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Design and Development a Model to Present Practices for Implementation Cloud Manufacturing System

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Abstract

The purpose of this paper is to identify and classify the main factors implementing the Cloud Manufacturing Systems (CMS) in the internet service providers company by Fuzzy Cognitive Map (FCM) methodology. Through expert opinions, 20 main factors were identified and classified based on the importance and then a FCM approach was applied for obtaining the relationship between the factors, and all of the impact factors are outputs of expert opinion. The outcomes of the study highlighted those three factors, including customer scoring, R&D, and method development were the most important factors impressing the implementation CMSs. Present practices for implementation CMS are and the relationship between the main factors also impressing CMS by employing the FCM approach in the Iranian internet service provider company. The model obtained in this study guides the managers to identify and classify the important factors of the cloud manufacturing and finally implement it successfully.

Keywords: Cloud Manufacturing System (CMS), Readiness for change, Implementation, Fuzzy Cognitive Map (FCM).

1 | Introduction

With the emergence of the concept of globalization, the conditions for communication between people around the world have become possible and everyone can share their knowledge and expertise and benefit from it. Today, global competition in manufacturing is steadily increasing, and the use of big data drastically increases production efficiency, thereupon cloud production has been discussed [1]. Cloud manufacturing is a new paradigm in manufacturing systems and is adopted by cloud computing in the network manufacturing system [2]. Cloud manufacturing is a new manufacturing method developing by cloud computing. The Cloud Manufacturing System (CMS) is a new manufacturing paradigm to share manufacturing capabilities and resources on a cloud platform [3]. The aim is to achieve a new production paradigm that resources are integrated and optimized globally [4]. By using cloud technologies, a manufacturing task can be executed in a selection of manufacturing resources distributed around the world, and also a proper matching between tasks and resources can be achieved in order to increase sustainability and flexibility. Regarding manufacturing systems

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management, cloud technologies increase productivity, reduce the time-to-market, and can also lead to enhanced end-user experience by raising product quality. The benefits as well as the potential challenges of applying cloud computing in the three manufacturing fields defined above, are defined and analyzed in the following sections [5]. In the implementation of CMSs, the performance of the system should be monitored and measured according to standards [6]. Fuzzy Cognitive Map (FCM) is a graphical method similar to the human decision-making process and reasoning [7] and [8]. FCM models utilize skills and knowledge in the form of theories and the power and type of associations/interconnections between theories. FCM is a simple and intuitive model and shows the feedback among activities by modeling various causal connections flexibly [8] and [9].

2 | Literature Review

To develop a literature review and to identify the related criteria in the realm of research, many articles from the following academic databases were investigated. The keywords included CMS, readiness for change, implementation and FCM.

2.1 | CMS

The cloud technology offers on-demand service access and resource pooling on the computing market. Thus, it is a natural thinking to utilize cloud applications in manufacturing directly. In this type of research, computer-aided or web-based manufacturing applications are deployed in the computing cloud, which can be considered as a manufacturing version of cloud computing. These applications are implemented at two levels of the system, which matches two service levels of computing cloud, i.e. Service and Platform levels. At the Software level, production software-as-a-service is particularly suitable for small and medium-sized enterprises (SMEs) since it offers on-demand services with lower entry barriers and initial investments [10]. Manufacturing software applications, e.g. design [11], [12] and [13], visualization [14], simulation [15], [16] and [17], and Enterprise Resource Planning (ERP), were deployed on the cloud to realize remote access and flexible billing. At the platform level cloud computing technologies were adopted to support the whole supply chain [18] and [19]. Qualitative results supported the assertion that information processing requirements and information processing capability affected intention to adopt cloud computing. Multiple models were developed to examine both information processing requirements and capacity, which eventually influenced the firm's desire to adopt cloud-based supply chain innovations [20]-[23]. Cloud manufacturing aimed to share manufacturing capacities with a configurable and virtual manufacturing network [6]. Lu et al. [24] presents a hybrid structure that allowed companies to create different cloud modes to achieve periodic business goals. Wang and Xu [25] proposed a cloud-based Manufacturing system to support production service integration and interoperability. The manufacturing cloud was also extended to the remanufacturing sector for electronic wastes management. However, despite the abovementioned cloud-based manufacturing achievements, there is still a lack of research in a cloud system that can support production management as a whole solution. Therefore in this paper, the designing and developing a model to present practices for implementing a CMS is presented along with the management structure and modules.

2.2 | Readiness for Change

Understanding organizational readiness for change may be a way to develop more effective and efficient change strategies [26]. Understanding the degree to which organizational members and organizations are "ready" to implement a specific change has been suggested as a way forward. Multiple definitions and multiple instruments to measure organizational readiness for change exist [27]. A unique implementation method needs for each change program [28].

