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Research Article

Effective Factors in Successful Establishment of Knowledge Management in Information and Communication Technology Companies

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Abstract: Nowadays, knowledge of employees is a very precious resource, which should be documented, developed, and shared among the members of a company. In order to work in the competitive world, companies must utilize their tacit and explicit knowledge in all their activities, and nothing as much as knowledge management (KM) processes can help companies to gain the competitive advantage. The present research aims to identify and measurethe effective factors in the successful establishment of KM in information and communication technology (ICT) companies. Grounded on a descriptive–survey research methodology, this research is a case study based on the data collected from182 companies belonging to Iranian ICT Guild Organization. The effective factors in the successful establishment of KM (the dependent variable) in ICT companies are human resources, processes, and information technology (the independent variables). According to the results, among the variables, the 'processes' variable has the most impact on the efficacy of establishment of KM (54.9%). It means that the 'processes' variable causes 54.9% deviations in the efficacy of KM establishment. Twenty-eight point one percent (28.1%) and 17.9% of the efficacy deviations are related to human resources and information technology, respectively. On the basis of a preliminary study, four processes are identified in KM, namely knowledge recognition, knowledge acquisition, knowledge codification, and knowledge sharing, which have significant effects on the establishment of KM. The findings indicate that the processes and in particular knowledge sharing have more significant contributions for ICT companies seeking the successful establishment of KM.

Keywords: knowledge management, knowledge recognition, knowledge acquisition, knowledge codification, knowledge sharing, KM establishment

Introduction

Not a completely new issue, knowledge management (KM) uses all the resources available in the company. A good library and database or even a proper educational program in a company means that KM has already been implemented. Benefiting from knowledge and information is necessary for the survival of companies and their participation in competitions (Soon & Zainal, 2011; Zerbino, et al., 2018). Producing, gaining, testing, presenting, and using knowledge are all influential in products and services of the company. It is vital that company managers make better decisions and improve the company's functions by using the superior knowledge (Chen & Jong, 2015; Garrido, et al., 2014; Aboelmaged, 2014). Today, an individual's knowledge is the only advantage that can be maintained. Knowledge should be kept, developed, and shared among the members of a company. All companies agree that knowledge should be highly regarded in all their activities in order to be able to work in the commercial and competitive world in which nothing can help companies as much as knowledge. Reaching conclusions quickly, making prompt adjustments, and achieving personal growth need knowledge and creativity, so the staff of a company is the main target of KM. KM is regarded as a tool that can gather, organize, and spread knowledge throughout the company (Chong & Chong, 2009; Centobelli, et al., 2017).

Although each company has a different approach to KM, similar approaches and key issues are also developed. Gradually, companies perceive knowledge as a privilege that flourishes and helps them gain the capability of competition and creativity. In order to use KM, a company needs a great change in the organizational culture and commitment in all its levels (Kuah&. Wong, 2011; Centobelli, et al., 2019).

Perceiving what the company can do and what should be done for the successful implementation of KM can facilitate its establishment. This perception also leads to the reduction of expenses and risks in the company. Undoubtedly, implementing KM and designing its software without considering the effective organizational factors are nothing but gathering a pile of data (Soon & Zainal, 2011; Wen, 2009; Chen & Jong, 2015; Irani, et al., 2017). If the staff of a company become aware not only of the advantages of using KM but also of the

necessary context for benefiting from KM, equipping it, and updating it by adding to the data, they will accept and improve KM. It is necessary to explore the readiness of companies to benefit from KM. It is also essential to design a model to identifythe factors influencing the readiness of companies and staff and determine the level of this readiness. In the present research, theoretical bases and related models were discussed, and the vital factors in the success of KM were identified. Furthermore, having gathered the data related to the indexes of the selected companies, the researchers determined the level of the readiness for KM.

Research hypotheses

Hypothesis 1: Organizational factors (human resources, processes, and information technology) are influential in the efficacy of KM establishment.

Hypothesis 2: KM processes (recognition, acquisition, codification, and sharing knowledge) are significantly more influential in the efficacy of KM establishment.

Hypothesis 3: Among the KM processes, sharing is more influential in the efficacy of KM establishment than the other processes.

Literature review

Considered as a way through which organizations manage their knowledge assets, KM includes collecting, storing, transferring, using, updating, and creating knowledge. Karkoulian et al. (2008) also believe that KM is an approach to create an organization whose members can gain, share, and create knowledge or apply it to decision-making activities.

In most resources, KM has four main parts: storage, retrieval, transfer, and application of knowledge. Knowledge measurement, as the fifth stage, is missing in the main stages of KM, while it is essential for the successful implementation of other processes of KM (Jafari, et al., 2007; Wen, 2009). More and better conversion of tacit knowledge into explicit knowledge is the main challenge of KM. Experience has shown that organizations have spent a lot of money in the field of KM in recent years. The calculation of this investment is easy, but accurate and correct calculation of its return on investment is very difficult (Khoshsima, et al., 2008). If we want to assess the success of KM, we must be able to assess knowledge. Knowledge assessment doesn't equal its monetary estimation. Instead, it means determining whether or not objectives of knowledge have been achieved. If organizations fail to measure their knowledge, the knowledge cycle remains incomplete. As a result, there won't be any feedback based on which companies can make possible modifications in several fundamental elements of KM. Due to this, defining alternative indicators to determine the success of KM system is among the challenges of KM (Probst, et al., 2000).

