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Identification of Intervening Factors on Agility of Iranian Mass Construction Associations' Supply Chain

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ABSTRACT

Aim: In the beginning of the 21st century organizations have experienced fundamental changes around. These changes forced them to encounter new challenges which can threaten the survival of the organizations. This situation leads the organizations to reassess their strategic perspectives and adapt themselves with changes of the market and its changing needs and costumers. They provide a new approach named agility to response to the new requires of business. In this study we seek to identify and determine the Intervening factorsof agility of supply chain of mass construction associations in Iran and find out the influential rate of each factor on others and agile supply chain.
Methodology: This is a developmental research. Methodology of this study is descriptive – analytical. To conduct this research we interviewed nine experts and used DELPHI approach to identify the effective factors on agility of supply chain, and then with the use of DEMATEL technique we determined and approved the relations among factors and their influence on agility in supply chain of mass construction associations in Iran.
Results and conclusion: Results show that the Intervening factors of agility of supply chain in mass construction associations in Iran are: "usage", "executor", "ownership", "Structure" and "location". Among these most and least effective factors are "location" (1/617) and "Structure" (1/018), and maximum and minimum influence of affectivity related to the factors "executor"(2/145) and "usage" (1/06).
KEYWORDS: Agile supply chain, DEMATELTechnique, Mass Construction Assosiactions

1. INTRODUCTION

Agility of supply chain has been emerged by the combination of "Agility" and "Supply Chain Management" since year 2000. Agility represents firms' ability to be adapted with unpredicted changes to achieve success in turbulent markets. It is closely related with other concepts such as "speed", "flexibility" and "accountability". Supply chain includes all the activities associated with flow and exchange of goods and service providing(from raw material supply stage to customers production usage stage).

To gain advantages in a competitive changing business environment, firms must operate in accordance with their customers and suppliers. They must cooperate in an acceptable level of agility which leads to the formation of Agile Supply Chain (Chiristopher and Towil ., 2002). An agile supply chain can be accountable to the changes which occur in a working environment (Agarwalet al., 2007). Agile supply chains not only response effectively to the changes of the market, which is a reason that their importance can be emphasized on (Teece et al., 1997), but also they are sensitive to the first dramatic changes of the market. Therefore we believe that agility is the required characteristic for dealing with future competitive pressures of organizations and gaining competitive advantages.(Yusuf et al., 1999 ;Giachetti Ronald et al., 2003)

On the one hand it is known that there is no chance of managing things when they can't be measured, and on the other hand the successful management of supply chain is an effective factor of competition in the market. If Iranian mass construction associations regard their supply chain as an important factor and apply the principles of supply chain's agility, they can benefit from the advantages of an agile supply chain (They can easily find the demands and changes in the market and be accountable for them). So mass construction associations need to identify the confounding and effective factors of agile supply chain and find their impact on each other to achieve the agile supply chain's advantages. Therefore the main object of this research is the recognition of intervening factors of supply chain's agility of mass construction associations in Iran.

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In the second part of this research we review the research literature. The third part starts with introduction of methodology and research stages, collection of the data and finishes with explanation of DELPHI methods and DIMTEL technique. The fourth part is specified to DIMTEL technique function and presentation of research findings, and finally the fifth part represents conclusion and comments for further researches.

1 Theoretical Framework

1.1 Supply Chain

Supply chain management has become important as a production paradigm to improve the organizational competitiveness (Gunasekaran et al., 2004). There are several definition for supply chain, for example Christopherindentifies the supply chain as a net with connected organizations within which cooperate to manage and improve the flow of goods from suppliers to customers(Christopher,2005). According to Hartmutsupply chain is a special form of a network organization (Hartmutet al., 2005)

1.2 Agility

"Agility" literary means ability to move quickly with suppleness and control, or ability to think quickly and intelligently(Hornby.,2000). The term organizational agility's root is agile manufacturing which is introduced as responding to changes of business environment and transforming these changes to opportunities. Agile manufacturing is applied to the organization's survival in a competitive environment which changingis its main feature and the ability to respond customers' desire in a fluctuating market. In an uncertain and changing environment, agility is one of the most important factor to survive(Sterling.,2008). From the business point of view, agility is the organizational ability for being flexible, responsible for changes.

