International Journal of Management, Accounting and Economics
Vol. 3, No. 1, January, 2016
ISSN 2383-2126 (Online)

www.ijmae.com

Ranking Knowledge Management Factors in Supply Chain of National Iranian Copper Industries Company Using FAHP Method

Alireza Modanlo Joibary[1]
Department of Management, Behshahr Branch, Islamic Azad University, Behshahr, Iran

Mostafa Mohammadi
Department of Management, Sari Branch, Islamic Azad University, Sari, Iran

Ruhollah Geraeeli
Department of Management, Farabi Campus, University of Tehran, Qom, Iran

Nasrin Karimian Shamsabadi
Department of Management, Najafabad Branch, Islamic Azad University, Najafabad, Iran

Abstract

Knowledge management is considered as one of the most significant competitive resources for any organization such that most believe that the faster the companies acquire knowledge taking into application, the more they are successful in a competitive market. On the other hand, the competition among companies is no more important; instead, the competition among supply chains is highly focused in order to provide the most value to the customer. Research statistical population included 30 individuals of all practitioners and middle management experts in National copper industries company headquarter. The present research used Fuzzy Analytic Hierarchy Process (FAHP) to rank knowledge management effective factors in supply chain of national Iranian copper industries company. Research results showed that management factors, knowledge creation, acquisition and production process, knowledge assessment and feedback process, knowledge transformation, sharing and distribution process, organizational culture, knowledge use, application and utilization process as well as employees' characteristics are in order the most to the least important knowledge management criteria in supply chain of national copper industries company through using FAHP technique.

[1] *Corresponding author's email: alireza.modanlojouybari@gmail.com*

Keywords: Knowledge management, supply chain, fuzzy analytical hierarchy process (FAHP).

Cite this article: Joibary, A. M., Mohammadi, M., Geraeeli, R., & Shamsabadi, N. K. (2016). Ranking Knowledge Management Factors in Supply Chain of National Iranian Copper Industries Company Using FAHP Method. *International Journal of Management, Accounting and Economics*, *3*(1), 14-27.

Introduction

Since the end of last century to the present, the issue of intangible assets is increasingly regarded as some part of organizational critical resources. Of these assets, knowledge draws most attention and is highly focused as organization intangible asset. Knowledge management is now turned into one of the major issues off management studies around the world. Knowledge derives from information; hence, it is much richer and significant. Knowledge embraces expertise, awareness and acquired perception through experience or studying. Further, knowledge results from comparison, continuous identification and communication.

Servin regards knowledge management the function of collective knowledge to achieve specific organizational goals (National Library for Health, 2009). In today's economy, the competition is not any more in term of companies; rather, these are the supply chains competing together (Hult et al, 2004). Supply chain (SC) management includes a whole set of activities for material control, financial status, as well as information trend among material suppliers, industrial sites, distribution centers, retailers and target end customers (Edwardson and Durst, 2013).

Knowledge management as an asset systematically serves to achieve goals and to improve supply chain performance. Now the question raised here is that why some components (members) of supply chain does not qualify for knowledge management? One explanation for knowledge transformation and sharing among groups with different objectives and various ways is to succeed whether inside the organization or among business partners in supply chain (Marra, Ho, and Edwards, 2011).

Supply chain contains some difficulties and challenges for improving and enhancing knowledge management. Knowledge management is not integrated within business processes; so, it is difficult to assess knowledge management performance. Knowledge management levels are low and it suffers inadequate budget (Zhao et al., 2012). If knowledge management is not approved in supply chain, it seems that it may not lead to a common understanding related to organization perspective, strategy, as well as supplier/customer relations (Natti and Ojaslo, 2008). Knowledge management is considered as the main source of competitive advantage. As a result, it enhances the interest of academics and physicians in understanding unique factors of transferring effective knowledge within supply chain (He, Ghobadin, and Gallear, 2013).

Knowledge management conformity in supply chain referred as a common environment in order to allow a more compatible chain and an indicator to improve strategic competitive status in the market. KM may provide interpersonal security of supply chain members for accessing outside knowledge. However, it also helps in

ISSN 2383-2126 (Online)

improving total competition of the whole supply chain (Li and Hu, 2012; Zhengyi and ronghua, 2005). In planning issues of integrated supply chain (SC), various knowledge dimensions, geographical distribution, hierarchical levels and functional affairs are identified (Stephanopoulos, 2011).

