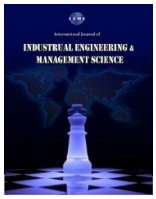
University of Hormozgan

International Journal of Industrial Engineering & Management Science

journal homepage: www.ijiems.com



Evaluating the Key Factors for the Success of International Data Transit

Ehram Safari [a,*], AlirezaYari [a]

[a] *ICT Research Center, Tehran, Iran*

ARTICLE INFO

Article history:
Received: 2021-06-22
Received in revised form: 2021-08-22
Accepted: 2021-09-14

Keywords:
International data transit
Fuzzy cognitive mapping
Key successful factor

ABSTRACT

Access to international cable systems (often submarine) or satellite systems and manage incoming and outgoing international voice, and data traffic is provided by connecting national networks to regional and global systems. In this connectivity provided through the international gateways in each country, there is a capacity to transmit data between different countries or points outside the country to help this overall connectivity called data transit. In this paper, we will evaluate the key factors that lead to the success of data transit. Fuzzy cognitive mapping is used for this purpose. The statistical population of this study is selected from experts and professors in the field of telecom capacity. In the first step, the key success factors are identified based on the opinions of 15 experts and then based on four initial impact matrices, fuzzy impact matrix, impact power matrix, and the final effect matrix, and Mental Modeler software creates the fuzzy cognitive mapping.

1. Introduction

Numerous and redundant international links connect most developed countries, often available at Internet Exchange Points (IXPs) to deliver Internet traffic to national infrastructure operators. Backhaul then connects between international gateways and access networks, which provide end-users with Internet services. Thus, if a country were to be disconnected from international Internet transit for data traffic, its Internet users would still access the online content produced and hosted in their own country. However, local Internet service providers have the facilities and capabilities to exchange traffic between themselves through a local IXP [1].

Iran's unique geographical location can shorten the route to Europe, where most servers from different countries are located, significantly reducing the delay in receiving and sending information. An essential competitor for transmitting and receiving data for the region's countries is the route in the Persian Gulf, which connects to Europe through the Suez Canal. Offshore routes face fundamental problems such as high maintenance costs, long routes, and lengthy troubleshooting that the onshore route in Iran solves these crucial problems. Of course, it should be noted that the existing path in Iraq can make Iraq a severe competitor for Iran. However, safety issues in Iraq create an opportunity for Iran to become more active in this area. Today all incumbent telecom companies or some newborn international telecom companies provide different services to help the international connectivity such as IP transit, capacity transit, bandwidth MPLS, VPLS, colocation (space rental), peering services, Switching (IXP), Dark Fiber, Equipment Maintenance.

To help the success of international connectivity worldwide, there is a process of restructuring the international gateways and opening the market for service providers [1]. Although opening the international gateway will help the competitive status in Iran's market, it will bring the market price of international transit at a meager price; therefore, the main goal is to restructure the service provider in Iran, not the international gateways. To succeed in this field, Iran needs to identify the factors that make it successful in this field and increase its chances of success by

* Corresponding author.
E-mail address: e.safari@itrc.ac.ir

focusing on them. This study intends to examine the current situation in Iran, identify the key success factors, obtain the interactions of key success factors by applying fuzzy cognitive mapping, prioritize them and finally, Examine different scenarios. In other words, this research seeks to answer the following questions:

• What are the key success factors in Iran's international data transit?

• What are the priorities and interactions between key success factors based on fuzzy cognitive mapping?

• What scenarios can be considered about the selection of different key factors?

In this article, after this section, the research background in international data transit, key factors for success, and fuzzy cognitive mapping are examined. First, the key factors for success in the international data transit sector are presented. In the next section, the research method is fully explained. In the next part, the research is performed based on the fuzzy cognitive mapping method. The last section is dedicated to analyzing the results and reviewing different scenarios.

2. Literature review

In this section, an attempt has been made to provide the literature review related to the key factors of success and fuzzy cognitive mapping. However, studies show that in none of the reviewed articles, the subject of the present research has been studied. We also reviewed the Scopus and WOF databases and concluded that no research had been conducted on the subject of international data transit.

The concept used for the critical factors of success dates back to the 1960s when Dr. Daniel first proposed it. According to Rockart, the critical success factors are several limited areas that will guarantee the desired results to ensure the organization's competitive performance.

In other words, the critical factors for success are the critical areas in which the organization's operations need to be performed well in order for the business to thrive and for managers to achieve their goals and objectives [1]. Ali identifies the critical success factors as possible events or happenings that can affect the organization positively or negatively and, as a result, require special attention [2]. In another definition, the critical success factors and the key success factors are considered equivalent. These factors are defined as the ability or resource in which the organization can invest and make a significant difference in the value received or relative costs of the organization compared to other organizations [3].

