

EXAMINING THE CRITICAL SUPPLY CHAIN KNOWLEDGE FLOW ENABLERS

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Abstract- The aim of the paper is to examine the interrelationship among enablers of knowledge flow mechanism in supply chain, based on the review of research articles. Total six enablers of knowledge flow mechanism were identified. This study develops a hierarchical framework to assess enabler of knowledge flow mechanism in supply chain. Knowledge flow mechanism factors can shape their knowledge resources to gain competitive advantage to share knowledge and experience by using not only integration of system systems but also using various means of knowledge flow techniques. The fuzzy Decision-making Trial and Evaluation Laboratory (DEMATEL) method is used which can confirm interdependence among enablers and aid in the development of a chart to reflect interrelationships between enablers. This method can be used for researching and solving the complicated and intertwined knowledge flow problem. This paper enabling organizations to build awareness of the critical influential factors on the success of knowledge flow in supply chain.

Index Terms- Knowledge flow mechanism, supply chain, DEMATEL method

I. INTRODUCTION

In the modern knowledge society, the enterprise knowledge sharing ability has become a main element to determine the competitiveness of the supply chain. Knowledge of supply chain has become a decisive factor about the development of the supply chain. Ability of the organization knowledge sharing has become a key aspect to determine the competitiveness of the supply chain in the modern knowledge society [13]. Because of volatile in global business, the production model has already shifted from mass production to mass customization over a large area of products ranging from personal computers to automobiles [12]. Because of variety of customer needs various production strategies are adopted in organizations such as make-to-forecast, locate-to-order and amend-to-order and build-to-order [7, 3]. To maintain competitive advantage within organization, knowledge is of principal importance among other resources (Ma et al., 2008). Logistics and supply chain management plays a critical role in the economy of every country. Like any other economic sector, a skilled workforce in logistics and supply chain contributes greatly to the success of the sector.

The of knowledge flow practices implementation assist a collaborative environment so that the supply chain to be more adaptive and responsive and ultimately achieve an improved strategic competitive position in the market place. While considering manufacturing and service industries supply chain management has assumed a leading operations strategy position. Knowledge management (KM) is a prime enabler of supply chain management, and is a critical element in information intensive and diverse enterprise environments [15].

II. LITERATURE OF KNOWLEDGE FLOW MECHANISM

Supply chain managers use information to make many important decisions related to key building blocks of supply chain, such as, inventory, transportation and facility. Cross-enterprise knowledge sharing in supply chain has thus become a common practice, because it enhances the competitive advantage of the supply chain as a whole [10]. However, it is an effective way to achieve the goal of cross-enterprise knowledge sharing among members by establishing a knowledge market in supply chain and then utilizing the market mechanisms to guide, encourage, stimulate, supervise and regulate the knowledge trading among the members of supply chain.

Knowledge flow mechanism enablers can shape their knowledge resources by using not only systematic document maintaining systems but also adopting various means of communication technologies to gain competitive advantage to share their project knowledge and experience [1]. Traditional and advanced knowledge sharing tool such as computer integrated tools, worldwide communication network, collaborative IT tools, collaborative electronic media, e-mails, telephone and discussion rooms increase communication between individuals and team members to exchange valuable knowledge. While accessing individual or organization knowledge face to face interaction will be enhanced with help of information technology and communication technology [1]. The knowledge transfer is firmly stimulated and assisted by the organization through continuous internal communication, brainstorming and knowledge fairs [4 14, 16].

Moreover integration of diverse knowledge requires significant effort, time and willingness to enables seamless flow of information and knowledge across the organization [9]. Knowledge codification is the is the process to encode knowledge into a set of rules, relationships and categorize so as it becomes user friendly, where it can be accessed and

used again and again by any person in the organization [8, 2]. Roberts (2000) argued that tacit knowledge transfer requires joint presence of the knowledge provider and receiver. It involves a process of demonstration (like video conferencing, virtual project rooms) and learning by doing. Thus education and training is necessary in updating and continues knowledge flow for the organization [11].

