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PRIORITIZING THE KEY COMPETENCE EXPECTATIONS OF EMPLOYERS FROM THE UNIVERSITY GRADUATES – A FCM'S PERSPECTIVE

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ABSTRACT

Association of American Colleges and Universities (AACU, April 2013) carried out a survey on Employers' expectations from the University students. It revealed that 93% of employers agreed that "a candidate's demonstrated capacity to think critically, communicate clearly and solve complex problems is more important than their undergraduate major". An AACU President Carol Geary Schneider described that colleges ought to stop narrowing their curricula and to prepare the students up to the employers' necessitate. Another National Not for Profit Survey conducted by Mission Australia (March, 2013) released that a willingness to learn and "mould-ability" are seen as key advantages of employing young people, but a perceived lack of qualifications and poor reliability are turning many employers off. The present study aims two aspects

(i) To analyze the Competencies / skills expectations by the employers from the University graduates

(ii) To prioritize the key competency (or) finding the skill which has more impact on the other skills.

To achieve the above goals, the present study uses Fuzzy Cognitive Map (FCM) an effective tool. FCM helps the decision makers to understand the complex dynamics between a certain strategic goal and the related factors. To identify, analyze and to prioritize the factors (skills needed) FCM is built and then analyzed. Two cases as simple FCM and weighted FCM are considered. Comparative studies with relevant examples are done to show how the factors affect the CEEFUS study.

Keywords : Fuzzy Cognitive Map, Employers' perspectives, Undergraduate Students' skills / Key Competencies, Simple FCM, Weighted FCM.

1. INTRODUCTION

In today's job market scenario, the correlation between employees' competencies and productivity (Buchel, 2002), the increasing demand for new / updated qualifications and the desire of employers to intensively use new technologies determined important shifts on the European labour market. Leaded by technically oriented professional managers (Meiers, 2000), modern companies are rapidly updating their technologies in the context of shorter product life cycles in order to become more market drives (Yang, 2005), smarter and able to respond quicker and better to new customer needs.

Competencies represent learning outcomes and are assessed by companies through HR frameworks that are usually evaluating employability skills, capabilities and key competencies. To gain a good set of employability potentials, various studies undertaken and revealed key competencies needed by the graduates to satisfy employers.

Table 1:Literature review on CEEFUS study.

Sl. No.	Study	Identified key competencies / employers' expectations	Findings
1.	Qunxiang, China & China (2010) Burch Devrim Ictenbar, Hande Eryilnaz (2011)	Knowledge – Professional, Practical, Operational Skills – Result oriented, Strong negotiation skill, Communication skill, Leadership, Intercultural competence, Multiple tasking, Flexibility in working with multi-national, multicultural environmen Spirits – High achieves, Career driven, Self-discipline, Open minded, Team player	Evaluated the effectiveness of teaching methods in terms of meeting employers' need. Especially, the most effective teaching methods are found as lecture, case study and project work. Using Quality Function Deployment (QFD) technology.
2.	Maria del Carner Aguilar Rivera, et al., 2012	Interpersonal skills, capacity for teamwork, dealing with people, responsibility effort and willingness to learn, education, the level of training and experiences	Mentioned core skills/competencies are becoming increasingly necessary in a changing society where demands are being constantly reformulated.
3.	Marelli (1999)	Knowledge, skills, abilities and attitudes	To adjust employability, individuals must have certain social / cultural attributes that qualify them better for their working life.
4.	Fernandez, 2007 : 43	Communication, interpersonal, problem-solving skills, organizational and process management skills and management of one's own knowledge according to the requirements of the job	They are a set of essential skills to learn and perform effectively in the work place.
5.	Brunner, 1999	Generic competencies (not related to a specific profession), transverse competencies (necessary in all kinds of jobs), transferable (they are acquired through systematic teaching and learning processes), generative (they allow a continuous development of new skills) and	The mentioned competencies are important based on the new work scenarios such as high labour mobility, increased skills requirement, a high-demand for self employment and the new ways of recruitment and working.

		measurable competencies (acquisition and performance can be evaluated rigorously)	
6.	Ying-Ju Pan, Rung-Sheng Lee, 2011	Foreign language ability, computer literacy, application of theory to work and stability and pressure resistance.	Employability is not only associated with employment processes but also related to academic publication of graduate students
7.	Codrin Chiru, 2012	24 competencies, (which are used in this paper)	Universities / academics need to improve their existing curriculum through enhancing competencies.
8.	Yahya (2005)	Cooperating with others, team spirit, loyality integrity, follow-up, interaction	The elements of employability skills are always integrated in the agricultural vocational education programs in vocation agricultural industry.