According to Bot (1999), organizations require to develop some knowledge management system that is consistent with local conditions and cultural barriers for predicting poor knowledge management relations in multicultural organizational culture optimization team; further, it needs to share the inherent value of optimization and understanding of knowledge, to be insensitive to firm's culture; instead, to be sensitive to various cultures in terms of interorganization functional skills (expertise).

Coordination of supply chain operations throughout internal business performance as well as throughout firms' borders implies cooperation, sharing information, integration and long-term commitment, which is the position and location of learning issues at the heart of supply chain. Knowledge may be an important source of coordination and central of chain performance. Generally, knowledge management in supply chain can aid companies to promote sources better utilization. Thus, the main question raised here is that "how knowledge management factors are identified and ranked in supply chain through using Fuzzy analytical hierarchy process (FAHP) technique?"

Literature review

Ahmandavand and Bagheri (2014) conducted a research naming selection knowledge management strategy by using analytic hierarchy process (AHP) hybrid approach and TOPSIS. Research objective was to select knowledge management strategy through using TOPSIS and AHP approach for decreasing implementation cost and time of a successful knowledge management system in organizations. AHP was used for data analysis and prioritizing effective factors of knowledge management strategy; in addition, knowledge management strategies were ranked through using TOPSIS technique. The factors influencing knowledge management strategy selection include creativity and innovation, knowledge sharing, incentives, time, cost, profitability, communication, culture and people, top management support, knowledge of competitors, organizational structure, technology and information, of which information and technology factor has the highest effect on selecting knowledge management strategy; moreover, system-based strategy in Tehran ministry of education ranked the highest.

Aliahmadi and et al (2011) studied the effect of knowledge management means on staff empowerment. To do this, seven knowledge management means were selected using experts' opinions. Research statistical populations were knowledge- based companies located in information and technology parks such that finally forty-three questionnaires were investigated. Seven knowledge management means were ranked utilizing AHP method. Results showed that of the seven means benefiting both fresh and experienced staffs as well as in service instructions maximally influenced staff empowerment; while, job flow and post operation review showed the least impact.

Findings of Taheri, Jouybari and rostami (2015) revealed that in ranking knowledge management effective factors in supply chain of Neka industrial estate through AHP, knowledge creation, acquisition and production process are highly prioritized; whereas, the least priority assigned to knowledge transferring, sharing and distributing. Furthermore, knowledge exchange in addition to value added of supply chain obtained the top priority comparing other alternatives. Research results using Entropy technique represented that staff characteristics achieved the highest priority. In ranking by TOPSIS technique, knowledge development potential in supply chain is the most critical factor.

Schoenherr et al (2014), in a research under the title of “knowledge management in supply chain: the role of covert and overt knowledge”, conducted a study based on knowledge view and theoretical distinction between explicit and implicit knowledge (overt and covert knowledge) in 195 small and medium companies. Results show that the potential of supply chain knowledge management is reflected in both explicit and implicit knowledge; though, it is more influenced by implicit knowledge. In addition, findings revealed that while both explicit and implicit knowledge influence supply chain performance, implicit knowledge significantly imposes higher impact comparing before. Moreover, in the proposed model for supply chain knowledge management potential, factors of knowledge acquisition, knowledge transfer, knowledge function and protection are introduced.

Zayed Almuiet and Salim (2013), in a study “knowledge flow in constructing supply chain; case study: food production company”, investigated different types of knowledge in supply chain of food production companies and developed knowledge flow model for supply chain management, which protects knowledge of supply chain members. Such that this model dramatically saves the knowledge and basically allows knowledge engineers to build a knowledge-based system according to the proposed model. The presented model aids in making knowledge repository for each system and decision-making in supply chain.

Samuel et al (2011), in a research entitled “knowledge management in supply chain: an experimental study in France”, tried to present a conceptual framework for supply chain knowledge management by practically studying 144 large and medium France companies. This study, relying upon Nonaka /Takeuchi four-stage spiral model, analyzed knowledge management critical factors in supply chain networks at three strategic, tactical, and operational levels. Research results indicate that it requires much proper knowledge management framework to increase supply chain competition.

Patil and Cant (2014) identified and ranked some solutions for adapting knowledge management in supply chain to overcome the obstacles. This research helped organizations to concentrate on higher ranking solutions and to develop some implementation strategies. This experimentally case study carried out in an Indian hydraulic valve manufacturing company. A proposed framework ranking knowledge management adaptation solutions in supply chain showed how to overcome the barriers. The proposed framework provides a more precise, effective, and systematic decision support tool for step by step implementing of adopted knowledge solutions in SC to achieve higher success.

