meetings, Studying the related news and media sources, studying brochures and extension sources, and attending professional communities. Operational indexes include levels of customer satisfaction, projects duration, efficiency of researchers, and personnel satisfaction (Emami Azadi et al,2011).

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### 3. The Questionnaire Outputs

Explaining and analyzing the model's data is as table 1.

Table 1: Distribution of respondents' viewpoints

| Variables | Component and area | | Pathology rate | | | | Descriptive indicators | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Ineffective | | Effective | | | | |
| | Component | Area | # | % | # | % | Average | SD | Skewness |
| Using project's achievements | 1 | 1 | 24 | 48% | 26 | 52% | 2.66 | 0.982 | 0.61 |
| Using project's achievements of others | 1 | 1 | 20 | 40% | 30 | 60% | 2.74 | 0.853 | -0.08 |
| Support of knowledge in Company's success | 1 | 1 | 16 | 32% | 34 | 68% | 2.9 | 1.055 | 0.098 |
| Using experience in future works | 2 | 1 | 23 | 46% | 27 | 54% | 2.66 | 0.939 | 0.438 |
| Reviewing the way of performing tasks | 2 | 1 | 13 | 26% | 37 | 74% | 3.06 | 1.018 | -0.245 |
| Using colleague's votes in affairs | 2 | 1 | 21 | 42% | 29 | 58% | 2.66 | 0.939 | 0.284 |
| Studying scientific texts in performing projects | 2 | 1 | 19 | 38% | 31 | 62% | 2.72 | 0.948 | 0.153 |
| Emphasis on organizing activities' records | 2 | 1 | 14 | 28% | 36 | 72% | 3.04 | 1.068 | 0.022 |
| Recording project details | 2 | 1 | 16 | 32% | 34 | 68% | 2.98 | 1.134 | -0.135 |
| Using specialized publications | 2 | 1 | 17 | 34% | 33 | 66% | 2.84 | 0.997 | -0.052 |
| Analyzing activities | 3 | 1 | 11 | 22% | 39 | 78% | 2.98 | 0.958 | -0.394 |
| emphasis on lining up knowledge with business goals | 3 | 1 | 9 | 18% | 41 | 82% | 3.08 | 0.829 | -0.825 |
| exchanging and developing knowledge via meetings | 3 | 1 | 12 | 24% | 38 | 76% | 3.26 | 1.065 | -0.339 |
| developing libraries and information centers | 4 | 1 | 24 | 48% | 36 | 52% | 2.9 | 1.182 | 0.509 |
| searching the knowledge needs of | 5 | 1 | 10 | 20% | 40 | 80% | 3.34 | 1.042 | -0.174 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| departments | | | | | | | | | |
| Investing in IT to save knowledge | 6 | 1 | 16 | 32% | 34 | 68% | 3.06 | 1.058 | 0.308 |
| Attracting skillful people for recruitment | 7 | 2 | 17 | 34% | 33 | 66% | 2.9 | 1.093 | 0.205 |
| Emphasis on identifying the ones who have key knowledge | 8 | 2 | 10 | 20% | 40 | 80% | 3.16 | 0.955 | -0.333 |
| Arrangements to hold electronic classes | 9 | 2 | 8 | 16% | 28 | 84% | 3.56 | 1.053 | -0.219 |
| Creating a method to facilitate learning | 10 | 2 | 11 | 22% | 27 | 78% | 3.26 | 1.084 | -0.147 |
| People's learning in different places from a unique source | 10 | 2 | 11 | 22% | 29 | 78% | 3.3 | 1.129 | -0.097 |
| Creating and maintaining electronic documents | 10 | 2 | 18 | 36% | 32 | 64% | 2.82 | 1.044 | 0.264 |
| Accessing other's knowledge via a computer system | 10 | 2 | 17 | 34% | 21 | 66% | 3.26 | 1.157 | 0.123 |
| Exchanging knowledge with other companies | 10 | 2 | 7 | 14% | 26 | 86% | 3.62 | 1.067 | 0.537 |
| Encoding knowledge in organizational processes | 11 | 3 | 4 | 8% | 26 | 92% | 3.72 | 0.97 | -0.797 |
| Using technology to make a partnership with customers | 11 | 3 | 6 | 12% | 27 | 88% | 3.56 | 1.013 | -0.476 |
| Permanent refining of specialized knowledge to do the tasks better | 12 | 3 | 11 | 22% | 19 | 78% | 3.4 | 0.99 | -0.368 |
| Analyzing the knowledge of competitors | 12 | 3 | 8 | 16% | 24 | 84% | 3.44 | 1.091 | -0.675 |
| Proposing a new | 13 | 3 | 18 | 36% | 32 | 64% | 2.64 | 1.025 | -0.04 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| plan using knowledge | | | | | | | | | |
| Capturing cutomers' knowledge | 11 | 3 | 7 | 14% | 26 | 86% | 3.3 | 0.886 | -0.458 |
| Permanent refinement of knowledge via research and development | 13 | 3 | 10 | 20% | 22 | 80% | 3.4 | 0.99 | -0.237 |
| Utilizing motives in order to use knowledge to develop the company | 14 | 3 | 13 | 26% | 25 | 74% | 3.28 | 1.011 | 0.264 |
| Utilizing knowledge to change the competitive conditions | 12 | 3 | 15 | 30% | 17 | 70% | 3.16 | 1.017 | -0.213 |
| Protecting knowledge and not using it in bad ways | 14 | 3 | 9 | 18% | 26 | 82% | 3.38 | 1.028 | -0.25 |
| Utilizing motives to increase personnel knowledge level | 14 | 3 | 13 | 26% | 25 | 74% | 3.12 | 0.982 | 0.02 |
| Public culture of distributing knowledge information in different departments | 4 | 1 | 7 | 14% | 33 | 86% | 3.36 | 1.102 | -0.296 |