The effectiveness of KM means meeting its objectives to a satisfactory level (Samimi&Aghaei, 2005). But the assessment of KM based on business interests is difficult, because KM tools are not clearly defined yet. Chen and Chen (2006) categorized KM performance assessment tools into two categories: quantitative and qualitative. Qualitative measures include improving staff skills, product quality, business processes and customer-seller relationships, and quantitative measures include reducing operational costs, improving productivity, and increasing profits. Chua and Gho (2008) defined four elements of organizational processes, namely knowledge activities, knowledge assets, impact on organizational activities, and commercial objectives.

Implementing KM requires the application of methods that can evaluate the contribution of KM to realizing the strategy and KM plan on the basis of the mentioned indicators.

However, these tools focus on the organization, not on KM per se. Therefore, the effective implementation of KM needs appropriate techniques, technologies, and tools (Jafari, et al., 2007; Darvishi, Darvishi,2019).

Considering KM mainly at national and organizational levels, most researches ignore the fact that many scientific activities in developing countries take place at the industrial level. However, in a study titled "An Industry-level Knowledge Management Model–A Study of Information-related Industry in Taiwan," Lin, Yen and Tarn (2007) aimed to understand KM at the industrial level, using a primary study and a structural model. After reviewing the previous studies, they reached the conclusion that industrial level knowledge management (ILKM) includes four main subcategories, namely "*knowledge clustering, knowledge enlarging, knowledge exchanging, and knowledge initiating"* (p. 22). On the basis of the results obtained from 123 questionnaires filled out in Taiwan, they concluded that ILKM scale coordinates with credibility of ensuring requirements, strength of internal factors, and credit building. Moreover, these four items were found to be positively related to one another; this presents the credit of ILKM mode (Lin, et al., 2007).

Governments are increasingly looking for ways to improve the performance of the police force, but the evaluation of the performance of the police is not explicit enough. In a study, Gottschalk (2007) considered value shop to evaluate the performance. Reviewing the related articles, he concluded that KM is an important criterion in the performance of the police. He actually studied the relation between the performance of the police and different stages of KM. Further studies should consider the empirical results obtained from the research hypotheses. Also, the idea of adopting a professional management approach to police management was presented through literature review of management science (Gottschalk, 2007).

In another study (Silya, et al, 2006), main concepts of holistic H&G viewpoint are defined as OpenCyc, which are related to teaching technology. Presented definitions make it possible to use this knowledge in different places through KM functions. OpenCyc provides predictive concepts and definitions of aspects of KM. These definitions can be expanded in order to express the precise functions of KM and help us understand its systematic base. The work done in this research, specifically the models of knowledge concept, a great spectrum of related knowledge, KM presentation details, and description of KM, is not complete yet (Silya, et.al, 2006).

Another related study carried out by Malhotra is titled "From Information Management to Knowledge Management: Beyond the Hi-Tech Hidebound Systems" (Malhotra, 2000). The mainstream of KM faces problems in terms of classifying information because of focusing on presupposed definitions of the problem and predetermined solutions. This research discussed theories on the basis of the strength of information classification model, while considering constraints at the lowest level. The need for the synergy of creativity and information classification was emphasized. Theoretical bases of the presented model were revised. Moreover, the model was defined and its main features were discussed. Also, the particular significance of the presented model in the model of creating new structures of knowledge was explained compared to the strengths of information classification systems in computerized KM (Malhotra, 2000).

Research Methodology

Grounded on a descriptive–survey research methodology, this correlational research is a multiple case study based on the data collected from 182 companies. The statistical population of this research includes mostly specialists who are all the managers and members of the Board of Directors in ICT companies belonging to Iranian ICT Guild Organization. The total population consists of 200 companies.

Research variables

In the present research, the research variables are categorized with respect to their types and measures.

Dependent variable: Efficacy of KM establishmentin ICT companies

Independent variables: Human resources, processes, and information technology

Data analysis

At the beginning of the statistical analysis with the available indicators, the demographic and main variables of the research are described and then structural equation modeling is used to test the hypotheses.

Description of demographic characteristics

Table 1. Description of demographic variables of individuals in the statistical sample

Demographic variable		**Frequency**	**Percentage frequency**
Position	Assistant	11	6
	Manager	38	20.9
	Expert	133	73.1
Education	Associate	27	14.8
	Bachelor's degree	124	68.1
	Master's degree and higher	31	17

Age	20–25	53	29.1
	25–30	84	46.2
	Over 30	45	24.7
Work experience	1–5 years	35	19.2
	5–10 years	93	51.1
	10–15 years	54	29.7
Total		182	100

As shown in the table above, out of 182 people in the statistical sample of the research, 6% are assistants, 20.9% are managers, and 73.1% are experts. As far as their level of education is concerned, the majority of individuals have a bachelor's degree. Considering the work experience, the category of 5–10 years is more frequent. Twenty-nine point one percent (29.1%) of respondents are between 20 and 25 years old, and46.2% of people are between 25 and 30 years old. Finally, it is reported that 24.7% of people are over 30 years old.