Cant and Sing (2011) focused on distinction between similarities and differences of KM measures in supply chain (SC) within Indian various divisions of manufacturing

ISSN 2383-2126 (Online)

organizations through formulating and testing some hypotheses. Questionnaire-based studying was represented in four sections of automobile, process, engineering, and fast moving consuming goods. This selected study showed no significant difference between various supply chains and KM using in different factors of SC performance. Furthermore, it seen that the selected sections are different for knowledge management in functional areas of various supply chains and different measurement criteria. Analysis demonstrated that the selected sections are fundamentally similar and different in term of operations and functions, which may results from similarities and dissimilarities of KM approaches in supply chain. According to research theoretical literature, the main question is “what are effective factors of knowledge management in supply chain through using FAHP technique?

Research methodology

The present research is an applied study in term of objectives and a survey, descriptive study in term of data collection.

Research statistical population and statistical sample

Research statistical population consisted of 30 middle managers, experts and practitioners of National Iranian Copper Industries Company with at least 10 years of experience. 30 sample individuals including the most experienced employees of National Iranian copper Industries Company were non-randomly selected through purposive sampling method.

Data collection and instrumentations

Data of the present research were gathered by two library and field study methods. Data collection instruments contained FAHP paired comparison questionnaire, which is provided by Sahfiei nikabadi (2013), Patil and Cant (2014), Mahmoudi and Safavi jahromi (2014), and Mohaghar et al (2014) and Shafiei nikabadi (2012) based on identified factors.

Data analysis method

Knowledge management in supply chain of National Copper Industries Company is now ranked based on using Fuzzy Analytical Hierarchy Process (FAHP).

Fuzzy Analytical Hierarchy Process (FAHP) technique

Proper decision-making models require proper decision-making models to disambiguate due to common ambiguity features in many shared decision-making issues (Yu, 2002).

Applying fuzzy sets is much more consistent with verbal and sometimes human vague descriptions; therefore, it is better to apply fuzzy sets (using fuzzy numbers) for long-term prediction and making decision in real world. Though, experts apply their competences and mental capabilities for comparisons in a hierarchal process; it is worth to notify that traditional hierarchical analysis process lacks totally reflecting human thinking style.

Using fuzzy numbers is more consistent with human verbal and sometimes vague expressions (statements); therefore, it is better to apply fuzzy numbers for real world decision-making.

Chang's developed expansion method

In 1992, Chang offered developmental analysis method. Then, in 1996, he improved this method (Chang, 1996). Chang expanded method is largely used for fuzzy hierarchical analysis computations comparing other methods. The numbers used in this method are fuzzy triangle figures. Chang extended AHP technique to fuzzy space through the concept of viability level. Viability level means determining how much is probable that one fuzzy number is larger than another fuzzy number. The concept of viability level or the probability of being larger must be described prior to stating Chang proposed algorithm (Chang et al, 2009).

Steps of fuzzy AHP method

Step 1: (Drawing) hierarchical chart

Step 2: Defining fuzzy numbers for paired comparisons

Step 3: Providing paired comparison matrix

Step 4: Measuring S_i per each row of paired comparison matrix

If fuzzy numbers are in triangular, they are shown as (l_i,m_i,u_i). Thus,

$$S_i = \sum_{j=1}^{m} M_{gi}^{j} \times \left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1}$$

$$\sum_{j=1}^{m} M_{gi}^{j} = \left(\sum_{j=1}^{m} l_j , \sum_{j=1}^{m} m_j , \sum_{j=1}^{m} u_j\right)$$

$$\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j} = \left(\sum_{i=1}^{n} l_i , \sum_{i=1}^{n} m_i , \sum_{i=1}^{n} u_i\right)$$

$$\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} = \left(\frac{1}{\sum_{i=1}^{n} u_i} , \frac{1}{\sum_{i=1}^{n} m_i} , \frac{1}{\sum_{i=1}^{n} l_i}\right)$$

Step 5: Calculating S_i magnitude relative to each other.

$$V(M_2 > M_1) = hgr(M_1 \cap M_2) = \mu_{M_2}(d) = \begin{cases} 1 & if\ m_2 \geq m_1 \\ 0 & if\ l_1 \geq u_2 \\ \dfrac{(l_1 - u_2)}{(m_2 - u_2) - (m_1 - l_1)} & otherwise \end{cases}$$