According to the current study (Codrin Chiru, et al., 2012), 24 factors were identified on key competencies. This study considers these key competencies as factors. The goal of prioritization of CEEFUS factors is prepared by Fuzzy Cognitive Map (FCM). FCMs are fuzzy structures that strongly resemble neural networks. These structures have powerful and far-reaching consequences as a Mathematical tool for modeling complex systems (Vasantha Kandasamy & Smarandache, 2003). We consider two cases as Simple FCM and Weighted FCM for analysis and illustration. In the case 1, expert determines simple values as {-1, 0, 1} for connections. By this approach, decision maker can study how determined factors affect on goal. A hidden pattern is identified by this case. In case 2, expert determines weighted values as [-1, 1] for connections. By this case, decision maker can analyze model sensitivity by changing factor values. In addition the FCM matrix can be used usefully for clearly measuring the composite effects resulting from changes of multiple factors. (Ghaderi, S.F., et al., 2012)
This article is organized as follows : Section 2 presents a foundations of FCM. Section 3 explains the methodology of FCM adopted here. Identified key factors are given in section 4. Modeling of defined problem is given by section 5. Experiments and results are presented in Section 5. Concluding remarks are drawn in Section 7.

2. FCM FOUNDATIONS

FCMs are fuzzy structures that strongly resemble neural networks. The FCM can handle the unsupervised data. The FCMs work on the opinion of experts. The main advantage of this method is its simplicity.
In 1986, Bart Kosko introduced Fuzzy Cognitive Maps (FCMs) (Kosko, 1986) as a tool to model and analyse causality in qualitative systems such as social, economic or political systems. In his following works, Kosko switched the focus of FCM towards modeling the dynamics of those systems (Kosko, 1992, 1993). FCMs are fuzzified CMs. Axelrods' pioneering work on Cognitive Maps (CMs) (Axelrod, 1976) introduced a graphic way to express real world qualitative dynamic social systems from the view point of such decision makers. CMs are nothing but graphs in which vertices representing concepts (the entities that are relevant for the system in question) and edges representing the relations between those concepts. For several years CM analysis was simply structural and consisted in methods to expect information based on the way the concepts were interconnected (Laukkanes, M., 1992 ; Laukkanes, M., 1998). These methods were based on positive / negative causal influences, and essentially allowed the identification of key concepts in the modeled system.
FCMs are fuzzy signed directed (Bhaderi. S.F., 2012) graphs with feedback. There are many causal feedback loops in FCMs. This graph is composed nodes and edges. There are concepts like policies, events etc. as nodes and causalities as edges (Vasantha Kandasamy & Smarandache, 2003). The graph represents causal relationship

between concepts. The directed edge e_{if} from causal concept C_i to concept C_j measures how much C_i causes/influences C_j. The edge can be signed as follows : If increase (or decrease) in concept C_i direct to decrease (or increase) in concept C_j then causality between two concepts is negative. If increase (or decrease) in concept C_i direct to increase (or decrease) in concept C_j then causality between two concepts is positive. If Ci does not influence Cj in any way means there is no causality.FCMs with edge weights or causalities from the set {-1, 0, 1} are called simple FCMs. In simple FCMs, edges can be signed as follows :

Positive causality is signed by $e_{ij} = +1$

Negative causality is signed by $e_{ij} = -1$

Non causality is shown by $e_{ij} = 0$

By simple FCMs, a quick first approximation is given to an expert stand or printed causal knowledge (Vasantha Kandasamy & Smarandache, 2003). The adjacency matrix (or) connection matrix of the FCM is defined by $E = [e_{ij}]_{NxN}$, N denotes number of concepts.

