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EXPLORING THE BASIC ELEMENTS OF SUCCESSFUL KNOWLEDGE MANAGEMENT SYSTEM WITH PRESENTING A THEORY THROUGH A SEMANTIC NETWORK

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Abstract: *Nowadays knowledge is recognized as an important enabler for competitive advantages and many companies are beginning to establish knowledge management systems. Within the last few years many organizations tried to design a suitable knowledge management system and many of them were successful. This paper is to discover critical success factors (CSF) of knowledge management (KM) and their relationships in an effective way. A qualitative case study technique has been used in this paper for data collection and analysis. In this way, grounded theory (GT) research approach has been selected .The collected data are categorized and analyzed through specific stages of GT. A semantic network has been developed by categorized data showing the relationships between the extracted CSFs and finally a theory has been emerged. The semantic network and the emerged theory show the roadmap of success in KM area for the organizations.*

Keywords*: Knowledge management, Grounded theory, Qualitative research, Semantic network, Critical success factors, Theory building.*

1. Introduction

Today's organizations are continuously faced with the challenge of complexity and urgency in their core business activities. The business environment is very hectic and organizations need to be able to cope with many different kinds of business, technological, social, and human requirements. There is an inherent need for organizations to improve their core business activities [1]. In order to be able to solve complex problems the individual and group problem-solving processes involved in computer-mediated communication systems need to be integrated [2]. On the basis of their studies of Japanese companies, Nonaka and Takeuchi (1995) proposed their widely known model of the knowledge-creating company [3]. They argued that much of the innovation created and accumulated in a firm is actually based on tacit knowledge, i.e. arising out of experience, and cannot be easily communicated by workers within excessively formalized management procedures, so there is a strong necessity to have a knowledge management system in the organization.

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Jones (2003) cited that "knowledge management is an integrated, systematic approach to identify, manage, and share all of the department's information assets, including databases, documents, policies and procedures, as well as previously unarticulated expertise and experience resident in individual officers" [4].

Wunram (2003) defines KM in this way: "…Knowledge management is a systematic, goal oriented application of measures to steer and control the tangible and intangible knowledge assets of organizations, with the aim of using existing knowledge inside and outside of these organizations to enable the creation of new knowledge, and generate value, innovation and improvement out of it…" [5].

Except from the debate about the meaning of knowledge comparatively to those of data and information, special interest has drawn the dichotomy of explicit and tacit knowledge. Webb (1998) cites that explicit knowledge can be articulated in formal language and transmitted through manuals, written specifications etc [6].

Tacit knowledge is seen as personal knowledge based on individual experience and values and therefore not as easily transmitted. Civic (2000), in addition, cites that explicit knowledge can be expressed in words and numbers and shared in the form of data, scientific formula, specifications and manuals. It is codified and stored in databases where it can be accessed and used

easily by anyone in the company, while tacit knowledge is highly personal and hard to formalize, making it difficult to communicate or share with others [7].

Important item in knowledge management adoption is the study of factors of success. Smith (2004) has presented a paper about knowledge management strategies in which through that paper three knowledge management case studies were analyzed and it had been cited that '… as one can see from the three case studies, it take many different forms within different organizations [8].

The justification that KM strategies and specific findings for these corporations can be extended to other companies. Specific data items that do remain essentially the same across the firms are the facts that successful organizations do manage their knowledge through codification processes and they seem to do it very effectively.... Specifically the IT knowledge themes were as follows: performing timely audits that were based on demand and tied to a schedule, capturing detailed hardware, software and user information, and the ability to track changes through the effective management of an asset's lifecycle by detecting changes and identifying patterns to check on customers' compliance requirements.

Most felt that KM strategies allowed for greater managerial and ultimate user's satisfaction and productivity by leveraging time, prioritizing particular problems and orders, managing and monitoring service levels, and automatically communicating through information sharing activities. These concerns are universal and management should heed them so that proper reward systems are in place in order that KM strategies are allowed to grow and become profitable for the firms involved …'.

Mathi (2004) considered culture, KM organization, strategy, IT infrastructure, processes and measures as the key success factors of knowledge management [9].

Also in Lotus Notes (1998) we found that "knowledge management is as much cultural as it is technological, that a culture that does not foster and reward sharing of knowledge cannot expect technology to solve its knowledge challenges and also successful knowledge management depends on the commitment of top management" [10]. Nowadays many leaders have understood the vital role of intellectual capital in the organizations and the importance of knowledge management. They search for a roadmap showing success in this area. In this way, the current research is to develop a theory in KM domain towards success.