From literature review, ranges of influencing enablers of knowledge flow mechanism are identified are conventional and modern knowledge sharing tool: telephone, discussion rooms or computer networks; information gathering, unscheduled meetings, dialogues, social events, brainstorming; integration of system; knowledge codification; hands on experience on new it system; employee training and education. The organization should focus more on the KFEs to strengthen the knowledge flow so that organizational performance can be improved. Figure 1 shows the hierarchical structure of enablers of knowledge flow mechanism.

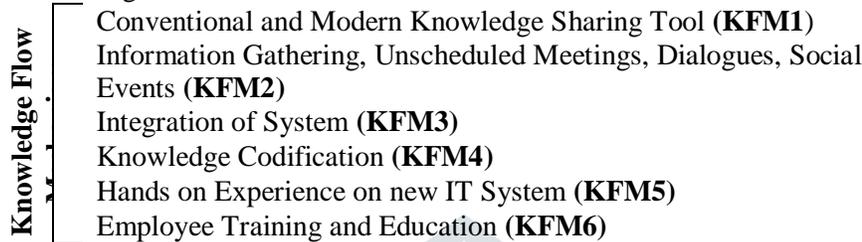


Fig. 1 The hierarchical structure of enablers of knowledge flow mechanism

III. METHODOLOGY

In this paper DEMATAL method in fuzzy environment is adopted to find out critical contextual knowledge flow enablers.

a) Triangular Fuzzy Numbers

The word “fuzzy” imply “vagueness”. Fuzziness exit when the boundary of a piece of information is not clear. Fuzzy set have been introduced by [17] as an extension of the classical notion of set. Traditional set theory allows the membership of the elements in the set of binary terms, whether or not an element belongs to a crisp set (1 or 0). Fuzzy set allows the gradual assessment of the membership of elements in the set, described with the help of membership function valued in the real unit interval [0, 1].

A triangular fuzzy number \tilde{A} is shown as a triplet (l, m, r) and a membership function $\mu_{\tilde{A}}$ is shown as Fig. 2.

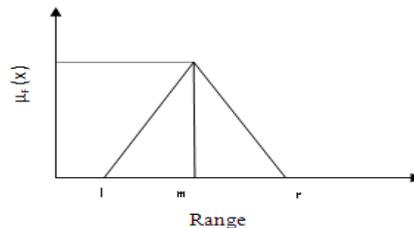


Fig. 2 Triangular fuzzy number

The triangular membership function is defined as,

$$\mu_{\tilde{f}}(x) = \begin{cases} 0 & x < l \\ \frac{x-l}{m-l} & l \leq x \leq m \\ \frac{r-x}{r-m} & m \leq x \leq r \\ 0 & x > r \end{cases}$$

This study applies the triangular fuzzy number to obtain ideal solutions from group decision-making. Especially, the group decision-making is the process of arriving at a consensus based upon the reaction of multiple individuals, and it can ease the exchange of ideas and information whereby an acceptable judgment may be obtained.

b) Fuzzy DEMATEL Method

Decision-making trial and evaluation laboratory method was invented by the Science and Human Affairs Program of the Battelle Memorial Institute of Geneva between 1972 and 1976 to study the structural relationship in complex systems. DEMATEL is an effective method which gathers a large number of complex factors, examines the interrelationship among the system factors, and ideates this structure through causal diagram [5,6].

Here fuzzy logic is applied to handle vague and ambiguous judgment from expert. Fuzzy DEMATEL approach developed to deal problems with complex interdependent factors in uncertain environment.

Step 1: Generating the direct-relation matrix. The notation of x_{ij} indicates the influential level that criteria i has on criteria j . By averaging individual expert’s scores, the average matrix $A = [a_{ij}]$ can be constructed as follows:

$$a_{ij} = \frac{1}{H} \sum_{k=1}^H x_{ij}^k \quad (1)$$

Step 2: Normalize the initial direct-relation matrix.