The model's areas are as follows:

1. knowledge quality
2. system quality
3. service quality

While the components include following items:

1. senior management's support of research
2. paying attention to learning, training, and shared knowledge
3. establishing knowledge management in a long-term period
4. using a reading room in the organization
5. a friendly atmosphere and recognizing the visitors' needs.
6. having networks and infrastructures of information technology

7. having human infrastructures of the knowledge network
8. access to information experts
9. holding electronic instruction courses
10. having a portal website in order to access the main recourses
11. Customers' expectations of services
12. competitive advantage of services
13. services differentiation
14. services and their related expenses values

## 4. Research Questions

Data in table 1 show that the most pathology is related to question number 25 (should it be emphasized on choosing and encoding the knowledge used in organizational processes?). The question number 25 is in component number 11 (customers' expectations of services) and area 3 (services quality). Actually, area 3 has the most pathology among three other areas. Component 9 (holding electronic instruction courses), however, has the most pathology among other 14 components and is related to the second area (system quality). Considering the averages of 14 components, the average of component 11 (customers' expectations of services), with just 0.03 difference with the average of component 9 (holding electronic instruction courses), has the highest average. Considering averages, statistical tests showed that areas 2 and 3 (system and services) don't have any significant difference with each other and both a have higher pathology than knowledge area.

It should be mentioned that Skewness of component 11 (customers' expectations of services) has a higher Absolute value than the component 9's. This shows that some has decreased the average of these three components by low reporting the pathology in component 11. It should be noted that component 11 has the potential to have a higher average for the pathology. The lowest standard deviation is for question number 12 (is it emphasized on lining up the knowledge of the organization with commercial purposes?). This shows that distribution of responses is lower than average. The highest standard deviation is for question number 14 (is it emphasized on mobilizing the library and information centers?). It has also a high Skewness.

### *4.1. Describing and analyzing the model's data*

Table 2 illustrates the average, the standard deviation, and the skewness of 14 components for fifty respondents. Whenever the average is high, the pathology is high too. If the standard deviation, that shows the distribution of responses, is low, there will be more agreement around the average. Skewness shows the shape of data's histogram. A positive skewness shows that concentration of data on lower values is higher and some respondents might have answered the questions higher than normal in order to increase the average. A negative skewness is vice versa. It is better to have a low average, a low standard deviation, and a positive skewness because this shows that the pathology's average could have been lower and some have responded to pathology higher than normal in order to increase the average.