Description of the research variables

It is clear that basic information alone cannot be obtained from raw data and should be summarized as much as possible by indicators.Table 2 describes the variables by using the central indicator anddispersion.

Table2. Descriptive indices and normality test of the research variables

Research variables	Central index	Indices of dispersion		Kolmogorov-Smirnov test	
	Average	Variance	Standard deviation	Statistics value	Significance level
Knowledge recognition	3.38	0.70	0.83	0.138	0.00
Knowledge acquisition	3.26	0.74	0.86	0.135	0.00
Knowledgecodification	3.42	0.69	0.83	0.14	0.00
Knowledge sharing	3.94	0.63	0.79	0.208	0.00
Processes	3.50	0.37	0.61	0.084	0.003
Human resources	3.65	0.56	0.75	0.13	0.00
Information technology	3.48	0.62	0.79	0.09	0.00
Organizational factors	3.54	0.33	0.57	0.062	0.088
Establishment ofknowledge management	3.54	0.67	0.81	0.076	0.012

As shown in the table above, the average scores of all available variables are more than 3 Also, the significance level of Kolmogorov-Smirnov test is less than the error level of 0.05 ($P< 0.05$) for all the variables except organizational factors. Therefore, it can be said that the data distribution of all variables except organization factors does not follow a normal statistical distribution. So, the method of partial least squares structural equation modeling (PLS-SEM) should be used.

Structural equation modeling

SmartPLS3 software was used to analyze the data by PLS-SEM method.Researchers have mentioned several reasons for using PLS method. The most important reason is its advantages for small sample sizes. The second reason concerns the non-normal data that researchers and scholars are dealing with in some studies. Finally, dealing with formative models is another reason for using PLS method.

The modeling method with PLS consists of the following three steps. After confirming the criteria of each stage, it finally tests the hypotheses.

1. Measurement model fit
2. Structural model fit
3. Overall model fit

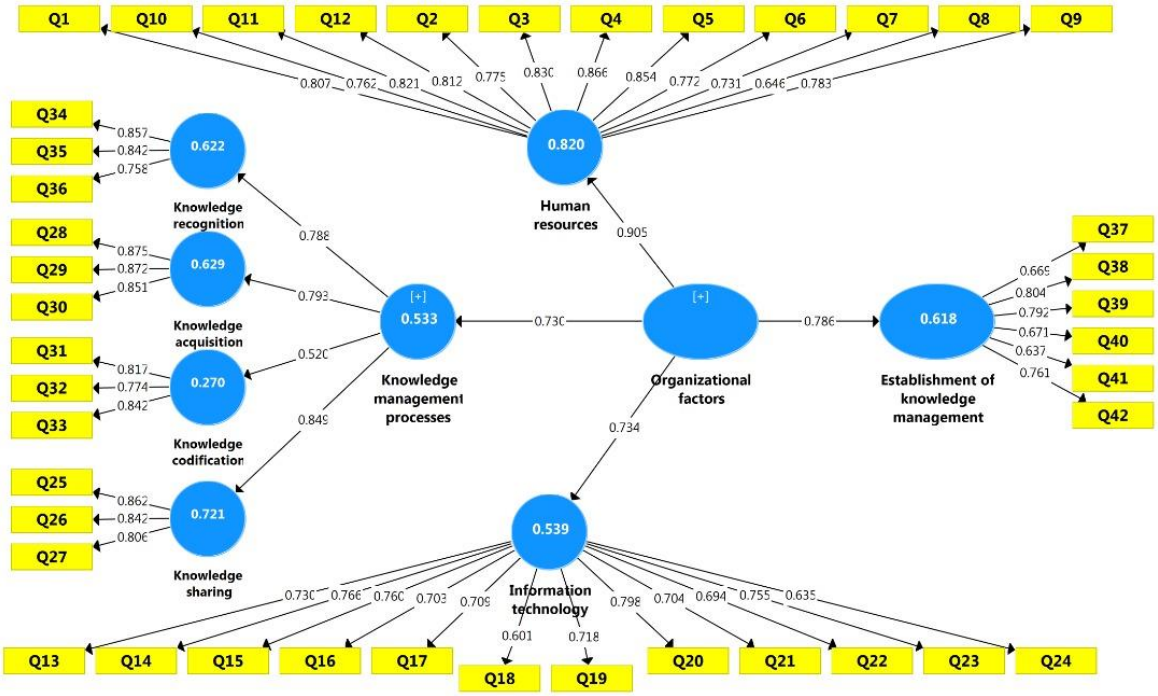

Figure1. Research model with standardized factor loading coefficients and path coefficients

