Use of knowledge maps in collaborative networks management (Case Study: SSFR Company)

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Summary
Today, knowledge is considered as a valuable and strategic source as well as an asset, and providing high quality products without proper management and use of this valuable resource is difficult and sometimes impossible. The use of knowledge management tools in the efficient and effective management of collaborative networks is very important. This study was carried out aimed to investigate knowledge management performance in the collaborative network and then by drawing a knowledge map, Sustainable Smart Force Research Company was studied as case study. Also, this study has investigated the indicators of supply chain performance including price, quality, flexibility, agility and speed and supplier selection indicators including past performance, financial stability, timely delivery, knowledge management indicators including transfer, sharing and distribution of knowledge, organizing, maintenance and accumulation of knowledge and acquisition, creation and production of knowledge for use in the knowledge mapping algorithm. In this study, an algorithm is provided which specifies the collaborative network status by drawing knowledge map to accelerate the drawing process of knowledge map in the collaborative network and help manager to make better decisions

Key words:
Knowledge Management, Knowledge Map, Collaborative Network, Supply Chain

1. Introduction

Today, knowledge is rapidly growing and developing, so that in the twentieth century technology and knowledge findings has increased only by 80%, and all technical information by 90% in the world. Nowadays, knowledge is considered as a valuable and strategic source as well as an asset, and providing high quality products without proper management and use of this valuable resource is difficult and sometimes impossible. [1]

Also, knowledge-based economy emphasizes the necessity of knowledge and as the important competitive resource at the individual, organizational and macro levels of the countries. In today's knowledge conditions, the importance of knowledge capitals and its important role in achieving and strengthening the competitive advantage of organizations seems obvious. The increasing importance of knowledge as one of the vital resources of organizations, including public and private, has caused more attention to be paid to the issue of knowledge management in the organization. [11]

Knowledge management has been considered in organizations because of four main reasons: 1. Increasing the organization's efficiency. 2. Developing old systems in order to improve efficiency and easier access to knowledge banks. 3. Improving responsiveness to existing threats and reducing them by creating a problem-solving system and making structured decisions. 4. Providing better services to the community at a lower cost and time. Accordingly, it is necessary to implement knowledge management in organizations. This requires a comprehensive and prospective look at the implicit and obvious knowledge management in goods or services supply chain among the organization employees and sharing it among the key forces of the organization to respond timely to the risks and events ahead of them [3].

Identifying the knowledge available in the collaborative network and the employees supply chain and classifying them for purposive sharing is one of the issues that knowledge management in organizations has always been faced with them. For this purpose, knowledge map is one of the knowledge management tools that are used in this study. Knowledge map is considered as a guide to specify the knowledge location or the possibility to store it in the organization. From this perspective, knowledge maps are not beyond the list of experts, documents and databases to guide people when they need a particular knowledge. [32]

Knowledge maps can be created graphically by transferring certain aspects of knowledge. In order to extract, share, learn, or create knowledge, these maps can be used. Also, the knowledge map can help the manager to make better decisions, determine and assess the relationships between employees and meet their needs together, as well as assess the organization knowledge culture and overcome organizational conflicts. [3]

Providing an image of the organization's knowledge areas for managers is the main purpose of drawing knowledge maps in the supply chain among employees, so that existing organizational knowledge can be identified if

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necessary, knowledge map is considered as one of the powerful tools to realize organizational learning [30].

Today, the evaluation of the organization's collaborative network in the shortest possible time and with sufficient accuracy is considered as one of the main concerns of the managers, therefore in many organizations, employees and collaborative companies are evaluated by collecting data and preparing reports on the performance of each employee and company. This process is time consuming and imposes a high cost on companies and is done by reviewing received data. Because these data only specify the priorities in the evaluation, and when there is a plurality of employees and suppliers, it is possible that this evaluation is done with a lot of errors. Also, companies and organizations also have a lot of data and information in managing collaborative networks and supplier evaluations, but they must become data and their evaluation data into knowledge, and then extract the images to make better decisions, so there is need to an illustrated assessment so that would make managers to be able to make decisions in the collaborative network with maximum speed, accuracy, and minimum time. On the other hand, most organizations don't pay attention to the collaborative network management using map, because this is a very novel issue and do not have enough knowledge about this. So, this study has investigated the necessity of using knowledge maps in the collaborative network management. The use of knowledge maps in the collaborative network has many advantages, including increasing the speed of decision making by the organization's manager about the collaborative companies and even the employees of the different departments, because evaluation visualization makes company manager to be able to constantly monitor its collaborative network and find out exactly what part of it faces with problems, and it is very applicable to justify senior executives for making decisions. Therefore, it can be said that the use of drawing knowledge map Technique in a collaborative network can be very useful for an organization.