All elements in matrix D are complying with $0 \leq d_{ij} \leq 1$, and all principal diagonal elements are equal to zero.

$$D = \frac{s}{\max_{1 \leq i \leq n} \sum_{j=1}^n a_{ij}} \quad (2)$$

Step 3: Calculate the total relation matrix. Once the normalized direct-relation matrix X is obtained, the total-influence matrix T can be acquired by using equation (3) in which I is an $n \times n$ identity matrix. The element T_{ij} indicates the indirect effects that factor i have on factor j, so the matrix T can reflect the total relationship between each pair of system factors

$$T = D(I - D)^{-1} \quad (3)$$

Step 4: Define r_i and c_j be $n \times 1$ and $1 \times n$ vectors representing the sum of rows and sum of columns of the total relation matrix T, respectively through equation (4 to 6). The sum of row i, which is denoted as r_i , represents all direct and indirect influence given by factor i to all other factors, and so r_i can be called the degree of influential impact. Similarly, the sum of column j, which is denoted as c_j can be called as the degree of influenced impact, since c_j summarizes both direct and indirect impact received by factor j from all other factors.

$$T = t_{ij} \quad i, j = 1, 2 \dots n \quad (4)$$

$$r_i = \sum_{1 \leq j \leq n} t_{ij} \quad (5)$$

$$c_j = \sum_{1 \leq i \leq n} t_{ij} \quad (6)$$

Step 5: Producing a causal diagram. The horizontal axis vector $(r_i + c_j)$ named ‘‘Prominence’’ is made by adding r_i to c_j , which reveals total effects given and received by factor i. That is, $(r_i + c_j)$ indicates the degree of importance that factor i plays in the entire system. The vertical axis $(r_i - c_j)$ named ‘‘Relation’’ is made by subtracting r_i from c_j , which may divide criteria into a cause and effect groups. Generally, when $(r_i + c_j)$ is positive, the criterion belongs to the cause group and when $(r_i - c_j)$ is negative, the criterion represents the effect group.

IV. PRACTICAL APPLICATION OF METHODOLOGY

The DEMATEL method is a highly pragmatic way to form a structural model of evaluation for better decision making. The procedure of the proposed method is explained as follows:

Step 1: Identify the decision objectives and form a committee. Decision-making is the process of defining the decision goals, gathering relevant information, generating the broadest possible range of alternatives, evaluating the alternatives as shown in figure 1.

Step 2: Develop evaluation criteria and design the fuzzy linguistic scale as shown table 1. For dealing with the ambiguities of human assessments, the linguistic variable ‘‘influence’’ is used with five linguistic terms as {Very high, High, Low, Very low, No} that are expressed in positive triangular fuzzy numbers (l_{ij}, m_{ij}, r_{ij}) as shown in table 1.

Table 1. THE FUZZY LINGUISTIC SCALE

Linguistic variable	Triangular fuzzy number
No influence	(0,0.1,0.3)
Very low influence	(0.1,0.3,0.5)
Low influence	(0.3,0.5,0.7)
High influence	(0.5,0.7,0.9)
Very high influence	(0.7,0.9,1.0)

Step 3: Generating the direct-relation matrix A. Generating the direct-relation matrix A. Relationships between enablers were measured by the expert through the use of the fuzzy linguistic scale, the assessment data of the expert for enablers are shown in table 2.

Table 2. DIRECT-RELATION MATRIX

	KFM1	KFM2	KFM3	KFM4	KFM5	KFM6
KFM1	1	$\tilde{1}$	$\tilde{5}^{-1}$	$\tilde{3}^{-1}$	$\tilde{3}$	$\tilde{1}^{-1}$
KFM2	$\tilde{1}^{-1}$	1	$\tilde{7}^{-1}$	$\tilde{5}^{-1}$	$\tilde{1}$	$\tilde{3}^{-1}$
KFM3	$\tilde{5}$	$\tilde{7}$	1	$\tilde{1}$	$\tilde{9}$	$\tilde{3}$
KFM4	$\tilde{3}$	$\tilde{5}$	$\tilde{1}^{-1}$	1	$\tilde{7}$	$\tilde{1}$
KFM5	$\tilde{3}^{-1}$	$\tilde{1}^{-1}$	$\tilde{9}^{-1}$	$\tilde{7}^{-1}$	1	$\tilde{5}^{-1}$
KFM6	$\tilde{1}$	$\tilde{3}$	$\tilde{3}^{-1}$	$\tilde{1}^{-1}$	$\tilde{5}$	1

