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Original Research

Presenting a Pattern for Success of Knowledge Management in the Knowledge-Based Companies Using Mixed Approach

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Abstract

The pattern of success for knowledge management may help companies achieve their goals regarding knowledge. Therefore, this research aims at planning the pattern of success for knowledge management in the knowledge-based companies. The research method was a combined one: at the first stage, theme analysis was used to identify the major and components that affect the success of knowledge management in the knowledge-based companies. The main tool for gathering data at this stage was interview. Sampling at this stage was accomplished in a theoretical way. At the second stage, the pattern of success for knowledge management in the knowledge-based companies was planned based on interpretive-structural modelling; the planned pattern was evaluated in the statistical population of knowledge-based companies using path-structural modelling. The data gathering tool in this phase was a questionnaire. The results of the qualitative phase showed 9 major themes and 42 components. The results of the quantitative phase showed that the strategy of knowledge management and the environmental and industrial factors are considered the main factors of success for knowledge management in a knowledge-based company. Evaluating the planned pattern in the statistical population of this research showed that the planned pattern fitted properly, and the entire acquired relations were confirmed.

Keywords: Knowledge Management, Knowledge-Based Companies, Theme Analysis, Interpretive-Structural Modelling, Structural-Path Modelling.

Introduction

Companies have developed through innovative productions and processes for years (Sachin

& kant, 2014). Innovation is a dynamic process and provides constant competition and economic growth for different companies and nations (Chen, Yin & Mei, 2018; Ode & Ayavoo, 2020). Companies, whether big or small, use different methods to maintain competition in a market; in fact, they create activities like research and development to conduct the ever-increasing or fundamental renovation of their work models (Dalmarco, Maehler, Trevisan & Schiavini, 2017). The said renovation process is generally accomplished through innovative activities that lead to the advancement of companies among their competitors because they become leaders for initiating new productions or services, and for increasing productivity, and profit. Dickel & de Moura (2016) point out that renovation ability of corporations is one of the main features of competitive, dynamic, and advanced organizations. Considering the importance of innovation for corporations, researchers are trying to find out how innovations advance in corporations (Hamdoun, Jabbour & Othman, 2018). Taking into account that developing productions and innovative processes are advantageous for companies (Baumol, Litan & Schramm, 2007), and such companies may enjoy advantages for initiating innovative productions (Christensen, 2013; Criscuolo, Nicolaou & Salter, 2012), creation and development of knowledge-based companies may be an alternative for a production unit that tries to foster innovation. Knowledge-based businesses play an important role for the effectiveness of production, knowledge manifestation in new productions and services, the promotion of economic level and welfare, and the production of wealth and value added in a society. Moving towards innovation and changing the composition of productions and services are among the activities of a knowledge-based company. In fact, knowledge-based businesses, which publish information and use it, create knowledge. Such businesses synchronize themselves with the newly found evolutions more than other companies; they try to survive in a competitive environment.

The studies of knowledge management have developed considerably through addressing knowledge as an important organizational source (Akhavan, Rahimy & Mehralian, 2013). Specifically, knowledge management has become the center of discussion about the mechanisms of facilitating the acquirement of more competitive advantages in the universal economy (Clarke & Tumer, 2004). Therefore, as Carlsson (2001) contends, knowledge management "acts as the process of identifying, managing and imposing personal and collective knowledge to support companies which act in a competitive mode." This definition makes the main components prominent in an ever-increasing competitive world. There are three main points in this definition: first of all, the personal and collective knowledge should be specified; second, knowledge management includes the process of gathering knowledge and integrating it; third, knowledge management is used to increase competition. Accordingly, taking into account that, in a knowledge-based company, the ratio of experts to the total staff is higher than other companies and, the goal is creating synergistic effect through the cooperation of experts, personal knowledge should be combined to achieve the collective knowledge. Finally, innovation and acquiring competitive advantage, as the base of knowledge management, requires knowing knowledge management and providing proper patterns and models for it. In other words, knowledge-based companies have some professional knowledge in different domains according to their nature, and having knowledge management is essential to use the said knowledge. Meanwhile, previous studies show that despite identifying the factors of success for different businesses and industries, the knowledge-based companies have failed to study these factors, and there is a theoretical gap in this domain. On the other hand, most of the

models are provided based on the studies carried out in the developed countries so that they cannot be generalized to the developing countries. Thus, some proper patterns should be planned to answer some questions and to create a new knowledge for knowledge management, like: what are the key factors of success for the management of knowledge in the knowledge-based companies? What are the causal relations between the said key factors? This paper will help in the development of knowledge management literature in two different domains; firstly, the relations between the factors of success for knowledge management in a knowledge-based company will be illustrated, i.e., which kind of tools do this kind of companies need to be successful for knowledge management; secondly, the extent of success is illustrated for the models created by qualitative analysis in a domestic context. The rest of this paper includes a review of research literature and then research method. After research method, the findings of research are provided in three parts: theme analysis, interpretive-structural modelling, and path-structural modelling; finally, the results and recommendations of research will be provided.