The use of knowledge maps in evaluating the collaborative network has discussed in this study. In the first part of this study, the definitions needed in the field of knowledge management and knowledge maps and collaborative network are firstly discussed. In the second part, the literature on research on the use of knowledge maps has been reviewed and, since so far, no research has focused on the use of knowledge maps in collaborative networks and supply chain, the methodology of drawing knowledge map, steps and operational steps of the scientists in the field of drawing knowledge map has been reviewed. In the findings section of this study, a conceptual model approved by experts in the field of knowledge management and collaborative network management and supply chain management, is provided, and using this model, a software is provided for drawing knowledge maps in the collaborative network of organizational supply chain and Sustainable Smart Force Research Company is studied as a case study. Finally, the knowledge map of the organizational external collaborative network of the Sustainable Smart Force Research Company is presented as the output of this model in this case study.

2. Theoretical fundamentals and research background Knowledge management

Knowledge management is defined as a set of activities, initiatives and strategies used by companies to generate, store, transfer, and apply knowledge in order to improve organizational performance. [15]

Recently, knowledge management is considered as one of the most interesting and challenging issues in business management and it being increasingly used with other topics of management. Knowledge management is considered as a process that makes managers to be enable to identify, select, organize, publish and transfer critical information and skills that are part of the history of the organization, and are generally unorganized in the organization. Since knowledge management is rooted in expert systems, organizational learning, and innovation, it can't be considered as a new idea. Successful executives have always benefited from intellectual capitals and recognized its value. [10]

Knowledge Map

Knowledge map refers to creating a graphic network with point-contact that reveals the relationships existing between concepts and can be useful in the knowledge management process [7].

Knowledge map is a visual representation of knowledge about knowledge, it is not a repository of knowledge. Some advantages of visualization in knowledge management includes better reviewing, quick access, more efficient representation of knowledge assets. An organizational knowledge map design is an important part of the process of encoding organizational knowledge. A knowledge map in the simplest form can be defined as a quick guide list to show the location of knowledge for those who need it. [18]

Supply chain

Supply chain is defined as the process of planning, implementing and controlling operations related to supply chain in the best possible way. Supply chain management is an integration approach to plan and control materials and information that begins from suppliers and ends to customers, as is arisen in different tasks within an organization. Supply chain management, inventory management focuses on management and establishes a link

between operations and analysis of communications in industrial organizations. [9]

Collaborative Network

A collaborative network consists of interdependent organizations. The relationship between these organizations is established through upward and downward communications between processes and activities that can create value [14].

A collaborative network can include all movements and storage of raw materials, inventory during work, and final product from the starting point to the end point of consumption.

Supplier selection indicators and criteria

Indicators and criteria affecting supplier selection include many items which depend on the type of activity and characteristics of the outsourcing organization. Past research has introduced various criteria from the perspective of different people for different activities and different industries, some of the most important are the following:

1 - Trust and credibility, and supplier credit history 2 - Duration of work experience 3 - Management and organization related to the supplier 4 - Information systems with supplier 5 - The position of each industry (including leadership and credibility) for the supplier 6- Works related to the contract with the supplier 7. Acceptance of the procedures related to the buyer's organization by the supplier 8. The history of the supplier's performance 9. The long relationship between the customer and the supplier 10. The supplier organization's flexibility. [5]

3. Research Method

Pelc in a paper titled "Thes role of knowledge, the integrity of technology management knowledge" describes the special task of these maps by drawing a conceptual map of technology management knowledge [29].

