

Determining the Effective Concepts of Institutionalization

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Abstract: Institutionalization is conducting the whole process of a company or organization systematically, notwithstanding the staff or people of the company. If institutions could not manage the institutionalization process successfully, they may not sustain in a long-term life cycle. Thus, a big challenge that the companies have been facing is how to evaluate and develop their institutionalization level. In this study, firstly, the concepts that affect the institutionalization level of companies are determined. Then, the weights of the interactions among the concepts are calculated by obtaining expert opinions and using Fuzzy Cognitive Maps (FCM) procedures. Through this way, institutions could find out the most affecting concept on the level of institutionalization. It also provides an insight for companies that they will be able to determine which concept to be prioritized in terms of developing institutionalization level.

Keywords: Business Management, Fuzzy cognitive maps, Institutionalization.

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I. Introduction

Institutionalization implies conducting the whole process of institutions systematically and obviously. In Today's competitive conditions, institutionalization is one of the most important processes that need to be implemented successfully in factories and institutions. In this way, organizations are able to sustain a long life cycle. The biggest problem in the institutionalization process is how to get in the institutionalization and what it needs to be done for this process is not known exactly. Various concepts effecting institutionalization are the keys for this process. But defining concepts which are more important is a problem to need to be solved for institutionalization. To conduct of the process of the institutionalization magnificently depends on well-conducted concepts that have an effect on it. Thus, an institutionalized organization will be on more steady foundations. The biggest problem of the institutions is to determine which concept is more important in terms of the institutionalization process. If it is determined, it will be reached in a more powerful way to institutionalization. The relationships between these concepts also have importance for institutions. By reason of the change of any concepts in a positive or negative direction effects the institutionalization level indirectly.

When studies are examined, it is seen lack of numerical analysis on the institutionalization. Generally, the concepts that have effect on the institutionalization were emphasized in detail. It is focused on proposed improvements on the concepts. On the other hand, there are few studies have been found about the numerical values of the relation between these concepts and at which rate effect of the concepts on the institutionalization [1]-[2]-[3]. These studies have not overcome of shortcomings that needed to be addressed in terms of the process of the institutionalizations. It is aimed to reveal some results that provide an insight to the institutions for the process of the institutionalization. In this paper, FCM that is the integration of the fuzzy logic and the cognitive map was used. It was determined the concepts that effect to institutionalization and the relation values between concepts.

II. Method

2.1 Fuzzy Cognitive Maps

Fuzzy cognitive maps (FCM) is a technique aiming to show the causal relationship between concepts graphically [4]. Concepts in FCM create the structure of the system. These can be identified as input, output, state, variable concepts [5]. FCM has been studied in various area. Studies that are in health [6]-[7]-[8], in agriculture [9]-[10]-[11], in business and management [12]-[13], in energy management [14]-[15] were done

with FCM. Fig. 1 shows a simple structure of the FCM. Nodes and arrows indicate concepts and causality respectively. Positive Relation: If an increase/decrease occur on C_i then increase/decrease occur on C_j in the same way. $W_{ij} > 0$. Negative Relation: If an increase/decrease occur on C_i then decrease/increase occur on C_j oppositely. $W_{ij} < 0$. No Effect: If a change on C_i does not to cause any change on C_j , causality equal zero. It is not used any arrow for $W_{ij} = 0$.

