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RESEARCH PAPER

Analyzing the Effective Factors on Innovative Supply Chain Model in Service Organizations Applying Intuitive Fuzzy DEMATEL and AHP Methods

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ABSTRACT
Innovation is an essential tool for the supply chain to gain its competitive advantage and improve its performance. Many researchers have remarked that supply chain innovation is a vital tool for improving the performance of a supply chain and can be very productive. This research attempts to identify and analyze the effective factors on the innovation supply chain in the health sector. The effective factors on the innovative supply chain were extracted by reviewing the literature, similar studies, and experts' surveys. In this regard, 49 criteria were determined in eight dimensions. Intuitive fuzzy DEMATEL (IFD) and AHP methods were used to determine the weight and the relationships between them. The results indicated organizational innovation as the most important dimension, government support innovation as the most effective dimension, and process innovation as the most affected dimension. Some researchers believe that this period guarantees the survival and success of service organizations in this competition. However, the logistics and communication network of a business is required as a new and innovative landscape to use the competitive advantage opportunities to perceive the global era.

KEYWORDS: *Innovative supply chain; Innovative supply chain in services; Intuitionistic fuzzy set.*

1. Introduction

Today, increasing global competition between companies and institutions creates new challenges in the supply chains. These include increased demand for cost reductions, high quality, improved customer service and assurance of continued supply [1-4]. At present, the supply chain faces advancement in ICT and chain integration by increasing customer responsiveness. Organizations in supply chains are forced to rebuild and re-engineer to increase their efficiency and meet customer expectations. At present supply chain is facing Increase customer responsiveness, advancement in ICT and Chain integration. Organizations in supply chains are forced to rebuild and re-engineer to increase their efficiency and meet their customers' expectations [3, 5]. Thus, one of integration cause is supply chain management that plays an important role in improving organizational performance to achieve a competitive advantage [5-9]. Many organizations including Health Care institutions use supply chain management (SCM). Over the past decade, many researchers have emphasized the importance of effective SCM in health services [7, 10-13]. The supply chain in the hospitals is unique and differs from ordinary supply chains in many ways. SCM is more complex in the hygiene care industry because it is directly related to patient care [8, 14]. The standard of services provided by the Health industry's supply chain is different from the production sector [15]. All these make the health chain more dynamic and sophisticated, which significantly affects the performance of health organizations. Thus, the concept of SCM in the field of health care is also considered as a tool to increase productivity and improve quality [16]. Therefore, SCM provides a new opportunity to create competitive

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advantages. But to use these opportunities and gain a competitive edge, for understanding global supply, logistics, and business communication networks; new thinking and innovation are needed. Innovation is an essential tool to gain their competitive edge and improve organizational performance [4, 17-21]. Innovation is a collective process that is created through organizational tasks or different organizations, ideas generated in resources, skills, and employees [22]. Therefore, it is important to provide an environment where health care leaders focus on innovation through various devices (such as IT applications programs, leadership, etc.) [23]. A complex generating process in the information chain and logistic innovation services is the application of technology and process innovations, to provide solutions to customer needs and identify new ways for better processes [23, 24] In this way, it not only improve operational capability but also increases the ability to manage risk and serves as a catalyst for facilitating multiple activities such as planning, monitoring, forecasting and purchasing in complex supply chain programs. Arlbjørn [25] stated that supply chain innovation is a change in a supply chain network, supply chain technology, or supply chain process(or a combination of these) that can be found in a plant, a company, an industry, or a chain supply, to increase new creation value for the shareholder. Many researchers have pointed out that supply chain innovation is a vital tool for improving the performance of a supply chain and can lead to improved productivity [18]. In this way, the Supply Chain Innovation (SCI), the mentality, and the creative practice of exploring the opportunities present in SCM are to create competitive advantage [25, 26]. Thus combining the two concepts of supply chain and innovation in the service sector, especially health care, will improve the performance of this sector and create a competitive advantage for it. In this regard, this research tries to identify and analyze the effective factors in the innovation supply chain in the health sector.

2. Literature Review

2.1. Innovative supply chain in services

Nowadays in a new business environment, successful organizations cover the needs of diverse customers, environmental dynamism, decrease environmental confidence, and the pace to meet the customers' needs, the flexibility and innovation in which the supply chain management has received special attention. Some researchers believe this is a guarantee for survival and service organizations' success in the competition [25, 27, 28]. In the area of service management, a supply chain management service means planning and managing activities from raw materials to the final product. While the main goal of the industry's supply chain management is to obtain a proper composition of inventories in response to demand (especially in the case of an overly moderate demand), service chain management is related to planning and managing activities from supporting services to providing services to final consumers. Nonetheless, unlike in manufacturing units where their supply and demand are clearly visible commodities, raw materials, intermediaries, or end-uses, in service chains and demands because of the intangible nature of supply, it is to some extent difficult to predict and plan resources [23, 29-32]. In fact, the main goal in service chains is to estimate demand to use skills and services available in the system [23, 27, 29-31]. In this way, it can be used as a way to organize the management operation of the supply chain in addition, to a strategic plan to create the key to success in a competitive market [4, 28]. Taking into account the inadequacy of production-oriented supply chain models in the service sector, various researchers have attempted to define the concept of the supply chain in the service sector. Over the past few years, there have been several definitions of the supply chain. Ellram [32] stated that there is no exchange of goods in professional services. Exchange in service companies means the use of the services suppliers and its employees' assets. Actually, the purchase of a service is a marker of the transforming capacity of the customer service provided to customers as a service, but the definition of the modified supply chain is, information management, processes, capacity, performance services, and funds from the initial supplier till final customers [27, 32, 33]. In addition, in the other definition, the supply chain of information management services, processes, resources, and service functions has been shown from the primary supplier to the end customer [27, 31-33]. Baltacioglu [27] also defined the supply chain system as a network of suppliers, service providers, customers, and other supportive units, focusing on the exchange of resources needed for services, transfer of these resources to core services, and support and delivery of these services to the customer. The supply chain as a life cycle process, including physical, informational, financial, and knowledge, flow, that is aimed at satisfying end-user needs through services is provided through connected suppliers. According to this definition, he further defines the management of supply chain management to design, maintain, and implement supply chain processes to meet the needs of the final customer service [28]. In the service dimension, like other industries, managers can also pay attention to supply and management. The service sector can be a significant sector, growth of which is increasing day by day and growing its range of activities, and it can be considerably affected by innovation. Innovation in services is a key to escape from traps, is a way to grow as well as a source of competitive advantage for organizations. Therefore, proper management and guidance towards innovations have high importance. Therefore, attention paid to innovation in organizations is obvious and is a new approach to business [24, 34].