2.3 | Implementation

Implementation science has progressed towards increased use of theoretical approaches to provide better understanding and explanation of how and why implementation succeeds or fails [29].

The implementation model is a collection of components, and the implementation subsystems that contain them. Components include both deliverable components, such as executables, and components from which the deliverables are produced, such as source code files [30].

2.4 | FCM

To meet the main objective, representing casual relations between the CMS and implementation, FCM is used. FCM was invented by Kosko [31] and it is a qualitative modeling tool that shows causality association between some different variables. In FCM, nodes indicate the system concepts that are examined and edges are indicative of the causal relationships that exist between these concepts.

FCM does not represent a static version of the world. When FCM is activated with a primary vector, it may enhance the perception of the system dynamics by assessing the acquired state. Descriptions of the studied system projections are proposed by a simulation study based on a consistent series of circumstances and the assumption that model rules are left unchanged. We try to obtain insights on the prediction of a forced scenario based on the defaults which may or may not be achieved and were, thus, under considerable uncertainties. FCM involvement can perform a proactive evaluation via tests to determine how alternative scenarios based on strengthening inhibitory and mitigating actions may impact future environments on a global and transparent perspective [32].

FCM can illustrate all systems that use a model consisting of three unique features: 1) positive or negative relationships indicated by signed causality 2) causal relationship strength adopt fuzzy values 3) dynamic causal links where the impact of a change in one concept or node affects the remaining nodes. The first feature indicates the essence and direction of the causality. The second feature associates a fuzzy number or linguistic value to indicate the causality strength or association degree among the concepts. Finally, the third feature indicates a feedback technique that identifies dynamic relationships between nodes and may entail temporal connotations [33].

In this paper, to formulate the formative (sequential) links between S3C's theories, the FCM technique was used. FCM is a graphical modeling method that adheres to a reasoning method that is similar to the human decision-making process and human reasoning [9]. This model utilizes expertise and knowledge in the shape of theories and the strength and type of associations/interconnections between theories. FCM is intuitive and simple whilst including feedback among activities. It provides the means for various causal connections to be flexibly modeled [34].

3 | Research Methodology

After identification of the CMS and practices for implementation CMS concepts, the causal relationships between concepts must be formulated. Many CMS concepts are interconnected as one concept's output is the input of other concepts. The complicated interconnections among influential concepts necessitate an approach such as an analytic network process, ANP, or FCMs to design models of causal relationships. Both of the methods regard the interconnections between the activities. The ANP approach is widely known in the decision-making field and it utilizes the interrelations of concepts to determine their impact coefficient on the sustainable and smart supply chain. Nevertheless, it does not consist of feedbacks between concepts in terms of analysis [33]. The FCM method possesses numerous benefits. It is straightforward and intuitive as well as providing feedback among concepts. Furthermore, it enables several

causal relationships to be flexibly modeled [34]. Due to such benefits, the FCM method was selected for our research. In *Table 1* a comparison between FCM and other alternative methods is provided.

Table 1. Comparison between possible methodologies.

Criteria	ANP	DEMATEL	FCM
Does it show the relationship between concepts?	✓	✓	✓
Does it show the strength of relationships between concepts?	×	✓	✓
Does it show the causal relationships between the variables?	×	✓	✓
Does it show the nature of relationships (positive or negative)?	×	×	✓
Does it show the feedback between concepts?	×	×	✓

3.1 | Formulating Interrelationships Between Activities

To formulate the interrelationship among activities to be performed in an organization, we use the FCM method. FCM is a graphical modeling technique that follows a reasoning approach similar to the human reasoning and human decision-making process [31]. The FCM model incorporates the available knowledge and expertise in the form of concepts and the type and strength of the interconnections between concepts [33].

Generally, concepts reflect attributes, characteristics, qualities, variables, and states of the system. Each concept represents one of the key factors of the modeled system and has a value *vi*.

The interconnections between concepts of FCM signify the cause-and-effect relationships that a concept has on the others. These causal relationships between concepts are illustrated by weighted links connecting the nodes of the FCM. The weighted interconnections show the direction and the degree with which a concept influences the interconnected concepts [35]. Each interconnection R_{ij} between two concepts C_i and C_j , has a weight, in the interval $[-1, 1]$. The sign of the weight indicates whether the relation between the two concepts is positively correlated or negatively correlated. In [33] and [36], authors described the approach for developing FCMs analytically by considering a group of experts to define concepts and describe each relationship among concepts. Each interconnection is described by experts applying a fuzzy rule, the result is a linguistic variable, which determines the grade of causality between the two concepts. All the inferred fuzzy variables for each interconnection are aggregated and applying the defuzzification method of the center of gravity [37], and overall linguistic weight is produced. Then it can be transformed into a numerical weight R_{ij} in the interval $[-1, 1]$ to illustrate the aggregated opinion of experts.