Step 4: A causal diagram is prepared through Eqs. (4-6). The causal diagram is built with the horizontal axis ($r_i + c_j$) called “Prominence” and the vertical axis ($r_i - c_j$) called “Relation” the causal digraph is as shown in figure 3. The horizontal axis “Prominence” shows the relative importance of each factor, whereas the vertical axis, Relation, divides factors into cause and effect groups. Generally, when the ($r_i - c_j$) is positive, the factor belongs to the cause group. Otherwise, the factor belongs to the effect group. Hence, causal diagrams can visualize the complicated causal relationships of factors into a visible structural model. The prominence and relation axis for cause and effect groups are shown in table 3.

	R_i	C_i	R_i+C_i	R_i-C_i
KFM1	1.3094	1.6120	2.9214	-0.3026
KFM2	0.9965	2.0086	3.0051	-1.0121
KFM3	2.2501	0.7431	2.9932	1.5070
KFM4	2.0619	0.9585	3.0204	1.1034
KFM5	0.6693	2.2237	2.8930	-1.5544
KFM6	1.6331	1.3744	3.0075	0.2587

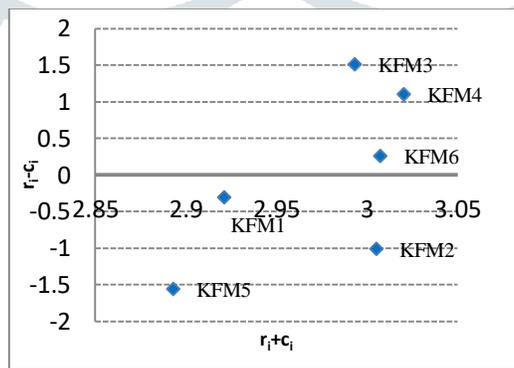


Fig. 3 The Cause Effect Relation Digraph

V. DISCUSSION

The graphical representation (the cause effect relation diagram) and digraphical relationships are now constructed. This step will allow a clearer visualization of the structure and relationships amongst the contextual KF enablers. One of the first activities of this sub-step is to plot the various enabler on a two-axes the prominence horizontal axis ($r_i - c_j$) and the net cause/effect vertical axis ($r_i - c_j$). We do this to help us observe general patterns and relationships amongst all the programs simultaneously and in pairs.

We can also observe general clusters into cause and effect groups. Generally from the result for successful contextual KF implementation requires a high level of focus on the cause group (KFM3, KFM4 and KFM6) rather than the effect group (KFM1, KFM2 and KFM5); though the cause group factors are difficult to move, while the effect group factors are easily moved. The causal relationships among contextual KF enabler can be depicted as the causal diagram (see figure 3).

VI. CONCLUSION

In this empirical study, the organization wanted to implement formal contextual KF in a stepwise manner, and needed to segment a list of critical factors into meaningful groups for making decision in successful KF initiatives in organization. To make the DEMATEL method suitable for solving a group decision-making problem in a fuzzy environment, we have developed a fuzzy DEMATEL method. The DEMATEL method is based on graph theory that enables us to project and solve problems visually, and it can divide multiple factors into cause group and effect group in order to better capture causal relationships visibly, as well as convert the relationship between critical factors into an intelligible structural model of the system.

From the fuzzy DEMATEL results, understand the Leadership Integration of System (KFM3) is the most influence and the strongest connection to other criteria. According to DEMATEL analysis results, top management commitment could directly or indirectly influence many other characteristics such as Conventional and Modern Knowledge Sharing Tool KFM1, Information Gathering, Unscheduled Meetings, Dialogues, Social Events KFM2, Knowledge Codification KFM4, Hands on Experience on new IT System KFM5 and Employee Training and Education KFM6

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