There are many definitions of innovation, taking those definitions into the account we can say that innovation is an idea, action, or product that is considered new by people in a new social system. Gumusluoglu [35] defined innovation as an organization's desire to develop advanced and new products and services and deliver them to the market for success. In fact, innovation is any new operation in an organization that can include equipment, products, services, processes, policies, and projects [36]. Drucker [37] Introduces innovation as a special tool for entrepreneurs, through which they use change as an opportunity to create a different service or business. The innovation is associated with new ideas that lead to improved organizational performance. The organization's ability to innovate is one of the important factors in the survival and success of organizations, especially service organizations [38]. According to Christian [39], effective corporate innovation is the key to survival in a competitive environment. Innovation is one of the basic tools for growth strategies to enter new markets that increase the present market share and prepare the organization to face a competitive situation [24, 34, 40]. Innovation in service-giving organizations such as health care institutions can occur in the supply chain. Innovation in this area can include the supply chain structure and serve as a means to rebuild the supply chain [41, 42]. In addition, SC innovation has been considered as a vital factor for organizational performance in the health care industry [7, 42, 43]. In fact, the innovative SC provides innovative solutions, and the SC decision-makers can use it to counteract uncertainty in a dynamic and competitive business environment [44, 45]. The researchers found that the innovative SC provides opportunities for increasing its productivity [44, 46], improving the product and service quality[47-49], providing greater customer's desired value [25, 50] and corporate social responsibility support [36, 51, 52].

Chapman [53] indicated that the effective delivery services industry also needs to focus on SC innovation [7]. Because of the effective delivery of innovative services and high quality, SCMs decrease costs, on-time delivery, and effective operations [54]. Therefore, SC innovation is essential for organizational sustainability [37]. In addition, organizations need to pay more attention to innovation in the service industry at an accelerating pace [7, 55, 56]. Arlbjorn [25] investigated a systematic literature review and described SCI as "a change in the SC network, technology, or processes (or a combination of these) that can be found in a company, in any industry or in a chain supply to create new value for shareholders."

Although SC management literature has discussed the innovation SC and mentioned the importance of SC innovation, there are often scientific studies on the content and determinants of SC innovation [25, 57]. In addition, some studies examined the various issues of innovation and their relationship with aspects of the SC [54, 58-60]. Yoon [54] investigated the effect of leadership on innovation, and SC innovation on the performance of SC in health care institutions. The study suggested that the innovation of SC plays an important role in improving operational processes for the effectiveness of SC and helps the management of healthcare institutions. Theoretically, for the healthcare industry to succeed, innovation in SC management is essential. Lee [7] reviewed the innovative SC to improve organizational performance in the healthcare industry. The results of this research indicated that organizational performance is positively related to the structure of SC innovation. The results revealed that successful SC management is achieved through continuous SC innovation with the supplier, which in turn improves organizational performance. Soosay [3] in their study examined the relationship of cooperation with innovation in the SC. Their goal was to explain the importance of this relationship for innovation. The results showed that the performance of companies could have an impact on generating innovation.

As various scholars have stated, SC innovation is a multidimensional structure that can incorporate various aspects of innovation [18, 24, 61, 62]. In innovation, the rule is multidimensional services. Most probably service innovations are a combination of modernization in different dimensions of services. In this regard, the importance of the innovative SC in the field of health care institutions caused the researchers to investigate the dimension of its components. To this end, the factors that composed the innovative SC were identified in eight dimensions including marketing innovation, technological innovation, innovative infrastructure, enterprise innovation, innovative collaboration, process innovation, service innovation, government support for innovation. Each one is dealt with in detail in the following paragraphs.

2.1.1. Marketing innovation

Marketing innovation in today's business and global competitive markets seems to be very functional and operational because in today's markets the goals of the companies are customer satisfaction and their needs and wants [63-66]. Marketing innovation is defined as a new marketing method that requires significant changes in product design or packaging, location, advertising, or price [67]. Much literature refers to the marketing innovation role as the competitive advantage motive for companies [39, 68]. In addition, creating innovative tools for production and services, innovation in product pricing or provision of services, in service delivery techniques, in product distribution or service delivery channels (such as advertising) [40], adaptation to the change in customer's desired value in the SC and acquisition of value considered by the customer in the innovative SC is involved in healthcare services [18].

2.1.2. Technological innovation

Technological innovation is the total product yield of / service/process innovation process and is described beyond the development of a new product and process. Major technological changes are also considered in existing products and processes, according to the situation [69]. Filipescu [70] argued that technological innovation can be a new method or the ability to produce a method for producing products, processes, and new services; in addition, offering new products for the first time, offering tailored products to the marketplace, developing (fast and competitive) new technologies, incorporating new technologies for the development of new products, utilizing modern techniques tailored to day-to-day knowledge and production processes [43, 71, 72]. The literature shows that selecting a technological innovation is not solely efficient to reach a competitive advantage, and other aspects of innovation should be considered in SC [73].

