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Research Article

IDENTIFICATION AND PRIORITIZATION OF FACTORS AFFECTING ON THE IMPROVEMENT OF SUPPLY CHAIN MANAGEMENT BY USING FUZZY AHP TECHNIQUES (CASE STUDY: GULF CEMENT COMPANY)

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ABSTRACT
Supply chain management is one of the most important issues raised in the field of production and integration processes related to it. The present study is conducted with the purpose of identifying and ranking the effective factors to improve the supply chain management of Gulf Cement Company. The method to implement this study is that first, status quo has been checked and after identifying effective factors and by using the techniques of fuzzy AHP (FAHP), as a multi-criteria decision-making techniques, it is ranked. For this study, 20 factors in relation with identified factors in the field of supply chain management were introduced. In this study, 42 people were surveyed. Based on this research, the most important factor relates to production indicator that respectively us a function of organizing along with operational lines, quality improvement in supply chain process, concurrent execution of activities in the supply chain, continuous updating of combining the manufacturing process in the supply chain. Using FAHP techniques since has the ability to meet multiple criteria decision making problems, also it provides a method for measuring the quality standards and priority-based methods, and it gives to the managers this possibility that by simplifying and speeding in their decision-making process, and they can take effective decisions on complex issues.

Keyword: *Supply Chain, Supply Chain Management and Fuzzy Analytic Hierarchy Process (FAHP)*

INTRODUCTION
In the 90s, along with improvement in production processes and using reengineering patterns, the managers of many industries found that to continues presence in market, only improvements of internal processes and flexibility in company ability is not enough. But suppliers of parts and materials should produce materials with the best quality and lowest cost and distributers of products should also have a close relationship with development policies of producer market. With this attitude, supply chain approaches and its management were born. On the other hand, with the rapid development of information technology in recent years and its widespread use in supply chain managements, many basic functions of chain management are done with new methods (Stadtler, 2005).
Supply chain management is a new approach that has dominated in the field of operation management in recent years. Supply chain is a network of facilities and distribution centers. And it can does the duties of procurement of raw materials, and convert it to final and mediating products and distributing these final products to customers. Supply chains exist in manufacturing and service organizations; although the complexity of supply chain can be vary greatly from an industry to another industry and from one company to another company (Lambert *et al.,* 1990).
Supply chain management is a combination of art and science and it improves the method to find raw materials needed for companies to production or service (Fayz, 2009). The supply chain is a set of units that converts raw materials into finished products and delivers it to the customer. We can simply say that supply chain management is having the right product in a right place at right price and at right time and right conditions (Ivanov *et al.,* 2007). In a more formal supply chain management, relationship

management between an organization and its suppliers is to achieve strategic advantage. Intense competition in domestic markets and in particular, today world and introducing products with short life cycles and big advances, in ICT, organizations should try to survive and thrive by rely in new management approaches and systems and technical systems. One of these new management procedures and approaches, as stated above is supply chain management. In other word, a functional look to activates and duties of organizations don't have a place, but also we should consider the activities and duties with regard to the relation that they have with each other. We should manage the chain which causes that product is supplied to final customer and we shouldn't only consider company management separately of before and after industries and activities. In this study, in order to improve supply chain management of Gulf Cement Company, the aspects of supply chains will be examined. And then, the effective factors on development of supply chain management is identified and ranked. Then, based on result analysis of this study, the approaches to improve supply chain management of Cement Company are provided.

Research Literature

Supply Chain Management

Supply chain management is an integrated approach for planning and controlling the material and information that flows from suppliers to customers as it flows in different duties in an organization. Supply chain management relates the inventory management by focusing on operation management with communication analysis in industrial organization. This field becomes very important in recent years (Azadikhah, 2001). Supply chain includes all activities associates to flow and good transformation from raw material stage (extraction) to delivery to the final consumer, also information flows associated with them. In general, supply chain is a chain that all activities associated with the flow of goods and material transformation includes the steps of preparation raw material to the delivery of final product to consumer. About the flow of goods, there are two other flows which are information flow and credit and financial resources flow (Sitkin and Pablo, 1992). Therefore, to investigate a unique organization within the definition of supply chain management, both suppliers and distribution channels should be considered. The provided definition for supply chain management, and it includes the issues of MIS management, sourcing and procurement, production scheduling, order processing, inventory management, warehousing and customer service. For an effective supply chain management, it is essential that suppliers and customers should work together in a coordinated manner and by communication and information sharing and discussion together. This means a rapid information flow between customers and suppliers, distribution centers and transportation systems that enable some of the companies to create so effective supply chain. Suppliers and customers should have the same goals. Suppliers and customers must have mutual trust.

In addition in designing supply chain to achieve mutual objectives, suppliers and customers should be associated with each other to facilitate communication and information flow. Some companies are trying to control their supply chain with a general-vertical control and to achieve this goal, they are using the ownership and integrity of all various components and services along the supply chain from materials procurement and services to final product delivery and serving customer. But even with this type of organizational structure, different activities and operational units may be inconsistent.

The company's organizational structure should rely on different activities coordination to achieve the company's overall objectives (Yazdi, 2004).