Literature Review

Knowledge & Knowledge Management

The importance of knowledge is recognized in knowledge-based companies as a competitive resource (Gaviria-Marin, Merigó & Baier-Fuentes, 2019; Ode & Ayavoo, 2020). Due to the role of knowledge in improving productivity, in creating a sustainable competitive advantage, and in creating and protecting a company's intangible assets, interest in knowledge management has increased among researchers and executives (Lopes, Scavarda, Hofmeister, Thomé & Vaccaro, 2017). Knowledge is the outcome of data and information, after combining background processes, deliberation, and interpretation (Filstad & Gottschalk, 2009). Marquardt (2011) defines knowledge as a set of information, principles, and experiences that lead the execution, management, decision-making, and problem solving in an active mode. Totally, it may be divided into two categories: implicit and explicit. Knowledge may be classified in three classes: personal, collective, and organizational (Hatch, 2010). The collective knowledge is the personal knowledge that its validity is trusted in a group; this kind of knowledge is shared between the members of a group and is understood by them (Richter, 2000). The organizational knowledge is a result of combining the collective knowledge of groups, which may be explicit or implicit (Hatch, 2010). Philosophically, there is no limit for knowledge. The process of knowledge management should pass the process of creation, acquisition, organization, storage, publication, and usage (Chournazidis, 2013; Kahreh, Shirmohammadi & Kahreh , 2014; Yusof & Bakar, 2012). Nowadays, knowledge management emphasizes three main subjects: Human, Structure, and Technology; it tries to balance the triple functional domains and achieve the organizational goals through production and use of knowledge sources in a correct way (Nonaka & Takeuchi, 1995).

Knowledge management is considered a strategic action in an organization because it is related to the main abilities of an organization. If the goal of knowledge is professional work, you cannot limit it in a definite and practical manner to use it as a problem-solver; but it should be extended as general knowledge that supports the process of rationalization as the basis of innovation and action in the professional domain (Rasmussen & Nielsen, 2011). On the other hand, knowledge management is a framework for acquiring, organizing, and transferring the different kinds of knowledge, from employees for the benefit of other employees, in order to increase the productivity of employees and organization (Kahreh et al., 2014). The process of

sharing knowledge requires a communicative platform. Lai & Lin (2012) used knowledge management to describe how knowledge is acquired and created by the members of the organization from inside and outside of the organization. Knowledge management describes how knowledge is acquired, created, codified, and used in an organization (Shujahat, Sousa, Hussain, Nawaz, Wang & Umer, 2019). Proper knowledge management may create new opportunities, values for customers, competitive advantages, and performance improvement for an organization (Begoña Lloria, 2008).

The Critical Factors of Success

The critical factors of success for knowledge management captures a vast range of factors, which may affect the design and implementation of knowledge management, and most of them relate to the subjects like culture, information technology, and leadership (Yew Wong, 2005). The critical factors of success for knowledge management may be considered as the activities that assure its successful execution. According to this definition, the critical factors of success include the interior factors that are controlled by an organization. The factors required for achieving successful results must be identified before the commencement of a knowledge management project (Choy, 2006). Since the late 1990s, many researchers have provided a comprehensive list of critical factors contributing to the success of knowledge management implementation. These lists differ in the multidisciplinary nature of knowledge management (ibid). Renukappa, Suresh, Al Nabt, Sarrakh & Algahtani (2020) considered the critical factors of knowledge management success in Saudi Arabia. In their research, the critical factors of knowledge management success in government organizations are examined, and the relationships among them are extracted using the ISM method. It has been shown that leadership, organizational culture, information technology infrastructure, reward system, knowledge management strategy, training, and knowledge auditing are considered as critical success factors in which leadership has the major role. Animesh & Mukti (2019) examined the critical factors of knowledge-management success in small and medium size enterprises in one of the states of India. The main aim of this study was to provide a better way to implement knowledge-management in the organization and promote customer satisfaction to increase the level of competition. Al-Shahrani (2018) identified the critical factors of knowledge success and compared these factors in two universities. One university was located in Australia and the other was in Saudi Arabia. Two categories of internal and external factors were identified as critical success factors in this study. Ghomi & Barzinpour (2018) identified the success factors of knowledge-management in academic research projects. They identified and prioritized the success factors using T-test and Friedman. It was found that the most important factors are culture, information technology, strategy, organizational infrastructure, employee motivation, leadership and management support. Sensuse, Qodarsih, Lusa & Prima (2018) examined the critical factors for the success of knowledge-management by conducting a complete literature review. It was concluded that technology, strategy, senior management or leadership, organizational culture, laws and legislations are considered as critical success factors. Gunasekera & Chong (2018) identified the critical factors of knowledge-management success. They also studied the impact of these factors on the results of project management performance in large construction organizations in Sri Lanka. It was shown that factors of culture, leadership, organizational structure, IT support, skills, training, teamwork, performance appraisal, and role modelling were critical success factors. Othman, Ismail, Yahya & Ahmad (2018) studied the