2.1.3. Innovative infrastructure

Furman [74] acknowledged in the research that the common infrastructure of innovation includes the knowledge of an organization, the level of human resources, and the capital allocated to innovation and other policies and commitment resources that support innovation in that organization. These infrastructures also include general policies and other resources that influence innovation incentives and research and development productivity. It can be stated that innovation infrastructure in the innovative SC in health services includes: a system for sharing, sharing knowledge between individuals, a comprehensive system for collecting and analyzing data, the existence of a database of information and customer needs [63], assigning material resources and equipment needed to produce new products and services, encouraging research and development units [36] and spending on research and development should be in relation to annual revenue [75].

2.1.4. Organizational innovation

Organizational innovation has different and diffuse literature, and still, researchers have not agreed to define this term. Organizational innovation is a management system that emphasizes the mission of the organization, and seeks exceptional and new opportunities, and identifies the criteria for success. Drucker [37] believes that the success of innovation requires hard, focused, and targeted work. Administrative innovation refers to changes in organizational structure, management approaches, strategies, processes, and administrative systems [76, 77]. Lu and Chen [78] considered organizational innovation to include changes in the structure and processes of an organization to employ new managerial, operational, and operational concepts such as the use of specialized workgroups in production, SC management, or quality management systems. In addition, organizational innovation in the innovative SC in healthcare can include Innovation in daily work, procedures and processes for managing company activities, innovation in quality management and production management systems, innovation in human resources management system, innovation in the information management system of the organization and activity in information sharing field [40]. It seems that knowledge sharing and organizational innovation are the key motives to reach a competitive advantage [19]. It is argued that technological and organizational innovation has a synergistic effect on international performance and this effect depends on unique domestic institutional factors [79].

2.1.5. Collaborative innovation (inter-organizational sharing)

Participatory innovation in processes and products is very important in the information age [80]. Based on the relational perspective, collaborative relationship helps organizations build and maintain relationships with customers and suppliers. Collaborative relationships can improve organizational capabilities and, in turn, facilitate superior organizational performance [81]. Organizations that engage in more collaborative communication with their customers and suppliers will achieve mutually beneficial relationships, market intelligence, and more collaborative activities. In this way, innovative technological collaboration refers to collaborative agreements between organizations aimed at developing technologies for process or product innovation using a variety of collaborative forms. The organization can enhance its technological capability in interaction with various partners (suppliers, customers, competitors, and research organizations) [82]. Tsai and Wang [82] found that the coordination and high internal sharing level of R & D with an external low level of R & D cause technological innovation of the organization.

Shen [80] examined the suppliers' and manufacturers' innovation participation in the SC in the study they conducted. Related to the supplier and producer innovation they indicated that if there are sufficient abilities and resources for investment in product innovation, the producer always intends to invest in the product innovation. However, the supplier is reluctant. Thus, the innovated production is mostly related to the producer’s innovative attempt.

2.1.6. Process innovation

Some studies have argued that service innovation should be part of product innovation for service organizations. However, Su [83] suggested it is better if innovation focus on services itselves. They argued that service companies need to implement service innovation practices to create a new market [83]. Innovation provides a tool for maintaining and improving quality and cost savings [84], and involves the adoption of new or improved methods of production, distribution, or delivery of services. In fact, the purpose of process innovation means to what extent the organization uses the new technologies in experimenting or testing. In fact, this innovation refers to everything that changes the way work is done and changes the designing methods of jobs [85, 86]. Thus, innovation in the innovative SC in healthcare involves: using an informal process for the production and development of ideas, Dolog [87] using modern technology in expanding the service delivery process [88], supporting ideology and creativity (development of new and non-traditional solutions [89], reduction of bureaucracy (for more access to services), Darroch [90] formal methods (using the formal process to improve services), Gupta and Sharma [91] developing strategy and perspectives (applying developed and specific strategies), identifying and eliminating waste activities in the process of product production or service delivery, reducing the cost of production factors, including methods, software and hardware products or services, increase in the speed of delivery of products or the provision of services to customers, the use of new methods, techniques and processes in order to produce a product or provide services [40].

De Giovanni and Cariola [92], studied the effect of process innovative strategy of companies by Industry 4.0 technology through the lean practices and green SCs. This research investigated whether the process innovation can be used as leverage to reinforce the relationships between lean practices, green SC management, and performance or not. The results showed that lean practices facilitate cooperation in environmental plans and positively help environmental performance.

2.1.7. Service innovation

Innovation in services provided by service organizations is seen as services like products and goods produced in manufacturing organizations. But service innovation can be defined as the supply of new services to existing or new customers and the provision of existing services to new customers [77]. The service companies focus on service innovation and provide opportunities to better understand the customer's needs and create processes that make money. But for manufacturing companies, service innovation means the review of innovation in achieving an integrated solution for product innovation and innovative activities. Therefore, service innovation involves changes that lead to changes in the way of delivering services or their features, and the use of new technology to meet market needs. Introducing the way of providing new services in the real sense means in the market at the right time [38]. In the area of SC Innovation, healthcare services include need assessment based on age group needs (providing services and products based on the needs of different age groups) [93], upgrading quality (improving current services and improving service quality) [88], technology (provision of services and Electronic products, related today technology [94], speed and accuracy of operation (speed in the identification of urban and citizen's needs and the provision of contingency services) [95], width and dynamics(providing a wide range of products and services) [87].