FCM has the following advantages: direct causal representation, user-friendly approach, easiness of use, modeling dynamic systems, practicality, and low time-consuming. It has been used to model complex systems where a large number of factors exit and are interrelated [34]. The main features of FCM such as simplicity in construction, flexibility in system analysis user-friendly design, and high-level decision making, makes it very suitable to use at the front-end of knowledge engineering for the causal knowledge acquired from human experts [38].

3.1.1 | Formulating interrelationships by using the FCM method

Schneider et al. [39] develop an automatic construction method of learning FCMs which depends on expert beliefs. In this method, numerical input vectors are proposed by experts and then are transformed into fuzzy sets. The causal relations between concepts are then defined based on the distances between numerical vectors. This method has four basic steps: (a) creating the Initial Matrix of Factors (IMF), (b) creating the Fuzzified Matrix of Factors (FZMF), (c) developing the Strength of Relationships Matrix of Factors (SRMF) and (d) creating the Final Matrix of Factors (FMF).

Step 1: Construct the IMF matrix. In the first step, the importance coefficients of all effective factors are gathered from experts and a $[n \times m]$ matrix is created. Where “ n ” is some factors and “ m ” is some experts. Each element of this matrix is O_{ij} which shows the importance coefficient of related factor “ i ” which has been determined by individual “ j ”. This matrix includes “ n ” row vectors where the elements $O_{i1}, O_{i2}, O_{i3}, \dots, O_{im}$ are the components of the vector V_i associated with the column factors ($i = 1, 2, 3, \dots$). In this step, experts are asked to determine the importance of each factor in the related domain, using a scale 0–10. The number 0 means that the related factor does not influence the related domain and it is not an important factor. The number 10 shows that the factor is very important and completely influences the readiness of the related domain.

Step 2: Construct the FZMF matrix. In this step, gathered data is transformed into fuzzy sets. Firstly, two threshold values are defined. These are the “up threshold” (au) and the “down threshold” (al). The value $X_i = 1$ is assigned to the up-threshold value ($au = O_{iq} \mid X_i(O_{iq}) = 1$) and $X_i = 0$ is assigned to the down threshold ($al = O_{ip} \mid X_i(O_{ip}) = 0$). Therefore, each value more than the up threshold will be given the value 1 ($(O_{ij} \geq au) \mid X_i(O_{ij}) = 1$) and each value lower than down threshold is given the value 0 ($(O_{ij} \leq al) \mid X_i(O_{ij}) = 0$). Each element of the IMF matrix transforms to a fuzzy set and the FZMF matrix is created with Eq. (1):

$$X_i(O_{ij}) = \frac{O_{ij} - \alpha_1}{\alpha_u - \alpha_1} \quad (1)$$

Step 3: Construct the SRMF matrix. In the third step, each row vector of the FZMF matrix is compared with the other row vectors and the distance between components of each pair of vectors is computed with Eq. (2). Subscript ‘ j ’ (column) is the responder and subscript ‘ $i = 1, 2, \dots$ ’ (row) refers to factor number.

This equation should be used when the two vectors (V_1) and (V_2) are monotonically increasing (direct relation). For two vectors that are monotonically decreasing the correct equation is Eq. (2).

$$d_j = \left| X_j(V_{i-1}) - \left(1 - X_j(V_{i-2}) \right) \right| \quad (2)$$

Finally, the row average of two vectors’ components distances is calculated by using Eq. (3) to determine the relationship between the two factors.

$$AD = \sqrt{\frac{1}{m} \sum_{j=1}^m d_j^2} \quad (3)$$

once the average distance is calculated, the similarity (S) of the two-row, or factor vectors is defined as:

$$S = 1 - AD \quad (4)$$

Where $S = 1$ corresponds to perfect similarity, $S = 0$ corresponds to perfect dissimilarity between the two vectors. The amount of S is computed for each pair of factors and the SRMF matrix is created with these amounts.

Step 4: Construct the FMF matrix. In the final step, the experts are asked to confirm that the cells of the SRMF matrix refer to sensible relationships – which means that there is a good practical reason why the relationship exists. Cell values that are not sensible are eliminated and the final matrix is created. The basic reason for the elimination of some elements of the SRMF matrix is that the elements of the SRMF matrix resulted from mathematical calculation, while in the real world the factors may not have an actual relationship. Therefore, some cells need to be eliminated so that the final matrix of relationships reflects the true physical situation.