3. FCM METHODOLOGY

An expert can use the adjacency matrix to list the cause and effect relationships between the nodes. In a FCM, instantaneous state ($A = [a_{ij}]_{1xN}$) indicates the ON-OFF position of the node at an instant.

If a_i = off ; then $a_i = 0$

If a_i = on ; then $a_i = 1$, for $1 = 1, 2, . . . , N$.

An FCM with feedback has cycles. Cyclic FCM possesses atleast a directed cycle and acyclic FCM does not possess any directed cycle. Dynamical systems is an FCM with feedback, in this systems causal relations flow through a cycle in a revolutionary way. The equilibrium state for this dynamical system is called the hidden patterns. If the equilibrium state of a dynamical system is a unique state vector, then it is called a fixed point. The algorithm for performing FCM is given as follows based on (Vasantha Kandasamy & Smarandache, 2003).

Step 1 :	Read the input vector A(t).
Step 2 :	Give the connection matrix, E.
Step 3 :	Calculate the output vector $O(t) = A(t) * E$.
Step 4 :	Apply threshold to output vector $O(t) \equiv A(t + 1)$.
Step 5 :	If $A(t + 1) = A(t)$, stop
Step 6 :	Else go to step 1.

The state vectors A are repeatedly passed through the FCM connection matrix E. After each pass, concluded vector is thresholded or non-linearly transformed. Independent of the FCMs size, it quickly stays in a temporal associative memory hidden pattern of the system. The hidden pattern inference summarizes the joint effects of all the interacting fuzzy knowledge. In the run time operation, the next value of each concept is determined from the current concept and connecting edge values (Brubakes, 1996). We can infer from model by studying the final state of the iterations when there are a set of repeated patterns, then the equilibrium in the systems have been attained.

Repeating patterns can be fixed points or limiting cycles or a chaotic attractor (Vasantha Kandasamy & Smarandache, 2003).

4. IDENTIFIED KEY FACTORS

In this paper, the strategic behavior of CEEFUS is modeled and simulated based on an FCM. FCM helps the decision makers understand the complex dynamics between goals and the related environmental and cognitive factors. For the modeling, this paper considered 24 identified skills (Codrin Chiris et al., 2012) as key factors. Table 2 shows those 24 factors with their status. It must be noted that all the factors are cognitive factors .

Table 2: Identified key competencies

Node No.	Competencies (Factors)	Status
C1	Planning, coordinating and organizing	High – low
C2	ICT skills	High – low
C3	Teamwork and cooperation	High – low
C4	Ability and willingness to learn	High – low
C5	Customer service orientation	High – low
C6	Interpersonal communication	High – low
C7	Accuracy, attention to detail	High – low
C8	Problem-solving abilities	High – low
C9	Taking responsibilities, decisions	High – low
C10	Working under pressure	High – low
C11	Oral communication skills	High – low
C12	Written communication skills	High – low
C13	Field specific technical expertise	High – low
C14	Foreign language proficiency	High – low
C15	Adaptability / Flexibility	High – low
C16	Analytical thinking	High – low
C17	Working independently	High – low
C18	Initiative	High – low
C19	Achievement orientation	High – low
C20	Getting personally involved	High – low
C21	Self-control	High – low
C22	Assertiveness, decisiveness, persistence	High – low
C23	Self-confidence	High – low
C24	Loyalty, integrity	High – low

5. MODELLING OF DEFINED PROBLEM

In this study, we have modeled and simulated strategic behavior of CEEFUS based on FCM in the present job market scenario. Here , the first node can be taken as in ON position and to find its influence on the other factors.That is planning, coordinating and organizing (C1) which is a very important skill required by an employee in the context environment. Codrin Chiru, (2012) concluded that planning, co-ordinating and organizing is one of the most valuable competencies for companies.

Now the simple statuses are considered for each concept. Consider a situation that all the defined concepts are balanced for CEEFUS analysis. We figured out how any changes on each concept can change other related concepts to get balanced, and which changes can maximize the factor C1. Therefore, it is needed to find the related concepts, which are defined as connection matrix. Two cases are considered for the analyses.