2.1.8. Government support for innovation

Examples of the advanced technology sector in the United States show that innovative organizations receive funding from public investment. In this regard, such investments cause a combination of the required amount of fixed costs and the degree of uncertainty in innovation, and the government is more likely to invest in physical and human infrastructure than individuals and businesses companies [96]. Government support for companies can take various forms, such as grants, tax incentives, government-sponsored labs, or direct investment through public investment. Literature showed that the government supports innovation factors directly and indirectly through innovation in R & D, internal and external cooperation [97-99]. Research on active companies in Brazil showed that government incentives to innovate and support organizations depend on the performance of organizations themselves [100-102]. However, public funding and government support for innovation are not the only way to advance innovation [103]. Government support in the SC of innovation in healthcare services can include: having necessary government's financial support to develop innovation, creation of new goods and services, the existence of laws and regulations from the government for the development of innovation, holding various classes from the government for educating the staff of the organization, providing the conditions and areas for marketing and sale of new ideas by the government [36].

2.2. Intuitionistic fuzzy set(IFS)

An intuitionistic fuzzy set (IFS) is one of the generalizations of fuzzy sets theory [104] out of several higher-order fuzzy sets, IFS, first introduced by Atanassov [105], are more compatible to deal with vagueness. The conception of IFS can be viewed as an appropriate/alternative approach in cases where available information is not sufficient to define the impreciseness by the conventional fuzzy set. Fuzzy sets only consider the degree of acceptance, but IFS is characterized by a membership function and a non-membership function so that the sum of both values is less than one [108]. Presently, IFSs are being studied and applied in different fields of science. Among the research works on IFS we can mention Atanassov and Szmidt [106-109].

Definition 1- Assume reference set $X=\{x_1,x_2,x_3,\ldots\}$. In this case, set A which is a subset of X is an intuitionistic fuzzy set defined as Eq. (1).

$$A=\{\prec x,u_A(x),v_A(x)\succ \forall x\in X\} \tag{1}$$

In the above definition, $u_A(x),v_A(x)$ are degree of membership and non-membership respectively, which are defined as $u_A(x):x\to[0,1],v_A(x):x\to[0,1]$ and satisfy $0\le u_{ij}(x)+v_{ij}(x)\le 1$. In addition, for each $x\in X$, intuitionistic index π_x is defined as $\pi_x=1-u_x-v_x$ [106].

Definition 2- $(u_{ij}(x),v_{ij}(x),\pi_{ij}(x))$ is an intuitionistic fuzzy number that satisfies the following conditions Eq. (2).

$$u_{ij}(x)\in[0,1],v_{ij}(x)\in[0,1],\pi_{ij}(x)\in[0,1],0\le u_{ij}(x)+v_{ij}(x)\le 1,\pi_{ij}(x)=1-u_{ij}(x)-v_{ij}(x) \tag{2}$$

It must be noted that although intuitionistic fuzzy number is similar (in appearance) to triangular fuzzy number (a,b,c), it is quite different. Triangular fuzzy number is a convex normal fuzzy set with a membership function in which $(a\prec b\prec c)$; while an intuitionistic fuzzy number is a point in three-dimensional space constructed by axes $u_{ij}(x),v_{ij}(x),\pi_{ij}(x)$ [39]. Atanassov and

Gargov [106] have described intuitionistic fuzzy number $(0.50, 0.20, 0.30)$ as a scenario where votes in favor of adoption are 0.5, votes against it are 0.2 and abstained votes are 0.30.

In this context the following relationship holds true (Eq. (3)).

$$\mu_{ij}^{\beta}(x)+v_{ij}^{\beta}(x)\le 1\ ,\ 0\le \mu_{ij}^{\alpha}(x)\le u_{ij}^{\beta}(x)\le 1\ ,\ 0\le v_{ij}^{\alpha}(x)\le v_{ij}^{\beta}(x)\le 1 \quad (3)$$

These numbers are better suited to deal with uncertainty and provide a more logical mathematical framework to deal with inexact facts and incomplete information [110].Some of the operators and relationships between these numbers are provided in the following. For simplicity's sake, these numbers are expressed as $[\mu_{ij}(x), v_{ij}(x), \pi_{ij}(x)]$ where $\mu_{ij}(x)$ ، $v_{ij}(x)$ and $\pi_{ij}(x)$ are numbers in the range [0, 1].

Definition 3- Assume intuitionistic fuzzy numbers $A=\{\langle x, \mu_A(x), v_A(x) | x\in X\rangle\}$ and $A_1=\{\langle x, \mu_{A1}(x), v_{A1}(x) | x\in X\rangle\}$ and $A_2=\{\langle x, \mu_{A2}(x), v_{A2}(x) | x\in X\rangle\}$ and the real number n . According to [112] the following relationships are defined as Eq. (4)-(10) :

$$\overline{A}=\{\langle x, v_A(x),\ \mu_A(x) | x\in X\rangle\} \quad (4)$$

$$A_1\cap A_2=\{\langle x, \min\{\mu_{A_1}(x), \mu_{A_2}(x)\}, \max\{v_{A_1}(x), v_{A_2}(x)\} | x\in X\rangle\} \quad (5)$$

$$A_1\cup A_2=\{\langle x, \max\{\mu_{A_1}(x), \mu_{A_2}(x)\}, \min\{v_{A_1}(x), v_{A_2}(x)\} | x\in X\rangle\} \quad (6)$$

$$A_1+A_2=\{\langle x, \mu_{A_1}(x)+\mu_{A_2}(x)-\mu_{A_1}(x)\cdot\mu_{A_2}(x), v_{A_1}(x)\cdot v_{A_2}(x)\ | x\in X\rangle\} \quad (7)$$

$$A_1\cdot A_2=\{\langle x, \mu_{A_1}(x)\cdot\mu_{A_2}(x), v_{A_1}(x)+v_{A_2}(x)-v_{A_1}(x)\cdot v_{A_2}(x)\ | x\in X\rangle\} \quad (8)$$

$$nA=\{\langle x, 1-(1-\mu_A(x))^n, (v_A(x))^n\ | x\in X\rangle\} \quad (9)$$

$$A^n=\{\langle x, (\mu_A(x))^n, 1-(1-v_A(x))^n\ | x\in X\rangle\} \quad (10)$$

Where n is a Positive integer.