Lee and Su conducted a study aimed to present quantitative maps of scientific research and analyzed 223 cited papers in the field of electrical conductivity nano-composites. They have combined two methods of terms co-occurrence and social network analysis and plotted a three-dimensional knowledge map. Then, they underlined the important and emerging sub-domains in this field using the maps. [23]

Leiva & et al analyzed the literature related to this field in 1961-2010 by identifying the sub-fields of financial marketing research and showing the relationships between them and plotted final results using the knowledge map in the marketing field [25]

Chen et al., identified the conceptual structures of the subject in this field by analyzing clustering and using the results of the analysis of the text and references of articles published in 1985-2007 related to knowledge and data engineering, and have shown highlighting patterns and its emerging trends using conceptual and network visualization maps [13]

By reviewing the literature and studies conducted by scientists and the use of knowledge maps in different fields, it can be concluded that these fields are commonly used and but no research has been carried out in the field of collaborative network. This study was carried out aimed to explain the need for using knowledge maps in a collaborative network. The use of knowledge maps in collaborative networks and supply chains is a novel issue that accelerates displaying information for each collaborative network to manage to be management and makes manager to be enable to adopt effective decisions for increasing productivity in the organization. Then, the steps studied in the field of knowledge maps by different scientists have been listed in Table 1, and then, in the next section of the study, a model is provided for designing and building a knowledge map.Table (1): Operational steps in the field of knowledge maps [7]

Scientists	Step 1	Step 2	Step 3	Step 4	Step 5
Inrou & et al	Analysis and extraction of knowledge through interview	Patterns of knowledge domains	Visualization of knowledge domains	Implementation of the knowledge map	Updating the knowledge map
Eppler	Definition of organizational knowledge	Analysis of organization process maps	Knowledge extraction	Creating a knowledge profile	Knowledge Map Validation
Lee et al	Determining the purpose and problem and determining the audiences and end users of the knowledge map	Conducting interviews with experts and end users	Compilation or selection of a standard framework for computerized map design	Creating and compiling citation database	Decision making on the type of knowledge map display and drawing it
Butter	Identifying key organization processes	Identifying the key activities of each of these processes	Understanding explicit knowledge and information needed for each activity	Extracting the implied knowledge domains of experts based on their roles in processes	Creating key competencies for each activity. Drawing a knowledge map based on it

Review and analysis of existing methodologies indicates that researchers' views varies on how to design the stages and procedures for drawing a knowledge map. The pattern used in this study is the pattern provided by Inrou & et al. Because, according to experts' opinions, we concluded that, in addition to this model can meet more research needs to use the knowledge map in collaborative networks; also, according to the specialists' view, this model is more precise and complete than other models, and have fewer obstacles and challenges, and is more updated than similar patterns in drawing up knowledge maps.

4. Methodology of research

The basis for doing that activity is method selection and how to do each activity. The method used for this study is explained here because the researcher determines what method must be chosen to help him achieve the desired goals in a more accurate, easier and cheaper manner [3]. The research is classified based on different criteria. The most important of these categorizations are based on the following criteria 1: objective 2- collecting data and information and 3- type of research implementation. One of the most important methods of objective-based research is basic research, applied research and research and development. Some of the most important data collection-based research methods includes exploratory research, descriptive research including descriptive surveying, descriptive experimental and field descriptive, and exploratory research. Research methods based on the research type include quantitative approach, qualitative approach and mixed methods [6].

This study is considered as an applied and basic research in terms of objective, because this study is carried out aimed to apply the concepts and definitions of knowledge maps in the collaborative network and so far, no research has been conducted on the use of knowledge maps in the collaborative network. This study is considered as an exploratory research in terms of collecting information and data, because there was no knowledge about the subject studied and in terms of research type, it is considered as a qualitative research because the experts' opinions were firstly used and then a case study has been reviewed.