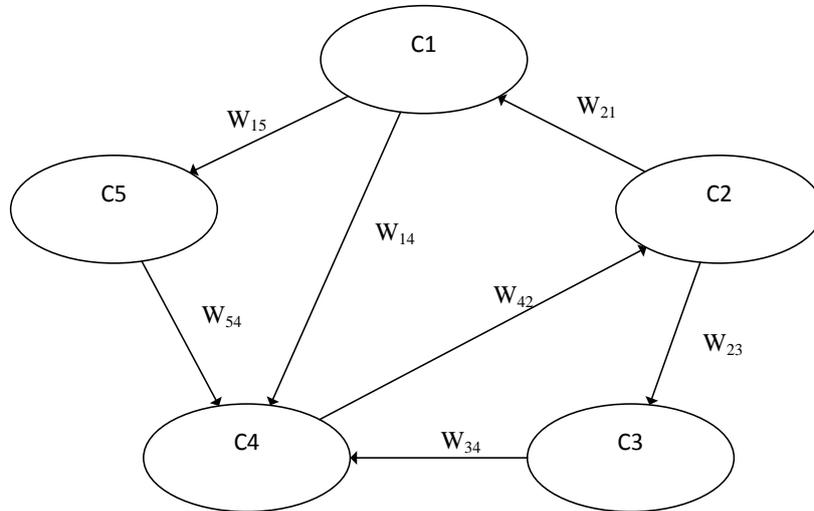


Fig. 1 A simple structure of FCM

2. 2 FCM Inference Algorithm

It is revealed a method to determine the positive or negative effect of C_i on C_j by Kosko in [4]. According to this method, it is determined all paths from a node to another node. The minimum value of the linguistic variable is taken for each path separately. Then, it is determined the maximum of minimum values for all paths as a weight value between concepts. For example, suppose the casual values are given $T = \{\text{negatively very strong, negatively strong, negatively medium, negatively weak, none, positively weak, positively medium, positively strong, positively very strong}\}$ and the casual map is shown in Fig. 2.

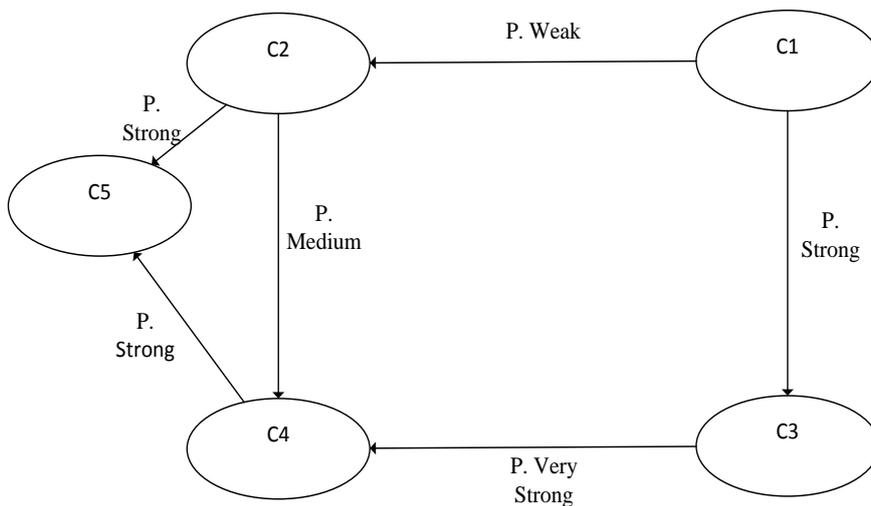


Fig. 2 The graph of causality

To find the effect of C1 on C5:

$$I1(C1 \rightarrow C5) = \min\{\text{£12, £25}\} = \min\{\text{P. Weak, P. Strong}\} = \text{P. Weak}$$

$$I2(C1 \rightarrow C5) = \min\{\text{£12, £24, £45}\} = \min\{\text{P. Weak, P. Medium, P. Strong}\} = \text{P. Weak}$$

$$I3(C1 \rightarrow C5) = \min\{\text{£13, £34, £45}\} = \min\{\text{P. Strong, P. Very Strong, P. Strong}\} = \text{P. Strong}$$

Total effect of C1 on C5 is;

$$T(C1 \rightarrow C5) = \max\{I1(C1 \rightarrow C5), I2(C1 \rightarrow C5), I3(C1 \rightarrow C5)\} = \max\{\text{P. Weak, P. Weak, P. Strong}\} = \text{P. Strong}$$

In the same way, it is determined the relations between concepts. Identified relationships create the weight matrix. The algorithm structure of FCM is based on neural network approach. The algorithm is executed with the thought that processes interact each other. It is given the algorithm at (1).

$$A^{(t+1)} = W * A^t \tag{1}$$

W indicates the weight matrix, A_t is the current state vector and $A_{(t+1)}$ is the state vector after one iteration step.

III. Implementation

In this paper, the main concepts that are very important for institutionalization are revealed. Firstly, it is determined concepts that effect on institutionalization from previous studies and shown in Table 1 [1]-[16]-[17]. Unlike studies on institutionalization, nepotism (C8) was added to the structure of system [18]. This concept means that people get to work or is rewarded although they do not deserve it.