3. Designing an Innovative SC Model in Service Using AHP and DEMATEL in Intuitionistic Fuzzy Environment

This study aims to identify and rank the effective factors on the innovative SC in the service sector. To identify the factors from the literature and similar studies, a survey of experts was used. On this basis, a total of 49 criteria were determined in eight dimensions. Determining the weight of the factors, regardless of their relationship matrix, their relationship is not in vain. So, to determine their weight, the integrated approach of AHP and DEMATEL in an intuitionistic fuzzy environment will be used. The research method consists of three phases and 14 steps, which will be presented in continuation. Figure 1 depicts a general outline of the research methodology stages, separated into three phases.

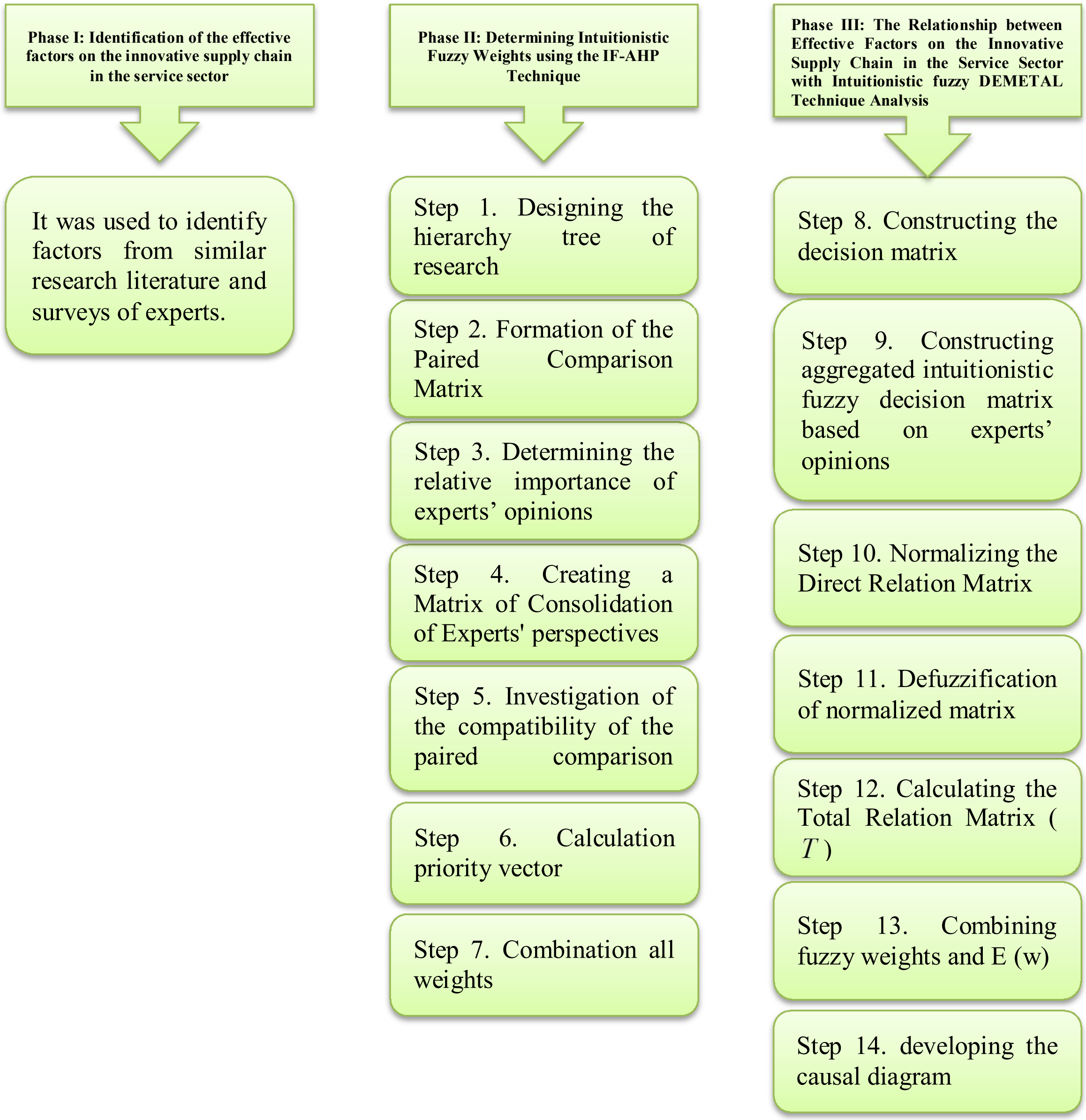

Fig. 1. A general overview of the research methodology steps

3.1. Phase I: Identification of the effective factors on the innovative SC in the service sector:

Applying the library resources and similar studies and expert perspective, effective factors affecting the innovative SC in the service sector were determined.

3.2. Phase II: Determining intuitionistic fuzzy weights using the IF-AHP technique:

Analytic Hierarchical Method (AHP) is a multi-criteria decision-making method for determining the weight and priority of factors. In fact, the AHP method is a method used to solve multi-criteria decision-making problems with a hierarchical structure. There are several intuitionistic fuzzy AHP methods. In this study, Zhou [111] Intuitionistic fuzzy AHP method, is used. Usually, the construction of the priority scale for each criterion and option can be expressed using the AHP measurement scale. A new priority scale with the sign of fuzzy intuitive numbers instead of definite numbers can be introduced. The discussion of intuitionistic fuzzy numbers includes the standard AHP scale and the intuitionistic fuzzy number. The AHP language priority scale is presented in the intuitionistic fuzzy number and inverse one in Table 1.