Most research on key success factors is usually related to identifying and evaluating key success factors that prioritize key success factors. In the following, some researches in this field will be presented. Li et al. Proposed a method for identifying critical success factors in emergency management, and the Demetel method was used to determine the relationship between factors. The results showed that the proposed method could improve the effectiveness and efficiency of the entire emergency management [4]. Huang and Lai examined the key success factors for knowledge management in the life insurance industry using structural equation modeling techniques [5]. Subramaniya et al. focused on identifying critical success factors using the TOPSIS method for the textile industry [6]. Raut et al. examined the critical success factors for cloud adoption in small and medium enterprises in India through a comprehensive review of the literature and expert opinions [7]. Alreemy et al. examined and identified the factors contributing to the successful implementation of IT governance [8]. Lee and Park examine the impact of R & D on successful innovation in the Korean interface. It divides the data based on two main criteria - the type of innovation (product versus process innovation) and the source of innovation (demand - elasticity versus technology pressure innovation) [9]. Saavedra et al. used fuzzy cognitive maps to model, analyze, and prioritize key success factors to decide on a resettlement plan for an Ecuadorian city. The results show that prioritizing basic information, citizen participation, and compensation factors for the success of the housing project have improved the decision-making process [10].

Axlerd formulated Graph theory-based cognitive mapping as a complex structure for evaluating social relations. Cognitive mapping is a method used for modeling complex systems and identifying cause-and-effect relationships between them. Therefore, it has been used in various technical and social sciences. Given that cognitive mapping involves the views of experts about mental reality [11]. Therefore, Kandasamy [12] introduced cognitive mapping with fuzzy weights, considering the power of fuzzy logic quantification. Fuzzy cognitive mappings are fuzzy graph structures to show causal relationships that show the degree of a causal relationship between concepts with a number in the range [-1,1]. Fuzzy values in addition to being used to express the intensity of the relationship between variables, also indicate the direction of the relationship. To analyze a cognitive map, we can count the number of variables and the number of connections; But graph theory gives us more indicators in addition to the number of variables (concepts, statements) and connections (relationships, links) [13]. Therefore, the type of map variables is essential; because it shows how variables work concerning other variables. Also, various variables in a cognitive map make it easy to understand its structure (Hedge and Harry, 1983). There are three types of variables: sender variables, receiver variables, and regular (central) variables. These variables are defined by their output and input degrees.

The output degree of the sum of the absolute values of the variables in the adjacency matrix indicates the cumulative ability of the relationships outside the variable. The input degree is the sum of the columns of the absolute value of the variables and shows the cumulative ability of the relationships entered in the variable. The centrality (total effect) of the algebraic sum variable of its input degree (input arrows) and its output degree (output arrows) is variable. Centrality represents the contribution of each variable to the cognitive map. It shows how one variable is related to other variables and how cumulative the capacity of these connections is [14].

3. Research methodology

This research is an applied-descriptive study that uses fuzzy cognitive mapping (FCM) method for data analysis. This method can model the complexities of a system and provide decision-makers with a clear view of the impact of each system component on each other. FCM is a type of mapping to represent the beliefs, ideas, perceptions, and interpretations of a situation based on the knowledge and experience of the individual or group and can be expressed with two components; concepts and causal relationship between concepts. A node or concept represents an entity of the system under consideration. Causal

relationships between concepts can be demonstrated using a weighted directional edge, a fixed static value, or a fuzzy value. Studies by Rodriguez-Repiso et al. [16] show that the FCM method performs better than the AHP method and the critical success chain method. One of the crucial advantages of FCM becomes apparent when the researcher does not have a proper understanding of the problem and, by increasing experience and clearing up ambiguities, can easily add new concepts and no longer need to repeat the problem from scratch. Describe and represent. This method can also provide a very strategic view of the concepts and help the analyst provide comprehensive and penetrating analysis.

In 2007, an advanced four-step approach to FCM was introduced [15]. In this paper, this method is used, which includes four matrices; Initial Impact Matrix (IIM), Fuzzy Impact Matrix (FZIM), Relationship Impact Power (SIRM), and Final Impact (FMI). This method has been recommended for evaluating success indicators in IT projects and seems applicable to evaluate key success factors in various fields. This method consists of five steps and four matrices that, after creating the matrices, FCM can be drawn. In the first stage, the initial impact matrix can be obtained based on the opinions of experts. The initial matrix is an $n \times m$ matrix where n represents the number of factors and m represents the number of experts whose opinions have been received. Each array of the matrix O_{ij} is the value of criterion i in the opinion of expert j. The vector V_i is shown as$(O_{i1}, O_{i2}, \dots, O_{im})$, which represents an expert opinion on various indicators. In the second step, the V_i vectors are transformed into fuzzy sets to construct a fuzzy impact matrix, where each element of the fuzzy set represents the degree of membership of a member of the V_i vector. The degree of membership of each fuzzy member will be numerically in the range [0, 1]. The V_i vector can be converted to fuzzy numbers using the following method.