5.1. Case 1 : Simple FCM

To obtain connection matrix, a domain expert is called for. He is the HR of a Software Solutions Pvt. Ltd., which recruits thousands of fresh graduates every year. For providing a simple connection matrix, an expert asked to consider three values {-1, 0, 1}.

As mentioned above, of C_i influences C_j positively (As C_i increases (decreases) C_j also increases (decreases)) then determine the component of matrix as +1. (Direct effect)

If C_i influences C_j negatively, then the value has been assigned as -1. (Direct Reverse effect)

In this way, the expert can determine any direct or direct reverse effects. However, if a concept from a row matrix did not have any direct or direct reverse effect on a concept from column, (no influence) then the component of matrix would be determined as 0. Table 3 gives the connection simple FCM matrix according to the expert opinion.

5.2. Case 2 : Weighted FCM

For the second case, the expert expected to determine a weighted connection matrix. We asked the expert to determine the relations between concepts with values from the interval [-1, 1]. Here the value $C_{ij} \in [-1, 1]$ shows that, how far the concept C_i influences C_j. For example of $C_{ij} = +0.7$ then we can conclude that the concept C_i could affect directly 70% on C_j. Table 4 provides weighted FCM connection matrix as per expert opinion.

6. EXPERIMENTS AND RESULTS

There are 24 nodes to be used and an experts opinion is obtained through two connection matrices M1, M2 which are the simple and weighted FCM matrices. [Table 3 and Table 4].

Table 3: Simple FCM connection matrix M1 = [$]_{24x24}$

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	1	0	0	1	0
2	0	0	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	0	1	0	1	1	0
3	1	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	1	1	1	1	0	1	0	0
4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1
5	0	0	1	0	0	1	0	1	1	1	1	0	0	0	1	0	0	0	1	0	0	1	0	0
6	0	0	0	0	1	0	0	1	1	0	1	0	1	1	1	0	1	0	1	0	0	0	1	0
7	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	1	1	0	1	0	1	0	1
8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0
9	1	0	1	1	1	0	0	0	0	0	0	0	1	0	1	0	0	1	1	1	0	1	1	1
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0
11	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0	1	1	0
12	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	1	0	1	0	0	1	0
13	1	1	0	0	1	1	0	0	0	0	0	1	0	1	0	0	1	1	1	1	0	1	1	0
14	1	1	0	1	0	1	0	0	0	0	1	1	1	0	0	0	1	1	1	0	0	0	1	0
15	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1
16	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
17	1	1	1	1	0	1	0	0	1	1	1	1	0	0	0	0	0	0	1	1	0	0	0	1
18	1	1	1	1	0	1	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
19	0	1	1	0	1	1	0	1	1	0	1	1	1	1	1	0	1	1	0	0	0	0	1	0
20	0	1	1	1	0	0	0	0	1	1	0	0	0	1	1	0	0	1	1	0	0	0	0	0
21	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	–1	0	0
22	1	0	1	0	1	0	0	1	0	–1	1	0	0	0	–1	0	1	1	0	1	–1	0	1	0
23	1	1	1	1	0	0	0	1	1	–1	1	1	1	0	–1	0	1	1	1	1	–1	1	0	0
24	0	0	1	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	0	0