Tab. 1. Linguistic terms for the inference fuzzy numbers

Preference in pairwise comparisons	intuitionistic fuzzy numbers	The inverse value of intuitionistic
Equal priority	(0.02, 0.18, 0.80)	(0.02, 0.18, 0.80)
Fairly preferred	(0.27, 0.13, 0.60)	(0.13, 0.27, 0.60)
Strong preference	(0.27, 0.33, 0.40)	(0.33, 0.20, 0.40)
Very strong preference	(0.18, 0.62, 0.20)	(0.62, 0.18, 0.20)
Quite strong preference	(0, 1, 0)	(1, 0, 0)

Zhou [111] Intuitionistic fuzzy AHP method, includes the following steps:

Step 1. Designing the hierarchy tree of research: In this step, a hierarchy tree of research is drawn based on criteria, sub-criteria, and options.

Step 2. Formation of the Paired Comparison Matrix: In this step, based on the hierarchy tree of the research, the paired comparison matrix is designed, and, based on experts' opinions, a pairwise comparison of the hierarchical tree levels is done. In this step, for pair comparison, linguistic terms and the Intuitionistic fuzzy numbers are used (Table 1).

Step 3. **Determining the relative importance of experts' opinions:** Suppose that the decision-making team is composed of k experts and the importance of each expert is expressed by linguistic terms and intuitionistic fuzzy numbers shown in Table 2.

Tab. 2. Linguistic terms for rank the importance of criteria and decision-makers

Linguistic terms	IFNs
Very important	(0.9,0.1)
Important	(0.75,0.2)
Middle important	(0.5,0.45)
Low important	(0.35,0.6)
Unimportant	(0.1,0.9)

Assuming that $D_k = \{\mu_k, v_k, \pi_k\}$ is an intuitionistic fuzzy number expressing the importance of k-th expert, the weight of k-th expert is calculated as Eq. (11):

$$q_k = \frac{\left(\mu_k + \pi_k \left(\frac{\mu_k}{\mu_k + v_k}\right)\right)}{\sum_{k=1}^{l} \left(\mu_k + \pi_k \left(\frac{\mu_k}{\mu_k + v_k}\right)\right)} \quad (11)$$

$$\sum_{k=1}^{l} q_k = 1$$

Step 4. **Creating a Matrix of Consolidation of Experts' perspectives:** The Eq. (12) is used to aggregate the paired comparison matrices. In this relationship, q_k is the weight of the expert k and is determined on the basis of Eq. (11).

$$r_{ij} = \left(\left[1-\prod_{k=1}^{h}\left(1-\mu_{ijk}^{-}(x)\right)^{q_k}, 1-\prod_{k=1}^{h}\left(1-\mu_{ijk}^{+}(x)\right)^{q_k}\right], \left[\prod_{k=1}^{h}\left(v_{ijk}^{-}(x)\right)^{q_k}, \prod_{k=1}^{h}\left(v_{ijk}^{+}(x)\right)^{q_k}\right]\right) \quad (12)$$

$$j = C_1, C_2, \ldots, C_n$$

Step 5. Investigation of the compatibility of the paired comparison matrix: Every Inference preference relationship, preference is based on Eq. (13), if all the intuitive parenting relationships have acceptable compatibility, then step 7 is considered; otherwise, step 5 should be performed.

$$d\left(R, \widetilde{R}\right) < \tau \quad (13)$$

Description of the above-mentioned parameters has been given in the continuation.

Step 6. Calculation of the priority vector: In this step, the priority vector, that is $\omega = (\omega_1, \omega_2, \ldots, \omega_n)$ any intuitive preference relationship, is calculated through Eq. (14).

$$\omega_i = \left(\frac{\sum_{k=1}^{n} \mu_{ik}}{\sum_{i=1}^{n}\sum_{k=1}^{n}(1-v_{ik})}, 1 - \frac{\sum_{k=1}^{n}(1-v_{ik})}{\sum_{i=1}^{n}\sum_{k=1}^{n}\mu_{ik}} \right), i,k = 1,2,\ldots,n \quad (14)$$

Step 7. Combination of all weights: From the lowest to the highest level using the Eq. (15), the combined weights, ranking of the total weights are calculated using Eq. (16). Then the best option is chosen.

$$W_i = \oplus_{j=1}^{m} (\omega_j \otimes \omega_{ij}) \quad (15)$$

$$p(\alpha) = 0.5(1+\pi_\alpha)(1-\mu_\alpha) \quad (16)$$

3.3. Phase III: The relationship between effective factors on the innovative SC in the service sector with intuitionistic fuzzy DEMETAL technique analysis

Step 8. Constructing the decision matrix: The present study aimed to explain the causal relationships between the key factors in the effective factors on the innovative SC in the service sector with the IF-DEMATEL technique. In this regard, the decision matrix was formed to evaluate the factors identified in the previous step. This matrix is as Eq. (17).

$$x_{ij} = [\pi_{ij}(C_j), v_{ij}(C_j), \pi_{ij}(C_j)]$$

$$D_k = \begin{bmatrix} x_{11}^k & \cdots & x_{1j}^k \\ \vdots & \ddots & \vdots \\ x_{i1}^k & \cdots & x_{ij}^k \end{bmatrix} \quad (17)$$

This matrix is used to evaluate the impact of each factor in the row on each factor in the column according to experts' opinions. Following the intuitionistic fuzzy approach used in this study, in this step, experts used linguistic terms and intuitionistic fuzzy numbers shown in Table 3 to fill the decision matrix.