Find the maximum value in V_i and assign $X_i = 1$ to it; that's mean:

$$MAX(O_{iq}) => X_i(O_{iq}) = 1 \quad (1)$$

Find the minimum value in V_i and assign $X_i = 0$ to it; that's mean:

$$MIN(O_{ip}) => X_i(O_{ip}) = 0 \quad (2)$$

The other elements of the V_i vector at [0,1] are calculated as follows:

$$X_i(O_{ij}) = \frac{O_{ij} - Min(O_{ip})}{Max(O_{iq}) - Min(O_{ip})} \quad (3)$$

Where $X_i(O_{ij})$ represents the degree of membership of O_{ij} in the vector V_i and the degree of membership of the values in the IIM matrix. $Max(O_{ip})$and $Min(O_{ip})$ represent the maximum and minimum values in the IIM matrix, respectively.

The results obtained for $X_i(O_{ij})$, which is in the range [0,1], may not have the value needed to decide in the real world, so it is necessary to consider the number zero or one for each $X_i(O_{ij})$ to be more tangible. A higher and lower threshold is used to analyze the data better. Therefore, for the vector V_i, which is related to experts for factor i, the upper and lower thresholds are denoted by α_u and α_l, respectively. As a result, we have:

$$\forall O_{ij}(O_{ij} \geq \alpha_u) => X_i(O_{ij}) = 1 \quad (4)$$

$$\forall O_{ij}(Oij \leq \alpha_l) => X_i(O_{ij}) = 0 \quad (5)$$

The third step is to build SIRM. This matrix has dimensions n × n in which both rows and columns represent the factors under consideration and represent three possible states between variables. Each element of S_{ij} represents the correlation between the elements i and j and its value is between -1 to +1. There is n to S_{ij} for each factor and it is used in drawing the map and expresses the positive and negative relationship between the factors. By calculating SIRM, three types of correlations can be reached:

- $S_{ij} > 0$ indicates a direct (positive) relationship between factor i and j; That is, an increase in factor i leads to an increase in factor j.
- $S_{ij} < 0$ indicates the inverse (negative) relationship between factor i and j; That is, an increase in factor i leads to a decrease in factor j.
- $S_{ij} = 0$ indicates the lack of relationship between factor i and j.

There are three things to keep in mind when assigning S_{ij} value:

1. The sign of S_{ij}, which indicates a direct or inverse relationship between factors i and j.

2- The value of S_{ij}, which indicates the intensity of the effect of factor i on j.

3. The direction of causality, which indicates whether factor i causes factor j or vice versa.

The following relationships are used to determine the strength of relationships between factors:

$$d_j = | X_1(V_j) - X_2(V_j) | \quad (7)$$

Where $d_j$is the distance of the element j from the vector V_1 and V_2.

Then AD represents the mean distance between vectors V_1 and V_2 can be calculated as follows:

$$AD = \frac{\sum_{j=1} |d_j|}{m} \quad (8)$$

Therefore, the value of the correlation between the two vectors will be as follows:

$$S = 1 - AD \quad (9)$$

According to Equation (8), the closeness or similarity of S is calculated between two vectors, if S = 1 it shows the highest similarity and if S = 0 it shows the lowest degree of dissimilarity.

Causation is a vague descriptor of the relationships between factors in a fuzzy perceptual mapping, which indicates whether a change in one factor causes a change in another. The mere existence of relationships in the FCM does not indicate a causal direction. A review of the FCM literature shows that causation is

determined by experts involved in the development of FCM. If the model or some components of the model can be examined as a laboratory test, the direction of causation may be determined experimentally. However, in many cases, including economic models, social models, political models, and business models, it is not possible to study and test in the laboratory. In such circumstances, the direction of causality is determined by experts.

In the last step, the FMS matrix is created. Once the SRMS matrix has been formed, the results need to review the results, as some of the data within the matrix may be misleading. In other words, although the results obtained from mathematical logic have been used, they may indicate an acceptable relationship and proximity between the factors, but the factors may be logically unrelated. Inappropriate communication can be easily identified and eliminated by experts in this field. Therefore, during a face-to-face interview with experts in this field, an interactive decision was made about a relationship between the components.

In this study, according to the opinion of experts, it was determined:

- If there is a positive relationship between the two indices and $S_{ij} > 0.75$, then $S_{ij} = S_{ij}$
- If there is no relationship between the two indices or $S_{ij} < 0.75$, then $S_{ij} = 0$
- If there is a negative relationship between the two indices and $S_{ij} > 0.75$, then $S_{ij} = -S_{ij}$

Table 1. Key factors for success in international data transit

#	Key success factors
C1	Mastering the value chain of regional and international transit services
C2	Presence in international places
C3	Presence of international actors in Iran's maritime borders
C4	Investment and participation in international projects
C5	Empowering human resources in the field of services and international marketing
C6	Attracting investment and private sector participation
C7	Appropriate financial transactions
C8	Flexibility in service pricing
C9	Process agility
C10	Use of new technologies
C11	Providing a variety of services
C12	Exploiting the geographical location and presence at all border points to establish communication services between neighboring countries
C13	Integrated use of existing networks in the country
C14	Effective international presence and increase international marketing activities
C15	Cooperation with competitors in the region
C16	Ability to improve communication channels with customers
C17	Ability to provide diverse customer service
C18	Having good regional communication
C19	the quality of service
C20	Ability to conduct market research
C21	Participation in consortia and permanent membership in assemblies
C22	Building trust in the region
C23	Ability to negotiate and bargain and familiarity with negotiation techniques
C24	Having an independent network for transit
C25	Ability to interact constructively with international actors