Table 2. Statistical descriptive measurements of 14 components

| Components | Mean | SD | Skewness |
|---|---|---|---|
| Senior manager's support of research | 2.77 | 0.65 | 0.555 |
| Paying attention to learning, training, and knowledge share | 2.85 | 727 | -0.15 |
| Establishing knowledge management in a long-term period | 3.11 | 0.763 | -0.369 |
| Using a reading room in the organization | 3.13 | 0.775 | -0.146 |
| A friendly atmosphere and identifying visitors' needs | 3.34 | 1.042 | -0.174 |
| Having a network and infrastructures of information technology | 3.06 | 1.058 | 0.308 |
| Having human infrastructures of knowledge network | 2.9 | 1.093 | 0.205 |
| Accessing information experts | 3.16 | 0.955 | -0.333 |
| Holding electronic instruction courses | 3.56 | 1.053 | -0.219 |
| Having a portal website to access main sources | 3.25 | 0.725 | 0.475 |
| Customers' expectations of services | 3.53 | 0.71 | -0.465 |
| Competitive advantage of services | 3.33 | 0.744 | -0.287 |
| Services differentiation | 3.02 | 0.808 | -0.218 |
| Services and their related expenditures value | 3.26 | 0.836 | -0.152 |

### *4.2. Describing And Analyzing Three Main Areas Of The Model*

Three main areas which are very important in this research are as the following:

1. Knowledge pathology
2. System pathology
3. Services pathology

In table 3 and table 4, descriptive indices of those three areas are illustrated.

Table 3. Descriptive statistics of areas in the triangle model

| Statistics | Pathology | | | |
|---|---|---|---|---|
| | Knowledge | System | Services | Total |
| Mean | 2.9553 | 3.235 | 3.3091 | 3.1665 |
| SD | 0.57458 | 0.63469 | 0.57701 | 0.53166 |
| Skewness | - 0.022 | 0.447 | - 0.243 | 0.095 |
| Minimum | 1.82 | 2.13 | 2.09 | 2.1 |
| Maximum | 4.24 | 4.75 | 4.45 | 4.48 |

According to table 3, the total pathology is related to the total pathology identified from each questionnaire. In each questionnaire, the average of knowledge, system, and services is considered as a total pathology in this table, the total average is higher than normal while the standard deviation and skewness are normal. In other words, a suitable standard deviation exists and the skewness is around zero to positive values. Therefore, pathology is a little bit more than average. Totally, system pathology and services pathology are more than average but knowledge pathology is less than average.

Table 4 is similar to table 3, however, its data are illustrated for two companies separately.

Table 4. Descriptive statistics of areas in the triangle model for the companies

| Statistics | Company | Pathology | | | |
|---|---|---|---|---|---|
| | | Knowledge | System | Services | Total |
| Mean | Zobahan | 2.8353 | 3.2 | 3.2091 | 3.0815 |
| | Irisa | 3.0353 | 3.2583 | 3.3758 | 3.2231 |
| Standard deviation | Zobahan | 0.46733 | 0.48734 | 0.53588 | 0.43886 |
| | Irisa | 0.63102 | 0.72363 | 0.60242 | 0.58575 |
| Minimum | Zobahan | 1.82 | 2.38 | 2.09 | 2.1 |
| | Irisa | 1.94 | 2.13 | 2.27 | 2.29 |
| Maximum | Zobahan | 3.82 | 4 | 4.18 | 3.96 |
| | Irisa | 4.24 | 4.75 | 4.45 | 4.48 |

## 5. Test of Hypotheses

Hypothesis: 14 components of pathology have equal importance in establishing knowledge management.