1.3 Agile supply chain and its indices

Agile supply chain indicates the enhancement of adaptability, flexibility and ability to respond the needs of a changing market. Agile supply chain is the dominant paradigm in 21st century. It also is a successful strategy for the firms which want to be known in national and international realm (Yusuf et al., 1999). Chiristopher is one of the researchers who has studied the concept of agility extensively and explained its characteristics. In a study conducted in 2000, he identified agile supply chain's characteristics. They are "Market Sensitivity", "Virtual Supply Chain", "Electronic Data Integration", "Integrated process" and "Network Based" (Chiristopher.,2000). He also presented an integrated providing model of agile supply chain in 2001. In a frame of 3 levels (principles, programs and actions) showed the mutual impact between logestic agility and agile production that leads to agile supply chain.(Christopherand Towill.,2001)

Van Hoekregards the "attention towards customers", "virtual integration" with emphasis on responsiveness, "process integration" by means of self-managed teams instead of standardization and "integration by dynamic group" as four dimensions of supply chain (Van Hoek et al., 2001). Agile supply chain initiatives include collaboration with competitors, long term cooperation with customers and suppliers, formation of networks with other firms to emphasize on human resources' impacts, alliances with business counterparts, integrating information based on computers (Yusuf et al., 1999). Swafford emphasize on "responsiveness", "competence", "flexibility" and "speed" as agility's capabilities (Swafford et al., 2006). Agarwal with the usage of research literature and brainstorming sessions could introduce a set of 15 variables for agility (Agarwal et al., 2007). In this study the recognized criteria of a research conducted by Poloie(are used for agile supply chain of mass construction association. They can be seen in the table below:

Table1: Effective Criteria on Agility of Iranian Mass Constructing Associations' Supply Chain (Poloie et al., 2012)

line	Criteria	Subcriteria
1	Technology	Time reduction by using modern technology, Designing and production improvement, Cost effectiveness
2	Quality	Manufacture Quality, Compatibility of production with designing
3	Partnership	Strategic relations among suppliers' parts, Problem quick solving, Logistic flexibility‹
4	Market	House cost, House location, Customer's satisfaction, Market's sensitivity
5	Information Technology	Integrated and accurate Information
6	Financial	Infrastructural investment ‹On-time budget providing ‹Clients' financial capacity, Contractors' financial capacity
7	Government	Regulations
8	Society	House owners' levels ‹Responsibility for social and environmental issues ‹Culture

2 RESEARCH METHODOLOGY

This is a descriptive – analytical and a developmental – functional research. To establish this study we first identified the effective factor with the use of interview technique and DELPHI method and then DEMATEL

technique was used to determine the impact of relations among effective factors on agile supply chain of mass constructing associations in Iran.

To find the effective factors on agility of supply chain in this study, nine managers who were university professors and experts in the realm of housing industry completed a questionnaire based onDEMATEL technique. This study is question-oriented and seeks the answers by decision making techniques. The main aim is to identify the effective and confounding factors of agility in supply chain in mass construction associations of Iran. To reach our goal we have to consider these secondary objectives:

1. Can "usage" be considered as a factor in agility of supply chain in mass construction industry?
2. Can "ownership" be considered as a factor in agility of supply chain in mass construction industry?
3. Can "executer" be considered as a factor in agility of supply chain in mass construction industry?
4. Can "location" be considered as a factor in agility of supply chain in mass construction industry?
5. Can "Structure" be considered as a factor in agility of supply chain in mass construction industry?
6. Which factors have the most and the least effectiveness on agility of supply chain in mass construction industry?
7. Which factors are the most and the least affected in agility of supply chain in mass construction industry?

To reach the answer of questions 1 to 5, we need to measure the rate of factors' effectiveness and affectedness of agility in supply chain. In this research the collected data are valid and reliable because the DELPHI questionnaire had been designed in an open way that made us able to add extra factors if needed. The DEMATEL questionnaire was a part of the procedure and the data collected in this process were collected by DIMATEI approach, so there is no need to have a valid and reliable calculation.

2.1 Methods of Data Analysis

2.1.1 DELPHI Approach

In 1950, there has been a project in the U.S Air Force conducted by Dalklyto find out the determined number of Russian atomic bombs which could bring about certain damages for United States with the use of experts' opinions. The project was known as DELPHIproject which is the source of the name of DELPHItechnique in research method. The aim of this method was to access to the most reliable agreement by a group of experts on a subject with the use of questionnaire for certain times (Asgharpour., 2010). Okoli and Pawlowskihave defined DELPHImethod as an "approach to form a group relationin a way that the process allows the group's members to challenge with the subject". To apply this structured relation we need the feedback of members' role, assessment of group's judgment, opportunity to improve the view point. DELPHIapproach is an alternative for systematic research approach with the usage of statistical methods (Okoli and Pawlowski., 2004).