Analysis of research data and findings

Determining key success factors in international data transit

Given that this paper seeks to identify the key factors of success in international data transit, our study shows that no research has been done in this area. Therefore, by examining the environment of Iran, which includes political, economic, social issues and examining competitors in Iran's regions and obtaining the opinions of experts, the key factors of success were extracted. To finalize the selected factors and evaluate the reliability of the questionnaire, 6 experts in the field of infrastructure and international marketing have been used.

Observations and findings

For conducting the present study, experts in international transit have been selected from the collections of the Ministry of Communications and Information Technology, Infrastructure Communication Company, Communication and Information Technology Research Institute, and companies holding fiber optics. The selected experts have at least five years of experience in the field of international data transit. At first, about 70 experts were identified and during the contact with them, about 25 of them agreed to cooperate in this research. To conduct the research, 5 experts were used to correct the questionnaire and validate the enumerated questionnaire, which was reduced from 30 to 16 during the suggestions of this group having key factors.

In the first stage of the initial impact matrix, the experts in the study were asked to express their views on the impact of each of the indicators in Table 1 on the success of the international data transit sector. Expert answers included one of the items "very low", "low", "medium", "high" and "very high", with scores of 10, 20, 30, 40 and 50, respectively. The results obtained for expert 1 to 25 for key success factors C1 to C16 are presented in Table 2. Fuzzy Matrix Expert Opinions Experts based on Equations (2) - (6) are shown in Table 4.

Table 3 shows the fuzzy effect of expert opinions. All scores for each of the key success factors are projected between zero and one in this matrix. In other words, experts' opinions are

fuzzy, so that the fuzzy mapping method can be used for it. Furthermore, we can find Table 4 and Figure 1 to show the effect of different factors on each other. Thus, according to table 4 and figure 1, we can provide some insight into the international transit factors.

Dominance in the value chain of regional and international transit services can reduce financial transactions, low pricing flexibility, and inadequate regional communications, mainly due to the governmental structure of international data transit in Iran. In order to facilitate financial transactions, increase price flexibility, streamline processes, and have good regional connections, it seems better for the government to reduce some of its dominance in the international transit value chain and outsource some of its activities to the private sector. Presence in international locations increased participation in international projects, attracting investment and private sector participation, proper financial interaction and effective international presence, and increased international marketing activities. The presence of international actors on Iran's maritime borders can increase cooperation with competitors in the region. In fact, with the increase of the presence of international actors in the maritime borders, the access to competitors will increase, and as a result, if Iran wants to cooperate with its competitors, it will be easily possible. Investment and participation in international projects can accelerate the presence of international locations, appropriate financial interactions, effective international presence and increase international marketing activities, the possibility of improving communication channels with customers. The empowerment of human resources in international services and marketing is an essential principle in developing the international transit market. It will lead to an influential international presence and increase international marketing activities and cooperation with competitors in the region. Attracting investment and private sector participation can improve appropriate financial interactions, streamline processes, and increase market research capabilities. Increasing financial transactions can increase investment and participation in international projects and thus facilitate the presence of the international data transit sector in regional markets. Flexibility in pricing services increases the effective international presence and leads to increased international marketing activities and good regional communication.

After calculating the final matrix, the obtained data were entered into Mental Modler software. The graphical representation of the final matrix can be seen in Figure 1. According to Figure 1 and Table 5, the maximum impact is related to the factor of effective international presence and increase international marketing activities. Also, ability to provide diverse customer service, ability to interact constructively with international actors, process agility, cooperation with competitors in the region, ability to negotiate and bargain and familiarity with negotiation techniques, having good regional communication, investment and participation in international projects, attracting investment and private sector participation, the quality of service, appropriate financial transactions, flexibility in service pricing, ability to improve communication channels with customers, ability to improve communication channels with customers and ability to conduct market research won the following ranks.