critical factors of knowledge-management success in real estate consultants in Malaysia. It was demonstrated that continuous support of the organization and senior management, culture of knowledge and sharing, program implementation, and continuous learning are critical success factors. Soleman, Abdelrahman, Skoumpopoulou & Wood-Harper (2017) carried out a literature review and identified the critical factors of knowledge-management success, which are effective in using knowledge management systems. In this study, the organizational culture, education, and information technology were considered as three important factors influencing knowledge-management programs. Kunthi, Sensuse & Tobing (2017) examined the critical factors for the success of knowledge-management application in Indonesia using structural equation modelling. Research findings show that senior management support, technology infrastructure, organizational structure, cultural factors, and human resources are critical success factors. Centobelli et al. (2017) examined the success factors of knowledge-management in start-ups by reviewing research literature in this area. It was demonstrated that seven main components including cultural and human resources factors, geographical factors, managerial and organizational factors, communication factors, structural factors, strategic factors, and technical factors have the greatest impact on the success of knowledge-management in start-ups. Sedighi, van Splunter, Zand & Brazier (2017) presented a model for evaluating the critical factors of knowledge-management success based on the AHP method. The findings of this study show that organizational culture, human and financial resources, strategy and leadership, structures and procedures, environmental factors, knowledge-management process, macro-environmental factors, technology, and infrastructure are the most critical factors. Enshassi, Falouji, AlKilani & Sundermeieri (2016) examined the critical factors of knowledge-management success in the Palestinian construction industry. Accordingly, using exploratory factor analysis, it was shown that the two factors of teamwork and face-to-face communication are the most important factors affecting the application of knowledge-management. Rohajawati, Sensuse, Sucahyo & Arymurthy (2016) identified the critical factors of applying knowledge-management in an organization active in the field of mental health. These researchers summarized the critical factors for the success of the application of knowledge-management in three domains: culture, resources, and knowledge-management enablers. In another study, Bello (2015) examined the critical factors of knowledge-management success in Albanian businesses. By examining the research literature, cultural factors, leadership, organizational structure, human resource management, information technology, evaluation system, and organizational strategy were identified as critical factors for knowledge-management success. Karami, Alvani, Zare & Kheirandish (2015) defined the critical factors for the success of knowledge-management in the Bahman group. In this study, the critical factors of knowledge-management success are categorized into five main groups. Huang & Lai (2014) examined the critical factors of knowledge-management success in insurance companies. The critical success factors extracted from this study were individual characteristics, knowledge-management characteristics, organizational characteristics, information technology infrastructure, and cultural factors. Zieba & Zieba (2014) studied the critical factors of knowledge-management success in knowledge-based service businesses. This study showed only two categories of support of managers and organizational leaders and motivational methods, which are effective in the success of knowledge management.

Table 1
Summary of the research background

Researcher	Research title	Statistical population	Data analysis approach
(Renukappa et al., 2020)	An ISM Approach to Evaluate Critical Success Factors for Knowledge Management in the Kingdom of Saudi Arabia	Government Agencies	Quantitative
(Animesh & Mukti, 2019)	Case Study of Critical Success Factors Affecting Knowledge Management in Small-and Medium-Sized Enterprises	Steel Sector	Systematic Literature Review
(Alshahrani, 2018)	Critical success factors of knowledge management in higher education institutions	University	Qualitative
(Ghomi & Barzinpour, 2018)	Identifying the success factors of knowledge management tools in research projects	University	Quantitative (T-test & Friedman)
(Sensuse et al., 2018)	Critical Success Factors of Knowledge Management: A Systematic Literature Review	-	Systematic Literature Review
(Gunasekera & Chong, 2018)	Knowledge management critical success factors and project management performance outcomes in major construction organisations in Sri Lanka: A case study	Construction Organisations	Quantitative (Linear Regression)
(Othman et al., 2018)	The mediating role of knowledge application in the relationship between knowledge management practices and firm innovation	Consultant Firms	Quantitative
(soleman et al., 2017)	Critical Success Factors Affecting Knowledge Management Systems Applications: A Theoretical Framework	-	Literature Review
(kunthi et al., 2017)	Critical Success Factors of the Implementation of Knowledge Management	Metal Sector	Quantitative (SEM)
(Centobelli et al., 2017)	Knowledge management in startups: Systematic literature review and future research agenda	-	Literature Review
(Sedighi et al., 2017)	Evaluating critical success factors model of knowledge management: An analytic hierarchy process (AHP) approach	Energy Sector	Quantitative
(Enshassi et al., 2016)	Knowledge Management Critical Success Factors in Construction Projects	Construction Projects	Quantitative
(Rohajawati et al., 2016)	Mental health knowledge management: critical success factors and strategy of implementation	Mental health	Qualitative (SWOT)
(Bello, 2015)	Critical success factors of knowledge management in Albania business organizations	Business Organizations	Quantitative
(Karami et al., 2015)	Determination of critical success factors for knowledge management implementation, using qualitative and quantitative tools	Automotive Sector	Qualitative (interview) – quantitative (Friedman test)
(Huang & Lai, 2014)	An investigation into the factors affecting knowledge management adoption and practice in the life insurance business	Insurance Business	Quantitative
(Zieba & Zieba, 2014)	Knowledge management critical success factors and the innovativeness of KIBS companies	KIBS companies	Quantitative

The Conceptual framework

A review of studies conducted in the field of knowledge-management demonstrates that

studies conducted in this field have mostly focused on two main approaches. In the first approach, researchers have studied the effect of knowledge-management on organizational and individual variables such as the role of knowledge-management in organizational learning (Anjaria 2020; Antunes & Pinheiro, 2020), organizational innovation (Ode & Ayavoo 2020; Mardani, Nikoosokhan, Moradi & Doustar (2018), green innovation (Abbas & Sağsan 2019), acceptance of extensive online courses (Arpaci, Al-Emran & Al-Sharafi, 2020), information technology (Al-Emran, Mezhuyev, Kamaludin & Shaalan, 2018), business process outsourcing (Zhang, Liu, Tan, Jiang, & Zhu, 2018), organizational performance (Obeso, Hernández-Linares, López-Fernández & Serrano-Bedia, 2020; Payal, Ahmed & Debnath, 2019; Muthuveloo, Shanmugam & Teoh, 2017), job performance (Xiaojun, 2017), job satisfaction (Kianto, Vanhala & Heilmann, 2016), to name but a few. In the second approach, which is mostly aimed at providing appropriate models for the application of knowledge-management, researchers have identified critical factors for the success of knowledge-management. In this approach, researchers have identified the factors that have played important roles in the successful application of knowledge-management in various industries. Renukappa et al. (2020), Animesh & Mukti (2019), Alshahrani (2018), Ghomi & Barzinpour (2018), Sensuse et al. (2018), and Kunthi et al. (2017) have conducted some of the studies in this area.