Factors Affecting on Supply Chain Management

In a study which was done in 2000 by Hughes and Feame in England, factors affecting of the supply chain were determined. Some of these factors include

-dynamic relation between all parts of supply chain;
-electronic complete integration;
-information sharing;
-innovation;
-strategic relation with the client;
-financial stability;

-management and cost control;
-product volume management;
-appropriate promotion and marketing (Fearne and Hughes, 2000).
In a study which was done in 2000 by Lillford and Howker in which a model was developed to identify the main effective factors on supply chain management. In this model, a set of inter relation of activities with supply chain is presented. One of this study finding was that there are many effective factors in promoting supply chain management include:
1-Commercial pressures of competition in order to find new markets;
2- Development of Science and Technology.
Also, in this study, the following factors were identified as success factors of a technology:
1-availability of Science and Technology
2-their application should be useful for at least one of supply chain sections.
The most probable changes are those that are acceptable and have some benefits to each member of supply chain (Lillford and Howker, 2000). Another study was conducted in the field of improvement of supply chain performance in Netherlands in 2002 by Jack Van der. In this study, it was shown that by reducing the uncertainty factor, we can increase the supply chain performance. Factors of uncertainty creation were identified; the most important uncertainty factors in supply chain were included:
-the horizon of order forecasting and it includes latency time of information flow, time of decision-making process and delay time in the production and distribution;
-input data, include re-order period, data accuracy and amount of available information and worn data. The ways to reduce this uncertainty were introduced which were known as recovery principles (Jack and Vorst, 2002). In a study which was conducted by Gopal *et al.*, (1999), they were provided a model to supply chain management and they introduced the effective factors on supply chain managements as follows:
-strategic relation (information sharing, high level costumer service-supplier sharing-integrated logistics processes);
-leadership: (cooperation culture-commitment to relation-commitment to quality);
-focus on customer: (commitment to customer satisfaction);
-participation (dynamic suppliers, cooperative objectives- cooperative discussion);
-management based on fact: (integrated structure- performance measurement-information exchange);
-continuous improvement (organizing in operational lines-planning and prevention-improving manufacturing processes of supply chain);
-Superior business: (customer satisfaction- business results, supplier sharing- supplier satisfaction) (Gopal and Wong, 2009).
Sotiris Ziagiaris knows the effective factors on improving supply chain, as inventory management, transportation services procurement, available materials, transportation operational management and warehouse management (Ziagiaris, 2000).

Krisztina and Gelei provided a model for developing and promoting supply chain management in 2004 and identified the following factors:

-strategy (presence of production formal strategy, production influence on business strategy- enrichment activities of basic activities and sourcing support process);

-process (production waiting time, preparation and buying wait time, concurrent components of activities during supply chain-using ICT or ERP software);

-coordination: (using ERP in planning and production control, using ERP in supply and buy management, using ERP in sales and distribution management-information sharing about inventory levels- information sharing about planning decisions of production and sales predictions);

-collaborating with partners: (investing in EDI/Extranet systems-capacity- specific equipment and items-special storage and transportation system-specific labor force-rational sharing revenue with partners) (Krisztina and Andrea, 2004).

In another study which was done by Kolzemolenkof (2004), it identified the following factors as effective factors on supply chain management:
-customer service (customer satisfication0 production customization- fact delivery- facilitate quickly and timely decisions);
-cost management (total cost of logistics-competitive cost);
-quality (reliability of delivery- responding- order flexibility- delivery flexibility);
-efficiency: (supporting information system, ability to conduct order- truncation cycle order);
-proper asset management (inventory turnover, ROI);
Another study was done in the field of improvement of supply chain management by Cohen *et al.,* (2005) and it identified the effective factors as operation strategy, sourcing strategy, channel strategy, customer service strategy- asset network (Cohen and Roussel, 2005).
Jaunti *et al.,* (2006) identified some effective factors on supply chain management in an article entitled globalization of supply chain management. And they identified the following aspects:
Customer service and value management-demand management- knowledge management- global environment identification- sales and marketing management- production management- operation management- integrated logistics management- asset management- transformation management-warehouse management-supply management-financial management- risk management- news and information interpretation systems- virtual communication management- controlling overall supply chain-supply chain innovation-continuous updating of productive processes of overall supply chain- truncation of order cycle-distribution management (Mentzer *et al.,* 2006).
Another study was done by Porakas *et al.,* (2006) and they identified leadership, relations outside the organization-logistics- orienting process improvement- information system- business results and outputs-marketing-shopping-organizing along operation lines-strategy as effective factors in the field of promotion of supply chain management (Burgess *et al*., 2006).
Xinyan *et al.,* (2009) divided the effective factors on supply chain management as major and minor factors which are described below:

-resources: (total cost of supply chain management-distribution cost-asset cost- production cost-inventory turnover cost- information management cost- guarantee cost- value added performance of staff-ROI);

-output: (profit, lost sales- fill rate- conducting order in delivery time- timely delivery- order complete conduction- customer satisfaction- planning time cycle- time cycle of fund to fund);

-flexibility: (flexible responding to the customer- production flexibility- provision and buying flexibility-Logistics flexibility- delivery flexibility-flexibility of new product- information system flexibility);

-innovation(sale range and introducing new products- updating the manufacturing process of supply chain- stability of supply chain);

-information (information accuracy- timely information-information availability- information sharing) (Zhang *et al.,* 2009)

Another study in was conducted by Jabbour *et al.,* (2011) about better management of supply chain and they identified the following factors:
Promoting integration activity in supply chain- reducing response time of supply chain-frequent communicating with the members of supply chain- involving supply chain in product design, service and marketing- development of the members of supply chain in demand and production planning- creating a scm team that included members of other companies- formal and in-formal information sharing- critical and transaction information sharing with other members of chain- participation and intervention of customers in marketing activities and trying- determining the future needs of clients- future sharing and involving with suppliers- capture final feedback of customer- engaging customers and suppliers in decision making for new products- encouraging suppliers to provide new products- timely introduction of new products- accelerating development and design cycle- final product assembly at the customer if possible-cooperation with client in demand forecasting-cooperating with supplier and consumer in warehouse planning- providing support for product development- cooperation with customer in product

planning-future strategy of communication with customer- the cost of information sharing with customer-creating multi-tasking teams (Jabbour and Beatriz, 2011).
Guptar *et al.*, (2011) conducted a research and they designed a model in the field of supply chain management and in the following, there are the most important factors:
-organizational strategy;
-construction and strategy of supply chain;
-marketing strategy;
Product designing and the life cycle of product;
-return evaluation and valuation;
-provision of information and valuation of information;
-Government programs and policies;
-integrated models and decision support tools (Gupta and Palsule, 2011).
Among the most important which was conducted in the country in the field of identifying effective factors on development of supply chain management and we can infer to the following factors:

Saeed (2009) introduced a reference model in the field of operations of supply chain. And he identified the following factors as the most effective factors on supply chain management:

-timely delivery

-delivery time of meeting demand

-filling rate (demand definition can be met from inventory);

-total order meeting

-response time of supply chain;

-production flexibility;

-the cost of managing supply chain;

-warranty costs as a percentage of income;

-value added per employee;

-total days about supply;

-Cycle time of fund to fund

-transfer rate of net assets (Taleb, 2008).

In another study Adel *et al.*, (2011) designed the service quality model in the supply chain and they identified four factors of logistic-distribution-rapid response and purchasing as effective factors (Azar *et al.*, 2010).

Dreyer considered presence of several factors in the success of supply chain. The first factor is demand and support of senior management of the organization integration process with suppliers and customers to create a supply chain, the second factor is the people training (staff and managers) that they prepared the context to create a new situation in the organization. The third factor is an appropriate information system for information circulating in organizations, efficiently and effectively. And this factor helps to the members of chain to establish a constructive interaction. It may be noted that presence of an accurate information flow causes to reach many of the goals of supply chain.

Research Hypothesis
First Main Hypothesis
The factors of conceptual model of research influence on supply chain management.
Secondary Hypothesis
1. Strategic relation factor is effective on supply chain management.

2. Marketing factor is effective on supply chain management.
3. Production factor is effective on supply chain management.
4. Financial factor is effective on supply chain management.

Second Main Hypothesis

The difference between the effects of effective factors on supply chain management is significant.

MATERIALS AND METHODS

This research is applicable and in terms of data collection, it is a descriptive survey which has a quantitative approach. Statistical population of this research includes managers, assistants and technicians of Gulf Cement Company which are formed the sample. It means that among 42 respondents to the questions of the questionnaire (Decision Matrix) they were 8 managers, 31 bachelor and 3 assistants. In this study, after identifying institutional factors through studying literature research and collecting the opinions of experts in the field of supply chain management, effective factors on the dimensions of supply chain has been identified that these dimensions include 4 main factors with 20 sub institutional –criteria. Since the purpose of this study was to prioritizing the effective factors on supply chain, fuzzy hierarchical techniques (FAHP) and paired comparisons indicators and sub-indicators were used. Part of the required information for this research is library information and it has been collected by reviewing the previous studies. First, by reviewing internal and external research and use of experts' opinions, we identify the aspects of supply chain in the Cement factory. So by providing a new conceptual model, effective variables on the dimensions of supply chain were identified. After that, to prioritizing these factors also determining the importance of mentioned factors, FAHP techniques with a development analysis approach was used (Chang, 1992). The tools used for data collection was paired comparison questionnaire which was designed by the researcher. In designing the questionnaire, it was tried to arrange the questions related to each criterion from general to detailed questions.

Data Analysis

Weighting and prioritizing seven sub indicators related to strategic relations in this section, we conducted the prioritization approach of seven sub-indicators related to strategic relations means (relations based on suppliers trust, collaborative objects and team goals between the members of supply chain, focusing on developing competitive advantages, choosing the best supplier and creating virtual communication, facilitate quick and timely decisions, remove barriers within organization). In this regard, first merging table of fuzzy group decision making related to paired comparisons of seven sub-indicators is provided. Then to compute the inconsistency rate of this matrix, first fuzzy numbers must be converted to absolute numbers and the inconsistency rate of decision matrix is calculated. In table (1), the Fuzzy AHP paired comparison matrix obtained by geometric mean of expert opinions about factor prioritization of strategic relation is given. In the table, it is said that the values in the bottom of original diameter are obtained from the inverse value and it is used to the values upper the main diameter. All the steps to obtain the weight if each sub-indicator is as follows.

Then, according to EA method, for each of the rows of paired comparison matrix, the value S_k was calculated which is itself a triangular fuzzy number.

$$\sum_{j=1}^{7} M_{g_1}^{j} == (4.876, 5.6884, 6.6997) \quad \sum_{j=1}^{7} M_{g_2}^{j} = (7.1839, 8.5183, 10.015)$$

$$\sum_{j=1}^{7} M_{g_3}^{j} = (4.8142, 5.5771, 6.5597) \quad \sum_{j=1}^{7} M_{g_4}^{j} = (6.7761, 8.0156, 9.4869)$$

$$\sum_{j=1}^{7} M_{g_5}^{j} = (6.4565, 7.5848, 8.9372) \quad \sum_{j=1}^{7} M_{g_6}^{j} = (6.7991, 8.025, 9.4654)$$

$$\sum_{j=1}^{7} M_{g_7}^{j} = (6.2673, 7.3902, 8.7286)$$

S_1=(0.08141, 0.11198, 0.15518)
S_2=(0.11994, 0.16768, 0.23199)
S_3=(0.08038, 0.10978, 0.21974)
S_4=(0.11314, 0.15779, 0.21974)
S_5=(0.1078, 0.14931, 0.20701)
S_6=(0.11352, 0.15799, 0.21924)
S_7=(0.10464, 0.14548, 0.20217)

Then the amount degree of each S_k is obtained and it is calculated relative to other values, in the counting, amount degree is obtained ،$V(S_i \geq S_K)$،and it is as follows for each of S_k