4-1. Research conceptual model

A model indicates the relationship between the theoretical plan (theory) and how to collect and analyze information. In the social sciences, the models include signs, so that the characteristics of some empirical phenomena (including their components and their relationship) are logically expressed using concepts related to each other. Therefore, the model reflects reality, and embodies certain aspects of the real world which are related to desired subject. It reveals major relationships among mentioned aspects, and finally makes possible performing a theory empirical test considering the nature of these relationships. A better understanding of some parts of the real world can be achieved after testing the model. [3] Therefore, considering the above arguments and the professors and experts' views in the field of collaborative network and supply chain, and also based on theoretical foundations of the research, the conceptual model of research has been designed and developed as is shown in Figure (1).

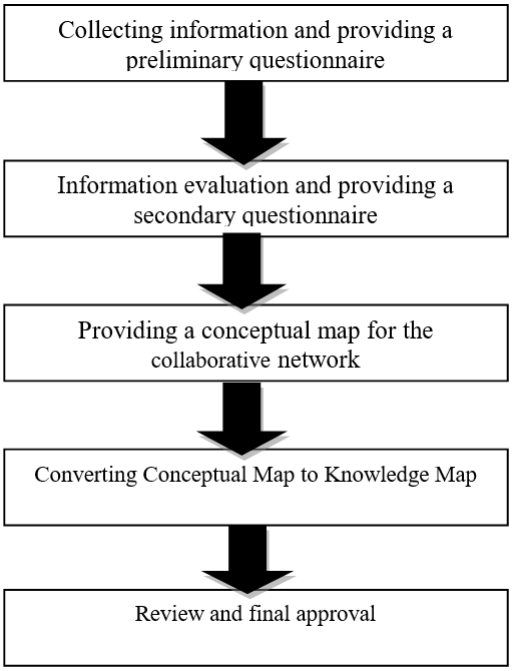


Figure (1): Conceptual Model of Research

In this model, a questionnaire was used as information collection tool. For designing questions, **5-point Likert** has been used to design research questions, which is considered as one of the most commonly used measure comparisons. Formal validity based on the experts' opinion has been used for validity of the research questionnaire. The validity of the questionnaire is confirmed, because the international standard questionnaires were used and as mentioned above, the professors in the field of knowledge management and collaborative networks management and supply chain confirmed the validity of the questionnaire.

The items used in the primary questionnaire include questions that are determined depending on the organization size relative to its external collaborative network and their degree of importance. The most important of these indicators include the history of cooperation, fixed and current assets, the ratio of the contracts volume with the company, the value of manufacturing contracts, the area of the company,

operations machinery and equipment, educational level and human resources experience, the use of specialized software, quality control system, the establishment of international standards, etc. [7]
There are other indicators that depend on the companies' type, but the most important ones include history of cooperation, fixed and current assets, the ratio of the contracts volume with the company, the value of production contracts, these indicators are used in most organizations and collaborative networks. These indicators are used in this study.

5. Results

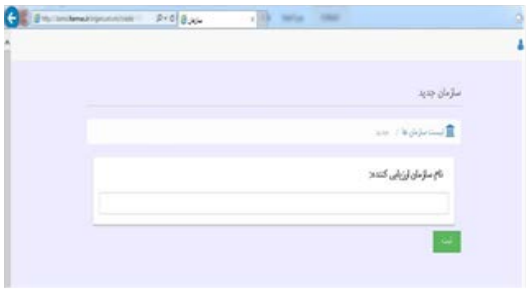
A conceptual model for using knowledge maps in collaborative networks outside the organization is presented in this study according to the concepts and definitions presented.

In this section, a model provided by experts in the field of network management and KM is confirmed based on the results obtained from studying Sustainable Smart Force Research Company as case study. This company is working in the field of delivering goods and electrical services to its customers. this study, because the other software performs this process using a single-threaded approach.
The company deals with the exchange of goods and services with other companies and in another way has a collaborative network composed of outside your organization. This company is chosen as case study, because the external collaborative network of this company is the product and the service provider, which has both goods and services processes. In this study, the algorithm presented is built on web-based software. One of the capabilities of this software is the assessment of companies and collaborative networks, as well as drawing their knowledge maps in an integrated manner, which it is considered as one of the innovations of