The research in this area demonstrates that cultural, organizational, and information technology variables have the highest frequency and most researchers have relied on these variables. However, the relationships between the critical factors of knowledge management success have scarcely been investigated and identified in these studies. Renukappa et al. (2020) demonstrated that there are causal relationships between the critical factors of knowledge management success in organizations. Nevertheless, these researchers have not specified whether or not these causal relationships are significant. In addition, through reviewing the theoretical framework, it can be seen that attention to the indigenous and cultural context of companies in identifying critical factors in the success of knowledge management and focusing on the research literature to identify these factors are lacking. Studies conducted in different industries and sectors are based on the cultural and indigenous context of the company or sector, which causes deviations in the results. Therefore, there are two basic assumptions in this model. First, it is assumed that the critical factors for the success of knowledge management should be identified based on the indigenous and cultural context of each country and region in which the company operates, and in this way, one cannot only rely on variables from other studies Therefore, based on the appropriate methods used in this article of theme analysis, the critical factors of knowledge management success should be identified. On the other hand, it is assumed that there are internal relationships between the critical factors of knowledge management success, which should be determined to define the meaning of these relationships and generalize them to the study community.

Materials and Methods

This research is “applied and developmental” regarding its goal and “mixed” (a combination of qualitative and quantitative methods) regarding its method.

Qualitative Phase

Theme analysis was used at the first stage of research, qualitative phase, to identify the major components that affect the success of knowledge management in a knowledge-based

company. The main tool for gathering data in this phase was interview. The experts included in this research possessed the following characteristics:

1. The managers of knowledge-based companies; they had more than 10 years of management experience and were familiar with the subjects of knowledge management.

2. The university professors; they had the experience of compiling and translating books or papers in the field of knowledge management.

Sampling was accomplished theoretically; i.e., sampling continued up to achieving the theoretical satiation. The theoretical saturation was acquired at the 14th interviewee, but the interview continued until the 17th to make sure of the saturation.

Theme analysis is a method to identify, analyse, and report the patterns (contents) inside the data (Braun & Clarke, 2006). Theme analysis aims at the identification of contents, i.e., the patterns of important data. The contents are used to tell something about a subject (Clarke & Braun, 2013). This is something more than summarizing. A good theme analysis interprets the different aspects of a research subject. Using the main questions of interview as contents is a big problem (Maguire & Delahunt, 2017). In a theme analysis, the data are summarized and organized (enriched) but not analysed (Braun & Clarke, 2006).

As Braun and Clarke (2006) assert, the six stages of analysis are as follows:

1st Stage: Getting familiar with data

The first step of qualitative analysis is reading and rereading texts (Maguire & Delahunt, 2017). Getting familiar with the data totally, whether personal or collective, (e.g., the entire interviews and other probable data) is necessary before the rest of research is conducted.

2nd Stage: Creating the initial codes

The data should be organized in a meaningful and neat way at this stage. Coding reduces the acquired data to the segments that are meaningful and conceptual. There are different methods of coding (Clarke & Braun, 2013).

3rd Stage: Finding contents (themes)

As mentioned before, a theme is a pattern and collects any important or interesting matter about data or the question of research at one point. As Braun & Clarke (2006) state, there is no strict rule about the matter that creates a subject. In a very small set of data, there may be a considerable overlap between the stage of coding and the stage of finding the initial contents (Maguire & Delahunt, 2017). In fact, the coding stage is a kind of selection; i.e., a researcher tries to find out how the different codes of the previous stage may form a general theme.

4th Stage: Revising the themes

The initial contents, which are specified at the 3rd stage, are reviewed, modified, and developed at this stage. Collecting any related data is useful at this stage. This stage includes two sub-stages: 1) revision and purification, and 2) forming the components (Braun & Clarke, 2006). The components are formed at this stage.

5th stage: Defining the components

At this stage, the final purification of themes is accomplished: our goal is specifying the "nature" of each subject (Braun & Clarke, 2006). The major theme is specified based on the nature of what the components are speaking about (Maguire & Delahunt, 2017).

6th Stage: Reporting

Finally, the final report terminates theme analysis. Quantitative Phase

In this part, at first, the pattern of success for knowledge management in the knowledge-based companies was planned using interpretive-structural modelling (ISM) based on the major

themes. For this purpose, the experts of the qualitative phase were asked to specify the causal relations between the major themes. This stage aims at planning the pattern of success for knowledge management. The required data were gathered using the specific questionnaire of ISM method, i.e., in paired comparisons. ISM method helps a system organize and direct the complexity of relations between its elements. A decision-making group reviewed the relations and specified whether such relations existed or not. Interpretive-structural modelling was based on structural relations, and a general structure was extracted from the complex set of variables.

At the second stage of the quantitative phase, the pattern achieved by path-structural modelling was tested. The statistical population of this phase included the entire employees and managers of the knowledge-based companies in East Azerbaijan Province. The statistical sample of this phase consisted of 140 people; the questionnaires of research were distributed among them. The required data were collected using a questionnaire. The data of the questionnaire were used to confirm the results of the qualitative phase. The questionnaire items were composed based on the subsidiary themes.