Table 1: Paired comparison merged matric related to strategic relations

	B1	**B2**	**B3**	**B4**
B1	(1,1,1)	(0.3726, 0.5528) 0.447,	(0.9501, 1.1584, 1.4065)	(0.6517, 0.8985) 0.7615,
B2	(1.8087, 2.6835) 2.2368,	(1,1,1)	(1.4035, 1.7079, 2.029)	(0.7192, 1.0449) 0.8654,
B3	(0.7109, 1.0525) 0.8632,	(0.4928, 0.7124) 0.5855,	(1,1,1)	(0.5344, 0.8034) 0.6497,
B4	(1.1128, 1.5343) 1.3131,	(0.957, 1.3903) 1.1555,	(1.2446, 1.539, 1.8711)	(1,1,1)
B5	(1.0167, 1.5066) 1.2397,	(0.9447, 1.2773) 1.1015,	(0.8504, 1.025, 1.2281)	(0.7945, 1.2078) 0.9784,
B6	(1.01, 1.237, 1.5073)	(1.0236, 1.5349) 1.2541,	(1.0947, 1.3066, 1.5507)	(0.9004, 1.3550) 1.1134,
B7	(1.1517, 1.7403) 1.4156,	(0.8178, 1.2225) 0.997,	(1.1086, 1.3553, 1.6205)	(0.7565, 1.1164) 0.9192,
	B5	**B6**	**B7**	
B1	(0.6637, 0.9835) 0.8066,	(0.6634, 0.9900) 0.8084,	(0.5746, 0.7064, 0.8682)	
B2	(0.7829, 1.0585) 0.9078,	(0.6515, 0.9769) 0.7974,	(0.8179, 1.0030, 1.2227)	
B3	(0.8143, 1.1759) 0.9755,	(0.6448, 0.9134) 0.7653,	(0.6171, 0.7378, 0.9020)	
B4	(0.8279, 1.2586) 1.0220,	(0.7380, 1.1106) 0.8981,	(0.8957, 1.0879, 1.3220)	
B5	(1,1,1)	(0.8874, 1.3156) 1.0780,	(0.9628, 1.1620, 1.4018)	
B6	(0.7601, 1.1269) 0.9277,	(1,1,1)	(1.0101, 1.1869, 1.3903)	
B7	(0.7134, 1.0387) 0.8606,	(0.7192, 0.9900) 0.8425,	(1,1,1)	

$$V(S_1 \geq S_2, \ldots, S_7) = Min(V(S_1 \geq S_2), \ldots, V(S_1 \geq S_7) = 0.997808$$
$$V(S_2 \geq S_1, \ldots, S_7) = Min(V(S_2 \geq S_1), \ldots, V(S_2 \geq S_7) = 0.942103$$
$$V(S_3 \geq S_1, \ldots, S_7) = Min(V(S_3 \geq S_1), \ldots, V(S_3 \geq S_7) = 1.002192$$

$$V(S_4 \geq S_1, \ldots, S_7) = Min(V(S_4 \geq S_1), \ldots, V(S_4 \geq S_7) = 0.951997$$
$$V(S_5 \geq S_1, \ldots, S_7) = Min(V(S_5 \geq S_1), \ldots, V(S_5 \geq S_7) = 0.960478$$
$$V(S_6 \geq S_1, \ldots, S_7) = Min(V(S_6 \geq S_1), \ldots, V(S_6 \geq S_7) = 0.951796$$
$$V(S_7 \geq S_1, \ldots, S_6) = Min(V(S_7 \geq S_1), \ldots, V(S_7 \geq S_6) = 0.964308$$
$$W' = (0.9978, 0.9421, 1.0021, 0.9519, 0.96047, 0.9517, 0.9643)$$
$$W_N = (0.1473, 0.1391, 0.14802, 0.14061, 0.1418, 0.14058, 0.1424)$$

So, final ranking of sub-indicators related to strategic relations is shown in table (2).

Table 2: Weights and the ranks of factors of strategic relation

Rank in term of importance degree	AHP fuzzy significant degree	Dimensions of strategic relation factors
2	0.1473	Relations based on suppliers trust
7	0.1391	Remove barrier within organization
1	0.1480	Team and cooperation objective between the members of supply chain
5	0.14061	Facilitating timely and rapidly decision making
4	0.1418	Creating virtual communicating
6	0.14058	Focus on development of competitive advantages
3	0.1224	Selecting the best supplier

Table (3) is the diffuzification of the fuzzy numbers of the strategic relation factors.

Table 3: Diffuzification of fuzzy numbers related to strategic relation factors

	B_1	B_2	B_3	B_4	B_5	B_6	B_7
B_1	1.0000	0.5777	1.4760	0.9352	1.0311	1.0384	0.9122
B_2	2.8263	1.0000	2.1305	1.0936	1.1002	1.0255	1.2844
B_3	1.1032	0.7434	1.0000	0.8419	1.2297	0.9536	0.9423
B_4	1.6011	1.4565	1.9693	1.0000	1.3233	1.1639	1.3860
B_5	1.5810	1.3296	1.2863	1.2691	1.0000	1.3791	1.4682
B_6	1.5830	1.6118	1.6214	1.4261	1.1828	1.0000	1.4493
B_7	1.8283	1.2823	1.7028	1.1707	1.0877	1.0311	1.0000
CI=0.0987							

As it can be seen from table (3), the amount of consistency rate is 0.0987 and this amount indicates the amount of answers consistency.