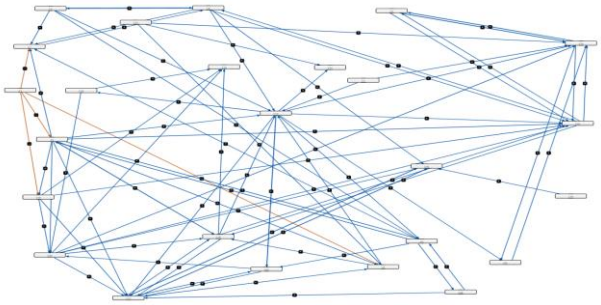


Fig. 1. Causal relationship between key factors

Table 2. Determining the Importance of Key Success Factors (IIM)

Factors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C1	40	40	40	30	50	50	20	10	50	30	40	40	40	50	30	40	50	40	30	30	30	40	40	40	50
C2	50	40	50	50	30	30	40	50	40	40	30	40	40	50	20	40	50	40	40	40	40	30	40	40	50
C3	50	40	40	50	50	40	40	30	50	30	40	40	40	50	30	40	30	40	40	40	30	40	40	40	50
C4	50	30	20	50	50	40	40	50	40	30	30	40	40	50	30	40	40	40	40	40	30	30	40	40	50
C5	50	40	50	50	40	50	40	30	40	30	50	40	30	50	40	50	30	40	50	50	30	50	40	30	50
C6	40	50	50	50	50	40	50	50	40	40	40	50	30	50	30	50	50	40	40	50	40	40	50	30	50
C7	30	40	20	50	50	50	50	50	40	40	40	50	40	50	30	50	50	50	30	40	40	40	50	40	50
C8	40	40	40	30	40	40	50	30	50	40	50	40	50	50	40	40	40	40	40	40	40	50	40	50	50
C9	40	50	40	50	50	50	50	40	50	40	40	50	50	50	30	40	50	40	40	40	40	50	50	50	50
C10	50	30	40	40	30	50	20	30	30	40	50	50	40	50	40	50	30	40	50	40	40	50	50	40	50
C11	40	30	30	40	40	40	40	30	30	40	40	50	40	50	40	50	30	40	30	30	40	40	50	40	50
C12	50	40	50	50	40	50	40	50	50	50	50	50	50	50	40	30	40	50	40	30	50	50	50	50	50
C13	30	30	30	50	40	50	50	30	40	40	40	40	40	50	40	40	40	40	30	40	40	40	40	40	50
C14	50	40	50	50	50	50	50	50	50	40	50	50	50	50	40	40	40	40	40	50	40	50	50	50	50

C15	40	40	40	50	40	50	40	30	40	30	40	40	40	50	40	30	40	30	40	40	30	40	40	40	50
C16	30	30	30	40	30	50	20	30	30	30	40	40	40	50	40	30	40	40	40	30	30	40	40	40	50
C17	30	40	30	30	40	50	50	20	40	30	40	50	40	50	50	30	40	40	40	30	30	40	50	40	50
C18	50	40	30	40	40	50	50	10	50	30	50	50	50	50	50	30	40	50	40	30	30	50	50	50	50
C19	50	40	50	50	50	50	50	30	40	40	50	50	50	50	50	40	50	50	40	30	40	50	50	50	50
C20	40	50	40	50	50	50	40	30	40	40	40	50	30	50	50	40	40	40	50	50	40	40	50	30	50
C21	40	40	30	50	40	50	40	50	30	30	30	40	30	50	40	30	40	40	30	40	30	30	40	30	50
C22	50	40	50	50	30	50	50	50	30	40	40	50	50	50	50	30	40	50	40	50	40	40	50	50	50
C23	40	40	40	50	40	50	40	40	40	40	50	50	40	50	50	30	40	50	40	40	40	50	50	40	50
C24	30	30	30	30	40	30	50	30	40	30	20	50	10	50	50	40	30	50	20	30	30	20	50	10	50
C25	50	40	40	50	50	50	50	50	50	30	50	40	40	50	50	40	50	40	40	40	30	50	40	40	50