The pattern of success for knowledge management in the knowledge-based companies was tested using path-structural modelling. For this purpose, at first, the indices of validity and reliability were reviewed for each measuring model (the major themes). The following indices were used to review validity and reliability: the explained average variance, factor loads, Cronbach's alpha coefficient, and composed reliability. Moreover, the appropriateness of each measuring model were reviewed using RMR (Root Mean Residuals), RAMSEA (Root Mean Square Error of Approximation), GFI (Goodness of Fit Indices), CFI (Comparative Fit Index), and the normalized Chi-squared test (X^2/df). Finally, the structural model was illustrated between the major themes, and the pattern of success for knowledge management in the knowledge-based companies was reviewed based on route coefficients and their corresponding t-values.

Results

Theme Analysis

According to the stages of theme analysis, after reviewing the set of acquired data at the 1st stage, the initial coding was accomplished at the 2nd stage, and totally 430 initial codes were extracted. Coding was performed according to the key points of coding. For example, a part of the interview with the 1st expert and the extracted initial codes are underlined in the following text:

"It seems that, to be successful during the establishment of knowledge management, knowing the goal of knowledge management in an organization is necessary. Where does knowledge management take us? Which kind of knowledge do we mean? … of course, people are involved in this process. The goals of an organization regarding knowledge may be specified by the academic level of people and their awareness regarding knowledge management. … I don't want to get into more details. But, most of the domestic knowledge-based companies cannot access proper resources and infrastructures to access information technology despite their knowledge-oriented nature. Still, nowadays, one of the most distinguished and important tools of knowledge management is accessing proper infrastructures of information technology. The companies are not able to use proper hardware and software because of financial resources shortage."

At the 3rd stage, the selective coding was performed; where a researcher tries to find out

how the different codes of the previous stage may form a general theme. At this stage, 76 initial themes were formed as the initial contents or themes. In other words, 76 initial themes were formed from 430 initial codes through deleting some repeated ones. At the 4th Stage, the initial contents specified at the 3rd stage were modified, and, 42 final components were acquired. Finally, at the 5th Stage, the major themes and the nature of the components were specified.

Composing the pattern of success for knowledge management in the knowledge-based companies

In this part of research, the experts of the qualitative phase of research were requested to specify if there was any relationship between the two variables (the major theme) based on ISM method. ISM method includes some stages: at the first stage, a structural self-interaction matrix was created to illustrate the paired and detailed relations among the elements of a system. At this stage, four symbols were used as follows: V represents the effect of i on j; A represents the effect of j on i; X represents the effect of i on j and j on I; and O represents that the two elements do not affect each other. The structural self-interaction matrix was created based on the majority judgement of experts (the highest frequency of each symbol for each position in a matrix).

At the second stage, the initial reachability matrix was created from the structural self-interaction matrix. A, V, X and O were converted to 0 and 1; thus, if the considered position contained V, ij position would contain 1, and ji position would contain 0 at the initial reachability matrix; if the considered position contained A, ji position would take 1, and ij position would take 0 at the initial reachability matrix; if the considered position contained X, ij position would take 1, and ji position would take 1 at the initial reachability matrix; and finally, if the considered position contained O, ij position would take 0, and ji position would take 0 at the initial reachability matrix. The results of this matrix are provided in Table 2.

Table 2
The initial reachability matrix

Major Themes	Row	1	2	3	4	5	6	7	8	9
Knowledge Management Strategy	1	0	0	1	1	0	0	0	0	0
Environmental & industrial factors	2	0	0	0	0	0	0	0	1	0
Cultural factors	3	0	0	0	0	0	0	0	0	1
IT infrastructures development	4	0	0	0	0	0	1	1	0	0
Personal factors	5	0	0	1	0	0	0	0	0	0
Organizational factors	6	0	0	1	0	0	0	1	0	0
Knowledge management incentives	7	0	0	0	0	0	0	0	0	1
Mental norms	8	0	0	0	0	1	0	0	0	0
Subject-orientation (Knowledge management)	9	0	0	0	0	0	0	0	0	0

At the next stage, the final reachability matrix was calculated. The relations of transferability among the elements were reviewed. The relations of transferability is an essential

assumption for ISM: if A is related to B and B is related to C, A is related to C. For this purpose, the initial reachability matrix was raised to power and at power 5, the matrix was converged. According to this convergence, the relations of transferability among the major themes were specified. The results are provided in Table 3.

Table 3
The final reachability matrix

		1	2	3	4	5	6	7	8	9
Knowledge Management Strategy	1	1	0	1	1	0	1	1	0	1
Environmental & industrial factors	2	0	1	1	0	1	0	0	1	1
Cultural factors	3	0	0	1	0	0	0	0	0	1
IT infrastructures development	4	0	0	1	1	0	1	1	0	1
Personal factors	5	0	0	1	0	1	0	0	0	1
Organizational factors	6	0	0	1	0	0	1	1	0	1
Knowledge management incentives	7	0	0	0	0	0	0	1	0	1
Mental norms	8	0	0	1	0	1	0	0	1	1
Subject-orientation (Knowledge management)	9	0	0	0	0	0	0	0	0	1

At the next stage, the final reachability matrix was divided into different levels. First, the variables were divided into two groups: reachability and pre-requisite. The reachability variables included the studied variable and the ones affected by it. The pre-requisite variables included the studied variable and the ones affected by it. Finally, the output of each level was a variable in which the intersection of reachability and pre-requisite parts was equal to the group of reachability variables. The results are provided in Tables 4 to 8.