2.1.2 DEMATEL Technique:

This technique is a comprehensive technique based on Graph theory and enables us to analyze structural models and issues in a visionary way. This method can change the multiple criteria into a cause and effect group and a clear and understandable model. Therefore these causal relations are more understandable for drawing a network relation(Vosooghi., 2012).

The DEMATEL method proposed by Battelle Memorial Institute and it is a useful method for creating and analyzing a structural model involving causal relationships between factors (Wei-Wen Wu., 2008). This method has been successfully utilized in many fields, such as development strategies, management systems, e-learning evaluations, and knowledge management (Wen-Rong Jerry Ho et al., 2011). This method can convert the relations among causes and effects into an understandable structural model of the system (VOSOOGHI.2010). Several steps are involved in DEMATEL which a summary of them is given as follows (Liou and Chuang., 2010؛ Ho et al., 2011؛Asgharpour., 2010):

Step 1: Determining the elements of the system

Step 2: Form the average matrix: Assume that there are h experts and n factors.We proposed the comparison scales, 0, 1, 2, 3and 4,representing'no influence', 'little influence', 'medium influence','strong influence', and 'very strong influence', respectively. The influence matrix of the h^{th} respondent between total factor n is given as:

$$Z^h = \left[z_{ij}^h\right]_{n\times n}$$

The total average influenced value from all respondentswhen considering the score from criteria a_i to a_j is givenas:

$$Z_{ij} = \frac{\sum_{h=1}^{H} z_{ij}^h}{H}$$

Step 3:Calculating the normalized initial direct-relation matrix: Thenormalized initial direct-relation matrix is achieved by normalizingthe average matrix Z through the following equation:

$$N = \lambda . Z$$

$$\lambda = Max\left[\max_{1\le i\le n}\sum_{j=1}^{n} z_{ij}\ ,\ \max_{1\le j\le n}\sum_{i=1}^{n} z_{ij}\right]$$

Step 4: Calculating the total relation matrix: The totalrelation matrix T can be acquired by usingthe following equation:

$$T = N.(I - N)^{-1}$$

Ift_{ij} be the (i, j) element of matrix T; the sum of the *i*th row andthe sum of the *j*th column, d_i and r_j, respectively, are obtained as follow:

$$D_i = \sum_{i=1}^{n} t_{ij} \qquad (i = 1,2,\dots,n)$$

$$R_j = \sum_{j=1}^{n} t_{ij} \qquad (j = 1,2,\dots,n)$$

Step 5:Set a threshold value and obtain the impact-relations map: in order to explain the structural relation between thefactors, it is necessary to set a threshold value *p* to filter out the unsuitable effects in matrix T. Atthis step, decision makers or experts will choosethe threshold value.

3 Applying DEMATEL technique to determine the relations among factors

3.1 First Stage: identify the elements of the system (Step 1)

According to interviews and results of DELPHItechnique, effective factors on agility of supply chain are presented in the table below:

Table 2: Identified Intervening Factors inAgility of Iranian Mass Constructing Associations' Supply Chain

Line	Factors	Source	Definition
1	Usage	Expert's opinion	Represents the function that the building has such as governmental, military ,commercial or private usage.
2	Executor	Expert's opinion	Represents the builder whether government orindividuals
3	Ownership	Expert's opinion	Means the one who designs building's plan. He/she can be related to government (industrial, military) or can be private (poor/ rich) and etc.
4	Location	Expert's opinion	The location where the building is constructed, for example urban, rural or deprived locations.
5	Structure	Expert's opinion	The metal which is used for the Structure such as metal, concrete and etc.

3.2 Second stage: determine the elements of the outlines of a diagraph and the governing relations among them (Step 2)

In this stage with the identified factors in the previous stage, we draw the elements as outline of a graph schematically and determine the relations among them with the help of experts' opinions.

3.3 Third stage: determine the group decision making rule to have a collective agreement of experts' opinions (Step 2)

Determine the group decision making rule to have a collective agreement of experts' opinions. In this study relations are presented according to experts' opinions. In the figure below the effective factors on agility of supply chain in Iran mass construction associations and the relation among them are shown.