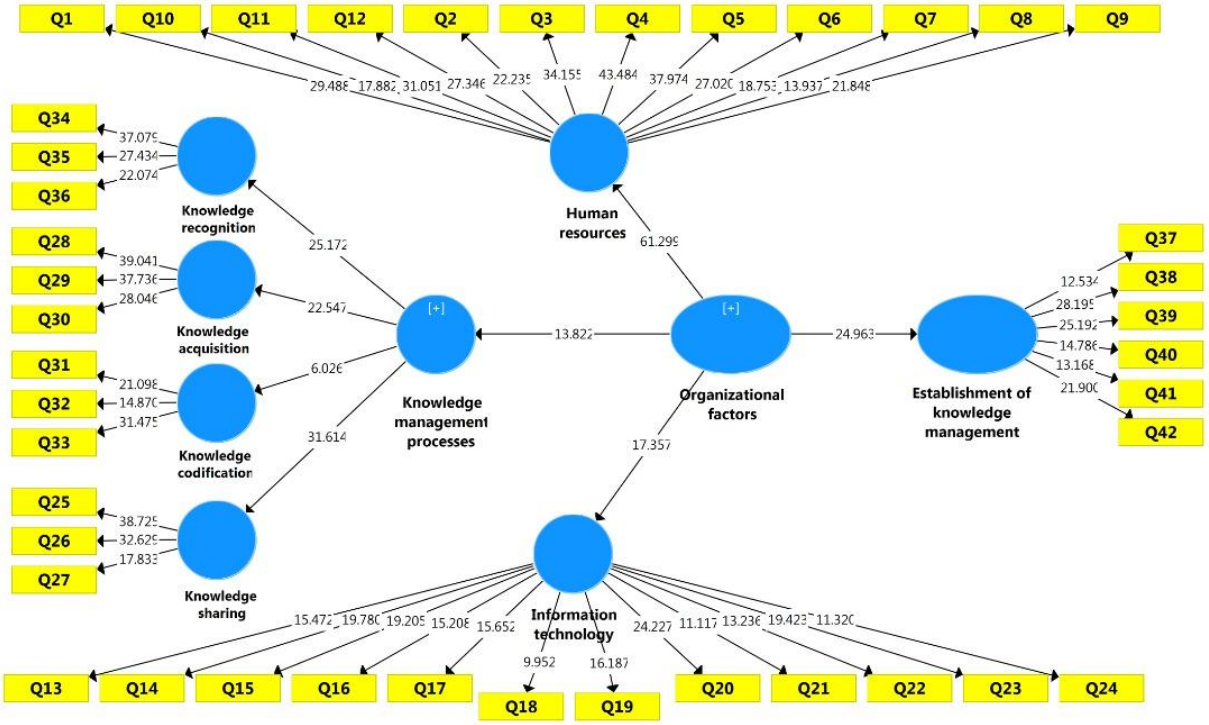

Figure2. Research model with coefficients t-Value

Investigation of indicators related to the measurement models

Measurement model is a model in which the relationships between observable and present variables are considered and measured.

The following criteria have been used to evaluate the fit of measurement models:

1. Significance of the factor between the item and the latent variables related to them,
2. Reliability measured by Cronbach's alpha coefficients and combined reliability,
3. Convergent validity checked by the average variance extracted (AVE) criterion,
4. Divergent validity measured by the Fornell and Larcker method.

Significant factor loadings

As shown in Figures 1 and 2, factor loading values and t-coefficients between the questions and the latent variables related to them are more than 0.4 and 1.96, which shows the relationship between each question and its own variables.

Cronbach's alpha coefficient and combined reliability coefficient

As shown in Table 3, combined reliability coefficient value and Cronbach's Alpha were calculated for all the research structures. It is clear that the combined reliability and Cronbach's alpha values for all the variables are greater than 0.7, which shows the high reliability of the model.

Convergent validity

The average variance extracted (AVE) was used to check convergent validity. A value above 0.5 indicates that this criterion is sufficient and appropriate. Table 3 shows that the value of AVE is above 0.5, hence suitable for all the structures.

Table3. Results of Cronbach's alpha coefficient, combined reliability, and convergent validity

Variables	Cronbach's alpha	Combined reliability	AVE

Knowledge recognition	0.755	0.860	0.672
Knowledge rcquisition	0.833	0.900	0.750
Knowledge codification	0.742	0.852	0.658
Knowledge sharing	0.787	0.875	0.700
Human resources	0.945	0.952	0.625
Processes	0.852	0.882	0.560
Information technology	0.913	0.926	0.513
Organizational factors	0.940	0.946	0.630
Establishment of knowledge management	0.817	0.869	0.526

Divergent validity

The matrix developed by Fornell and Larcker (1981) was used to investigate divergent validity. The square root of the latent variables is in the principal diameter of the matrix, and the other cells of the matrix are the degrees of correlation between the latent variables. As shown in Table 4 the values of the square root of the AVE are greater than the values in the cells below and to the left of the original diameter. It can be said that in the research model, the latent variables interact with their own questions more than other structures. In other words, this table shows the desirability of divergent validity of the model.