Weighting and Prioritizing of Five Sub-indicators related to Marketing Factors

Table 4: Merged paired comparison matrix related to marketing factors

	A_1	A_2	A_3	A_4	A_5
A_1	(1,1,1)	(0.7527, 0.8811, 1.0395)	(0.6834, 0.8094, 0.9705)	(0.3841, 0.4539, 0.5531)	(0.5172, 0.6166, 0.7430)
A_2	(0.9620, 1.1350,1.3285)	(1,1,1)	(1.0465, 1.2351, 1.4573)	(0.6609, 0.7809, 0.9368)	(0.7292, 0.8629, 1.0443)
A_3	(1.0304, 1.2355, 1.4633)	(0.6862, 0.8097, 0.9556)	(1,1,1)	(0.6270, 0.7525, 0.9061)	(0.5350, 0.6501, 0.8065)
A_4	(1.8081, 2.2030, 2.6038)	(1.0675, 1.2806, 1.5130)	(1.1037, 1.3290, 1.5949)	(1,1,1)	(0.8694, 1.0001, 1.1450)
A_5	(1.3459, 1.6219, 1.9334)	(0.9576, 1.1589, 1.3714)	(1.2399, 1.5382, 1.8693)	(0.8733, 0.9999, 1.1503)	(1,1,1)

$$\sum_{j=1}^{5} M_{g_1}^{j} == (3.3374, 3.7609, 4.306) \quad \sum_{j=1}^{5} M_{g_2}^{j} = (4.3986, 5.0138, 5.7669)$$

$$\sum_{j=1}^{5} M_{g_3}^{j} = (3.8786, 4.4478, 5.1315) \quad \sum_{j=1}^{5} M_{g_4}^{j} = (5.8487, 6.8127, 7.8568)$$

$$\sum_{j=1}^{5} M_{g_5}^{j} = (5.4167, 6.3188, 7.3243)$$

$$\sum_{i=1}^{5}\sum_{j=1}^{5} M_{g_i}^{j} = (22.88, 26.354, 30.385 \quad \left(\sum_{i=1}^{5}\sum_{j=1}^{5} M_{g_i}^{j}\right)^{-1} = (0.0329, 0.0379, 0.0437$$

S_1= (0.1098, 0.1427, 0.1882)
S_2= (0.1448, 0.1902, 0.252)
S_3= (0.1276, 0.1688, 0.2243)
S_4= (0.1925, 0.2585, 0.3434)
S_5= (0.1983, 0.2398, 0.3201)

$$V(S_1 \geq S_2, \ldots, S_5) = Min(V(S_1 \geq S_2), \ldots, V(S_1 \geq S_5) = 1.0261$$
$$V(S_2 \geq S_1, \ldots, S_5) = Min(V(S_2 \geq S_1), \ldots, V(S_2 \geq S_5) = 0.9525$$
$$V(S_3 \geq S_1, \ldots, S_5) = Min(V(S_3 \geq S_1), \ldots, V(S_3 \geq S_5) = 0.9739$$
$$V(S_4 \geq S_1, \ldots, S_5) = Min(V(S_4 \geq S_1), \ldots, V(S_4 \geq S_5) = 0.8842$$
$$V(S_5 \geq S_1, \ldots, S_4) = Min(V(S_5 \geq S_1), \ldots, V(S_5 \geq S_4) = 0.9029$$

$$W' = (1.0261, 0.9525, 0.9739, 0.8842, 0.9029\ )$$
$$W_N = (0.216, 0.201, 0.205, 0.187, 0.191)$$

So the final ranking of sub-indicators related to marketing factor is shown in table (5).

Table 5: Final ranking about sub-indicators related to marketing factor

Rank in term of importance degree	Obtained significance degree from AHP fuzzy	Dimensions of marketing factors
1	0.216	Maintain and developing the communication with customers
3	0.201	Identifying customers' needs
2	0.205	Flexible responding to customer
5	0.187	Truncation of order cycle
4	0.191	Improving in the performance of good delivery to customer

Table (6) shows deffuzification of fuzzy numbers related to marketing factors.

Table 6: Deffuzified fuzzy numbers related to marketing factor

	A_1	A_2	A_3	A_4	A_5
A_1	1.0000	1.0823	1.0125	0.5763	0.7761
A_2	1.3862	1.0000	1.5202	0.9768	1.0888
A_3	1.5317	0.9968	1.0000	0.9479	0.8449
A_4	2.7354	1.5841	1.6700	1.0000	1.1886
A_5	2.0253	1.4385	1.9688	1.1924	1.0000
CI=0.0798					

As table (6) shows the value of compatibility range is 0.0798 and this amount shows the compatibility range of desired results.
Weighting and prioritization of four sub-indicators related to production factors are as follows:

Table 7: Paired comparison matrix of production factor

	C_1	C_2	C_3	C_4
C_1	(1,1,1)	(0/611, 0/694, 0/79)	(1/366, 1/68, 1/994)	(0/915, 1/136, 1/407)
C_2	(1/265, 1/44, 1/636)	(1,1,1)	(2/31, 3/028, 3/727)	(0/868, 1/017, 1/174)
C_3	(0/501, 0/595, 0/732)	(0/268, 0/33, 0/432)	(1,1,1)	(0/236, 0/283, 0/357)
C_4	(0/71, 0/88, 1/092)	(0/851, 0/983, 1/152)	(2/801, 3/533, 4/237)	(1,1,1)

Then, according to method EA< for each of the matrix rows of the above paired comparison matrix, the value of S_k is calculated which is a triangular fuzzy number.