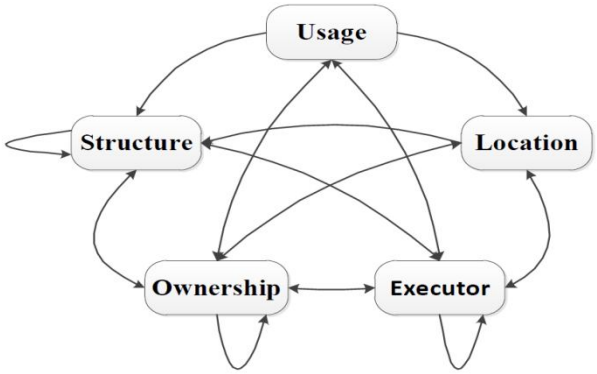

Figure 1: Determination of headlines and their relations

3.4 Fourth stage: determine the rate of final relations among elements (Step 2)

Achieve the rate of final relations from experts. This rate can be graded (in this study from zero to 4). Then calculate the median of the scores between each two elements (or geometric median in case of using percentage). As it is said before, in this study nine experts completed the DEMATEL technique questionnaire. Here is a table filled by one of the experts:

Table 2: DEMATEL Technique Questionnaire of The First Expert

Criteria	Technology	Quality	Partnership	Market	IT	Financial	Government	Society	Usage	Structure	Location	Executor	Ownership
Technology	0	3	3	2	3	1	0	3	1	3	0	0	0
Quality	0	0	2	3	0	0	0	3	0	3	3	0	0
Partnership	3	3	0	2	3	2	0	3	1	0	0	3	3
Market	0	0	0	0	0	0	0	0	3	0	0	0	0
IT	3	3	2	2	0	3	0	3	0	0	0	0	0
Financial	3	3	2	2	3	0	0	3	2	2	3	3	3
Government	3	2	3	1	3	3	0	1	1	1	3	1	1
Society	0	3	0	3	0	0	0	0	1	0	1	1	1
Usage	2	3	2	0	1	2	0	0	0	3	0	2	0
Structure	3	2	0	1	0	1	0	0	3	0	0	3	0
Location	2	3	0	3	0	3	0	2	3	2	0	0	3
Executor	3	3	3	1	1	3	0	0	0	3	0	0	1
Ownership	3	2	3	3	1	3	0	0	0	1	0	2	0

3.5 Fifth stage: show the final scores by a matrix (Step 3)

Collect the nine filled questionnaire by experts and attain the initial average matrixby using median, then calculate the sum of each row and column. Determine the biggest scores (for rows and columns) to normalize average initial matrix. As you can notice the biggest score dedicates to the sum of the “financial” factor row.

Table 3: The Initial Average Matrix for Effective Factors on Agility of Iranian Mass Constructing Associations’Supply Chain

Criteria	Technology	Quality	Partnership	Market	IT	Financial	Government	Society	Usage	Structure	Location	Executor	Ownership	SUM
Technology	0	2.556	2.222	2.222	3	0.889	0	2.667	0.889	2.889	0	0	0	17.333
Quality	0	0	1778	3	0	0	0	2.333	0	2.778	2.778	0	0	12.667
Partnership	2.333	2.556	0	1778	2.333	2.111	0	2.111	0.889	0	0	2.556	2.667	19.333
Market	0.667	0.667	0	0	0	0	0	0	3	0.111	0	0	0	4.444
IT	2.778	2.222	2.111	1889	0	2.111	0	1667	0	0	0	0	0	12.778
Financial	3	3	2.111	2.111	2.778	0	0	2.333	2	2.333	3	2.889	3	**28.556**
Government	2.556	2	2.667	1.111	2.333	2.556	0	1.111	1222	1222	2.889	1222	1333	22.222
Society	0.556	2.444	0	2.778	0.222	0	0	0	1.111	0.111	1.111	1	1	10.333
Usage	2	2.889	1889	0.333	1.111	2	0	0	0	3	0.222	2	0.333	15.778
Structure	3	2.111	0	1.111	0	1	0	0	3	0	0	2.889	0	13.111
Location	2	2.889	0.111	3	0.222	2.889	0	2.111	3	2.111	0	0.333	2.889	21556
Executor	2.889	3	2.889	1.111	1	3	0	0	0.222	2.778	0.222	0	1	18.111
Ownership	3	2.111	2.889	2.889	1	2.889	0	0	0.667	1	0	2.111	0	18.556
SUM	24.778	28.444	18.667	23.333	14	19.444	0	14.333	16	18.333	10.222	15	12.222	

3.6 Sixth Stage: Multiplication of each entry from matrix by inversing the biggest score of rows’ sum.(Step 3)

Divide all the average initial matrix‘s elements by 28.556 that leads us to final average matrix (normalized matrix).