Table 4. Results of divergent validity

First-order variables	Knowledge recognition	Knowledge acquisition	Knowledge codification	Knowledge sharing	Human resources	Processes	Establishment of knowledge management
Knowledge recognition	0.820						
Knowledge acquisition	0.494	0.866					
Knowledge codification	0.269	0.190	0.811				
Knowledge sharing	0.552	0.575	0.315	0.837			
Human resources	0.374	0.340	0.525	0.468	0.790		
Processes	0.156	0.124	0.408	0.284	0.487	0.716	
Establishment of knowledge management	0.578	0.508	0.528	0.661	0.670	0.482	0.725

Structural model

Structural model is a model in which the relationships between latent independent (exogenous) and dependent (derivative) variables are investigated. The structural model only examines the relationships between latent variables. The structural model test criteria include the following:

1. Path coefficients (beta) and their significance (t-values),
2. Coefficient of determination index (R^2) of the endogenous latent variables,
3. Predictive relevance (Q^2).

Significance of coefficients t-value

The values of the coefficient T between the latent variables given in Figure 2 are all greater than 1.96, which indicates the significance of these paths and the appropriateness of the structural model.

Criterion R^2

This is a measure that shows the effect of one or more exogenous variables on an endogenous variable . Three values of 0.19, 0.33, and 0.67 are considered as weak, moderate, and substantial R^2 values, respectively. The coefficient of determination of KM is equal to 0.618 andat the desired level. Therefore, it can be concluded that 8.61% of the changes in this variable are predicted by organizational factors, and the rest of them are dependent on other factors and variables that are not included in the model.

Criterion Q^2

Criterion Q^2 determines the predictive power of the model concerning dependent variables for all endogenous structures. Three values of 0.02, 0.15, and 0.35 are considered as small, medium, and large, respectively. According to Table 5, the value of Q^2 endogenous structure of KM (319.0) is positive and at an appropriate level, which indicates the appropriate predictive power of the model regarding this variable.

Overall model

There is only one criterion called the goodness of fit (GoF) to examine the overall model , for which three values of 0.01, 0.25, and 0.36 were introduced as small, medium, and large. According to Table 5, the GoF criterion value was equal to 0.488, which, according to the mentioned classification, shows a strong fit of the overall research model.

Table5. Results of structural and overall model fit criteria

Path Independent variable →Dependent variable	β	T-Value	Significance level	R^2 The dependent variable	Q^2 The dependent variable
Organizational Factors →Establishment of knowledge management	0. 786	24.963	0.00	0.618	0.319
$\text{GoF} = \sqrt{Communalities \times R^2} = \sqrt{0.402 \times 0.594} = 0.488$					

Findings related to the test of general hypotheses

The t-statistic value and the calculated level of significance of the path of organizational factors necessary for the establishment of KM were calculated as 24.963 and 0.00, respectively. Therefore, considering that the significance level of the test is less than 0.05 and the t-value is more than 1.96, it can be said that organizational factors have a significant effect on the establishment of KM. Also, considering the fact that the standardized path coefficient between the two variables is positive and equal to 0.786, it can be concluded that by increasing a standard deviation in the scores of organizational factors the scores of KM establishment increase by 0.786 standard deviation. Therefore, according to the collected data, the general hypothesis of the research about the effect of organizational factors on the establishment of KM is confirmed with a probability of 95%.

Investigating the effectiveness of human resources, processes, and information technology in the establishment of knowledge management

After proving the effectiveness of organizational factors in the establishment of KM, we sought to confirm or reject the impact of human resources, processes, and information technology on the establishmentof KM. Therefore, modeling was created in the software once again; its results are as follows:

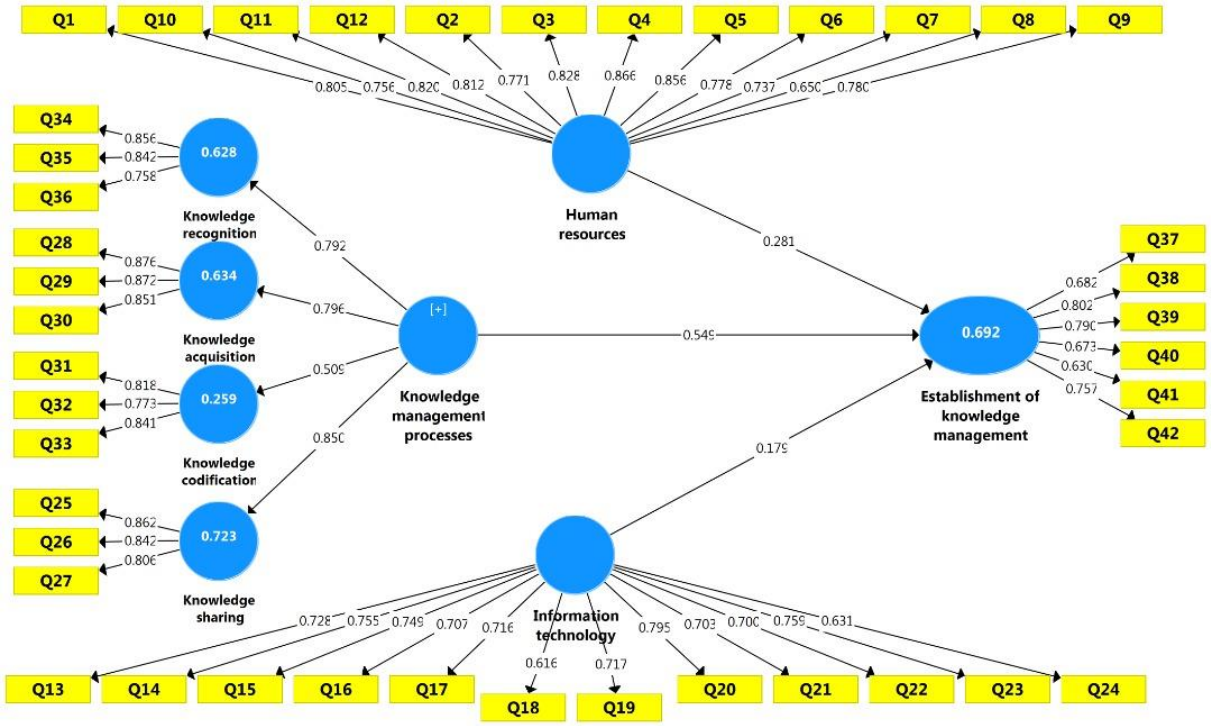

Figure 3. Research model with standardized factor loading coefficients and path coefficients (first sub-model)

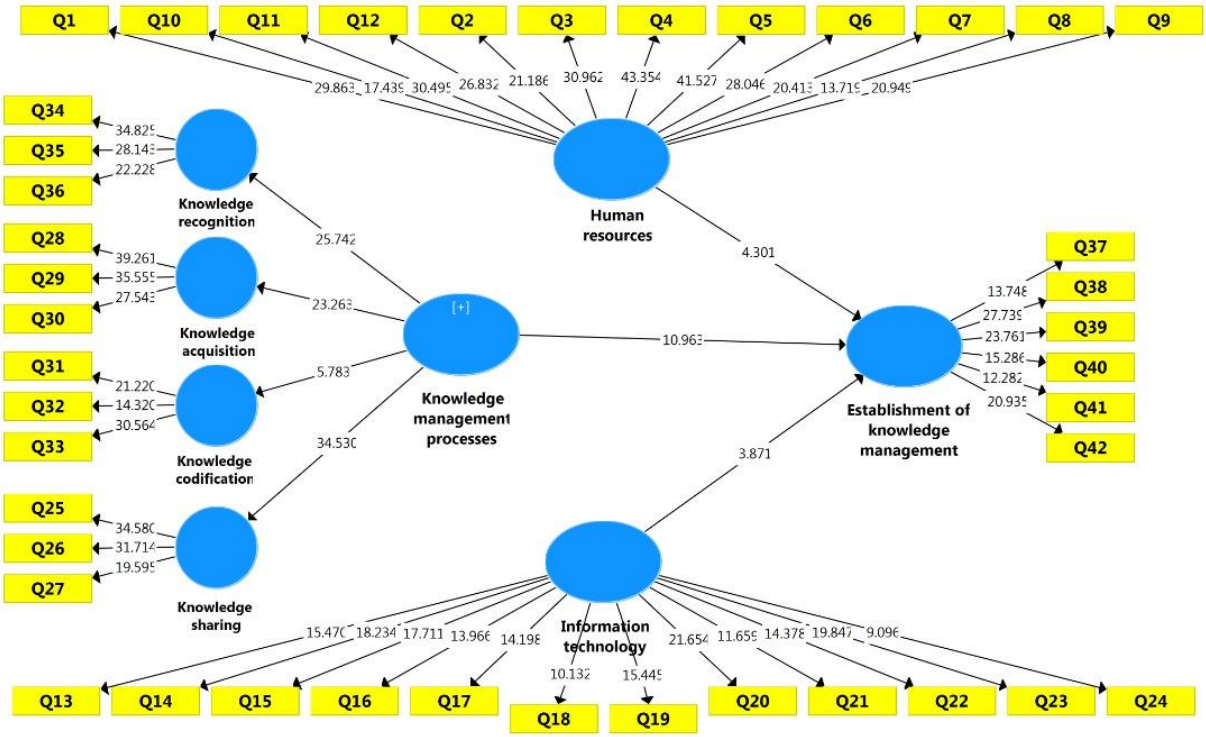

Figure 4. Research model with t-values coefficients (first sub-model)

The table 6 shows the results.

Table 6. Results regarding the hypotheses of the first part

Path Independent variable →Dependent variable	β	T-Value	Significance level	R^2 The dependent variable	Q^2 The dependent variable	f^2	VIF
Human resources →Establishment of knowledge management	0.281	4.301	0.00	0.692	0.355	0.150	1.713
Processes →Establishment of knowledge management	0.549	10.963	0.00	0.692	0.355	0.681	1.439
Information technology→ Establishment of knowledge management	0.179	3.871	0.00	0.692	0.355	0.08	1.312
$\text{GoF} = \sqrt{Communalities \times R^2} = \sqrt{0.40 \times 0.59} = 0.485$							

As shown in the table above, the coefficient of determination of KM establishment is equal to 0.692. Therefore, it can be inferred that the variables of human resources, processes, and information technology were able to work together, and in total 69.2% of the variance (changes) predict the establishment of KM. The fit model of the whole model also shows the confirmation of the model shown in this section. On the basis of standardized path coefficients, it was concluded that the effectiveness of processes (0.549) is much higher than human resources and information technology.