Table 4: Weighted FCM connection matrix M1 = [ ]$_{24x24}$

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	0	0.2	0.9	0.5	0.5	0.8	0.4	0.6	0.8	0.2	0	0	0	0	0.9	0.7	1	0.7	1	0.7	0	0.5	1	0
2	0	0	0	0.2	0	0	0.5	1	0.2	0	0	0	0.6	0.7	0	0	0	0	0.6	0.5	0	0.6	0.6	0
3	0.4	0	0	0	0.6	0.8	0	0	0.4	0	0	0	0	0	0.6	0.8	0.9	1	0	1	0	0	0	0
4	0.6	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0.8	0	0.4	0	0	0	0	0	0.9
5	0	0	0.4	0	0	0.6	0	0.4	0.5	0.3	0.2	0	0	0	0.8	0	0	0	0.4	0	0	0.4	0	0.2
6	0	0	0	0	0.8	0	0	0.4	0.6	0.2	0.6	0	0.8	0.8	0.2	0	0.1	0	0.4	0	0	0	0.8	0
7	0	0	0	0.5	0	0	0	0.6	0	0	0.4	0	0	0	0	0	0.7	0.8	0	0.9	0	0.8	0	0.9
8	0.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.8	0	0.7	0	0.8	0.7	0.7	0	0
9	0.8	0	0.8	0.8	0.8	0.8	0	0	0	0	0	0	0.5	0	0.6	0	0	0.7	0.7	0.6	0	0.2	0.2	0.9
10	0	0	0	0	0	0	0	0.2	0	0	0	0	0.2	0	0.9	0	0	0	0	0	0.5	0.7	0	0
11	0	0	0	0	0.5	0.8	0	0	0	0	0	0	0.5	0.7	0	0	0.9	0	0.5	0	0	0.6	0.4	0
12	0	0	0	0	0	0.9	0	0	0	0	0	0	0.9	0.8	0	0	0	0.5	0.6	0	0.5	0	0.8	0
13	0.9	0.8	0	0	0.7	0.7	0	0	0	0	0	0.2	0	0.8	0	0	0.7	0.8	0.9	0	0	0	0.9	0
14	0.8	0.9	0	0.7	0	0.9	0	0	0	0	0.7	0.9	0.5	0	0	0	0.4	0.6	0.8	0	0	0	0.7	0
15	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0.8	0	0	0	0.9
16	0	0	0	0	0	0	0.9	0	0.8	0	0	0	0	0	0	0	1	0	0	0	0	0.7	0	0
17	0.9	0.8	0.7	0.5	0	0.6	0	0	0.9	0.9	0.9	0.8	0	0	0	0	0	0	0.7	0.7	0	0	0	0.9
18	0.7	0.7	0.8	0.9	0	0.9	0	0	0.8	0.6	0.5	0.7	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0.6	0.7	0	0.5	0.4	0	0.9	0.8	0	0.9	0.7	0.6	0.5	0.8	0	0.7	0.8	0	0	0	0	0.7	0
20	0	0.7	0.8	0.6	0	0	0	0	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0.7	0	0
21	0	0	0	0	0.5	0.8	0	0	0.9	0	0	0	0	0	0	0	0	0	0	0	0.9	0	1	0
22	0.5	0	0.9	0	0.8	0	0	0	–0.6	0.8	0	0	0	0	–0.9	0.5	0.8	0	–0.9	0	0	0	0.9	0
23	0.6	0.8	0.9	0.8	0	0	0	0	0	–0.9	0.9	0.9	0.8	0	–0.9	0	0.9	0.8	0.7	0.7	–0.7	1	0	0
24	0	0	1	0	0	0.7	0.8	0	0	0	0	0	0	0	0.8	0	0	0.8	0.9	0.9	0.9	0	0	0

6.1. Case 1 : Simple FCM

As discussed earlier, it will be shown the impact of the first factor (skill) for the CEEFUS study. Consider C1 = 1, Node C1 is hold or clamped on the temporal associative memories for recall process. Threshold signal functions synchronously update each concept after each pair, through the connection matrix E. The process is started by the population by the following vector :

$C1 = (1\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0)$

The process is continued and performed as follows :

$C1 * M1 \rightarrow C2$ where symbol '$\rightarrow$' means the resultant vector has reached threshold and updated.

$C1 * M1 \rightarrow (1\ \ 0\ \ 1\ \ 0\ \ 0\ \ 0\ \ 1\ \ 0\ \ 1\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 1\ \ 0\ \ 1\ \ 1\ \ 0\ \ 0\ \ 1\ \ 0)$

$= C2$

Now $C2 * M1 \rightarrow (1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 0\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1)$

$= C3$

Then $C3 * M1 \rightarrow (1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 0\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1)$

$= C4 = C3$

It was observed that C3 = C4. Therefore a fixed point is obtained. Thus at the end of process, we infer increase the skill of planning, organizing and coordinating will increase almost all the factors except working independently. So the first factor C1 influences all the factors except one. So, it is considered to be one of the most impactful skill required by employers.