Table 4: The Final Average Matrix for Effective Factors on Agility of Iranian Mass Constructing Associations’Supply Chain

Criteria	Technology	Quality	Partnership	Market	IT	Financial	Government	Society	Usage	Structure	Location	Executor	Ownership
Technology	0	0.089	0.078	0.078	0.105	0.031	0	0.093	0.031	0.101	0	0	0
Quality	0	0	0.062	0.105	0	0	0	0.082	0	0.097	0.097	0	0
Partnership	0.082	0.089	0	0.062	0.082	0.074	0	0.074	0.031	0	0	0.089	0.093
Market	0.023	0.023	0	0	0	0	0	0	0.105	0.004	0	0	0
IT	0.097	0.078	0.074	0.066	0	0.074	0	0.058	0	0	0	0	0
Financial	0.105	0.105	0.074	0.074	0.097	0	0	0.082	0.07	0.082	0.105	0.101	0.105
Government	0.089	0.07	0.093	0.039	0.082	0.089	0	0.039	0.043	0.043	0.101	0.043	0.047
Society	0.019	0.086	0	0.097	0.008	0	0	0	0.039	0.004	0.039	0.035	0.035
Usage	0.07	0.101	0.066	0.012	0.039	0.07	0	0	0	0.105	0.008	0.07	0.012
Structure	0.105	0.074	0	0.039	0	0.035	0	0	0.105	0	0	0.101	0
Location	0.07	0.101	0.004	0.105	0.008	0.101	0	0.074	0.105	0.074	0	0.012	0.101
Executor	0.101	0.105	0.101	0.039	0.035	0.105	0	0	0.008	0.097	0.008	0	0.035
Ownership	0.105	0.074	0.101	0.101	0.035	0.101	0	0	0.023	0.035	0	0.074	0

3.7 Seventh Stage: Calculate the set of infinite sequence of direct and indirect effects of elements on each other. (Step 4)

According to defined relations in fourth step, attain the DEMATEL technique of direct and indirect effects of elements on each other. Matrix below defines the direct and indirect effects of elements on each other.

Table 5: The Matrix of Direct Effects of Elements on Agility of Iranian Mass Constructing Associations'Supply Chain

Criteria	Technology	Quality	Partnership	Market	IT	Financial	Government	Society	Usage	Structure	Location	Executor	Ownership
Technology	1.044	0.128	0.038	0.111	0.085	0.066	0	0.158	0.094	0.188	0.168	0.177	0.188
Quality	0.078	1.062	0.049	0.169	0.072	0.068	0	0.16	0.092	0.133	0.166	0.206	0.185
Partnership	0.139	0.079	1.045	0.16	0.176	0.133	0	0.162	0.063	0.204	0.08	0.213	0.162
Market	0.024	0.134	0.026	1.068	0.141	0.042	0	0.078	0.041	0.098	0.056	0.148	0.16
IT	0.048	0.12	0.043	0.171	1.053	0.057	0	0.122	0.085	0.093	0.125	0.19	0.146
Financial	0.051	0.056	0.057	0.044	0.072	1.026	0	0.029	0.026	0.139	0.032	0.13	0.056
Government	0.105	0.111	0.145	0.135	0.12	0.12	1	0.169	0.148	0.157	0.175	0.203	0.196
Society	0.161	0.176	0.15	0.191	0.159	0.166	0	1.1	0.166	0.212	0.173	0.259	0.23
Usage	0.03	0.035	0.03	0.049	0.042	0.105	0	0.104	1.039	0.13	0.114	0.144	0.143
Structure	0.006	0.015	0.008	0.029	0.114	0.012	0	0.016	0.013	1.017	0.018	0.049	0.042
Location	0.129	0.138	0.04	0.078	0.086	0.133	0	0.135	0.133	0.158	1.078	0.193	0.166
Executor	0.029	0.035	0.112	0.131	0.054	0.111	0	0.036	0.022	0.157	0.085	1.063	0.05
Ownership	0.03	0.047	0.031	0.148	0.083	0.139	0	0.074	0.137	0.152	0.123	0.17	1.069

3.8 Eighth Stage: Calculate the possibility of indirect relations' rate (step 4)

With the multiplication of matrix of direct effects by final average matrix attain the rate and general relation of factors.