This theory can be conceptualized through a CSF-based semantic network. The core elements of this network are the critical success factors of knowledge management resulted by the analysis of real case studies.

2. Methodology

The authors adopted a qualitative research design due to their need for facilitating the generation of theoretical categories.

Data used in this paper comes from a longitudinal study during a two-year period examining new KM establishment processes. This research paradigm, which was based on an in-depth qualitative study, derives its theoretical insights from naturally occurring data including observations, texts, interviews, or questionnaires [11]. Especially, the researcher should intervene in the results of project on a matter of genuine concern to them on which they have a genuine need to take action. Research data and insight are gained alongside or on the back of the intervention [12, 13].

In addition to the use of literature, grounded theory differs in a number of respects from other qualitative methodologies, particularly with regard to sampling. According to Coyle (1997), most sampling is purposive and defined before data collection commences. In the case of grounded theory, sampling begins as a "commonsense" process of talking to those informants who are most likely to provide early information, which is known as theoretical sampling. This information is then analyzed through the application of open coding techniques, or line-by-line analysis (looking for words and sentences in the text that have meaning), which can help to identify provisional explanatory concepts and direct the researcher to further "theoretically" identified samples, locations, and forms of data [14].

For this research, data from some successful companies in KM adoption were collected. The data collected over the two years of the intervention have derived from different papers, journals, books, reports and through browsing the internet. During these interventions, the expressed experiences, views, practices and actual actions of the companies have been recorded as research data.

After reviewing the data for each case study, some of them were selected according to the requirements of the research. In this analysis, the authors were to answer:

-Why do these companies have to apply a knowledge management system?

-What are the essential issues of KM programs in these companies?

-What are the critical success factors of KM adoption in these corporations?

In the first stage of the data analysis, chronological descriptions of the project's activities were constructed with respect to KM establishment in the companies, describing how it came about, when it started, who was involved (rank of authority in the company), the level of involvement, and the major outcomes. Through this work, an in-depth case history of the project was completed. The second stage of analysis involved coding the in-depth case history with respect to its characteristics, origin, and effects. This highly iterative procedure involved moving between the in-depth case history, existing theory, and the raw data [15, 16]. The next stage is to search for links through the identification of concepts that may go some way to explaining the phenomenon under study. This process is normally associated with axial coding that is achieved by specifying relationships and delineating a

core category or construct around which the other concepts revolve. Axial coding is the appreciation of concepts in terms of their dynamic interrelationships and they should form the basis for theory construction [17].

The next stage of the theory development process is the construction of the core categories. A core category pulls together all the concepts in order to explain the phenomenon. It should have theoretical significance and should be traceable back through the data and then through selective coding, the categories integrate in order to build the theoretical framework.

Literature comparison with the results of each stage is the main mechanism of emerging and appearing new ideas and concepts. This will be continued until saturation stage. In this stage, new cases will not add any new concept to the findings. As mentioned, data from successful companies in KM adoption were collected.

Microsoft, Hewlett Packard, Siemens , Ernst & Young, Tel-tech, Malaysian aerospace, NASA, British aerospace, Xerox, Chrysler, IBM, Phonak, Ford motors, and Rolls Royce were our selected companies [18~26].

For the study as a whole, data collection, data ordering, and data analysis were interrelated as depicted in figure 1. The numbers indicate the activity's analytic sequence[32]. Within this general framework, data analysis for each case involved generating concepts through the process of coding which represents the operations by which data are broken down, conceptualized, and put back together in new ways.

It is the central process by which theories are built from data [27]. The collected data were analyzed carefully during many days by the help of Atlas.ti software.

Atlas.ti is strong software that has been developed for text mining and grounded theory building.

For each case, all related reports, texts, and documents that were associated with any efforts in knowledge management area in the company including the first steps, the planning, the lessons learned, story of failures and successes, and the interviews were considered as input data for the software. Figure 2 shows how to execute the Atlas.ti software for the case studies analysis.