At the initial stage, we identify activities and after identifying main activities we find relationships between them. We want to use a team of experts to determine these relationships. Also, the expert team includes department managers of companies that want the implementation of a CMS. Cloud manufacturing consultants are university academics who work in the area of CMSs. Salmeron used the Delphi method for FCM construction [40]. The Delphi method was expanded in the rand company during the 1950s [41]. It is a recognized method for achieving experts' consensus about a complex problem. The Delphi methodology application to FCMs is applied to estimate measures of the intensity and sign of the influence of employing consulting a team of experts [42]. In the Delphi method, experts can receive feedback reports and change their initial opinion based on this feedback and this is an important feature of this method [43]. The first step in the Delphi method is to define the problem and its details. In the second step, experts will be selected and then the designed questionnaire will be distributed among the specialists. This process is repeated until a reasonable consensus of experts is reached [44]. *Fig. 1* shows these steps in the base algorithm, there are two data collection steps before FCM construction. These steps and model validation are shown in *Fig. 2*.

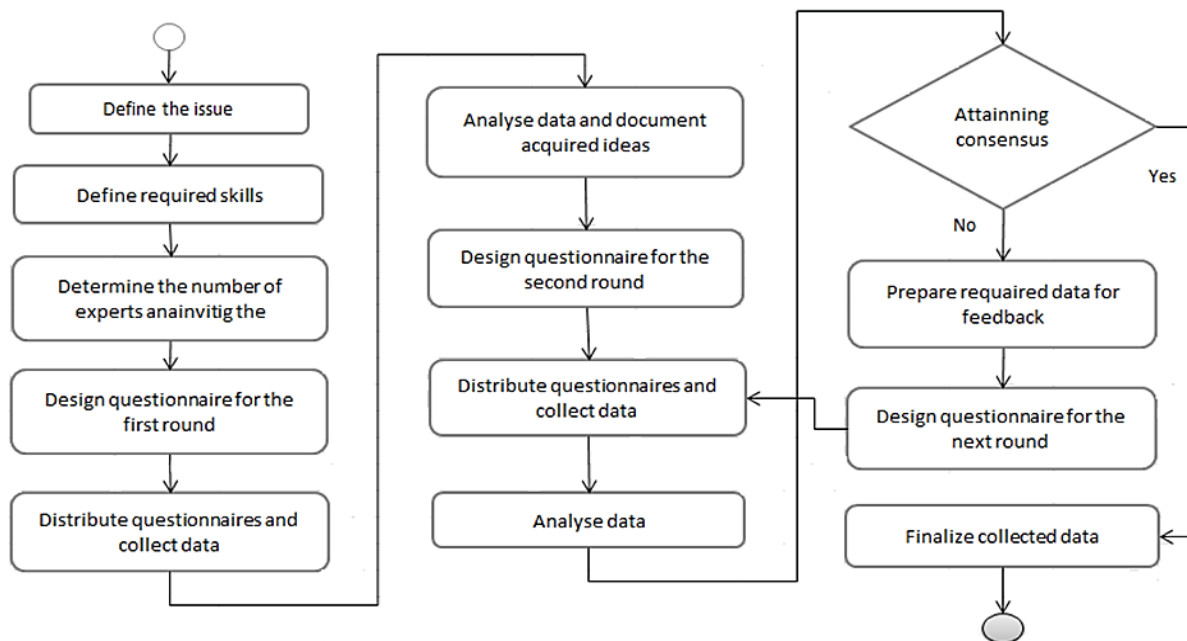


Fig. 1. Process of data collection and analysis [8].

Fig. 2 also includes the model validation.

In this paper, at the beginning, the most suitable instances of cloud manufacturing and implementation management dimensions were determined by the literature review. *Table 2* presents a concept list used to assess the cloud manufacturing and implementation. Data was collected from interviews with experts who were familiar with the cloud manufacturing. The experts were asked to specify the relationships among concepts and make expert opinions on a seven-point Likert scale where each item ranged from 1 "strongly disagree/not at all" to 7 "strongly agree/fully applied or developed."