$$\sum_{j=1}^{4} M_{g_1}^{j} = (4.618, 5.196, 5.945)$$

$$\sum_{j=1}^{4} M_{g_2}^{j} = (6.768, 7.542, 8.0408) \qquad \sum_{j=1}^{4} M_{g_3}^{j} = (3.448, 3.91, 4.561)$$

$$\sum_{j=1}^{4} M_{g_4}^{j} = (7.763, 8.738, 9.788\ ) \qquad \sum_{j=1}^{4} M_{g_5}^{j} = (8.383, 9.179, 10.561)$$

$$\sum_{j=1}^{4} M_{g_6}^{j} = (4.824, 5.339, 5.936)$$

$$\sum_{i=1}^{3}\sum_{j=1}^{3} M_{g_i}^{j} = (35.804, 39.904, 45.199) \qquad \left(\sum_{i=1}^{3}\sum_{j=1}^{3} M_{g_i}^{j}\right)^{-1}$$

$$= (0.022, 0.0250, 0.0279)$$

S_1= (0/102, 0/130, 0/166) S_2= (0/149, 0/189, 0/234)
S_3= (0/076, 0/097, 0/127) S_4= (0/171, 0/218, 0/273)

Then, magnitude degree of each s_k is obtained and it is calculated relative to the others. In the following, the amounts of magnitude amount $V(S_i \geq S_K)$ is calculated for each of the S_K.

$$V(S_1 \geq S_2, \ldots, S_4) = Min(V(S_1 \geq S_2), \ldots, V(S_1 \geq S_4) = 0.069$$

$$V(S_2 \geq S_1, \ldots, S_4) = Min(V(S_2 \geq S_1), \ldots, V(S_2 \geq S_4) = 0.546$$
$$V(S_3 \geq S_1, \ldots, S_4) = Min(V(S_3 \geq S_1), \ldots, V(S_3 \geq S_4) = 0.057$$
$$V(S_4 \geq S_1, \ldots, S_3) = Min(V(S_4 \geq S_2), \ldots, V(S_4 \geq S_3) = 0.888$$

$$W' = (0.069, 0.546, 0.057, 0.888)$$
$$W_N = (0.044, 0.35, 0.036, 0.56)$$

So, the results of application fuzzy AHP shows that what is the preference of each of above factors and it is shown in table 4-8.

Table 8: Ranking the related dimensions to production factors

Rank in term of importance degree	Obtained significance degree of fuzzy AHP	Dimensions of production factors
3	0.044	Concurrent implementations of activities in supply chain
2	0.35	Quality improvement of activities in supply chain
4	0.036	Continuous updating the combination of production process in supply chain
1	0.56	Organizing along with operational line
	0.0856	Compatibility rate

Weighting and prioritization of four sub-indicators related to financial factors

Table 9: Paired comparison matrix of financial factor

	C1	C2	C3	C4
C1	(1,1,1)	(1.4461, 2.0178)	1.7241,(1.7766, 2.2089, 2.6643)	1.1424, 1.4102, 1.6974)
C2	(0.4955, 0.6914)	0.5799,(1,1,1)	(1.3191,1.6485, 2.0003)	(1.0852, 1.3005, 1.5162)
C3	(0.3753,0.4527, 0.5628)	(0.4999, 0.7580)	0.6065,(1,1,1)	(0.4944, 0.5905, 0.7213)
C4	(0.5891, 0.709, 0.8753)	(0.6595, 0.9214)	0.7689,(1.3863,1.6932, 2.0223)	(1,1,1)

According to EA method, for each of the rows of above paired comparison matrix, the value of S_K is calculated which is a triangular fuzzy number.

$$\sum_{j=1}^{4} M_{g_1}^{j} = (9.2390, 11.0006, 12.9318) \quad \sum_{j=1}^{4} M_{g_2}^{j} = (7.11, 8.4169, 9.912)$$
$$\sum_{j=1}^{4} M_{g_4}^{j} = (6.788, 8.0030, 9.446) \quad \sum_{j=1}^{4} M_{g_3}^{j} = (4.5772, 5.3023, 6.2528)$$
$$\sum_{i=1}^{4}\sum_{j=1}^{4} M_{g_i}^{j} = (58.417, 69.07, 81.549) \quad \left(\sum_{i=1}^{4}\sum_{j=1}^{4} M_{g_i}^{j}\right)^{-1} = (0.0122, 0.0144, 0.0171)$$

S_1=(0.113294, 0.159267, 0.22137) S_2=(0.087197, 0.12186, 0.16967)
S_3=(0.056128, 0.076767, 0.107038) S_4=(0.083243, 0.115869, 0.1617)

Then, magnitude degree of each calculated S_K is calculated relative to others. In the following, magnitude degree $V(S_i \geq S_K)$ is obtained for each of the S_K.

$$V(S_1 \geq S_2, \dots, S_4) = Min(V(S_1 \geq S_2), \dots, V(S_1 \geq S_4) = 0.9175$$
$$V(S_2 \geq S_1, \dots, S_4) = Min(V(S_2 \geq S_1), \dots, V(S_2 \geq S_4) = 0.9549$$
$$V(S_3 \geq S_1, \dots, S_4) = Min(V(S_3 \geq S_1), \dots, V(S_3 \geq S_4) = 1.011659$$
$$V(S_4 \geq S_1, \dots, S_8) = Min(V(S_4 \geq S_1), \dots, V(S_4 \geq S_8) = 0.96089$$

$$W' = (0.9175, 0.954, 1.0117, 0.9609)$$
$$W_N = (0.2386, 0.2481, 0.2631, 0.2499)$$

So, the obtained results of using fuzzy AHP shows that priority of each of above factors is as table 10:

Table 10: Final ranking of sub-indicators of financial factor

Rank in term of importance degree	Obtained significance degree of fuzzy AHP	Dimensions of financial factors
4	0.2381	Rational revenue sharing with partners
3	0.2481	Competitiveness cost
1	0.2631	Increasing the speed of fund transfer
2	0.2499	Proper asset management
	0.0067	Compatibility rate