Tab. 3. Intuitionistic fuzzy linguistic terms

Linguistic terms	IFNs
No Influence	(0.1,0.9)
Very Low Influence	(0.35,0.6)
Low Influence	(0.5,0.45)
High Influence	(0.75,0.2)
Very High Influence	(0.9,0.1)

After collecting the evaluations of experts in the format of linguistic terms, the values of linguistic terms were converted into corresponding intuitionistic fuzzy numbers and construct an intuitionistic fuzzy matrix of evaluation of each expert.

Step 9. Constructing aggregated intuitionistic fuzzy decision matrix based on experts' opinions (Direct Relation Matrix): Suppose that $R^{(k)} = (r_{ij}^k)_{m\times m}$ is the intuitionistic fuzzy decision matrix of expert k, and $q = \{q_1, q_2, q_3, \ldots, q_k\}$ is the weight of each expert obtained from Step 3, where $\sum_{k=1}^{l} q_k = 1$, $q_k \in [0,1]$. The group decision-making process requires all individual decisions to be aggregated in the form of an intuitionistic fuzzy decision matrix. This can be done by IFWA operator provided by Xu (2007d) as Eq. (18). In this case $R = (r_{ij}^k)_{m\times m}$, and we have:

$$\begin{aligned} r_{ij} &= IFWA_\lambda\left(r_{ij}^{(1)}, r_{ij}^{(2)}, \ldots, r_{ij}^{(l)}\right) \\ &= q_1 r_{ij}^{(1)} \oplus q_2 r_{ij}^{(2)} \oplus q_3 r_{ij}^{(3)} \oplus \ldots \oplus q_l r_{ij}^{(l)} \\ &= \left[1 - \prod_{k=1}^{l}\left(1-\mu_{ij}^{(k)}\right)^{q_k}, \prod_{k=1}^{l}\left(v_{ij}^{(k)}\right)^{q_k}, \prod_{k=1}^{l}\left(1-\mu_{ij}^{(k)}\right)^{q_k} - \prod_{k=1}^{l}\left(v_{ij}^{(k)}\right)^{q_k}\right] \end{aligned} \quad (18)$$

Where: $r_{ij} = \left(\mu_{C_i}\left(C_j\right), v_{C_i}\left(C_j\right), \pi_{C_i}\left(C_j\right)\right)\ \left(i = j = 1,2,\ldots,m\right)$

The aggregated intuitionistic fuzzy decision matrix has been shown below:

$$R = \begin{bmatrix} (0.1,0,0.9) & \left(\mu_{C_1}(C_2), v_{C_1}(C_2), \pi_{C_1}(C_2)\right) & \cdots & \left(\mu_{C_1}(C_n), v_{C_1}(C_n), \pi_{C_1}(C_n)\right) \\ \left(\mu_{C_2}(C_1), v_{C_2}(C_1), \pi_{C_2}(C_1)\right) & (0.1,0,0.9) & \cdots & \left(\mu_{C_2}(C_n), v_{C_2}(C_n), \pi_{C_2}(C_n)\right) \\ \left(\mu_{C_3}(C_1), v_{C_3}(C_1), \pi_{C_3}(C_1)\right) & \left(\mu_{C_3}(C_2), v_{C_3}(C_2), \pi_{C_3}(C_2)\right) & \cdots & \left(\mu_{C_3}(C_n), v_{C_3}(C_n), \pi_{C_3}(C_n)\right) \\ \vdots & \vdots & \ddots & \vdots \\ \left(\mu_{C_n}(C_1), v_{C_n}(C_1), \pi_{C_n}(C_1)\right) & \left(\mu_{C_n}(C_2), v_{C_n}(C_2), \pi_{C_n}(C_2)\right) & \cdots & (0.1,0,0.9) \end{bmatrix}$$

Step 10. Normalizing the Direct Relation Matrix: In this step, the concept of function score was used to normalize the direct relation matrix. To do so, first Eq. (19) was used to obtain the sum of entries in each column of the direct relation matrix. Then, Eq. (20) was used to determine the function score for the summation of each column.

$$\begin{aligned} \tilde{\alpha}_1 + \tilde{\alpha}_2 &= \left(\mu_{ij1}(C_j) + \mu_{ij2}(C_j) - \mu_{ij1}(C_j) \times \mu_{ij2}(C_j), v_{ij1}(C_j) \times v_{ij2}(C_j)\right) \\ \pi &= 1 - \left(\mu_{ij1}(C_j) + \mu_{ij2}(C_j) - \mu_{ij1}(C_j) \times \mu_{ij2}(C_j)\right) - \left(v_{ij1}(C_j) \times v_{ij2}(C_j)\right) \end{aligned} \tag{19}$$

$$S_{ij} = \mu_{ij}(C_j) - v_{ij}(C_j) \tag{20}$$

Assuming that $N_{ij} = \left(\tilde{n}_{ij}\right)_{m\times m}$ is the normalized matrix, L is the inverse of maximum function score in direct relation matrix(R); on this basis, the normalized matrix was obtained by the Eq. (21)-(22):

$$\left(N_{ij}\right)_{m\times m} = L \times \left(R_{ij}\right)_{m\times m} \tag{21}$$

Where:

$$\tilde{n}_{ij} = \left(\left[1 - \left(1 - \mu_{ij}(C_j)\right)^L\right], \left[v_{ij}(C_j)^L\right]\right) \tag{22}$$

$$N_{ij} = \begin{bmatrix} \tilde{n}_{11} & \cdots & \tilde{n}_{1j} \\ \vdots & \ddots & \vdots \\ \tilde{n}_{i1} & \cdots & \tilde{n}_{ij} \end{bmatrix}_{m\times m}$$