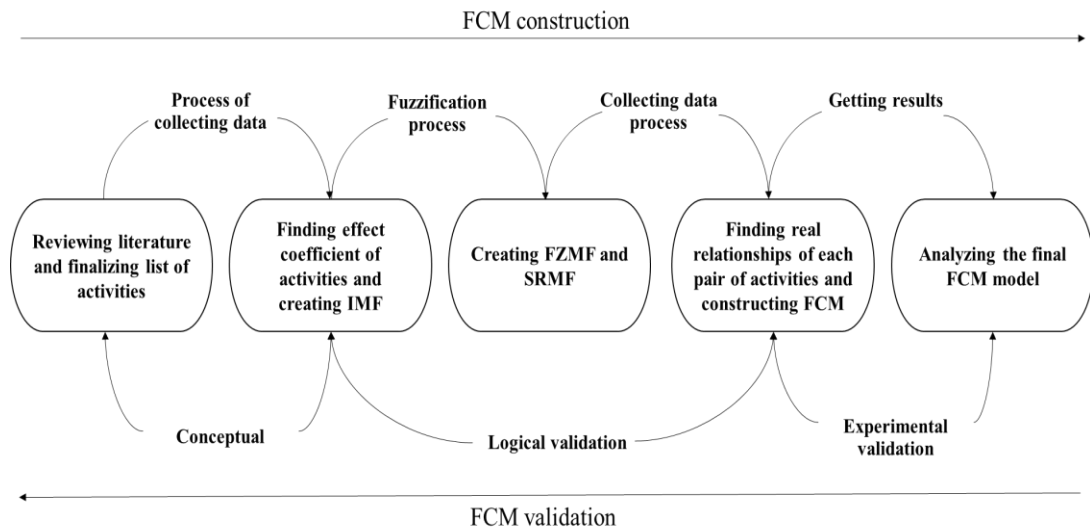


Fig. 2. Summary of FCM construction and validation [8].

Table 2. List of concepts used in the CMS.

Group variable	Concept	Concept description
Strategic management	C1	Strategy development
	C2	
	C3	Organization development
	C4	Mergers and acquisitions
	C5	Manage care business
	C6	Innovation and technology management
	C7	Internals management
	C8	Strategic business initiatives
Customers Relationships		Business concept
	C9	Customer management
	C10	Contact management
	C11	Customer scoring
	C12	Order management
	C13	Complaints management
	C14	SLA management
Product and service development	C15	Engineering
	C16	Quality management
	C17	R&D
	C18	Requirement's definition
	C19	Method development
	C20	Product and services delivery

The participants were ensured that their answers would be confidential. Anonymity allows the experts to express their opinions freely, encourage openness, and avoid admitting errors by revising earlier forecasts.

3.1.3 | Achieving consensus

Distance-based algorithms as non-parametric methods are able to classify criteria. With applying these algorithms, experts can generate the final matrix of factors in terms of their idea and consequently can achieve results on expert ideas. Two methods of achieving a final matrix of factors have been developed by Salmeron [45] and Mkrtchyan and Ruan [46].

The first algorithm the final connection matrix is developed by calculating the average of all proposed relationships. The final matrix in this method is called the augmented matrix which is given the symbol W_{ij}^{Aug} . Each element of this matrix is denoted by W_{ij}^{Aug} . The cell values of this matrix are calculated by Eq. (5).

$$W_{ij}^{Aug} = \frac{\sum_{k=1}^m W_{ik}^k}{m} \quad (5)$$

where m is the number of experts and k refers to expert number k . The second algorithm is called the belief degree-distributed method. This algorithm is almost the same as the previous method but includes weights for each expert. The final matrix of factors is then constructed using Eq. (6).

$$\beta_{ij} = \frac{\sum_{k=1}^m W_k \cdot \beta_{ik}^k}{\sum_{k=1}^m W_k} \quad \forall i, \forall j \quad (6)$$

where m is the number of experts, and $W_k > 0$ is the weight of expert k . β_{ij}^k is the cell value of expert k . In this study the weights of all experts are the same. Consequently, the first method of generalizing consensus has been used to create a final matrix of factors and construct the final FCM model.

Table 3. The respondents' demographic details.

Relevant Dimension	Profile	Relevant Dimension	Profile
Gender of respondents	85% Male 15% Female	Qualifications of respondents	15% Undergraduate 85% Undergraduate
Job positions of respondents	25% Middle- level 75% Senior- level	Age of respondents (years)	25% between 25 and 30 50% between 30 and 40 25% > 40
Number of employees	40% >1000 15% <200 15% between 200 and 399 30% >400	Experience of respondents (years)	35% between 5 and 9 40% between 10 and 14 20% between 15 and 19 5% > 20

Before sending the questionnaire to the experts, to verify the validity of the content in the questionnaire, to guarantee that questions measure the correct factor, Content Validity Ratio (CVR) is applied, which is presented as a quantitative index for assessing content validity. The CVR process begins by selecting an expert panel to review survey questions to assess how questions represent the factors. For this purpose, a poll is presented to ask experts' opinions regarding the factors. Thus, the necessity of the questions is determined by the experts. The panel of experts consisted of 10 members including professors and researchers in the cloud manufacturing area. These experts possess a deep perception of the subject and all of them have Iranian nationality. The survey results were utilized to create the initial matrix.

$$CVR = \frac{n_e - \frac{n}{2}}{\frac{n}{2}} \quad (7)$$

thus, n indicates the total number of panel experts. But n_e does not denote how many panels agree with the subject.