Step 6: Measuring criteria's weights in paired comparisons matrix

Step 7: Calculating final vector weight

International Journal of Management, Accounting and Economics
Vol. 3, No. 1, January, 2016
ISSN 2383-2126 (Online)

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Data analysis

Step 1: Hierarchical diagram

Table 1 Objective function, criteria, and sub-criteria of research conceptual model

Objective function	Criterion	Sub-criterion
Effective factors of supply chain knowledge management	Knowledge acquisition and creation process	Continuous participation with colleagues' companies
		Company's sensitivity to market variations
		Attracting and maintaining knowledge-based employees
		Creating material and nonmaterial incentives
		Existence of employees' educational systems
	Knowledge transfer and sharing process	Existence of tools, communication networks
		Existence informal groups
		Sharing technical and specialized information
		Personnel encouraging and supporting by management
		Bilateral organizational communications
	Function and utilization process	Knowledge involvement extent in manufacturing and developing the product
		Accessibility to knowledge and experiences
		Interest to knowledge-based activities
		Organization ability adapting its processes with knowledge
	Assessment and feedback process	Improved communications of chain members
		Staff's improved empowerment
		Improved mean time problem solving
	Employees' characteristics	Exchanging knowledge and value added in chain
		Virtual teaming
		Capacity of knowledge development in supply chain
		Staff participation
	Organizational culture	Learning from previous experiences and efforts
		Learning from others' experiences and best methods

Objective function	Criterion	Sub-criterion
		Reliable teamwork for knowledge exchange Mutual trust among supply chain members Encouraging and accepting innovation in the chain
	Managerial factors	Frequent contacting of SC members Employees' empowerment Decision-making on knowledge sharing Incentive alignment Knowledge and information flow integration

Step 2: Defining fuzzy numbers for paired comparisons

Table 2 Fuzzy range corresponding to 9 degree/hour in AHP technique (Habibi et al, 2014)

Verbal statement of comparing i to j	Fuzzy equivalent	Reverse fuzzy equivalent
Preferred equally	(1,1,1)	(1,1,1)
Intermediate	(1,2,3)	(0.333,0.5,1)
Preferred moderately	(2,3,4)	(0.25,0.333,0.5)
Intermediate	(3,4,5)	(0.2,0.25,0.333)
Preferred strongly	(4,5,6)	(0.166,0.2,0.25)
Intermediate	(5,6,7)	(0.142,0.16,0.2)
Very strongly preferred	(6,7,8)	(0.125,0.142,0.166)
Intermediate	(7,8,9)	(0.111,0.125,0.142)
Extremely preferred	(9,9,9)	(0.111,0.111,0.111)

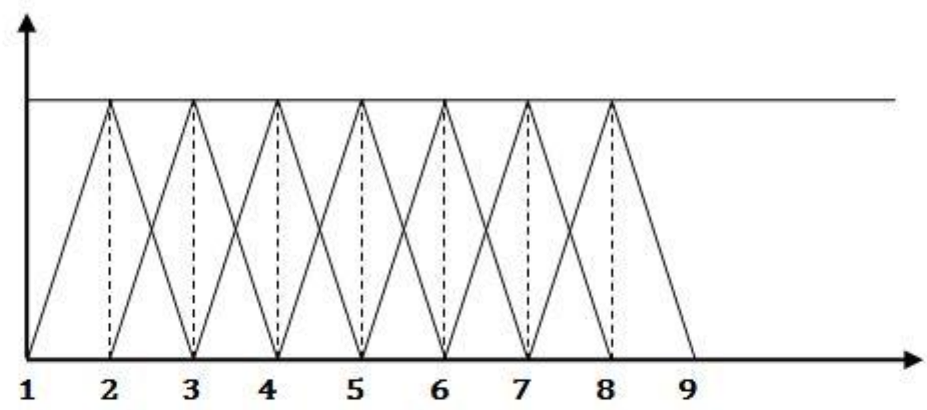

Figure 1: Triangular membership function for verbal values

International Journal of Management, Accounting and Economics
Vol. 3, No. 1, January, 2016
ISSN 2383-2126 (Online)

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Step 3: Paired comparisons matrix