In previous sections, it was observed that the highest pathology average is for component 9 (not holding electronic instruction courses). The lowest average is for "senior managers don't have a desire to support doing research and utilizing its results". A question is if it is possible to extend the results of samples to the society and conclude that the average of these 14 components is different. Therefore, the test of hypotheses is described as the following:

$$\begin{cases} H_0 : \mu_1 = ... = \mu_{14} \\ H_1 : \exists i, j \ni \quad \mu_i \neq \mu_j , \quad (i \neq j) = 1,...,14 \end{cases}$$

In other words, the equality of 14 averages should be tested in the society. Actually, it is needed to know if lack of equality in samples could be extended to society or it is due to the random sampling process. As these 14 components are calculated for each respondent, the equality of 14 related societies (as null hypothesis) should be tested. With regard to the lack of normality of conditions, a Friedman Test which is a non-parametric test is used to test the equality of the average of multiple dependent samples. The statistic of this test which has a Chi-square distribution is 82.496. With regard to the significant level which is zero, it is concluded that the zero hypothesis is rejected. It means that the difference of averages can be extended to the statistical society of this research.

Table 5 show that some of variables have sig <0.5 or sig <0.05. This means that they are not normal; therefore, it is not possible to use F test and its nonparametric equivalent (Friedman test) should be applied.

Table 5. Kolmogrov-Smirnov test results

| Components | p-value of Kolmogorov Smirnov test |
|---|---|
| Senior manager's support of research | 0.469 |
| Paying attention to learning, training, and knowledge share | 0.88 |
| Establishing knowledge management in a long-term period | 0.248 |
| Using a reading room in the organization | 0.069 |
| A friendly atmosphere and identifying visitors' needs | 0.059 |
| Having a network and infrastructures of information technology | 0.014 |
| Having human infrastructures of knowledge network | 0.014 |
| Accessing information experts | 0.009 |
| Holding electronic instruction courses | 0.071 |
| Having a portal website to access main sources | 0.597 |
| Customers' expectations of services | 0.295 |
| Competitive advantage of services | 0.524 |
| Services differentiation | 0.137 |
| Services and their related expenditures value | 0.322 |

In Table 6, the p-value is zero and the null hypothesis (equality of 14-folded averages in society) is rejected. So the difference between the means of those components should be tested. When the null hypothesis was rejected in Friedman Test, it was concluded that at least two components from fourteen components have averages with significant differences. Therefore, this test can tell us if components have significant differences with each other.

Table 6. Friedman Test

| Friedman Test | | |
|---|---|---|
| **Components** | **Average Rating** | n=50 |
| Senior manager's support of research | 4.81 | $\chi^2 = 82.496$ |
| Paying attention to learning, training, and knowledge share | 5.32 | df=13 |
| Establishing knowledge management in a long-term period | 7.32 | p-value = 0.000 |
| Using a reading room in the organization | 7.4 | |
| A friendly atmosphere and identifying visitors' needs | 8.6 | |
| Having a network and infrastructures of information technology | 6.81 | |
| Having human infrastructures of knowledge network | 6.45 | |
| Accessing information experts | 7.44 | |
| Holding electronic instruction courses | 9.64 | |
| Having a portal website to access main sources | 7.91 | |
| Customers' expectations of services | 9.79 | |
| Competitive advantage of services | 8.69 | |
| Services differentiation | 6.64 | |
| Services and their related expenditures value | 8.18 | |

Table 7 shows the sig. values to compare each two components. Each Row and each column belongs to one component and their cross shows the sig. value of their comparison test. If this value is lower than 0.05, it can be concluded that in a 5% level, they have a significant difference in their averages.