Table 1. The concepts of institutionalization

Concepts No.	The Name of Concept
C1	Strategic Management
C2	Process Management
C3	Technology Management
C4	Product Management
C5	Knowledge Management
C6	Human Resource Management
C7	Enterprise Environment
C8	Nepotism
C9	Institutionalization Tendency

After the concepts are determined, interaction map is revealed with consensus by three experts (one manager, two academicians) in the field. The nodes indicate the concepts and the arrows indicate the causality in this map. Institutionalization Tendency (C9) is output concept of the model. The change of this concept provides an insight to decision makers about institutionalization level of organizations. It is shown the map that is created with consensus by three experts for institutionalization in Fig. 3.

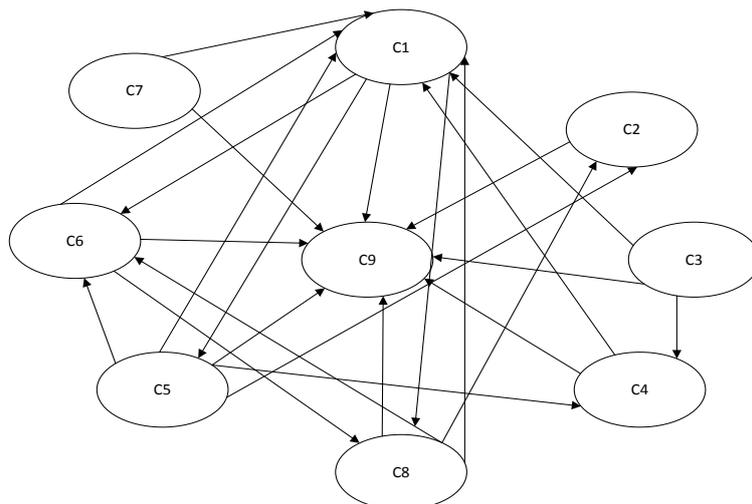


Fig. 1 Interaction map of the model

After creating a map, the relationships between concepts are found as [4]. Linguistic variables are determined according to membership function in Fig. 4.

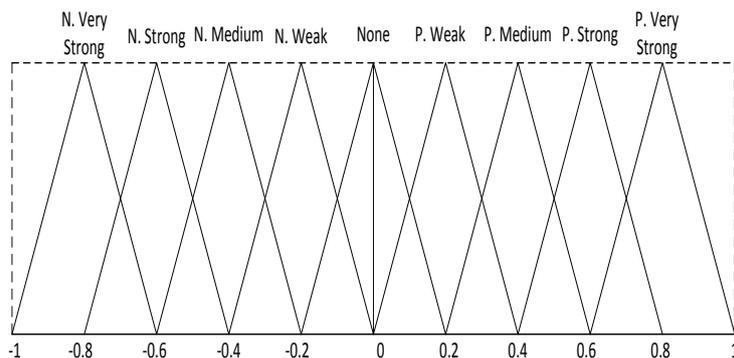


Fig. 2 Linguistic variables

For example, let see how to find effect C1 on C9. In Fig. 5, it is given that paths and linguistic variables from C1 to C9 according to one expert.

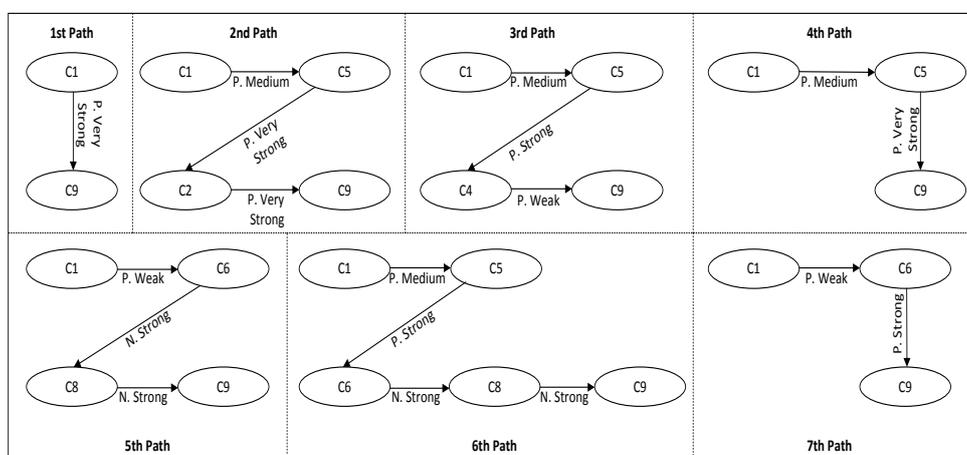


Fig. 3 Paths from C1 To C9

Firstly, the minimum linguistic variable is determined inside seven paths (P).