Table 6: Total Relation Matrix for Effective Factors on Agility of Iranian Mass Constructing Associations'Supply Chain

Criteria	Technology	Quality	Partnership	Market	IT	Financial	Government	Society	Usage	Structure	Location	Executor	Ownership	SUM
Technology	0.03	0.047	0.031	0.148	0.083	0.139	0	0.074	0.137	0.152	0.123	0.17	0.069	1.203
Quality	0.029	0.035	0.112	0.131	0.054	0.111	0	0.036	0.022	0.157	0.085	0.063	0.051	0.886
Partnership	0.129	0.138	0.04	0.078	0.086	0.133	0	0.135	0.133	0.158	0.078	0.193	0.166	1.467
Market	0.006	0.015	0.008	0.029	0.114	0.012	0	0.016	0.013	0.017	0.018	0.049	0.042	0.339
IT	0.03	0.035	0.03	0.049	0.042	0.105	0	0.104	0.039	0.13	0.114	0.144	0.143	0.965
Financial	0.161	0.176	0.15	0.191	0.159	0.166	0	0.1	0.166	0.213	0.173	0.259	0.23	2.144
Government	0.105	0.111	0.145	0.135	0.12	0.12	0	0.169	0.148	0.157	0.175	0.203	0.196	1.784
Society	0.051	0.056	0.057	0.044	0.072	0.026	0	0.029	0.027	0.139	0.032	0.13	0.056	0.719
Usage	0.048	0.12	0.043	0.171	0.053	0.057	0	0.122	0.085	0.093	0.125	0.19	0.146	1.253
Structure	0.024	0.134	0.027	0.068	0.141	0.042	0	0.079	0.041	0.098	0.056	0.148	0.16	1.018
Location	0.14	0.079	0.045	0.16	0.176	0.133	0	0.162	0.063	0.204	0.08	0.213	0.162	1.617
Executor	0.078	0.062	0.049	0.17	0.072	0.069	0	0.16	0.092	0.133	0.166	0.206	0.185	1.442
Ownership	0.044	0.128	0.038	0.111	0.085	0.066	0	0.158	0.094	0.188	0.168	0.177	0.188	1.445
SUM	0.875	1.136	0.775	1.485	1.257	1.179	0	1.344	1.06	1.839	1.393	2.145	1.794	

3.9 Ninth Stage: determine the hierarchy or possible structure of elements (Step 5)

With the help of Total relation matrix the hierarchy of factors is represented in the table below. As you can notice the most effective factor is "location" and the least affective one is "Structure". Among these factors "executor" is the most affective and "usage" is the factor that has the least "affectivity". According to the experts of this study, the threshold value of 0.08 is determined.

Table 7: Determination of Effective Elements' Hierarchy on Agility of Iranian Mass Constructing Associations' Supply Chain

Rating based on row's sum(R)	The rate of effectiveness of desired factors on other	Ranking based on column's sum(D)	The rate of affectiveness of desired factors on other	Importance of criteria's ranking	R+D	Ranking based on column's subtraction of row	R-D
Financial	2.144	Executor	2.145	Executor	3.587	Government	1.784
Government	1.784	Structure	1.839	Financial	3.323	Financial	0.965
Location	1.617	Ownership	1.794	Ownership	3.239	Partnership	0.692
Partnership	1.467	Market	1.485	Location	3.01	Technology	0.328
Ownership	1.445	Location	1.393	Structure	2.857	Location	0.224
Executor	1.442	Society	1.344	Usage	2.313	Usage	0.193
Usage	1.253	Financial	1.179	Partnership	2.242	Quality	-0.25
Technology	1.203	IT	1.257	IT	2.222	IT	-0.292
Structure	1.018	Quality	1.136	Technology	2.078	Ownership	-0.349
IT	0.965	Usage	1.06	Society	2.063	Society	-0.625
Quality	0.886	Technology	0.875	Quality	2.022	Executor	-0.703
Society	0.719	Partnership	0.775	Market	1.824	Structure	-0.821
Market	0.339	Government	0	Government	1.784	Market	-1.146