Table 7. LSD test for significant differences of components

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | | | |
| 2 | 0.625 | | | | | | | | | | | | | |
| 3 | 0.050 | 0.141 | | | | | | | | | | | | |
| 4 | 0.036 | 0.108 | 0.893 | | | | | | | | | | | |
| 5 | 0.001 | 0.005 | 0.178 | 0.226 | | | | | | | | | | |
| 6 | 0.091 | 0.229 | 0.788 | 0.686 | 0.106 | | | | | | | | | |
| 7 | 0.441 | 0.779 | 0.233 | 0.184 | 0.011 | 0.356 | | | | | | | | |
| 8 | 0.023 | 0.075 | 0.758 | 0.862 | 0.299 | 0.564 | 0.134 | | | | | | | |
| 9 | 0.000 | 0.000 | 0.009 | 0.013 | 0.204 | 0.004 | 0.000 | 0.021 | | | | | | |
| 10 | 0.005 | 0.021 | 0.401 | 0.481 | 0.611 | 0.268 | 0.042 | 0.595 | 0.076 | | | | | |
| 11 | 0.000 | 0.000 | 0.016 | 0.022 | 0.281 | 0.007 | 0.000 | 0.035 | 0.847 | 0.113 | | | | |
| 12 | 0.001 | 0.006 | 0.191 | 0.241 | 0.969 | 0.115 | 0.013 | 0.317 | 0.191 | 0.639 | 0.264 | | | |
| 13 | 0.144 | 0.331 | 0.617 | 0.525 | 0.065 | 0.817 | 0.488 | 0.419 | 0.002 | 0.181 | 0.004 | 0.071 | | |
| 14 | 0.005 | 0.019 | 0.376 | 0.453 | 0.644 | 0.248 | 0.038 | 0.564 | 0.084 | 0.963 | 0.124 | 0.672 | 0.166 | |

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Table 8 shows the ninth component (holding electronic instruction courses) has the highest average. According to table 8, The 9th component doesn't have any significant difference in average with the 11th component (customers' expectations of services), 5th component (a friendly atmosphere and identifying visitors needs), 12th component (competitive advantage of services), 14th component (services and their expenses value), and 10th component (having a portal site to access main sources). But it has significant differences with components 1, 2, 3, 4, 6, 7, and 8.

Table 8. Ranks of the model's components

| Components | Mean |
|---|---|
| Senior manager's support of research | 3.56 |
| Paying attention to learning, training, and knowledge share | 3.53 |
| Establishing knowledge management in a long-term period | 3.34 |
| Using a reading room in the organization | 3.33 |
| A friendly atmosphere and identifying visitors' needs | 3.26 |
| Having a network and infrastructures of information technology | 3.25 |
| Having human infrastructures of knowledge network | 3.16 |
| Accessing information experts | 3.13 |
| Holding electronic instruction courses | 3.11 |
| Having a portal website to access main sources | 3.06 |
| Customers' expectations of services | 3.02 |
| Competitive advantage of services | 2.9 |
| Services differentiation | 2.85 |
| Services and their related expenditures value | 2.77 |

According to table 9, the components including: 1.having human infrastructures of knowledge network, 2.having infrastructures and networks of information technology, 3.a friendly atmosphere and identifying visitors needs, 4.accessing information experts, and 5.holding electronic instruction courses, have higher averages and as a result have a higher pathology. Other components have a pathology lower than average.

Table 9. Components' coefficient of variation in an ascending order

| Components | Mean | SD | CV |
|---|---|---|---|
| Having human infrastructures of knowledge network | 2.9 | 1.093 | 0.377 |
| Having a network and infrastructures of information technology | 3.06 | 1.058 | 0.346 |
| A friendly atmosphere and identifying visitors' needs | 3.34 | 1.042 | 0.312 |
| Accessing information experts | 3.16 | 0.955 | 0.302 |
| Holding electronic instruction courses | 3.56 | 1.053 | 0.296 |
| Services differentiation | 3.02 | 0.808 | 0.267 |
| Services and their related expenditures value | 3.26 | 0.836 | 0.256 |
| Paying attention to learning, training, and knowledge share | 2.85 | 0.727 | 0.255 |
| Using a reading room in the organization | 3.13 | 0.775 | 0.248 |
| Establishing knowledge management in a long-term period | 3.11 | 0.763 | 0.245 |
| Senior manager's support of research | 2.77 | 0.65 | 0.235 |

| | | | |
|---|---|---|---|
| Competitive advantage of services | 3.33 | 0.744 | 0.223 |
| Having a portal website to access main sources | 3.25 | 0.725 | 0.233 |
| Customers' expectations of services | 3.53 | 0.71 | 0.201 |

## 6. Analysis Finding

The findings are in terms of hypothesis and its questions. Hypothesis: three areas of pathology in establishing knowledge management are equally important.