$$P1(C1 \rightarrow C9) = \min\{\text{£19}\} = \min\{P. \text{ Very Strong}\} = P. \text{ Very Strong}$$

$$P2(C1 \rightarrow C9) = \min\{\text{£15}, \text{£52}, \text{£29}\} = \min\{P. \text{ Medium}, P. \text{ Very Strong}, P. \text{ Very Strong}\} = P. \text{ Medium}$$

$$P3(C1 \rightarrow C9) = \min\{\text{£15}, \text{£54}, \text{£49}\} = \min\{P. \text{ Medium}, P. \text{ Strong}, P. \text{ Weak}\} = P. \text{ Weak}$$

$$P4(C1 \rightarrow C9) = \min\{\text{£15}, \text{£59}\} = \min\{P. \text{ Medium}, P. \text{ Very Strong}\} = P. \text{ Medium}$$

$$P5(C1 \rightarrow C9) = \min\{\text{£16}, \text{£68}, \text{£89}\} = \min\{P. \text{ Weak}, N. \text{ Strong}, N. \text{ Strong}\} = N. \text{ Strong}$$

$$P6(C1 \rightarrow C9) = \min\{\text{£15}, \text{£56}, \text{£68}, \text{£89}\} = \min\{P. \text{ Medium}, P. \text{ Strong}, N. \text{ Strong}, N. \text{ Strong}\} = N. \text{ Strong}$$

$$P7(C1 \rightarrow C9) = \min\{\text{£16}, \text{£69}\} = \min\{P. \text{ Weak}, P. \text{ Strong}\} = P. \text{ Weak}$$

Then, the maximum linguistic variable that is found for each path is determined as effect of C1 to C9. This procedure is implemented for each expert (E) separately.

$$E1(C1 \rightarrow C9) = \max\{I1(C1 \rightarrow C9), I2(C1 \rightarrow C9), I3(C1 \rightarrow C9), I4(C1 \rightarrow C9), I5(C1 \rightarrow C9), I6(C1 \rightarrow C9), I7(C1 \rightarrow C9)\} = \max\{P. \text{ Very Strong}, P. \text{ Medium}, P. \text{ Weak}, P. \text{ Medium}, N. \text{ Strong}, N. \text{ Strong}, N. \text{ Strong}, P. \text{ Weak}\} = P. \text{ Very Strong}$$

$$E2(C1 \rightarrow C9) = P. \text{ Very Strong}$$

$$E3(C1 \rightarrow C9) = P. \text{ Strong}$$

After comments are expressed by three experts, interaction weight of C1 on C9 is determined as Fig. 6 using Centre of Gravity Method [19] with membership function taken from Fig. 4.

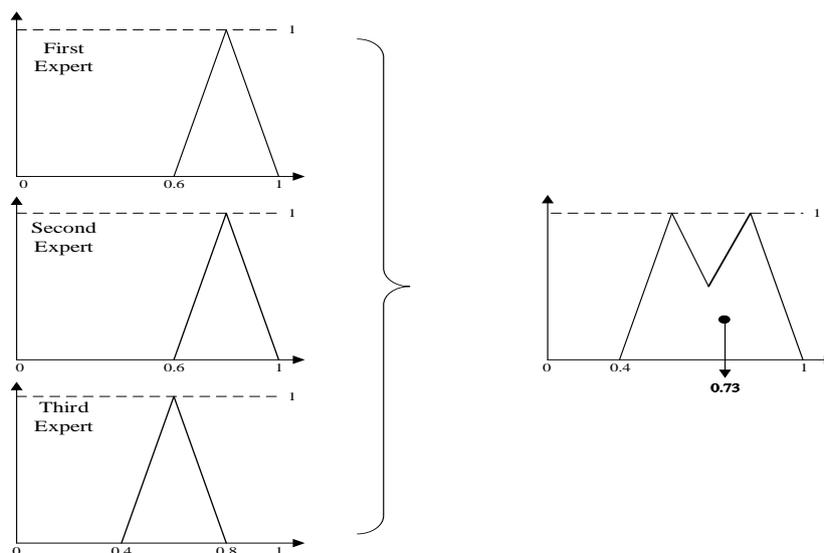


Fig. 4 A numerical illustration of Centre of Gravity Method (C1→C9)

After all interactions are found, the weight matrix is formed in Table 2.