After obtaining the CVR index Table 4 is used to interpret CVR that can lead to accept or reject a question. Some questions in the main questionnaire were eliminated based on CVR results and the remaining questions are reviewed. This panel consisted of 10 members. Thus, each question with a below 0.59 CVR index was revised or eliminated from the questionnaire [47].

Table 4. Minimum CVR vs number of experts in the panel.

Number of experts in panel	5	6	7	8	9	10	11	15	20
Minimum CVR to accept the question	0.98	0.88	0.72	0.68	0.63	0.59	0.45	0.39	0.30

4 | Results and Discussion

We design influence matrix in graphical form a, FCM graph for practices implementation CMS in internet service provider companies. FCM was created as a simple tool for analysis, based on Excel and VBA, and was made available for non-commercial use on the Internet. At first, FCM calculate all in indices. Then, dynamic simulations are conducted. Finally the matrix coded FCMs is turned into displayable files. Further analysis was carried out using network analysis software. To anticipate the maps, the FCM and Pajek were used and as an example, *Fig. 3* depicts the graphical form of similarities regarding common factors among case studies and single maps. The aggregated or single maps, their size, and the quantity of case study or map factors are shown as circles. The network has been shown in terms of a visual map in *Fig. 3*. The created aggregated network upon individual post-processing maps consists of 20 variables and 380 network connections. Negative connections (negative w_{ij}) were presented using segment lines. Positive connections (positive w_{ij}) were presented using solid lines. The variables were organized into eight groups based on thematic issues: (1 Strategic Management; 2 Customer Relationship, (3 Product & Service Development.

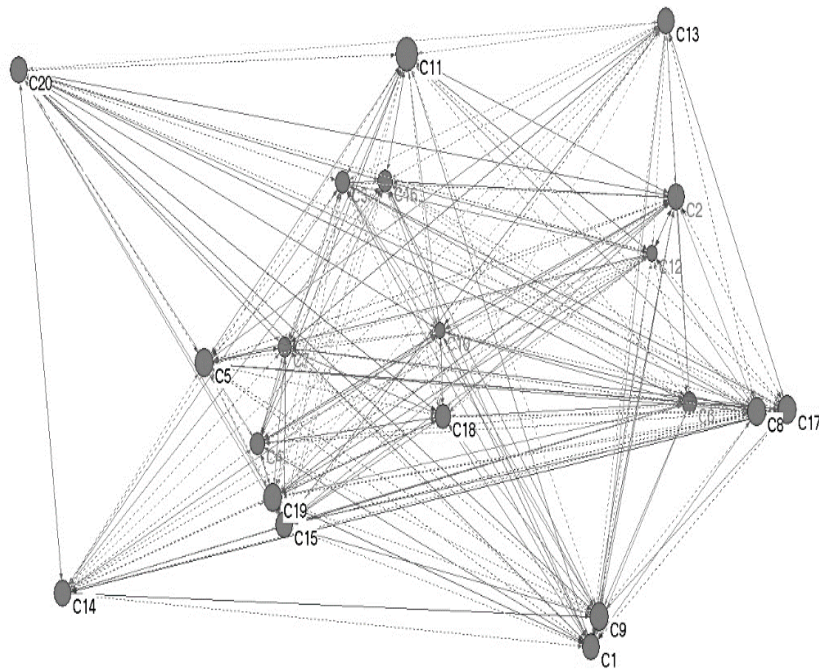


Fig. 3. Graphic visualization of the practices for implementation CMS: Solid arrows represent positive relationships and line segment arrows represent negative relationships.