Question: if this hypothesis is rejected (14 components of pathology are equally important in establishing knowledge management), then how is the difference?

Sub-questions:

1. Have the managers and experts of two companies equally assessed pathology in their organizations?
2. Have men and women equally assessed pathology in their organizations?
3. Have the personnel in different organization's hierarchy equally assessed pathology?
4. Have the personnel with different work experience equally assessed pathology in their organization?
5. Have the personnel with different educations equally assessed pathology in their organization?
6. Have the personnel equally assessed pathology in their organization with regard to their familiarity to knowledge management?

If it is desired to find answers to these hypotheses and questions, all variables suspected to be effective should be involved in the statistical analysis model simultaneously. Therefore, the variance analysis model is applied to study the effects. In the variance analysis table, test statistics are based on F ratio; and a null hypothesis in each component is actually ineffectiveness of that component. Therefore, when Sig. value is lower than 0.05, a zero hypothesis is rejected and the related variable is considered to have a significant effect. Considering the existence of a factor with repeated measures (in three levels), and six more crossover factors in the model, a 7-way variance analysis with one repetition factor and six crossover factors is utilized.

In Table 10, a multiple variance analysis in which higher-level effects are omitted and one factor has three repeated measures is illustrated. According to this table, only gender and familiarity with knowledge management are considered as effective factors (with regard to significance levels). Different levels of these effective factors have reported different rates of pathology. For example, gender having a significant effect means that the rate of pathology is different in viewpoints of men and women.

Table 10. MANOVA of effective variables on the response variable in the primary model

| Sources | SS | df | MSS | F | p-value |
|---|---|---|---|---|---|
| Area | 0.051 | 2 | 0.026 | 0.232 | 0.793 |
| Area * company | 0.191 | 2 | 0.096 | 0.867 | 0.424 |
| Area * gender | 0.24 | 2 | 0.12 | 1.089 | 0.342 |
| Area * Job | 0.517 | 6 | 0.086 | 0.782 | 0.587 |
| Area * experience | 0.119 | 6 | 0.02 | 0.18 | 0.981 |
| Area * education | 0.985 | 4 | 0.246 | 2.234 | 0.073 |
| Area * familiarity | 0.813 | 4 | 0.203 | 1.844 | 0.13 |
| Internal error | 8.154 | 74 | 0.11 | --- | --- |
| company | 0.041 | 1 | 0.041 | 0.079 | 0.78 |
| gender | 2.956 | 1 | 2.956 | 5.74 | 0.022 |
| career | 3.705 | 3 | 1.235 | 2.398 | 0.084 |
| experience | 1.682 | 3 | 0.561 | 1.089 | 0.366 |
| education | 2.807 | 2 | 1.404 | 2.726 | 0.079 |
| familiarity | 9.893 | 2 | 4.947 | 9.606 | 0 |
| External error | 19.053 | 37 | 0.515 | --- | --- |

Considering that some factors have been recognized as ineffective, a new model for variance analysis is designed in which insignificant effects of the primary model is omitted. Gender, area, and familiarity with knowledge management which had significant effects in variance analysis table of the primary model will be entered into this new model (Table 11).

Table 11. MANOVA of effective variables on the response variable in the new model

| Sources | SS | df | MSS | F | p-value |
|---|---|---|---|---|---|
| Area | 1.491 | 2 | 0.745 | 6.683 | 0.002 |
| Area * Gender | 0.149 | 2 | 0.075 | 0.668 | 0.515 |
| Area * Familiarity | 0.34 | 4 | 0.085 | 0.763 | 0.552 |
| Internal error | 10.263 | 92 | 0.112 | --- | --- |
| Gender | 5.286 | 1 | 5.286 | 9.287 | 0.004 |
| Familiarity | 13.724 | 2 | 6.862 | 12.056 | 0 |
| External error | 26.183 | 46 | 0.569 | --- | --- |

According to Sig. values in this table, it can be concluded that area, gender, and familiarity to knowledge management are effective factors. In other words, three areas of pathology (knowledge, system, and services) are different from each other while gender and familiarity with knowledge management has led to a different report of pathology. According to these results, some questions are raised such as:

- If gender has led to a different report, do women reported more pathology or men?
- More familiarity has led to more reports or less reports of pathology?
- If these areas are different from each other, what is the difference?
- What is the estimated value for each area?