Sub-hypothesis 1: Human resources have a significant effect on the establishment of knowledge management

The value of t-statistic and the calculated significance level of the human resources' path to the establishment of KM were calculated as 4.301 and 0.00 respectively. Therefore, considering that the significance level of the test is less than 0.05 and the value of t is more than 1.96, it can be said that the 'human resources' variable has a significant effect on the establishment of KM. Considering the fact that the standardized path coefficient between the two variables is positive and equal to 0.281, it can be concluded that by increasing a standard deviation in human resources scores, KM establishment scores increase by 0.281 standard deviation. Therefore, according to the collected data, the first hypothesis of the research concerning the impact of human resources on the establishment of KM is confirmed with a probability of 95%.

Sub-hypothesis 2: Processes have a significant effect on the establishment of knowledge management

As shown in Table 6, the significance level of the test for the hypothesis is less than 0.05 and its t value is more than 1.96, so it can be said that the 'processes' variable has a significant effect on the establishment of KM. Considering the fact that the standardized path coefficient between the two variables is positive and equal to 0.549, it can be concluded that by increasing a standard deviation in processes scores, KM establishment scores increase by 0.549 standard deviation. Therefore, according to the collected data, the second hypothesis of the research concerning the effect of processes on the establishment of KM is confirmed with a probability of 95%.

Sub-hypothesis 3: Information technology has a significant effect on the establishment of knowledge management

Table 6 shows that the significance level of the test for the hypothesis under study is less than 0.05, and its t value (3.871) is more than 1.96, so it can be said that 'information technology' variable has a significant effect on the establishment of KM. Considering the fact that the standardized path coefficient between the two variables is positive and equal to 0.179, it can be concluded that by increasing a standard deviation in information technology scores, KM establishment scores increase by 0.179 standard deviation. Therefore, according to the collected data, the third hypothesis of the research about the effect of information technology on the establishment of KM is confirmed with a probability of 95%.

Investigating the effectiveness of knowledge management processes in establishing knowledge management

This section of the study aims to confirm or deny the impact of KM processes on the establishment of KM. Therefore, modeling was created in the software once again; its results are as follows:

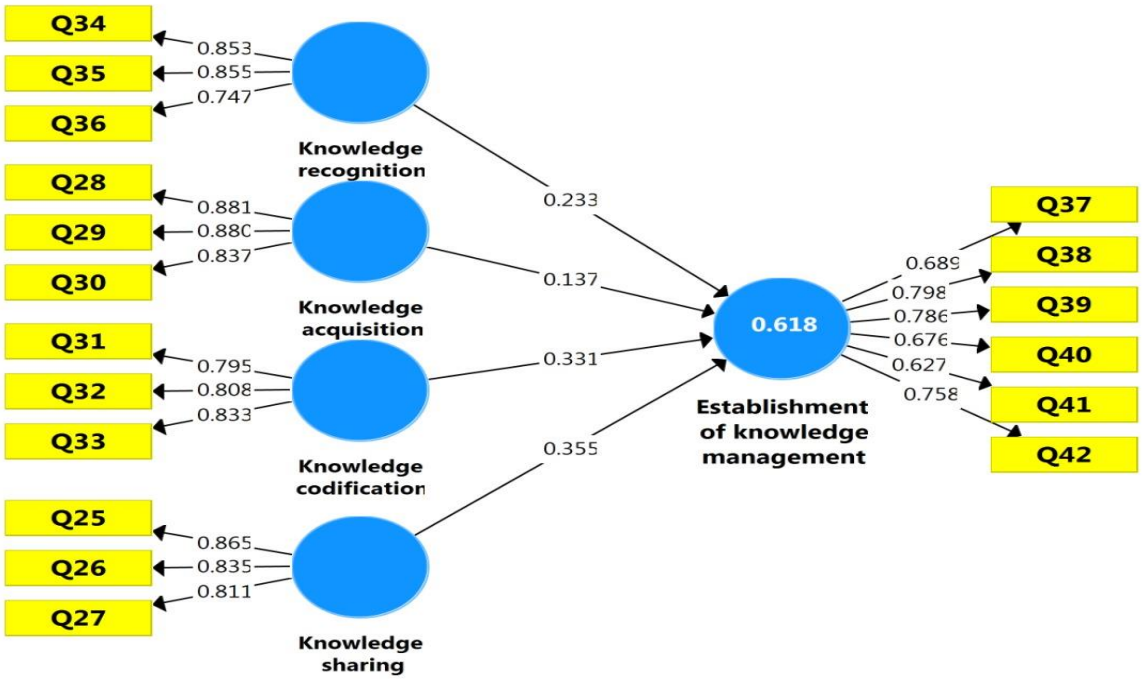

Figure 5. Research model with standardized factor loading coefficients and path coefficients (second sub-model)