Table 3. Fuzzy Matrix Expert Opinions

Factors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C1	0.8	0.8	0.8	0.5	1	1	0.3	0	1	0.5	0.8	0.8	0.8	1	0.5	0.8	1	0.8	0.5	0.5	0.5	0.8	0.8	0.8	1
C2	1	0.7	1	1	0.3	0.3	0.7	1	0.7	0.7	0.3	0.7	0.7	1	0	0.7	1	0.7	0.7	0.7	0.7	0.3	0.7	0.7	1
C3	1	0.5	0.5	1	1	0.5	0.5	0	1	0	0.5	0.5	0.5	1	0	0.5	0	0.5	0.5	0.5	0	0.5	0.5	0.5	1
C4	1	0.3	0	1	1	0.7	0.7	1	0.7	0.3	0.3	0.7	0.7	1	0.3	0.7	0.7	0.7	0.7	0.7	0.3	0.3	0.7	0.7	1
C5	1	0.5	1	1	0.5	1	0.5	0	0.5	0	1	0.5	0	1	0.5	1	0	0.5	1	1	0	1	0.5	0	1
C6	0.5	1	1	1	1	0.5	1	1	0.5	0.5	0.5	1	0	1	0	1	1	0.5	0.5	1	0.5	0.5	1	0	1
C7	0.3	0.7	0	1	1	1	1	1	0.7	0.7	0.7	1	0.7	1	0.3	1	1	1	0.3	0.7	0.7	0.7	1	0.7	1
C8	0.5	0.5	0.5	0	0.5	0.5	1	0	1	0.5	1	0.5	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.5	1	1
C9	0.5	1	0.5	1	1	1	1	0.5	1	0.5	0.5	1	1	1	0	0.5	1	0.5	0.5	0.5	0.5	1	1	1	1
C10	1	0.3	0.7	0.7	0.3	1	0	0.3	0.3	0.7	1	1	0.7	1	0.7	1	0.3	0.7	1	0.7	0.7	1	1	0.7	1
C11	0.5	0	0	0.5	0.5	0.5	0.5	0	0	0.5	0.5	1	0.5	1	0.5	1	0	0.5	0	0	0.5	0.5	1	0.5	1
C12	1	0.5	1	1	0.5	1	0.5	1	1	1	1	1	1	1	0.5	0	0.5	1	0.5	0	1	1	1	1	1
C13	0	0	0	1	0.5	1	1	0	0.5	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5	0.5	0	0.5	0.5	0.5	0.5	0.5	1
C14	1	0	1	1	1	1	1	1	1	0	1	1	1	1	0	0	0	0	0	1	0	1	1	1	1
C15	0.5	0.5	0.5	1	0.5	1	0.5	0	0.5	0	0.5	0.5	0.5	1	0.5	0	0.5	0	0.5	0.5	0	0.5	0.5	0.5	1
C16	0.3	0.3	0.3	0.7	0.3	1	0	0.3	0.3	0.3	0.7	0.7	0.7	1	0.7	0.3	0.7	0.7	0.7	0.3	0.3	0.7	0.7	0.7	1
C17	0.3	0.7	0.3	0.3	0.7	1	1	0	0.7	0.3	0.7	1	0.7	1	1	0.3	0.7	0.7	0.7	0.3	0.3	0.7	1	0.7	1
C18	1	0.8	0.5	0.8	0.8	1	1	0	1	0.5	1	1	1	1	1	0.5	0.8	1	0.8	0.5	0.5	1	1	1	1
C19	1	0.5	1	1	1	1	1	0	0.5	0.5	1	1	1	1	1	0.5	1	1	0.5	0	0.5	1	1	1	1
C20	0.5	1	0.5	1	1	1	0.5	0	0.5	0.5	0.5	1	0	1	1	0.5	0.5	0.5	1	1	0.5	0.5	1	0	1
C21	0.5	0.5	0	1	0.5	1	0.5	1	0	0	0	0.5	0	1	0.5	0	0.5	0.5	0	0.5	0	0	0.5	0	1
C22	1	0.5	1	1	0	1	1	1	0	0.5	0.5	1	1	1	1	0	0.5	1	0.5	1	0.5	0.5	1	1	1
C23	0.5	0.5	0.5	1	0.5	1	0.5	0.5	0.5	0.5	1	1	0.5	1	1	0	0.5	1	0.5	0.5	0.5	1	1	0.5	1
C24	0.5	0.5	0.5	0.5	0.8	0.5	1	0.5	0.8	0.5	0.3	1	0	1	1	0.8	0.5	1	0.3	0.5	0.5	0.3	1	0	1
C25	1	0.5	0.5	1	1	1	1	1	1	0	1	0.5	0.5	1	1	0.5	1	0.5	0.5	0.5	0	1	0.5	0.5	1

Table 4. Final Matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25
C1	1						-0.76	-0.78	-0.8										-0.8						
C2		1		0.84		0.76	0.76							0.8											
C3			1												0.84										0.8
C4		0.84		1			0.79							0.75		0.76									0.75
C5					1									0.8	0.76										
C6						1	0.77		0.78											0.8				0.77	
C7				0.79			1																		
C8								1						0.76				0.8							
C9						0.78	0.8	0.78	1					0.78			0.76	0.84	0.8				0.76		0.76
C10										1						0.8									
C11											1														
C12												1													
C13								0.76			0.8		1		0.82										
C14						0.78					0.8			1	0.76		0.8			0.9	0.75	0.78			76
C15			0.84												1						0.8				0.76
C16																1	0.85								
C17								0.76								0.85	1	0.82		0.75					
C18												0.76		0.75			0.82	1							0.77
C19												0.8					0.77		1				0.8		0.76
C20																	0.75			1			0.78		
C21															0.8						1				
C22												0.78										1	0.78		
C23												0.8			0.8	0.78	0.79	0.8					1		0.76
C24						0.77											0.75							1	
C25			0.8	0.75											0.76			0.77							1

Table 5. Degree of centrality and type of factors

	Factors	Input	Output	Total
C14	Effective international presence and increase international marketing activities	5.64	7.4	13.04
C17	Ability to provide diverse customer service	7.29	4.18	11.47
C25	Ability to interact constructively with international actors	7.19	4.08	11.27
C9	Process agility	2.58	8.06	10.64
C15	Cooperation with competitors in the region	6.54	3.4	9.94
C23	Ability to negotiate and bargain and familiarity with negotiation techniques	4.12	5.73	9.85
C18	Having good regional communication	5.03	4.1	9.13
C4	Investment and participation in international projects	3.38	4.89	8.27
C6	Attracting investment and private sector participation	4.09	4.12	8.21
C19	the quality of service	2.6	4.13	6.73
C7	Appropriate financial transactions	4.88	1.79	6.67