3. Discussions

Analysis of selected case studies indicates that there are some important concepts which lead the organization towards success in KM adoption as listed in table 1. The authors will discuss more about these concepts and their relationships in this section. Each company has some strategies for reaching its objectives. For being successful in implementing knowledge management system in the organization, knowledge efforts and knowledge strategies should be aligned completely and correctly with organization strategy. On the other hand, success of every program and planning in the organization depends directly on CEO support and commitment. Of course a knowledge management program also needs complete CEO support for being successful in implementation. CEO support and commitment plays a very important role in knowledge management systems. Some factors such as investment, execution the project on a pilot, decentralization and define and supports of knowledge strategies, and business process reengineering are directly or indirectly dependent to CEO support.

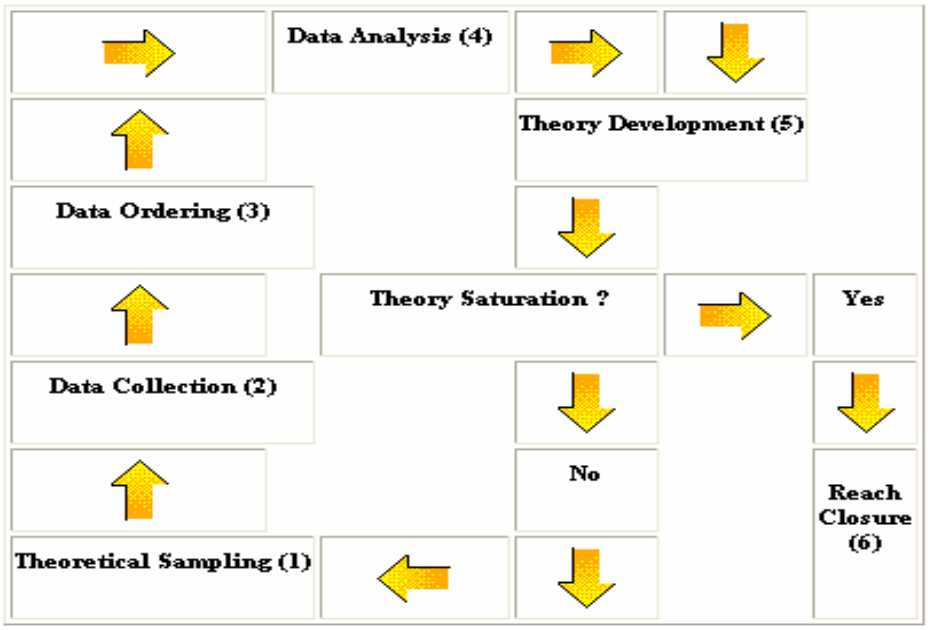

Fig 1. The interrelated processes of data collection, data ordering, and data analysis to build grounded theory
Source: http://www.nova.edu/ssss/QR/QR2-4/pandit.html [32]

The process of reengineering involves the breaking of old, traditional ways of doing business and finding new and innovative ways, and from the redesigned processes, new rules emerge that determine how the processes will operate. Considering BPR definition, usually the processes in the organizations may not be well designed. Now if we want to establish a knowledge management system on a weak foundation, knowledge efforts will be failed. So, BPR helps the organization to decentralize and define a value-oriented structure, in which knowledge management system can be implemented correctly.