Weighting and prioritization of four sub-indicators related to main factors

Table 11: Paired comparison matrix of sub-indicator related to main factors

	C_1	C_2	C_3	C_4
C_1	(1,1,1)	(0/611, 0/694, 0/79)	(1/366, 1/68, 1/994)	(0/915, 1/136,1/407)
C_2	(1/265, 1/44, 1/636)	(1,1,1)	(2/31, 3/028, 3/727)	(0/868, 1/017,1/174)
C_3	(0/501, 0/595,0/732)	(0/268, 0/33, 0/432)	(1,1,1)	(0/236, 0/283,0/357)
C_4	(0/71, 0/88, 1/092)	(0/851, 0/983,1/152)	(2/801, 3/533,4/237)	(1,1,1)

All calculations are obtained similar to the results of factors and we avoid to present calculation. The results are as follows:

$$\sum_{j=1}^{4} M_{g_1}^{j} = (5.453, 6.493, 7.668) \quad \sum_{j=1}^{4} M_{g_2}^{j} = (7.556, 9.077, 10.654)$$
$$\sum_{j=1}^{4} M_{g_3}^{j} = (2.592, 2.901, 3.365) \quad \sum_{j=1}^{4} M_{g_4}^{j} = (7.381, 8.824, 10.371\ )$$

$$\sum_{i=1}^{4}\sum_{j=1}^{4} M_{g_i}^{j} = (37.581, 44.43, 52.068) \qquad \left(\sum_{i=1}^{4}\sum_{j=1}^{4} M_{g_i}^{j}\right)^{-1}$$

$$= (0.0192, 0.022, 0.026)$$

S_1= (0.1047, 0.146, 0.204) S_2= (0/145, 0/204, 0/283)
S_3= (0/049, 0/065, 0.089) S_4= (0/141, 0/198, 0/275)
S_5= (0/187, 0/257, 0/355)

$$V(S_1 \geq S_2, \ldots, S_5) = Min(V(S_1 \geq S_2), \ldots, V(S_1 \geq S_5) = 0.129$$
$$V(S_2 \geq S_1, \ldots, S_5) = Min(V(S_2 \geq S_1), \ldots, V(S_2 \geq S_5) = 0.641$$
$$V(S_3 \geq S_1, \ldots, S_5) = Min(V(S_3 \geq S_1), \ldots, V(S_3 \geq S_5) = 0.035$$
$$V(S_4 \geq S_1, \ldots, S_5) = Min(V(S_4 \geq S_2), \ldots, V(S_4 \geq S_5) = 0.598$$

$$\mathbf{W'} = (0.129, 0.641, 0.035, 0.598) \rightarrow$$
$$\mathbf{W_N} = (0.0919, 0.4568, 0.0249, 0.4262,)$$

Table 12: Final weight and rank of identified main factors

Rank in term of importance degree	Obtained significance degree of fuzzy AHP	Main factors
3	0.0919	Strategic relation
1	0.4568	Production
4	0.0249	Financial
2	0.4262	Marketing
	0.0619	Compatibility range

Weighting and Prioritization of all Aspects of the Conceptual Model

After calculating weight of each of main indicators and each of indicators, we can weight and prorated all model dimensions. Final prioritization of sub-indicators is as follows. And we can multiply the weight of each indicator in its original indicator weight and so the final weight of each indicator is calculated.

Table 13: Final weight of each sub-indicators

rank	Final weight of sub-measure	Weight of sub-measure	Sub measures	rank	The weight of measure	Main measures
10	0.01353	0.1473	Trust-based relations with suppliers	3	0.0919	Strategic relations
15	0.01278	0.1391	Remove inter-organizational barriers			
9	0.01360	0.14802	Collaborative and team objectives between the members of supply chain			
13	0.01292	0.14061	Facilitate quickly and timely decisions			
12	0.01303	0.1418	Creating virtual connections			
14	0.01291	0.14058	Focus on developing competitive			

			advantages			
11	0.01308	0.1424	Selecting best supplier			
4	0.09205	0.216	Maintaining and developing relation with customer	2	0.4262	Marketing
6	0.08566	0.201	Indentifying customer needs			
5	0.08737	0.205	Flexible responding to customer			
8	0.07969	0.187	Trincation of order cycle			
7	0.0814	0.191	Improving the performance of good delivery to customers			
16	0.02009	0.044	Concurrent execution of activities in the supply chain	1	0.4568	Manufacturing
3	0.1598	0.35	Quality improvement in supply chain processes			
2	0.1644	0.036	Continuous updating the combination of manufacturing process in supply chain			
1	0.2558	0.56	Organizaing along functional lines			
20	0.0059	0.2381	Rational revenue sharing with partners	4	0.0249	Financial
19	0.00617	0.2481	Competitiveness cost			
17	0.0065	0.2631	Increasing the speed of fund transfer			
18	0.0062	*0.2499*	Proper asset management			

The First Hypothesis

Hypothesis H0: the factor of strategic relation is not effective on supply chain management.
Hypothesis H1: the factor of strategic relation is effective on supply chain management.

Table 14: The results of correlation test

Test result	Sig	Correlation coefficient	number	Second variable	First variable
Presence of significance relation	0.000	0.173	178	Supply chain management	Strategic relation

According to table (14), Pearson correlation coefficient between the variable of strategic relations with supply chain management is 0.173 and test significance level is 0.000. According to this fact that the significant level of correlation test is lower than 0.05, so null hypothesis is rejected and with 0.95 confidence level, we can say that there is a significant relation between these two variables.

The Second Hypothesis

Hypothesis H0: the factor of marketing is not effective on supply chain management.
Hypothesis H1: the factor of marketing is effective on supply chain management.