The potential connections within a network are described as network density; indeed, the actual connections. A “potential connection” is a connection that could potentially exist between two “concepts” – regardless of whether or not it works. Network density indicates the correlations between the existing concepts. The density index for the network is 0.9. This means that from the 20 concepts, 90% of the potentially existing concepts are made. To illustrate, the network was further aggregated in the form of three group variables shown in positive terms. For example, Procurement & Logistics (see *Fig. 3*). Generally, based on the purpose of stimulating, cloud manufacturing, a higher density is assumed to be a favorable network property. Although the 20 concepts aggregated network may be arduous to visualize, regarding the conclusions obtained by its analysis and the insights gained by the scenario development, it has more potential. Therefore, the original aggregated network with 20 concepts was used for further

analysis. Fig. 3 provides a comparison of the various indicator centrality levels and out-and in-degrees for the ones with significant C_t value. To compare, Fig. 4 presents the indices relative to maximum centrality (C_t max) 69.56 observed inefficiency which shows that from the stakeholder's perspective, this is the most strongly connected variable. Generally, the R&D variables (group 3) have more centrality. The high C_t of some elements, namely organization development, is because they have a relatively high out-degree index, i.e., they have a high level of impact on other elements of the network. Contrarily, other network variables such as order management have high centrality because of a high in-degree index. Therefore, cost has a vital role in implementing cloud manufacturing in internet service providers companies due to its high sensitivity towards changes within a large number of other network variables.

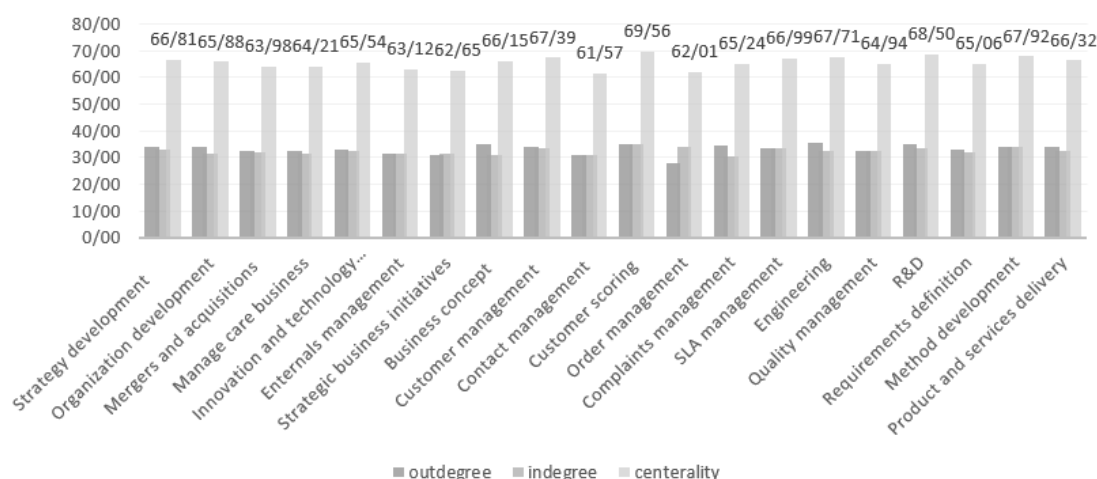


Fig. 4. Network indices: out-degree (O), in-degree (I) and centrality (C_t) = O + I.

4.1 | Scenario Analysis

Scenario simulation in a development program can help players analyze different aspects of the studied problem [42] and [48]. Scenarios provide us a complete description of a possible future condition based on a network of affecting factors [43]. Scenarios simulate the future by making it easier to think and make decisions. The future is predicted by studying several different scenarios to extend the realm of experts think [49]. Therefore, a series of reasonable future can be achieved [50]. The extent of the change in each element of the network has been tested for the three scenarios, as well as for the combined scenario (see Table 5). A description of the results of each scenario has been presented in terms of the potential of reaching practices for implementation CMS.

I.C.M.S.: Implementation CMS: +, a positive change is desirable; −, a negative change is desirable.

Network characteristics: OD, out-degree; ID, in-degree, CT, centrality.

Scenario A includes strategic management. In this scenario, we consider new strategies and innovations in management methods. This approach enables faster identification of organizational strengths and weaknesses and evaluation of information systems performance, thus increasing the efficiency of the cloud system.

Scenario B provides customers with a wide range of information on demand, sales, orders, and customer satisfaction, thus enhancing the quality of our products and services and creating a smart customer information system. Get a lot of information from customers and use it to discover customer behavior patterns and make informed choices.

Scenario C emphasizes the role of research and development of the services, and measures needed to create optimal quality in internet service delivery. For example, R&D is one of the key factors in implementing a cloud system that is highly centralized to other factors.

Table 5. Complete list of variables and main results of the FCM scenario and network analyses.