*Question:* Do women reported more pathology or men?

With regard to the gender factors, the distribution rank of them in terms of mean is 3.3264 for female and 3.0979 for male. Therefore, females have reported more pathology than males have. In finding these dissatisfactions, some problems are discussed such as philosophical and social topics which express that current systems have been established based on emotional and physical structures of men. Although women have entered social activities in recent decades, organizations have maintained their masculine system. This dissatisfaction may be due to managers' specific functions in the surveyed organizations. In addition, with regard to logical structure of statistical tests, this result may have been accidentally obtained.

*Question:* what is the difference between various rates of pathology reports in different levels of familiarity with knowledge management?

In variance analysis for factors which have three or more levels, post hoc tests are used to categorize levels in homogeneous groups. The post hoc test used here is Duncan's test. It can be observed in table 12 that top and middle levels which have lower averages, have been placed in one category. The low level has a higher average and has been placed in a separate category.In other word, with regard to this table, it can be concluded that high and middle familiarity with knowledge management has led to a similar report of pathology and this report is different from the report of the ones who had low familiarity with knowledge management. A general conclusion is that whenever the familiarity is higher, the reported pathology is lower.

Table 12. Dunken's test

| Factor Levels | Total | Mean | Cluster | Significant Levels |
|---|---|---|---|---|
| High | 11 | 2.8834 | 1 | 0.186 |
| Medium | 30 | 3.1153 | | |
| Low | 9 | 3.683 | 2 | 1 |

*Question:* what is the difference between pathology of different areas?

Table 13. Different levels of test areas (knowledge, system, and services)

| Areas | p-value of Kolmogorov-Smirnov test | Mean |
|---|---|---|
| Knowledge | 0.964 | 2.9553 |
| System | 0.595 | 3.235 |
| Services | 0.761 | 3.3091 |

According to table 13, knowledge, system, and services have lowest to highest pathology respectively. These three levels are repeated measures of the areas; the average difference of these levels have been tested via paired T test (considering p-values, the normality of three levels has been confirmed in table 12). Table 14 shows that knowledge and system have zero p-values and are different from each other. Knowledge and services have also zero p-values and are different from each other. However, considering its table, system and services have a close pathology. Knowledge has a lower and a different pathology than system and services.

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Table 14. Paired Ts

| Pairs | t-value | Df | p-value |
|---|---|---|---|
| K - System | - 4.325 | 49 | 0 |
| K - Services | - 4.941 | 49 | 0 |
| System - Services | - 1.207 | 49 | 0.233 |

## 7. Conclusion and Recommendations

According to demographic data and other findings, the following conclusions are proposed.

40% of respondents are Zobahan personnel and 60% of them are IRISA personnel. Tables show that men are dominant in samples and most of respondents are middle managers. While more than 72% have more than 6 years of work experience, only one person has less than 2 years of work experience. Most of respondents have master's degree and have stated that moderately know primary topics of knowledge management. The total pathology is estimated a little bit more than average. Three different areas of pathology (knowledge, system, and services) have averages with significant differences. Knowledge has less pathology, and system and services has more and different pathology than knowledge. In addition, system and services do not have any difference with each other. Women have reported pathology more than men and the ones who had less familiarity with knowledge management reported more pathology than the ones who had moderate and high familiarity with it. The highest pathology is when it is emphasized on having and encoding the knowledge used in organizational processes. The lowest pathology is when using knowledge leads to proposing new and innovative plans in companies, which its average is 2.64. Component 9 (holding electronic instruction courses) which is related to the second area (system quality) has the highest pathology between 14 components. According to table of descriptive statistics of three areas derived from the questionnaire, it is obvious that the total average is more than moderate while standard deviation and skewness are moderate. It means that the standard deviation is suitable and skewness has a positive value around zero; therefore, pathology is a little bit more than moderate. Totally, it can be concluded that system's pathology and services' pathology are more than average but knowledge's pathology is less than average. It is also concluded that the difference between averages can be generalized to the population. In addition, gender and familiarity with knowledge management are effective factors on pathology (with regard to significant levels). For example, when gender has a significant effect, the rate of pathology is different in viewpoints of men and women.