Table 2. Weight matrix

W_{ij}	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1	0	0.40	0	0.40	0.66	0.40	0	-0.53	0.73
C2	0	0	0	0	0	0	0	0	0.66
C3	0.33	0.26	0	0.33	0.26	0.26	0	-0.73	0.53
C4	0.33	0.53	0	0	0.33	0	0	-0.66	0.40
C5	0.66	0.73	0	0.46	0	0.53	0	-0.73	0.73
C6	0.33	-0.40	0	0.33	0.33	0	0	-0.74	0.66
C7	0.26	0.26	0	0.26	0.26	0.26	0	-0.74	0.53
C8	-0.54	-0.40	0	-0.53	-0.53	-0.60	0	0	-0.80
C9	0	0	0	0	0	0	0	0	0

Mines values indicate negative interactions, plus values indicate positive interactions between concepts at Table II. Thus, the complex structure of the institutionalization has numerical values using FCM.

IV. Analysis

In this study, the approach used in the DEMATEL method has been adapted as a novelty to the FCM method in order to determine the most important concept for institutionalization which aims to provide the right decisions on the way of institutionalization and creating a model with the concepts that affect the institutionalization in this direction. In Table 3, the sum of the rows (D) indicates the total effect of a concept on all other concepts. The sum of columns (R) indicates the effect of the criteria taken from other criteria. (D + R) is the importance level of the concepts. Knowledge management (C5) has the highest (D + R) value. Organizations that desire to improve the institutionalization level should an attach importance to knowledge management structure. (D-R) indicates that the concepts are either in the cause or in the effect. Since the concepts of C1, C2, C3, C5, C7, and C8 are positive, these concepts constituted the effect group. Since C1 has the highest value (D-R), it is the most effecting concept in the model. The C4 and C6 concepts with negative values constitute the cause concept group. Institutionalization Tendency (C7) has the most negative value because it is the output concept in the model.

Table 3. Causal relationship matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	D	D+R	D-R
C1	0	0.40	0	0.40	0.66	0.40	0	-0.53	0.73	2.06	2.63	1.69
C2	0	0	0	0	0	0	0	0	0.66	0.66	1.24	0.08
C3	0.33	0.26	0	0.33	0.26	0.26	0	-0.73	0.53	1.24	1.24	1.24
C4	0.33	0.53	0	0	0.33	0	0	-0.66	0.40	0.93	2.18	-0.32
C5	0.66	0.73	0	0.46	0	0.53	0	-0.73	0.73	2.38	3.69	1.13
C6	0.33	-0.40	0	0.33	0.33	0	0	-0.74	0.66	0.51	1.36	-0.34
C7	0.26	0.26	0	0.26	0.26	0.26	0	-0.74	0.53	1.09	1.09	1.09
C8	-0.54	-0.40	0	-0.53	-0.53	-0.60	0	0	-0.80	-3.40	-7.53	0.73
C9	0	0	0	0	0	0	0	0	0	0	3.44	-3.44
R	1.37	0.58	0	1.25	1.31	0.85	0	-4.13	3.44			

V. Conclusion

In Today’s World, institutionalization is a process which companies need perform successfully for the long life cycle. This process became complicated to manage well because of the complex system structure. To eliminate this problem, all concepts which effect on institutionalization should be managed systematically. It is aimed to convert the interaction variables between concepts that are defined as linguistic values into numerical values using FCM. Thus, organizations know the relationship between the concepts as numerical and will get to the achievement of institutionalization easily. In this study, it is determined nine concepts for institutionalization analysis. Institutionalization Tendency (C9) is the output concept of the model. Firstly, it is revealed the map of institutionalization with consensus by three experts. And then each of the experts expressed causality between concepts as a linguistic value according to the direction of the arrows on the map. The linguistic variables of each causality are determined as in [4]. Then numerical values are obtained using COG. The weight matrix has been established with numerical values. Thus, it is clearly seen that Knowledge Management and Strategic Management are most important concepts that effect to the institutionalization. Nepotism has negative effect on the institutionalization. It is revealed that the results found in this paper have parallels with other studies in this area. FCM is sufficient method for institutionalization analysis. It is understandably seen that FCM is an important technique which is aim to indicate complex system structure graphically.

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