ID	Factors	Scenarios			ICMS	Network		
		A	B	C		OD	ID	CT
Group 1								
1	Strategy development		0.897490	0.885707	+	33.96	32.86	66.81
2	Organization development		0.919113	0.958373	+	34.24	31.64	65.88
3	Mergers and acquisitions		0.940067	0.986642	+	32.24	31.75	63.98
4	Manage care business		0.944040	0.986416	+	32.6	31.62	64.21
5	Innovation and technology management		0.934408	0.975901	+	32.87	32.67	65.54
6	Internals management		0.910289	0.943165	+	31.64	31.47	63.12
7	Strategic business initiatives		0.873052	0.858142	+	31.16	31.5	62.65
8	Business concept		0.829696	0.739039	+	34.97	31.17	66.15
Group 2								
9	Customer management	0.940067		0.957672	+	33.8	31.17	67.39
10	Contact management	0.944040		0.989297	+	30.79	30.78	61.57
11	Customer scoring	0.934408		0.983637	+	34.79	34.78	69.56
12	Order management	0.910289		0.972753	+	27.76	34.26	62.01
13	Complaints management	0.873052		0.968059	+	34.7	30.55	65.24
14	SLA management	0.829696		0.971955	+	33.6	33.4	66.99
Group 3								
15	Engineering	0.948081	0.897308		+	35.39	32.32	67.71
16	Quality management	0.977129	0.947851		+	32.57	32.37	64.94
17	R&D	0.981218	0.966959		+	34.79	33.72	68.5
18	Requirements definition	0.984637	0.977655		+	32.88	32.18	65.06
19	Method development	0.986038	0.983759		+	33.98	33.94	67.92
20	Product and services delivery	0.985334	0.986763		+	33.98	32.34	66.32

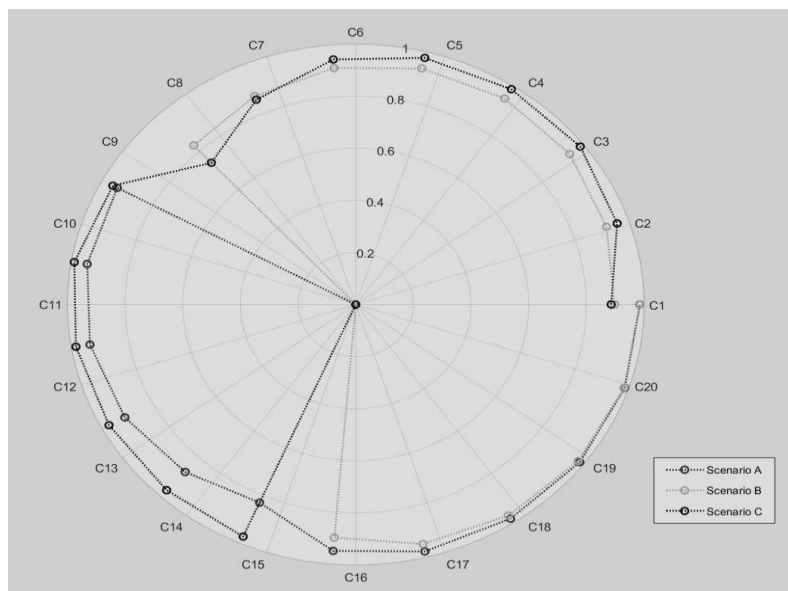


Fig. 5. Scenario chart and scenario ranking.

A comparison of the results of the FCM scenario is presented graphically in Fig. 5. This provides valuable information for CMSs executives. Also, the graphical figure shows which scenarios are more effective and which ones should be highlighted. Using product and services development in CMSs, the third scenario plays the most crucial role in making implementation CMSs.

5 | Conclusion

Successful implementation of a CMS depends on the organization's management practices to achieve a proper level of readiness for the CMS. In this paper, we have presented a new model approach for managing present practices in implementing a CMS. This approach makes new conceptual and methodological contributions for addressing key issues in achieving practices for CMS implementation. The approach has three methodological advances:

- It can model causal relationships between practices during the assessment process.
- It can handle comparative judgment to determine how much each factor contributes to the overall readiness of the implementation.
- It can identify the main factors for the implementation of CMS in each organization.

As a practical study, we have applied the approach of the practice to an internet service provider company and demonstrated how the overall prospering of the company can be assessed, designed, and developed. We have demonstrated how this approach can help successfully implement a CMS in an organization with identifying the main practices which are required for managers and assessing the degree of importance of each factor related to prospering.

The performed studies on this research area confirm that the perposed model can be implemented in other companies such as production services. Therefore, the result of the perposed model can be compared with the results of the performed studies. Besides, presenting a model for prioritizing strategies to improve the readiness of companies based on the results of readiness assessment and the development of appropriate quantitative indicators to assess the readiness factors can be considered in future research.

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