Table (2): Secondary questionnaire items in the algorithm

Variables		question number	Reference
Supply chain performance	Price	1	[26]
	Quality	2	[26]
	Flexibility and agility	3-6	[20]
	Speed	7-8	[17]
Supplier Selection	Past performance	9	[31]
	Financial stability	10	[31]
	Timely delivery	11-13	[16]
	reputation	14-15	[31]
Knowledge Management	Transfer, sharing and distribution of knowledge	16-17	[24]
	Organizing, maintaining and accumulating knowledge.	18-19	[28]
	Earning, creating and generating knowledge	20	[19]

1. Collecting information and providing a primary questionnaire: Three steps have been developed at this stage of the conceptual model. 1. Holding a workshop in this first step, so that a common language to be achieved among the organization's knowledge management committees about the knowledge management concepts and vocabulary, educational team working is done by the management training experts in the organization. This section introduces some fundamental concepts such as knowledge Management, Knowledge Map, Benefits and Methodology of developing a Knowledge Map in a collaborative network. 2. Examining the process documents that are studied at this stage to take advantage of the initial processes and procedures, as well as familiarity with the documentation and standards structure in the organization, all existing documents are being studied. In this step, after ranking the units based on their importance, the processes involved are identified, and the executive documentations related to the processes are studied which includes the implementation methods, the instructions and how to perform the task in each process, as well as the skills required to implement the processes in order to identify the important knowledge fields of the organization and 3- This step investigates the organizational structure and determines the status of each employee, identifies the relationship between them, describes the duties of each section and identifies the knowledge-related needs in each unit. Firstly, we need to enter the main company name (in this study, the main company is the Sustainable Smart Force Research Company).



New order, Organization Name Figure 2: Collecting Primary Information (Entering Organization Name)

Then, we enter the name of the collaborative company. After entering the company's name into the system, the system immediately issues a question to find out which the company supplies its products on what market for the main company, because the products supply in the market demanded is very important to determine the importance degree of collaborative companies.

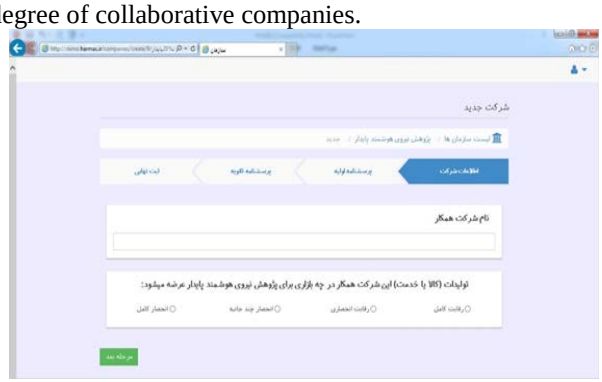


Figure 3: Collecting Initial Information (Determining Supply Market Type)

The software is designed in such a way that, if the absolute monopoly market option is chosen by evaluator, since the valuator company has to provide its product or service from the collaborative company, then the rating of the collaborative company is very important for the evaluating company and secondary questions will be arisen.

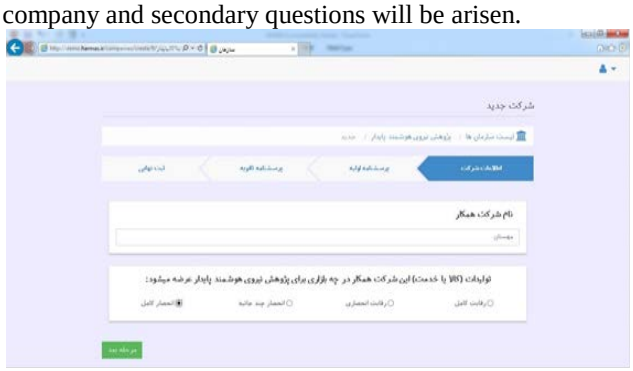


Figure 4: Selecting the absolute Monopoly Option and entering the secondary questionnaire

Figure 5: A primary questionnaire for determining the importance of the collaborative company

2. Information assessment and providing a secondary questionnaire: After entering information into the software (information provided by the evaluating organization and the collaborative company and the primary questionnaire for determining the importance degree of the organization), a secondary questionnaire is introduced by the evaluating company. The software analyzes and calculates the obtained values and specifies the collaborative company's output color, and enters it on the knowledge map. If, after the registration of the collaborative partner, the monopoly market option is chosen as products supplier market, the initial questionnaire will appear to determine the rank of this company.