Table 4
The 1st level of rating

Major theme	Row	Reachability	Pre-requisite	Interface	Output
Knowledge management strategy	1	1, 3, 4, 6, 7, 9	1	1	-
Environmental & industrial factors	2	2, 3, 5, 8, 9	2	2	-
Cultural factors	3	3, 9	1, 2, 3, 4, 5, 6, 8	3	-
IT Infrastructure development	4	3, 4, 6, 7, 9	1, 4	4	-
Personal factors	5	3, 5, 9	2, 5, 8	5	-
Organizational factors	6	3, 6, 7, 9	1, 4, 6	6	-
Management incentives	7	7, 9	1, 4, 6, 7	7	-
Mental norms	8	3, 5, 8, 9	2, 8	8	-
Knowledge management	9	9	1, 2, 3, 4, 5, 6, 7, 8, 9	9	9

Table 5
The 2nd level of rating

Major theme	Row	Reachability	Pre-requisite	Interface	Output
Knowledge management strategy	1	1, 3, 4, 6, 7	1	1	-
Environmental & industrial factors	2	2, 3, 5, 8	2	2	-
Cultural factors	3	3	1, 2, 3, 4, 5, 6, 8	3	3
Infrastructure development	4	3, 4, 6, 7	1, 4	4	-
Personal factors	5	3, 5	2, 5, 8	5	-
Organizational factors	6	3, 6, 7	1, 4, 6	6	-
Management incentives	7	7	1, 4, 6, 7	7	7
Mental norms	8	3, 5, 8	2, 8	8	-

Table 6
The 3rd level of rating

Major theme	Row	Reachability	Pre-requisite	Interface	Output
Knowledge management strategy	1	1, 4, 6	1	1	-
Environmental & industrial factors	2	2, 5, 8	2	2	-
Infrastructure development	4	4, 6	1, 4	4	-
Personal factors	5	5	2, 5, 8	5	5
Organizational factors	6	6	1, 4, 6	6	6
Mental norms	8	5, 8	2, 8	8	-

Table 7
The 4th Level of rating

Major theme	Row	Reachability	Pre-requisite	Interface	Output
Knowledge management strategy	1	1, 4	1	1	-
Environmental & industrial factors	2	2, 8	2	2	-
Infrastructure development	4	4	1, 4	4	4
Mental norms	8	8	2, 8	8	8

Table 8
The 5th Level of rating

Major theme	Row	Reachability	Pre-requisite	Interface	Output
Knowledge management strategy	1	1	1	1	1
Environmental & industrial factors	2	2	2	2	2

The results of tables 4 to 8 show that in a knowledge-based company, knowledge management strategy and the environmental and industrial factors, the last level, are the major factors of success for knowledge management. These variables are considered as the leaders of

a system and may affect the upper levels. At the 4th level, IT infrastructures development and mental norms have key roles in the success of the system of knowledge management in knowledge-based companies; still, they are not as important as the last level variables. At the 3rd level, the personal and organizational factors are affected by the upper levels and in turn affect the lower ones. At the 2nd Level, the cultural factors and knowledge management incentives are considered as the direct stimulants of knowledge management processes. Finally, at the 1st stage, as expected, knowledge management resides; to be successful in this domain, the different factors at the different levels should be ideal.

At the last step, the direct diagram between the variables was drawn through deleting the transfer relations (indirect). This diagram is illustrated in Figure 1 and shows the causal relations among the different success factors for knowledge management in the knowledge-based companies.

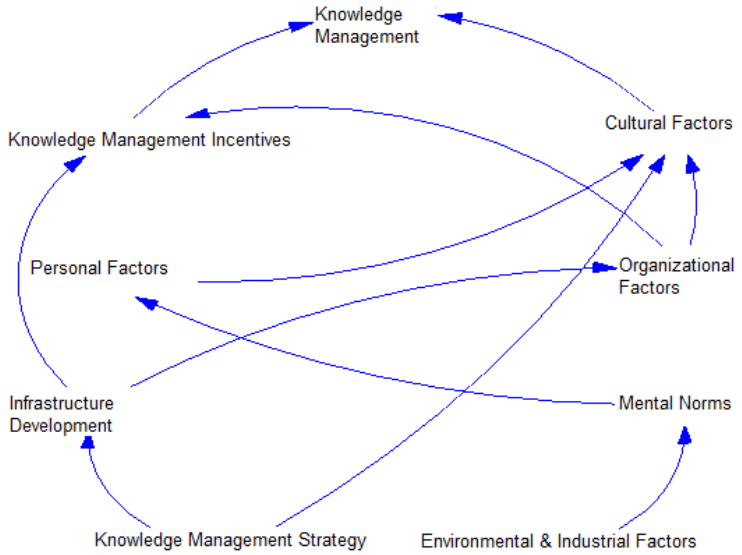

Figure 1. The pattern of success for knowledge management in the knowledge-based companies

Testing the pattern of success for knowledge management in the knowledge-based companies

After planning the pattern of success for knowledge management in the knowledge-based companies, the achieved pattern should be tested to make sure it is appropriate to the statistical population. In other words, the composed pattern was presented to the employees and managers of the knowledge-based companies in East Azerbaijan Province by the experts. After gathering data, the validity and reliability of measuring models and their proper indices were reviewed. The results of validity and reliability are provided in Table 9.