In this manner, all the concepts can be held as 'ON' state. This proposed process can be used for analyzing complex systems like defined system in this study. Thus, the FCMs give us the hidden pattern. It should be noted that other methods do not provide these results with the unsupervised data.

6.2. Case 2 : Weighted FCM

In this case, the FCM matrix can be used for clearly measuring the composite effects resulting from changes of multiple factors.

For example, let us assume three factors changed. That is, we are going to estimate the influence of three factors together with the other factors.

Then stimulus input vector may be obtained as follows :

Stimulus Input

ICT Skills = -0.1

Interpersonal communication = 0.5

Analytical thinking = 0.9

This information can be organized into stimulus input vector 1.

Stimulus vector 1

$= (0\ \ -0.1\ \ 0\ \ 0\ \ 0\ \ 0.5\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0.9\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0)$

Therefore, multiplying this stimulus input vector with FCM matrix, a consequence vector can be obtained as follows.

Stimulus vector $i*$ weighted matrix = stimulus vector $(i + 1)$ (1)

Therefore, stimulus vector 2 can be obtained using (1) as follows.

Stimulus vector 2

$$= (0 \quad 0.21 \quad 0 \quad 0 \quad 0 \quad 0.47 \quad 0.1 \quad 0.2 \quad 0.7 \quad 0.3 \quad 0.4 \quad 0.18 \quad 0.1 \quad 0 \quad 0 \quad 0.37 \quad 0.4 \quad 0.8 \quad 0.9 \quad 0.78 \quad 0 \quad 0 \quad 0 \quad 0.49)$$

Obtained results from the last transition are shown in Table 5

Table 5. Results from Sensitivity Analysis

Node No.	**Concepts (Factors)**	**Status**
C1	Planning, coordinating and organizing	-0.01
C4	Ability and willingness to learn	0.29
C5	Interpersonal communication	0.52
C8	Taking responsibilities	0.65
C10	Oral communication skills	-0.29
C11	Written communication skills	0.61
C16	Working independently	0.58
C18	Achievement orientation	0.67
C20	Self control	0.93

$\therefore$ Consequence Vector

$$= \left(-0.01 \quad 0 \quad 0 \quad 0.29 \quad 0.52 \quad 0 \quad 0 \quad 0.65 \quad 0 \quad -0.29 \quad 0.61 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0.58 \quad 0 \quad 0.67 \quad 0 \quad 0.93 \quad 0 \quad 0 \quad 0 \quad 0\right)$$

Consequence vector shows that the changes of three factors 'ICT Skills', 'Interpersonal Communication', 'Taking responsibilities', 'Written communication skills', 'Working independently', 'Achievement orientation' and 'self control' in various statuses.

Likewise the composite effects of 'group of factors' can be discussed using weighted FCM.

7. CONCLUSION

In this study, CEEFUS Factor prioritization is done using two cases of FCM namely simple FCM and weighted FCM. Simple FCM showed that how effective factors affect on the goal. A hidden pattern is obtained in this case. Important factors that affect on strategic behavior of CEEFUS were defined. Especially the first factor is found to be one of the most important factor. All the remaining competencies required by employers were analyzed in a similar manner.

Also, weighted FCM used for sensitivity analysis of the model. In this case, the weighted FCM was used for measuring the composite effects resulting from charges of multiple factors. Consequence vector showed composite effect of stimulus input vectors on the goal.

The proposed FCM approach is capable of simulating and modeling the CEEFUS prioritization in an effective way.