C8	Flexibility in service pricing	4.08	2.56	6.64
C16	Ability to improve communication channels with customers	4.19	1.85	6.04
C2	Presence in international places	1.84	4.16	6
C20	Ability to conduct market research	3.45	2.53	5.98
C3	Presence of international actors in Iran's maritime borders	2.64	2.64	5.28
C1	Mastering the value chain of regional and international transit services	1	4.14	5.14
C12	Exploiting the geographical location and presence at all border points to establish communication services between neighboring countries	4.14	1	5.14
C13	Integrated use of existing networks in the country	1	3.38	4.38
C21	Participation in consortia and permanent membership in assemblies	2.55	1.8	4.35
C22	Building trust in the region	1.78	2.56	4.34
C24	Having an independent network for transit	1.77	2.52	4.29
C11	Providing a variety of services	2.6	1	3.6
C5	Empowering human resources in the field of services and international marketing	1	2.56	3.56
C10	Use of new technologies	1	1.8	2.8

Examining different Scenarios

In scenario design, it is necessary to pay attention to which scenario can be used to change the factors that have the most significant impact on the success of ICT research centers. In this section, several policies were developed using FCM results. Scenarios were selected according to the influence of each factor. In this research, five scenarios are designed as follows:

Scenario 1: Based on a change in five factors with the highest degree of centrality, Factors considered in the first scenario include C14 (Effective international presence and increase international marketing activities), C17 (Ability to provide various customer service), C25 (Ability to interact constructively with international actors), C9 (Process agility), C15 (Cooperation with competitors in the region). This scenario shows what changes in other factors occur with a 30% increase in these factors. Figure 2 shows the changes in other factors. With the increase in the first five factors, six other factors also increased. The total increase was 0.09.

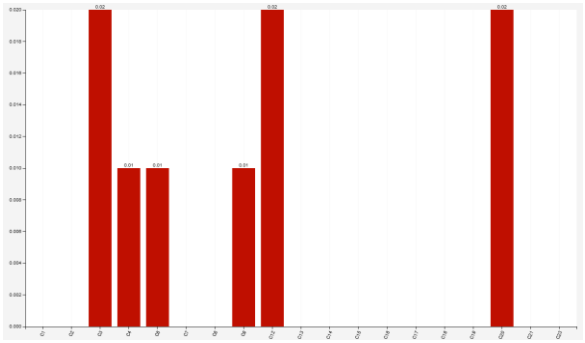


Fig. 2. Changes due to increased factors C14, C17, C25, C9, and C15

Scenario 2: This scenario is based on the 5-second factors having the most central degree after the first scenario. The factors considered in the second scenario include C23 (Ability to negotiate and bargain and familiarity with negotiation techniques), C18 (Having good regional communication), C4 (Investment and participation in international projects), C6 (Attracting investment and private sector participation), C19 (the quality of service). This scenario shows what changes in other factors occur with a 30% increase in these factors. Figure 3 shows the changes in other factors. With the increase in the value of the second four factors, 9 other factors also increased, the total increase was 0.31.

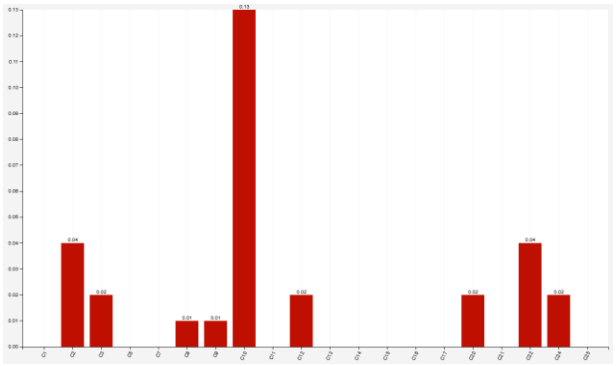


Fig. 3. Changes due to increased factors C23, C18, C4, C6, and C19

Scenario 3: This scenario is based on the five third factors having the most central degree after the second scenario. Factors considered in the third scenario are C7 (Appropriate financial transactions), C8 (Flexibility in service pricing), C16 (Ability to improve communication channels with customers), C2 (Presence in international places), C20 (Ability to conduct market research). This scenario shows what changes in other factors occur with a 30% increase in these factors. Figure 4 shows the changes in other factors. With the increase in the value of the fourth four factors, five other factors also increased. The total increase was 0.09.