Table 9
The results of the validity and reliability of measuring models

Major theme	Explained average variance	Cronbach's alpha coefficient (α)	Composed reliability (CR)
Knowledge management strategy	0.71	0.92	0.94
Environmental & Industrial factors	0.68	0.88	0.91
Cultural factors	0.70	0.90	0.93
IT infrastructures development	0.64	0.81	0.85
Personal factors	0.65	0.83	0.86
Organizational factors	0.69	0.85	0.89
Knowledge management incentives	0.72	0.93	0.96
Mental norms	0.55	0.79	0.82
Subject-Orientation (Knowledge management)	0.69	0.89	0.92

The results of table 9 show that the explained average variance is more than 0.5 for the entire major themes; this fact represents the proper convergence of validity. In other words, each major theme is able to explain more than 50% of the observed variables distribution (the components). Besides, the value of Cronbach's alpha coefficient and the composed reliability is more than 0.7; this fact represents the internal consistency of the components in the frame of each major theme. In table 10, factor loads, their corresponding t-values, and fit indices of the confirmed models are reviewed. Factor loads indicate the relationship between a structure (major theme) and measures (components). Experimentally, any amount more than 0.5 is proper for each factor load, and the relationship between the structure and the measure is confirmed. Each factor load is assessed versus its corresponding t-value, statistically. At 95% confidence level, t-value more than 1.96 should be calculated for the positive factor loads. The ideal values of RMR (Root Mean Residuals), RMSEA (Root Mean Square Error of Approximation), GFI (Goodness of Fit Indices), CFI (Comparative Fit Index) and the normalized Chi-squared test (X^2/df) are, respectively, less than 0.05, less than 0.09, more than 0.9, more than 0.9, and less than 3.

Table 10
The results of confirmatory factor analysis for the major themes

Major theme	Components Factor load	t-value	The fit indices of confirmatory model				
			RMR	RMSEA	GFI	CFI	X^2/df
Knowledge Management Strategy	0.89	13.27	0.039	0.083	0.96	0.95	1.965
	0.87	12.86					
	0.89	13.30					
	0.82	11.64					
	0.91	13.87					
	0.86	12.58					
Environmental & industrial factors	0.83	11.82	0.041	0.082	0.95	0.93	2.285
	0.80	12.12					
	0.81	12.19					
	0.87	13.93					

Major theme	Components Factor load	t-value	The fit indices of confirmatory model				
			RMR	RMSEA	GFI	CFI	X^2/df
Cultural factors	0.90	14.46	0.037	0.074	0.97	0.95	1.843
	0.83	12.56					
	0.81	11.78					
	0.92	14.78					
	0.81	11.23					
	0.91	14.89					
IT infrastructures development	0.74	11.53	0.047	0.087	0.91	0.90	2.595
	0.71	10.65					
	0.78	11.77					
	0.74	11.56					
	0.73	11.39					
Personal factors	0.85	12.22	0.043	0.078	0.95	0.93	2.115
	0.89	12.88					
	0.81	11.82					
	0.80	11.39					
Organizational factors	0.68	9.98	0.048	0.087	0.92	0.90	2.770
	0.65	9.72					
	0.73	11.29					
	0.88	13.23					
Knowledge management incentives	0.81	11.69	0.044	0.084	0.95	0.94	2.023
	0.75	11.47					
	0.71	10.99					
	0.79	11.53					
	0.86	13.03					
	0.80	11.59					
Mental norms	0.83	12.92	0.000	0.000	1.00	1.00	0.000
	0.69	10.27					
	0.71	11.32					
Subject-orientation (Knowledge Management)	0.79	11.93	0.044	0.086	0.94	0.92	2.420
	0.87	12.63					
	0.81	12.06					
	0.78	11.91					

Before studying the relationship between a structure (a major theme) and measures (the components), the appropriateness of each measuring model (the major themes) should be confirmed according to the indices. The results acquired through studying the indices of knowledge management strategy showed that RMR, RMSEA, GFI, CFI, and the normalized Chi-squared test were calculated, respectively, as follows: 0.039, 0.083, 0.96, 0.95, and 1.965. The same indices for the environmental and industrial factors were, respectively, 0.041, 0.082, 0.95, 0.93, and 2.285. The same indices for the cultural factors were, respectively, 0.037, 0.074, 0.97, 0.95, and 1.843. The same indices for IT infrastructures development were, respectively, 0.047, 0.087, 0.91, 0.90, and 2.595. The same indices for the personal factors were, respectively, 0.043, 0.078, 0.95, 0.93, and 2.115. The same indices for the organizational factors were, respectively, 0.048, 0.087, 0.92, 0.90, and 2.770. The same indices for knowledge management incentives were, respectively, 0.044, 0.084, 0.95, 0.94, and 2.023. The same indices for the mental norms were, respectively, 0.000, 0.000, 1.00, 1.00 and 0.00. The same indices for

subject-orientation (knowledge management) were, respectively, 0.044, 0.086, 0.94, 0.92, and 2.420. The results revealed that the entire models were appropriate so that the results of the qualitative phase could be generalized to the considered statistical population. After making sure of measuring models and confirming them, factor loads should be reviewed. The results of Table 10 show that the entire factor loads were more than 0.5, and their corresponding t-values were more than 1.96; i.e., factor loads are confirmed statistically, and the relationship between the major and minor themes is appropriate. Finally, the structural model was implemented after making sure that the validity, reliability, and fitting indices of the major themes are appropriate; Figure 2 illustrates the coefficients of route. The results of significance for route coefficients are illustrated in Table 11. The results of Table 11 show that the entire routes of success pattern implemented for knowledge management in the knowledge-based companies are significant. Thus, the model created by the experts is confirmed.