REFERENCES

1. AACU Survey, The Huffington Post, by Tyler KingKade, Posted 04.10.2013, http://www.huffingtonpost.com/employers-college-graduates-educated on 3054028.html

2. MissionAustraliaSurvey,http://www.probonoaustralia.com.au/news/2013/03/employers-dissatisfied-younger-workers-survey.
3. Buchel, F. (2002). The effects of overducation on productivity in Germany – the firms' viewpoint. Economics of Education Review, 21, 263-275.
4. Meier, R.L., Williams, M.R., and Humphreys, M.A. (2000). Refocussing our efforts : Assessing Non-Technical Competency Gaps. Journal of Engineering Education, 89:3, 377-385.
5. Yang, M.Y., You, M., Chen, F.C. (2005). Competencies and qualifications for industrial design jobs : implications for design practice, education, and student career guidance. Design studies, 26(2), P155-189.
6. Vasantha Kandasamy, W.B. & Rani Kishore, M. (1999). Symptom – disease model in children using FCM, Ultra Science, 11, 318-324.
7. Vasantha Kandasamy, W.B. & Smarandache, F., (2003), Fuzzy Cognitive Map and Neutrosophic Cognitive Maps, Phonix, USA. : Xiquan.
8. S.F. Ghaderi, A. Azadeh, B. Pourvalithan Nokhandan, E. Fathi, (2012), Behavioural simulation and optimization of generation companies in electricity markets by fuzzy cognitive map, Expert systems with applications, 39, p4635-4646.
9. Kosko, B. (1986) Fuzy Cognitive Maps, International Journal of Man-Machine Studies, 24, 65-75.
10. Kosko, B. (1992). Neural Networks and Fuzzy Systems : A dynamical systems approach to machine intelligence, Prentice-Hall International Editions.
11. Kosko, B. (1993), Fuzzy thinking, Hyperion.
12. Singh T.P. (2012) "Mathematics in the Twenty first century : Fuzzy Sets & System : Issues & Challenges !" Aryabhatta Journal of Mathematics & Informatics. Vol. 4 (2) pp. 389-392.
13. Axelrod, R. (1976). The structure of Decision : Cognitive Maps of Political / Elites, Princeton University Press.
14. Laukkanen, M., (1992), Comparative cause mapping of management cognition : A computer database for Natural Data, Helsinki School of Economics and Business Publications.
15. Laukkanen, M. (1998), Conducting causal mapping research : opportunities and challenges, in : C. Eden, S. Spender (Eds.), Managerial and Organisational cognition.
16. Brubaker, D. (1996). More on Fuzzy Cognitive Maps, EDN ACCESS, 25 April.
17. Codrin Chine, Stela Georgiana Ciucheta, Gina Gilet Lefter (Sztruten), Elena Paduretu (Sandor), 2012, A own country study on University graduates key competencies. An employer's perspective, Procedia – Social and Behavioural Sciences, 46, P4258-4262.
18. Qunxiang, Z., China, L. & China, H. (2010). Applying QFD to improve the quality of teaching : taking a course of Management as an example. In proceedings of the 2010 International conference on Intelligent computation Technology and Automation, (1), P.760-999.
19. Burcu Devrim Ictenbas, Hande Eryilmaz (2011). Linking Employers' Expectations with Teaching Methods : Quality Function Development Approach, Procedia-Social and Behavioural Sciences, 28, p.568-572.
20. Maria del Carmen Aguilar Rivera, Lourdes Villardon Gallego, Manuela Alvarez Alverez, Alvaro Moro Inchaurtieta, Itziar Elexpure Albizuri, Concepcion Yaniz Alvarez de Eulate, (2012), Procedia-Social and Behavioural Sciences, 69, p.1191-1197.
21. Marelli, A. (1999). Introductional analysis y desarrollo de competencia. En vargas, F. ; Casanova, F. ; Montanaro, L. (2001) El entoque de competencies latoral : manual de formacion. Cinter for / OIT. Montevideo.

22. Fernandez, B. (2007). Competencias en la education vocationa. Calidad en la Education, No.27.
23. Brunner, J.J. (1999). Competencies de Empleabilidad. Bibliographical review. Available at http://www.geocities.com/brunner-cl/empleab.html. Last visited 9 March 2012.
24. Yahya, B. (2005) Employability Standards : Inclusion in family and consumer science middle school curriculum. Journal of career and technical education, 23, No.1, Fall, 2007-MS.18.