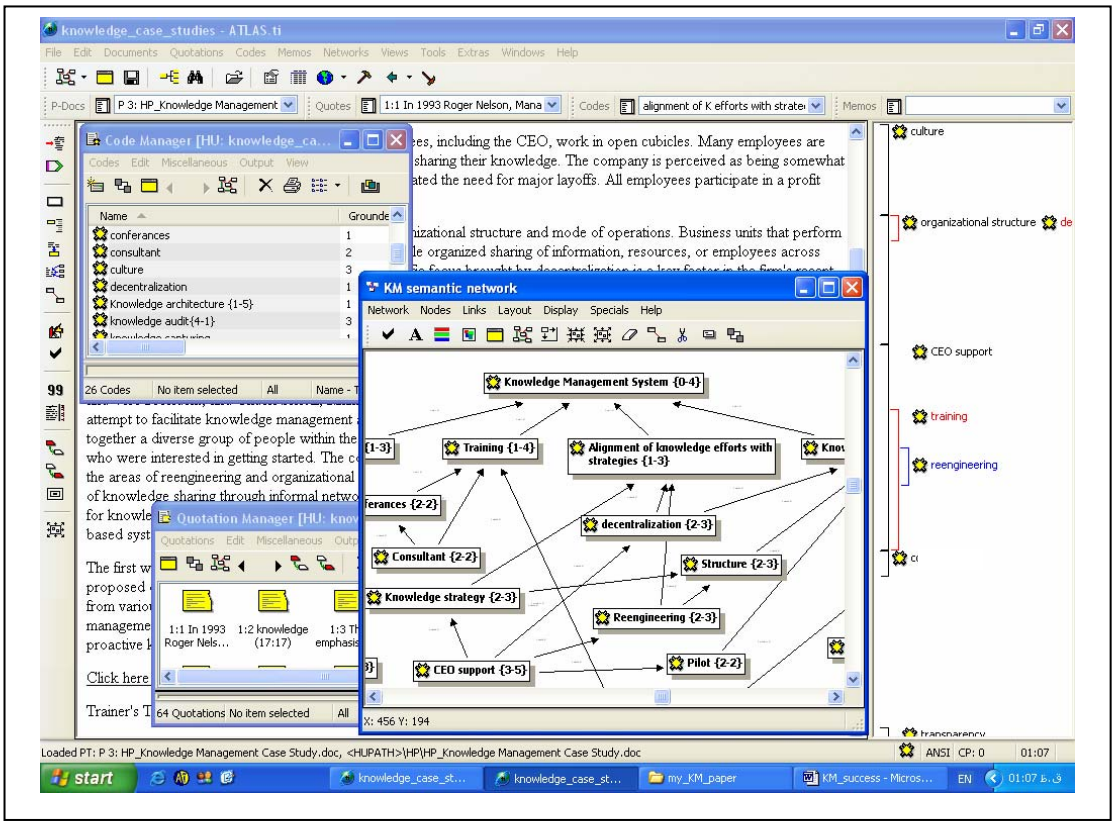

Fig 2. Atlas-ti software

BPR based KM efforts need a strong foundation of culture. The political and cultural surroundings are known from the analysis of knowledge culture because effective knowledge management cannot take place without extensive behavioral, cultural, and organizational change [29]; there is a need to initiate the relevant changes. This especially aims at creating an environment where knowledge sharing is encouraged.

Knowledge sharing plays an important role on implementing and executing knowledge management system. Knowledge sharing can often be done effectively by regular or event-triggered knowledge sharing occasions.

Regular means repeated at specific intervals while event-triggered means at specific events like e.g. a project's end, coming up of a new technology etc [28]. Of course knowledge sharing between employees needs a strong culture, trust and also transparency in all over the organization.

This arrangement clearly points out the interest of the management in culture openness and knowledge creation, especially regarding innovation, and the company has been successful with this. So organizational culture should be considered as an important driver for knowledge management system which may be established through architecture.

An organizational architecture can be defined as a complex, multi-dimensional construct expressing principles that guide how the organization is to be designed, that is, how the elements of the business model are actually organized and executed. Architecture can be studied from two views: descriptive view and prescriptive view.

In descriptive view architecture describes how a design actually is in terms of its functional, operational or material manifestation and in prescriptive view architecture guides how a design should be accomplished [30].

So knowledge architecture can be defined as a logically set of principles and standards which guides the engineering of an organization's knowledge management system infrastructure. So the companies which are to design their knowledge management system should be really sensitive to construct their knowledge architecture correctly and robustly.

It is important to say that a comprehensive KM cycle in the organization should include all relevant KM processes.

Theses processes may be as knowledge identification, knowledge organizing, knowledge audit, knowledge storage, and knowledge sharing. All these functions should work harmonically in the organization to shape the KM system in an effective way. Saving the knowledge of organization (tacit and explicit) is one of the most important elements of a KM system. Skill databases, expertise database, and storage of tacit and explicit knowledge of the organization is as important as the other elements of knowledge management systems. If an organization cannot store its knowledge truly, the most important property of the organization (knowledge), may be missed easily. Knowledge identification, knowledge capturing and knowledge audit are also important in a knowledge management system and storage the knowledge of organization should be considered for both tacit and explicit knowledge. For knowledge sharing, transparency in all over the organization and also a strong culture and good atmosphere of cooperation between employees are necessary. Also, trust factor drives knowledge management efforts and also enables knowledge sharing. Employees should become completely and deeply familiar with knowledge concepts for spreading knowledge policies and totality of knowledge in the organization. So, training programs are very important for an organization which is to conduct knowledge management. Continuous training of employees may be notified through seminars, training courses, conferences and etc and the important role of academic education shouldn't be forgotten.