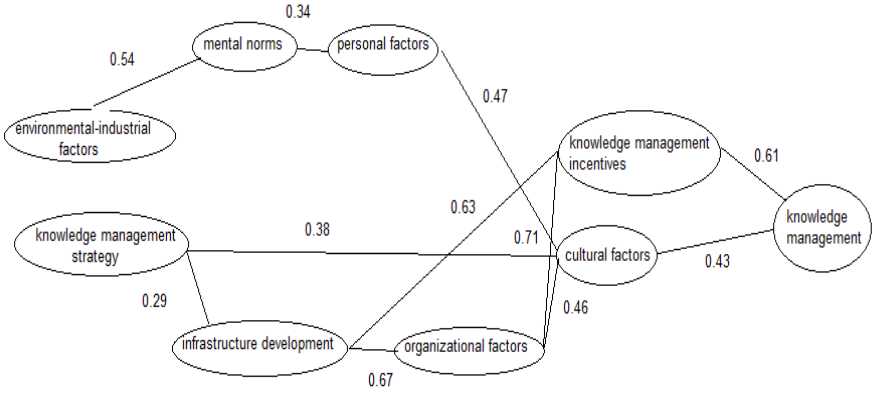

Figure 2. *The results of the structural part of the pattern of success for knowledge management in the knowledge-based companies*

The significance of route coefficients is showed in Table 11.

Table 11
The significance of route coefficients

Route	Route Coefficient	t-value	Result
Environmental-industrial factors → mental norms	0.54	7.89	Confirmed
Knowledge management strategy → infrastructure development	0.29	2.46	Confirmed
Knowledge management strategy → cultural factors	0.38	3.55	Confirmed
Infrastructure development → organizational factors	0.67	9.39	Confirmed
Infrastructure development → knowledge management incentives	0.63	8.72	Confirmed
Mental norms → personal factors	0.34	3.09	Confirmed
Personal factors → cultural factors	0.47	5.61	Confirmed
Organizational factors → cultural factors	0.46	4.96	Confirmed
Organizational factors → knowledge management incentives	0.71	10.37	Confirmed
Cultural factors → knowledge management incentives	0.43	4.92	Confirmed
Knowledge management incentives → knowledge management	0.61	8.24	Confirmed

Discussion

The knowledge-based companies use knowledge and information in their work processes to analyse the matters correctly, make decisions properly, and answer the perceived needs of people and society; they want to synchronize with the variable needs of market and customers. Some studies in relation with the role of knowledge management in the knowledge-based companies show that this kind of companies use knowledge management to achieve more success. In other words, knowledge, as a factor of distinction for these companies, requires proper management to play a more developed role during the growth of a company. Taking into account that creating value for customers is an important factor for the success and survival of a knowledge-based company, knowledge management may convert the existing knowledge to some value for customers. Thus, this research aims at planning the pattern of success for knowledge management in knowledge-based companies through a combination of theme analysis and interpretive-structural modelling. The results of this research created a conceptual model of success for knowledge management taken from the opinions of knowledge management experts. The pattern acquired for success using theme analysis as a qualitative method tried to address the native context of knowledge-based companies at first. In other words, researchers tried to create a pattern consistent with the domestic conditions and features of the knowledge-based companies instead of using the available theoretical frames. After theme analysis, a conceptual pattern was created using interpretive-structural modelling. The results showed that knowledge management strategy and the environmental and industrial factors are the main factors of success for knowledge management and may accelerate the process of success for knowledge management in the knowledge-based companies. On the other hand, factors like IT infrastructures development, mental norms, personal factors, organizational factors, cultural factors, and knowledge management incentives may affect the success of knowledge management in a positive way while at the same time, they may affect other variables and be affected by them. The results of the qualitative phase in relation to identifying the effective factors of success for knowledge management correspond with the following studies: for "knowledge management strategy", Ghomi & Barzinpour (2018), Centobelli et al. (2017) and Bello (2015); for "the environmental and industrial factors", Sensuse et al. (2018) and Sedighi et al. (2017); for "IT infrastructures development", Gunasekera & Chong (2018), Soleman et al. (2017), and Huang & Lai (2014); for "mental norms", Huang, Quaddus, Rowe & Lai (2011); for "personal factors", Huang & Lai (2014) and Akhavan & Jafari (2006); for ""organizational factors", Gunasekera & Chong (2018), Kunthi et al. (2017) and karami et al. (2015); for "cultural factors", Renukappa et al. (2020), Kunthi et al. (2017), Centobelli et al. (2017), and Rohajawati et al. (2016); and for "knowledge management incentives", Renukappa et al. (2020), Huang et al. (2011), and Singh & Kant (2008); the above-mentioned correspondence shows the high validity of the performed analyses. Taking into account that the planned pattern was created by the experts, the structural-path modelling was used to make sure that it was appropriate for the society of knowledge-based companies. The results showed that the pattern created by the experts of research in the qualitative phase was appropriate for the statistical population, and the entire relations were significant. The planned model will help managers know the factors of success for knowledge management and program in a proper way; naturally, making decisions in relation to knowledge management will follow this approach.

Conclusions

Based on the results and considering that the research findings showed that knowledge management strategy, environmental and industrial factors are considered as the main factors in the success of knowledge management, in order to increase the success of knowledge management in knowledge-based companies through Knowledge management strategies, it is recommended to the managers of these companies to first determine the organizational knowledge map, and then, target organizational knowledge map and formulate organizational knowledge strategy. Finally, it is important to adapt the organization's knowledge strategy to organizational processes. It is also suggested to reduce cumbersome domestic laws and to invest in technology development to strengthen industrial factors and increase the success of knowledge management in companies. This research includes some limitations; being limited to plan the pattern of success for knowledge management through ISM is one of them. Therefore, future researchers are suggested to use DEMATEL instead of this method for planning the pattern and compare their results with this approach. Moreover, taking into account that the results of the qualitative phase are the results of theme analysis, future researchers are suggested to use other qualitative methods through extracting the effective factors of knowledge management. For this purpose, grounded theory may be a proper method.

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