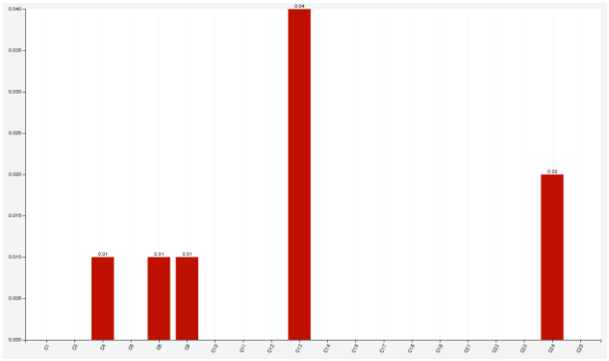


Fig. 4. Changes due to increased factors C7, C8, C16, C2, and C20

Scenario 4: This scenario is based on five fourth factors with the most central degree after the second scenario. The factors considered in the fourth scenario encompass C3 (Presence of international actors in Iran's maritime borders), C1 (Mastering the value chain of regional and international transit services), C12 (Exploiting the geographical location and presence at all border points to establish communication services between neighboring countries), C13 (Integrated use of existing networks in the country), C21 (Participation in consortia and permanent membership in assemblies). This scenario shows what changes in other factors occur with a 30% increase in these factors. Figure 5 shows the changes in other factors. With an increase in the value of the four third factors, six other factors also increased. The total increase was 0.32.

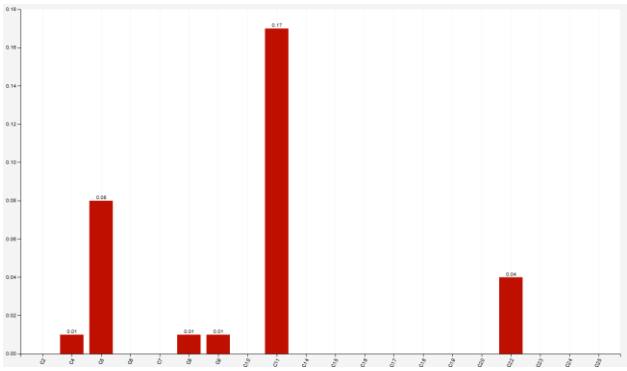


Fig. 5. Changes due to increased factors C3, C1, C12, C13, and C21

Scenario 4: This scenario is based on five fifth factors with the most central degree after the second scenario. The factors considered in the fifth scenario encompass C22 (Building trust in the region), C24 (Having an independent network for transit), C11 (Providing a variety of services), C5 (Empowering human resources in the field of services and international marketing), C10 (Use of new technologies). This scenario shows what changes in other factors occur with a 30% increase in these factors. Figure 5 shows the changes in other factors. With an increase in the value of the four third factors, six other factors also increased. The total increase was 0.09.

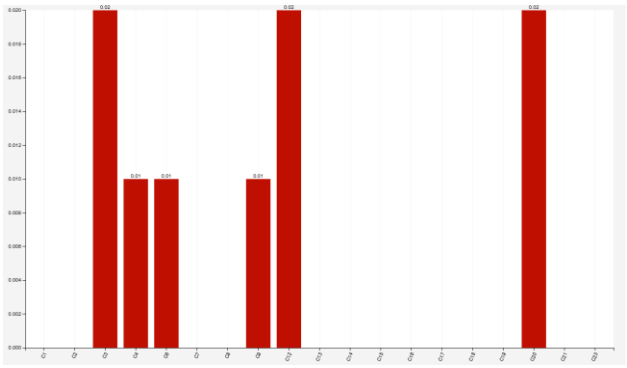


Fig. 5. Changes due to increased factors C22, C24, C5, C10, and C11

4. Conclusion

One of the critical capacities of the country is data transit to different countries through Iran. To make better use of this capacity, it is necessary to evaluate the factors that lead to the success of this issue. This study assesses the key factors for the success of international data transit through Iran. In this study, using experts' opinions, 25 key success factors for the international data transit sector were extracted. Using fuzzy cognitive mapping, the results are analyzed, and four matrices; the initial effect, fuzzy effect, power of relationship effect, and final effect, were obtained, and finally fuzzy mapping was created using Mental Modeler software. The results obtained in the power matrices of the impact of relationships and the final impact were presented with 8 experts and the validity of the results was evaluated. Then, the items that were not logically related to each other were removed. Also, the direct and indirect

relationships between the factors were determined by the experts, all of which were directly related to each other.

A large number of relationships between factors indicates a high degree of interaction in the mental model. In this study, there are 144 relationships between indicators that seem to be the appropriate level of interaction. All 25 factors studied are normal and are influenced by and affect other factors. The degree of centrality of each factor indicates the importance of that indicator in the system, obtained from the sum of input and output weights to the factor. According to Table 5, factor C14 (Effective international presence and increase international marketing activities) has the highest degree of centrality, which indicates the importance of this factor among other factors. Most inputs and outputs are with this factor. In fact, if this factor can be controlled and tried to achieve it, it can strengthen many existing factors, but to succeed in this factor, it is necessary to strengthen some factors. Because the number of factors identified in this article is relatively high and control of this number of factors is difficult, so five different scenarios were evaluated. The results showed that Scenario 4 performed better than other scenarios.

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