Table 1. Critical issues of knowledge management

Critical issues of knowledge management (main concepts)	Microsoft	Hewlett Packard	Siemens	Ernst & Young	Tel tech	Malaysian aerospace	NASA	British aerospace	Xerox	Chrysler	IBM	Phonak	Ford motors	Rolls Royce
Strategy	√	√	√	√	√	√	√	√			√			
KM architecture							√		√				√	
Network of experts (CoP)	√	√	√	√	√		√	√	√	√	√	√	√	√
Training programs	√	√	√	√	√	√	√	√			√			√
Transparency		√						√	√			√		
CEO Support	√		√			√		√	√	√	√	√	√	√
Organizational culture	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Trust	√	√	√					√						
Organizational structure				√								√		
Reengineering (BPR)				√						√	√		√	√
Pilot	√		√										√	√
Knowledge identification	√		√		√		√	√		√	√	√	√	√
Knowledge capturing			√		√	√	√	√		√		√		√
Knowledge audit		√	√	√				√		√	√	√	√	√
Knowledge storage			√		√		√	√	√	√	√	√		√
Knowledge sharing	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Information technology	√	√	√	√	√		√	√	√	√	√		√	√
Investment								√	√	√				
Benchmarking			√					√					√	√
Collaboration & team working		√	√				√	√			√	√	√	√
Awareness	√		√		√	√								
Attention to human resources		√	√				√	√	√	√	√	√		