## 8. A Model to Establish Knowledge Management

Considering that the highest pathology is for not encoding the knowledge used in organizational processes and not holding electronic instruction courses, it is worth to find practical solutions in order to solve these problems. One of these practical solutions is to attend electronic instruction courses and seminars according to personnel educational needs. In addition, new methods of instructions can be applied as useful tools of accessing a tacit knowledge. Some of these new methods are job games, case studies, behavior modeling, adventure learning, and team training that help learners to share their ideas and experiences with each other.

Lack of a friendly atmosphere and not identifying visitors' needs are main pathologies of this research. It is recommended to create a friendly atmosphere and identify visitors' needs.
In this research, it was found that women know system's pathology more than men. It should be noted that the purpose of this research is to study pathologies and there shouldn't be any difference between men and women in recognizing pathologies and their rate. The effect of a gender factor is studied in this research and contrary to what was expected normally, women have reported system's pathology more. This phenomenon can be the subject of future research. Table 15 shows the knowledge management research model and its various levels.

Table 15. KM research model and its various levels

| Fields of KM | Structure | Human | Technical and Instrumental Issues |
|---|---|---|---|
| Determining knowledge purposes,<br><br>Showing the working processes | Strategies | Important working processes of scanning tools | Data storage |
| Recognizing knowledge,<br><br>How to recognize the knowledge related to the working processes | Internal and external sensors of competency and success factors | Understanding competencies of informal networks via their roles and tasks; data extraction | Scenarios and electronic newsletters for customers |
| Acquiring knowledge,<br><br>How knowledge innovation is supported? | Organizational structure,<br><br>Team work,<br><br>Organizing texts,<br><br>Network structures,<br><br>References,<br><br>Knowledge addressing | Readiness for innovation,<br><br>Creativity,<br><br>Utilizing participation opportunities | Computer support of Participatory work systems,<br><br>Virtual forms for ideas and relations |

| | | | |
|---|---|---|---|
| Enrichment and development of knowledge,<br><br>How can exchange and sharing knowledge be done successfully? | Communication structures,<br><br>Utilizing potentials,<br><br>Proposing reports,<br><br>Creating places for knowledge distribution | Creating a trustful atmosphere and a sharing culture,<br><br>Providing tools for knowledge exchange,<br><br>Readiness to transfer not evident knowledge | Structures of communication infrastructures, Media and canals,<br><br>Telephone, fax, internal network, group tools, post, etc. |
| Maintaining knowledge,<br><br>How can knowledge be appeared in an organization | Document management,<br><br>Permanent and updated saving of work description,<br><br>Technical knowledge, consulting | Consolidation of common work theories,<br><br>Readiness and flexibility for new issues,<br><br>Subject knowledge plans | Selecting,<br><br>Saving,<br><br>Updating,<br><br>Refining,<br><br>Revising,<br><br>Preparing,<br><br>Creating suitable hardware and software |
| Sharing and using knowledge,<br><br>How can the acquired knowledge be used in job? | Understanding individual and structural barriers | Transfer,<br><br>Tolerance of mistake | Assigning departments for research about new tasks |
| Knowledge evaluation,<br><br>How can one learn from knowledge? (its training potential in work place) | Creating behavioral loops and reporting the results and feedback | Motives of creating, maintaining, and transforming innovation | Training laboratory,<br><br>Simulation |

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