Table 3 Paired comparisons matrix of research conceptual model criteria

	C1 Knowledge acquisition and creation process	C2 Knowledge transferring and sharing	C3 (Function and utilization process)	C4 (Assessment and feedback process)	C5 (Staff's characteristics)	C6 (Organizational culture)	C7 Managerial factors
C1 (Knowledge acquisition and creation process)							
C2 (Knowledge transferring and sharing)							
C3 (Function and utilization process)							
C4 (Assessment and feedback process)							
C5 (Staff's characteristics)							
C6 (Organizational culture)							
C7 (Managerial factors)							

Steps 4 and 5: Computing S_i per each row of pared comparisons matrix

$$\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j} = (19.133,36.833,62)$$

$$\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} = (0.016,0.027,0.052)$$

S1= (6, 13, 21) $\otimes$ (0.16, 0.27, 0.052) = (0.097, 0.353, 11.098)

S2= (4.25, 9.5, 16) $\otimes$ (0.16, 0.27, 0.052) = (0.069, 0.258, 0.836)

S3= (1.78, 2.33, 4) $\otimes$ (0.16, 0.27, 0.052) = (0.029, 0.063, 0.209)

S4= (4.45, 7.83, 13) ⊗ (0.16, 0.27, 0.052) = (0.072, 0.213, 0.679)

S5= (2.65, 4.17, 8) ⊗ (0.16, 0.27, 0.052) = (0.043, 0.113, 0.0148)

S6= (2.17, 8, 3.7) ⊗ (0.16, 0.27, 0.052) = (0.347, 2. 16, 0.192)

S7= (5, 4.1, 12) ⊗ (0.16, 0.27, 0.052) = (0.8, 1.107, 0.624)

Step 6: Calculating criteria weight in paired comparisons matrix

Table 4 illustrates the normalized and non-normalized weights of research variables' criteria.

Table 4: Criteria's normalized and non-normalized weights

Criterion	Non-normalized weight	Normalized weight
C1	1.00	0.282
C2	0.89	0.250
C3	0.28	0.079
C4	0.81	0.227
C5	0.57	0.162
C6	0.17	.0980
C7	0.48	0.14

Step 7: Computing final vector weight

Each final weight is computed by the product of criteria's relative weights.

Table 5: Final vector weight

Criterion	Weight	Final rank
Knowledge creation, acquisition, and production process	0.698	2
Knowledge transfer, sharing and distribution process	0.519	4
Knowledge usage, application and utilization process	0.298	6
Knowledge assessment and feedback process	0.618	3
Staffs' characteristics	0.129	7
Organizational culture	0.456	5
Managerial factors	0.781	1

Conclusion

Knowledge management is regarded as one of the critical competitive resources in any organization such that many argue that the faster knowledge approaches to acquisition and functional stages, the more successful are those companies in a competitive market. On the other side, competition between companies is no more interesting; rather, competition between supply chains is much focused for delivering maximum value to the customer. KM in the form of SC can serve as a critical element of information and compressed organizational contexts. KM various organizations require obtaining competitive advantage through effective resource using. Concurrently, some organizations also failed.

Results showed that managerial factors, knowledge creation, acquisition and production process, knowledge assessment and feedback process, knowledge transferring, sharing and distribution process, organizational culture, knowledge use, application and utilization process as well as staff's characteristics are orderly from the most to the least important knowledge management criteria in SC of National Copper Industries companies through using FAHP. According to obtained results, some recommendations and implications for National Copper Industries Companies are suggested as follows:

- Offering integrated software systems for performance evaluation and analysis of KM measures as well as periodically reviewing KM measures' progress within the organization and among supply chain members.

- Encouraging staff taking notes of their new knowledge in order to reuse and share the knowledge

- Training KM team members and organization staffs as well as familiarizing with KM philosophy and applied methods.

- Assigning the individuals in organization's main groups responsible for promoting and directing KM measures and activities from team members.

- Investigating staffs' knowledge- based assessment and promotion methods in organizations, providing knowledge sharing methodology in supply chain regarding to inherent difference of chain member organizations.

- Presenting a enhancing researchers' educational system methodology based on created knowledge and reviewing maintaining and compromising knowledge-oriented staffs' services.

- Explaining long-term profitability, KM implementation as well as adjusting investment point of view in the set of KM efforts for senior executives of companies activating in National Copper Industries Company such that avoid operational, short-term and cost-based knowledge management.

- Selecting and recruiting expertise and knowledge-oriented individuals in all organizational sections, offering fit of goodness matrices as well as formulating precise job plans to determine knowledge requirements.

- Studying challenges before distribution organizations for KM implementation.

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