Table 15: The results of correlation test

Test result	Sig	Correlation coefficient	number	Second variable	First variable
Presence of significance relation	0.012	0.184	178	Supply chain management	Marketing factor

According to table (15), Pearson correlation coefficient between the variable of strategic relations with supply chain management is 0.184 and test significance level is 0.012. According to this fact that the

significant level of correlation test is lower than 0.05, so null hypothesis is rejected and with 0.95 confidence level, we can say that there is a significant relation between these two variables.

The Forth Hypothesis

Hypothesis H0: the factor of financing is not effective on supply chain management.
Hypothesis H1: the factor of financing is effective on supply chain management.

Table 16: The results of correlation test

Test result	Sig	Correlation coefficient	number	Second variable	First variable
Presence of significance relation	0.048	0. 109	178	Supply chain management	Financing factor

According to table (16), Pearson correlation coefficient between the variable of financing factor with supply chain management is 0.109 and test significance level is 0.048. According to this fact that the significant level of correlation test is lower than 0.05, so null hypothesis is rejected and with 0.95 confidence level, we can say that there is a significant relation between these two variables.

RESULTS AND DISCUSSION

Results

In this study, we identified 23 effective factors and a questionnaire is designed based on it, and it was distributed in Gulf Cement Company. The obtained results showed that between 23 identified factors, 20 factors are effective on supply chian of Gulf Cement industry. And it was studied a conceptual research model.

Effective Factors on the Improvement of Supply Chain Management

Effective factors on the improvement of supply chain management is divided in to four categories of manufacturing, strategic relation and financial, the process of hierarchical analysis process shows that among above criteria, manufacturing criteria allocated the higher weight to itself. And the criteria of marketing, strategic relation and financial relation are in lower ranks.

Indicators Related to the Manufacturing

Manufacturing relations of manufacturing are divided into 4 indicators, the results shows that among indicators related to organized production along functional lines, quality improvement in supply chain process, concurrent execution of activities in supply chain, continuous updating of combined manufacturing process in the supply chain allocated the highest level of importance to themselves.

Indicators Related to Marketing

Indicators related to marketing in this study were divided into 5 indexes.

The results of hierarchical analysis process shows that among these 5 truncation indicators of order cycle, flexible responding to customers, understanding customer needs, making improvement in the performance of good delivery to customer and maintain and developing the relation with customers have the highest level of importance.

Indicators Related to the Strategic Relation

Indicator related to strategic relation is divided into 7 indexes.

The results show that among these 7 indicators of collaboration goals and team between the members of supply chain, trust-based relation with suppliers, remove the inter-organization barriers, creating virtual communication, facilitating quickly and timely decisions, and focus on developing competitive advantages and choosing the best supplier have the highest level of importance.

Indicators Related to Financial Factors

Indicators related to financial factors are divided into 4 indexes, he obtained results of hierarchical analysis process shows that among 4 relevant index, rational revenue sharing with partners, true asset management, competitive costs and increasing the transfer speed of funds have the highest level of importance.

Offers

1. They should organize along their operational lines. Many technologies and tools are used in improving the supply chain solutions. The range of technology implementation introduces new ways to change the organizational structure from hardware technology to software and information technology for organizing.
2. They should maintain and develop more relations with their customers. For effective management, supply chain management is essential. And suppliers and customers should work together in a coordinated manner with communication and information sharing and dialogue. This issue is called rapid flow of information between customers and suppliers, distribution centers and transportation systems that enables some companies to create so efficient supply chain. Suppliers and customers should have the same goals. And suppliers and customers must have mutual trust,
3. They should walk in line with team and collaboration objectives between the members of s supply chain. This section refers to types of essential relation for the company. This performance develops the communications of supply chain with partnership of outside factors of company. Partners should be informed about any change in supply chain and be implemented in total chain.
4. They should accelerate fund transfer.
5. They should attach more importance to quality improvement in the supply chain processes.
6. With true identification of customer needs and adopting it with current capacity, we can increase the speed of responding to demand. And it should meet the long-term goals of organization. This balance between demand and organization capacity is not realized only with identifying product type and true supply chain.
7. They should have an appropriate management on their assets. Cost reduction is not realized only by removing all activities which dose not create added value.

As a result, we can supply the final product with low cost, and it is not obtained only by a proper use of available facilities in these industries.

8. In any supply chain, numerous elements interacted. And this interaction orientation is taken from supplying raw materials to distributing final products, different sources such as labor, raw material, energy and funds are used. Planning for optimum use of the resources needed to effectively managing each of these elements.
9. In successful managing of the supply chain, it is necessary to provide people depending of needs and perspectives of management, trained persons and a suitable environment should be prepared for collaborating among people and increasing their sense of responsibility.
10. To improve supply chain management, it should be more flexible and responsive to customer.
11. Cost competitiveness should be on priority.
12. They should identify more customers.

Identifying customers include the customer notion of compering products, purchasing and decision-making criteria, reference groups and role of others. Excellent understanding of customers is an objective that all organizations must follow it and correct understanding of customer is the first step of customer satisfaction.

13. The main topic of today's market is not only product or service, but perceived value of customer in its relation with company is so important. Customer satisfaction is one of the most important criteria for assessing the quality of products and services of company. The quality is considered as two forms of internal and external for each company. Internal quality standards are items such as number of defects and waste and etc. while customer satisfaction is based in the quality of products and provided services to customers and this can bring valuable information for companies.
14. They should choose the best supplier; the topics related to selecting supplier are complex an issue which may have many concerns with qualitative and quantitative accepts. A network analysis network as a framework is presented to help managers to determine the goal of assessment. Determining the most important factor for assessment and selection of the best supplier is a strategy in supply chain.

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