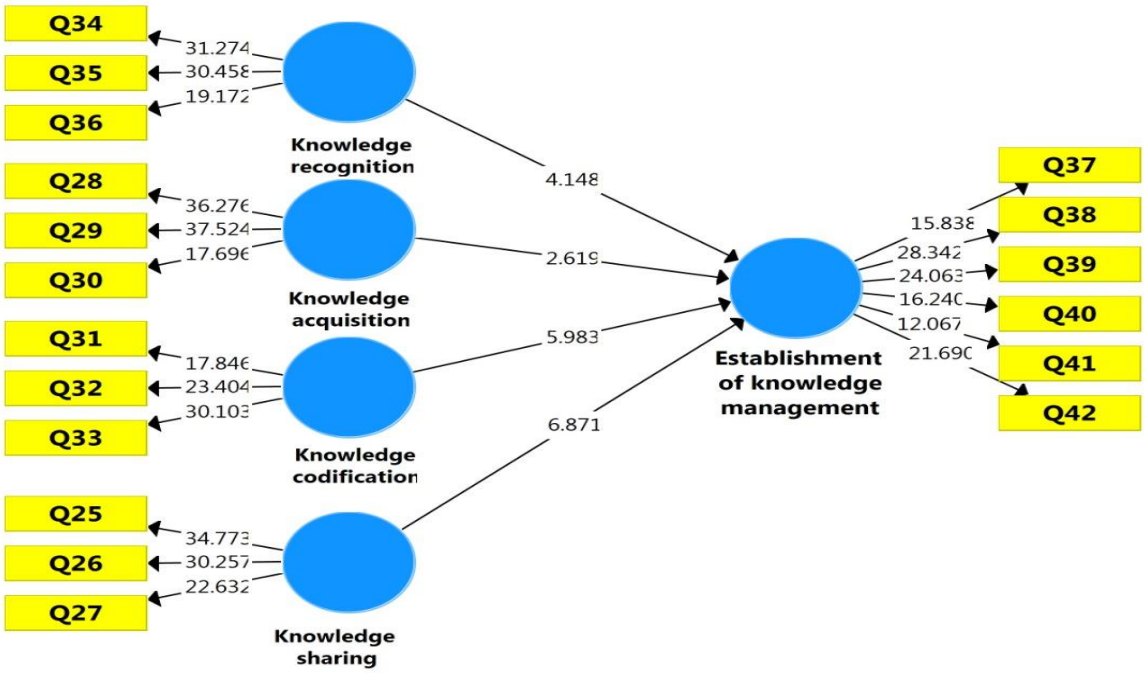

Figure 6. Research model with t-Values coefficients (second sub-model)

The table 7 shows the results of the above model.

Table 7. Results regarding the hypotheses of the second part

Path Independent variable →Dependent variable	β	T-Value	Significance level	R^2 The dependent variable	Q^2 The dependent variable	F^2	VIF
Knowledge recognition → Establishment of knowledge management	0.233	4.148	0.00	0.618	0.315	0.091	1.560
Knowledge acquisition →Establishment of knowledge management	0.137	2.619	0.09	0.618	0.315	0.031	1.602
Knowledge codification → Establishment of knowledge management	0.331	5.983	0.00	0.618	0.315	0.255	1.126
Knowledge sharing → Establishment of knowledge management	0.355	6.871	0.00	0.618	0.315	0.183	1.804
$\text{GoF} = \sqrt{Communalities \times R^2} = \sqrt{0.373 \times 0.618} = 0.48$							

As shown in the table above, the coefficient related to determination of KM establishment is equal to 0.618. Therefore, it can be inferred that KM processes were able to predict 61.8% of the variance (changes) in the establishment of KM. The fit model of the whole model also shows the confirmation of the model shown in this section. On the basis of standardized path coefficients, it is concluded that the impact of knowledge sharing (355.0) is much higher than other variables.

Sub-hypothesis 4: Knowledge recognition has a significant effect on the establishment of knowledge management

As shown in the table above, the value of t-statistic related to the path of knowledge recognition and establishment of KM is equal to 4.148. Therefore, because the value of t-statistic is higher than the limit of 1.96, it can be concluded that knowledge recognition has a significant effect on the establishment of KM.

Sub-hypothesis 5: Knowledge acquisition has a significant effect on the establishment of knowledge management

As shown in the table above, the value of t-statistic related to the path of knowledge acquisition and the establishment of KM is equal to 2.619. Therefore, because the value of t-statistic is higher than the limit of 1.96, it can be concluded that knowledge acquisition has a significant effect on the establishment of KM.

Sub-hypothesis 6: Knowledge codification has a significant effect on the establishment of knowledge management

As shown in the table above, the value of t-statistic related to the path of knowledge development and the establishment of KM is equal to 5.983. Therefore, because the value of t-statistic is higher than the limitof 1.96, it can be concluded that knowledge codification has a significant effect on the establishment of KM.

Sub-hypothesis 7: Knowledge sharing has a significant effect on the establishment of knowledge management

As shown in the table above, the value of t-statistic related to the knowledge sharing path and the establishment of KM is equal to 6.871. Therefore, because the value of t-statistic is higher than the limit of 1.96, it can be concluded that knowledge sharing has a significant effect on the establishment of KM.

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