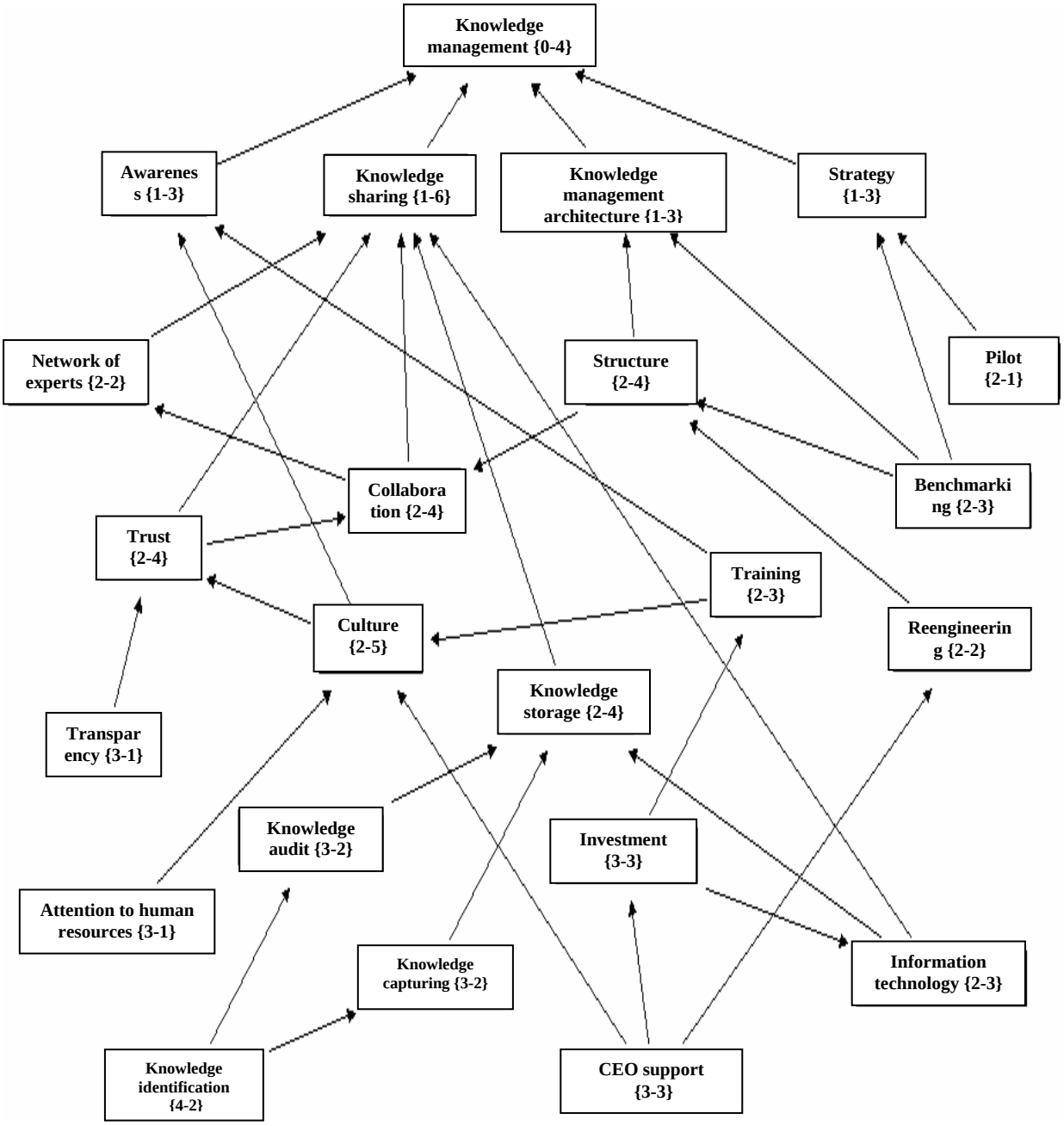

Fig 3. Semantic network resulted from case studies analysis

The knowledge centers in the organization lead knowledge activities through knowledge committees, communities of practice, knowledge
teams and network of experts and totally focus and drive knowledge efforts in the organization
The above mentioned factors affect on success of knowledge management system directly or indirectly and have also effects on one another.
These relations are clearly shown in a semantic network as depicted in figure 3 which is taken from final analysis of input data. The semantic network can present the research findings as a whole, and give a visualized picture from the findings for better understanding. All relationships between the concepts can be presented and the position and the level of strength for each concept can be demonstrated by the semantic network.
For discovering the relationships between the concepts, the researcher should follow the concepts through each case study analysis.
Of course, the patterns that have been considered by each company for KM adoption, the priorities, and the path can help the researcher to follow the relationship. The researcher should also consider the concepts as a whole and analyze and compare them one by one with each other and with the whole.
In this way, the semantic network can be emerged and completed gradually and the relations can be discovered.

In the semantic network each vector shows a cause and effect relationship, end of vector as "cause" and start point of it shows "effect".
For each factor (node) in the network, there are two numbers, one for factor layer and the other shows the number of relations with the other factors of network.
Number of layer shows us the distance between present factor and zero level and also shows that the factor is located at which level of the network.
The second number shows the strength (density) of factor and its role in the network. So two factors "knowledge sharing" and "KM architecture" are the strongest in the network.
These factors are known as core categories.
The critical factors are the main parts of "theories" and here, the above mentioned main factors make our theory that shows how to be successful in knowledge management system design and implementation. So the emerged theory will be as follows:
For being successful in knowledge management adoption, the organizations should notice to alignment of knowledge strategies with organizational strategies. The atmosphere and the organizational culture should adopt knowledge management through collaboration, trust, and transparency. The networks of experts should be reinforced for knowledge sharing. This can be facilitated through flexible and horizontal structures by business process reengineering and pilot projects.
The employees should be completely familiar with KM bases through trainings and should follow knowledge management process in the organization including knowledge identification, knowledge organizing, knowledge audit, knowledge storage, and knowledge sharing. Appropriate knowledge management architecture with CEO support and commitment are the important drivers of this process.
Semantic network is a strong and effective support for this theory and can answer any related questions.

4. Conclusion

The importance of knowledge management is clear to every organization and nowadays, many companies search for the main reasons and factors for being successful in knowledge management system design and implementation through their organization.
In this paper, we analyzed 14 companies which were successful in implementing knowledge management system and found out critical success factors of knowledge management. We can conclude that the main contribution of the paper is extracting the basic elements of success in knowledge management systems or KM critical success factors (CSF), discovering the relations between them, developing the CSF-based semantic network, and finally presenting a theory that is supported by research findings.
It is important to say that the number of real case studies (14 corporations) and the analysis shows the validity of research that has been rarely done with this scale in knowledge management domain, and it can be considered as the other contribution of the research.
The grounded theory of this research is highly supported by saturated concepts which have been extracted through the analysis of 14 case studies.
This theory clarifies the main success factors of knowledge management system completely. The available semantic network also supports the emerged theory effectively.

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