3. Providing a Collaborative Network Conceptual Map: At this stage, it is determined that whether other areas should also be added to the map or not, this decision is made based on knowledge fields identified and important knowledge fields, the organization's conceptual map. At this stage, when the software shows a secondary questionnaire to determine the knowledge status of the collaborative network outside the organization, it identifies the conceptual map and color range of the company in terms of knowledge for drawing the final map.

Figure 6: Output of the secondary questionnaire and building a conceptual map

4. Converting a conceptual map to mental map: At this stage, the knowledge map of the organization is provided based on the previous stage as well as concepts in the conceptual map which are provided by the software developed for this study in relation to drawing knowledge map.

Figure 7: Converting conceptual map into the mental map

5. Reviewing the knowledge map and its final approval: In this step, the final step, after building the knowledge map for the organization, the KM and the collaborative networks committees are obliged to review all aspects of the map during a meeting and, if necessary, amend it and thus, in the end, approve final knowledge map provided for communicating to organizational units (the final map on a collaborative network is different for each organization due to the different indicators used by each organization).

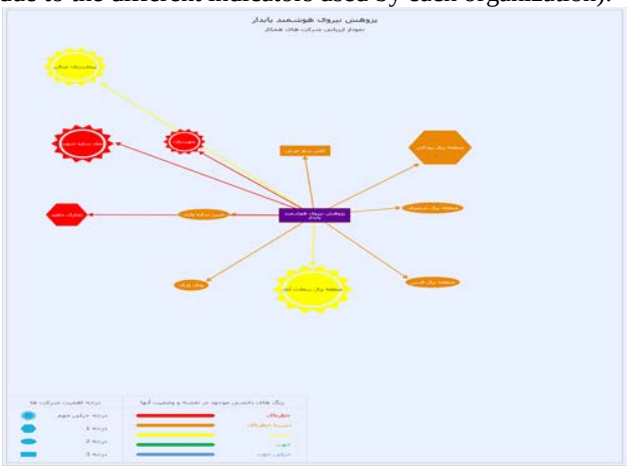


Figure 8: Final review and approval of the Sustainable Smart Force Research Company map

6. Conclusion

This study was carried out aimed to discuss drawing knowledge map in the collaborative network. According to the results obtained from studying the structural model of the research, the use of knowledge mapping technology in the collaborative network is effective in evaluating companies and individuals inside and outside the organization. Also, the conceptual model of research includes identifying indicators and information collection steps and providing a primary questionnaire, evaluation of the collected data and providing a secondary questionnaire, the development of a conceptual map in the collaborative network, converting conceptual mapping into the knowledge map, and ultimately the final review and approval of the map. Since the field of the external collaborative networks of an organization was evaluated by this study, four indicators of cooperation history, fixed and current assets, The ratio of the contract volume with the main company and the total value of manufacturing, consultancy and service contracts of the company in the primary questionnaire and eleven indicators of price, quality, flexibility and agility, speed, past performance, financial stability, timely delivery, reputation, transfer, sharing and distribution of knowledge, organizing, maintaining and accumulation of knowledge and acquisition, creation and production of knowledge were listed in the secondary questionnaire.

According to the proposed model in this study, it can conclude that the model used in this research is a hybrid model of supply chain management in the collaborative network and providing a primary and a secondary questionnaire in the algorithm and knowledge management field for the use of Knowledge maps tools for evaluation of the collaborative network in the goods or services supply chain of employees from each other outside the organization. The importance of using knowledge maps in the collaborative network to evaluate managers from collaborative companies and employees to make decisions about their growth and excellence is also addressed by this study.

One of the main recommendations of this study is to use the method used for drawing knowledge map in the intra-organizational collaborative network in order to evaluate employees, and it is suggested that the results obtained be compared with the results of this study. Lack of cooperation of large organizations to implement drawing knowledge map in the organizational collaborative network can be mentioned as one of the research constraints.

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