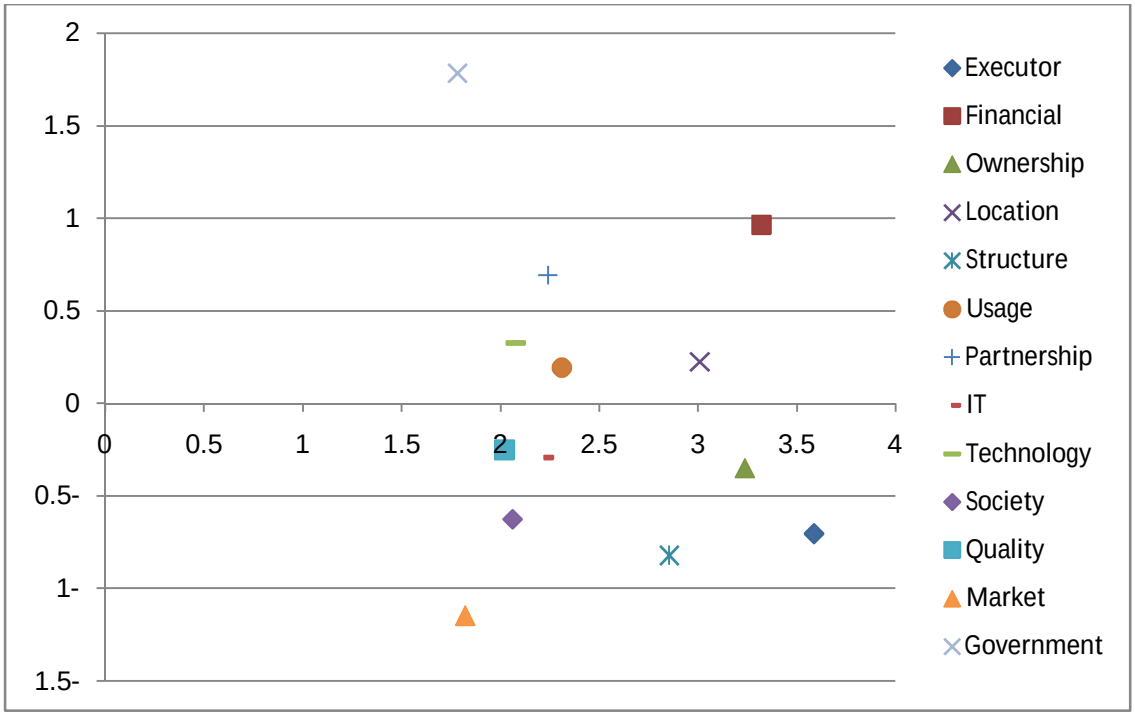

Figure 2: Determination of Elements' Hierarchy or Sequence on Agility of Iranian Mass Constructing Associations' Supply Chain

4 Conclusion and Discussion

Challenges of 21st century have imposed pressure on "maintaining in competition", "increase of production capability", "production flexibility", "price", "speed", "services", "delivery and its guarantee" and "quality" that force them to reengineer the structure. Agility is related to the firms' ability to survive and success in a competitive and unpredictable environment. This capability is specified not only to "flexibility" and "accountability" but also to "providing productionswith high quality and low cost and better services in good conditions". In a scientific era those firms can be successful which apply on time the new strategies based on competitive advantages and improve their services and actions by considering the markets and customers.

Mass construction associations in Iran, do not pay enough attention to their supply chain. If they do, they can benefit from the advantages of an agile supply chain. Mass construction associations need to identify the effective factors on agility of supply chain and the rate of the factors' effects on each other to benefit from the advantages of an agile supply chain. This study tries to solve the problems by examining the agility in supply chain of mass

construction associations, identify the effective factors. It seeks to enrich the theoretical foundation of this subject in Iran. According to application of DELPHI and DEMATEL technique, we can summarize the results as follow:

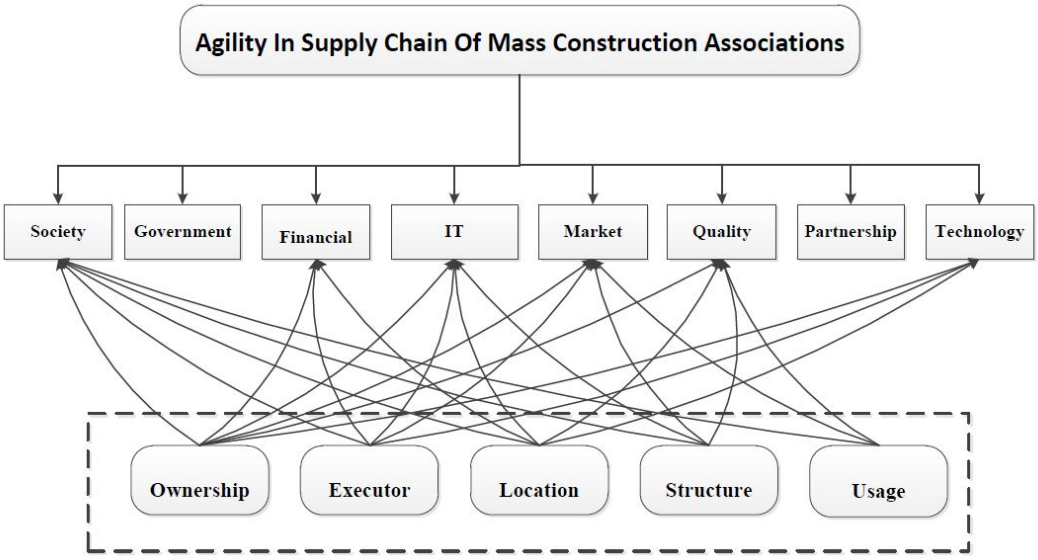

Figure 3: Effect of the Identified Factors of Agility of Iranian Mass Constructing Associations' Supply Chain

As you can see in the figure above, there are five effective factors identified in agility of supply chain in mass construction associations in Iran. In fact they are intervening factors. These five factors are: "usage", "Structure", "location", "executor" and "ownership". We have to consider both criteria of agility and other effective factors which can be identified later in the study, because they have the ability to change the conditions during the process of the research. As it is said before, to reach the main goal of the study "recognition of the effective factors (meddler) on agility of supply chain in mass construction associations in Iran", we just need to prove that these factors are influential on the criteria of agility in supply chain of associations in Iran. So we have:

Secondary objective 1:The factor "usage" influences the criteria "quality", "market", "society" of agile supply chain of mass construction associations. So it can be said that this factor is effective on agility and plays as an intervening factor.

Secondary objective 2: The factor "Structure" influences the criteria "quality", "market", "information technology" and "society" of agile supply chain of mass construction associations. So it can be said that this factor is effective on agility and plays as an intervening factor.

Secondary objective 3: The factor "location" influences the criteria "technology", "quality", "financial", "information technology" and "society" of agile supply chain of mass construction associations. So it can be said that this factor is effective on agility and plays as an intervening factor.

Secondary objective 4:The factor "executor" influences the criteria "technology", "market", "financial", "information technology" and "society" of agile supply chain of mass construction associations. So it can be said that this factor is effective on agility and plays as an intervening factor.

Secondary objective 5: The factor "usage" influences the criteria "quality", "market" and "society" of agile supply chain of mass construction associations. So it can be said that this factor is effective on agility and plays as an intervening factor.

As you can see in the figure none of the five factors are effective on criteria "partnership" and "government" of agility in supply chain. These two criteria are independent, but there is a difference between them, the rates of affectivity of these two criteria by five identified factors are different in table 7. The rate of effect of factors on "government" is equal with absolute zero, but the rate of effect on "partnership" is not, but it is considered zero, because these rates must be less than threshold value defined by experts.

Secondary objective 6: among recognized factors the sequence of effect is: "location" (1.617), "ownership" (1.445), "executor" (1.442), "usage" (1.253) and "Structure" (1.018).

Secondary objective 7: among recognized factors the sequence of affectivity is :"executor" (2.145), "Structure" (1.839), "ownership" (1.794),"location" (1.393) and "Usage" (1.06)

Results of this research can be useful for the managers who seek for agility in their organizations and operate in a dynamic and complex environment. To identify the effective and intervening factors in agility of supply chain, we applied DELPHI approach while Fuzzy DELPHIor analytical approach could be used too. With the help of DELPHI approach we can find more realistic factors in accordance with economical, political, social and cultural situation of our country. This research is one of the first researches in the realm of agility of supply chain in mass construction associations, while this kind of research can be used for other industries by expanding statistical community. Also we can test the achieved model by path analysis to assess the model's validity.

It should be noted that the importance of factors is different in altered situations and environments. It is the reason that different experts consider several factors for agile supply chain. Therefore a manager should regard factors differently according to organization and environment. There is a chance to improve for conceptual model and proposed method. It is suggested to use experts' opinions to assess the conceptual model in a more general scale, and to obtain priority of the factors, mathematical approaches such as decision making techniques with Fuzzy approach can be helpful. For future research it is needed to investigate the conditions, requirements and resources for the introduced technique in this study, and also compare it with other frequently used approaches.

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