Step 11. Defuzzification of normalized matrix: To defuzzify the normalized matrix, the preference risk coefficient (β) (Eq. (23)) was usedas below:

Preference risk coefficient $\beta \in [0,1]$ represents an expert's uncertainty in a decision; so $1-\beta$ is the certainty of expert regarding the decision. A $\beta \succ 0.5$ indicates that decision-maker is willing to take risks, and higher β s represent a greater risk in decisions; in contrast $\beta \prec 0.5$ indicate a more risk-averse approach. When $\beta = 0.5$, an expert has a balanced approach toward risks in decisions.

$$\bar{n}_{ij} = \mu_{ij}(C_j) - v_{ij}(C_j) + (2\beta - 1)\pi_{ij}(C_j) \tag{23}$$

Where $\beta \in [0,1]$

Step 12. Calculating the Total Relation Matrix (T): After defuzzifying the normalized direct relation matrix (R),the total relation matrix (T) via the Eq. (24) is obtained:

$$\left(T_{ij}\right)_{m\times m} = \left(N_{ij}\right)_{m\times m} \times \left(I - N_{ij}\right)^{-1} \tag{24}$$

Where I is the identity matrix.

Step 13. Combining fuzzy weights and E (w): Fuzzy weights from Step. 6 in phase II were combined with E (W). The new expected value was obtained using the multiplication operation as Eq. (25).

$$E(W)_{new} = w_j \otimes E(W) \tag{25}$$

Step 14. developing the causal diagram: The sum of entries of each row (*D*) shows how much a variable affects other variables, and the sum of entries of each column (*R*) shows how much a variable is affected by other variables. The horizontal vector ($D_i + R_i$) represents how influencing and influenced a factor is; this means that a factor with higher $D+R$ has more interaction with other variables. The vertical vector ($D_i - R_i$) shows the overall influence of each variable; so generally, when $D_i - R_i$ is positive variable is a "cause", and when $D_i - R_i$ is negative variable is an "effect". Finally, Cartesian coordinate system was plotted, where longitudinal axis represents $D + R$ and transverse axis represent $D - R$; so status of each variable is represented by a point with coordinates $\left(D + R, D - R\right)$.

4. Analysis

Based on the proposed steps, in the present section, the results of the research data collected are presented in the form of phases.

Phase I: Identifying Effective Factors on the Innovative SC in the Service Sector using library resources and similar studies, and academic and industrial experts' effective factors on the innovative SC were identified in the service sector. In this way, the component factors of the innovative SC in eight dimensions were identified including marketing innovation, technological innovation, infrastructural innovation, organizational innovation, collaborative innovation, process innovation, service innovation, governmental support for innovation. The factors mentioned are shown in Table 4.

Tab. 4. Effective factors on the innovative SC in the healthcare sector

Index	sub-Indexes (sub- categories)	Source
Marketing Innovation	Learning the value considered by customer in the SC	[18]
	Adapting to changes in customers desired value in the SC	
	Innovation in product design (by altering appearance, packaging, shape or volume without changing the technical characteristics of goods and services)	[40]
	Innovation in distribution channels or service delivery (such as offering new advertisements)	
	Innovation in product pricing or service delivery techniques	
	Innovative tools for developing product and service markets	
Technological innovation	Utilizing modern techniques and technology innovation appropriate to up to date knowledge and the production process	[43, 71, 72, 112]
	New technologies for the development of new products	
	The speed of developing new products (fast and competitive)	
	Providing adequate products suitable for the marketplace	
	Introducing new products first time to the market.	
Infrastructure Innovation	A system for sharing and sharing knowledge between organization	[63]
	A comprehensive system for collecting and analyzing data	
	The existence of a database of information and customer needs	
	Allocation of material resources and equipment necessary for the production of new products and services	[36]
	Encourage R & D units	
	R & D expenditure related to annual revenue	[75]
Organizational Innovation	Innovation in daily work, procedures and processes used to manage company activities.	[40]
	Innovation in Quality Management and Production Systems	
	Innovation in HRM	
	Innovation in Internal Management Information System of organization and in Information Sharing activities.	
	Innovation in organizational structure in order to facilitate teamwork, find strategic partnerships and build long-term partnerships with them, coordination between different tasks such as marketing, production, and performing organizational projects.	
Cooperation (inter-organizational partnership)	Organization cooperation with other similar organizations in the field of R & D innovation and activities.	[75]
	Cooperation of the organization with customers in the field of research and development activities and innovation.	
	Organization cooperation with suppliers in the field of R & D and innovation activities.	

Index	sub-Indexes (sub- categories)	Source
	Cooperation of the organization with competitors in the field of research and development activities and innovation	
	Cooperation with specialists and consultants in the field of R & D and innovation activities	
	Cooperation of organizational Laboratory and research and development companies.	
	Organization cooperation with universities in research, development and innovation activities	
	The organization's cooperation with public scholars or technical centers in research and development activities and innovation.	
Process Innovation	Using the informal process to produce ideas	[87]
	Use of modern technology in expanding the delivery process	[88]
	Support for ideas and creativity (the development of new and non-traditional solutions)	[89]
	Decrease in bureaucracy (for easy access to services)	[90]
	Official practices (using the formal process to improve services)	[91]
	Developing strategy and vision (applying developed and specific strategies)	[7]
	Determine and eliminate wasteful activities in the process of product production or service provision	[40]
	Reducing the cost of production factors including methods, software, and hardware and product manufacturing or service provision	
	Increasing the speed of delivery of products or providing services to customers	
	Application of new methods, techniques and processes in order to produce a product or provide services	
Innovation in Service	Need analysis based on age group (providing services and products based on the needs of different age groups)	[93]
	Upgrading Quality (Improving Current Services and Upgrading Service Quality)	[88]
	Technology (providing services and electronic products related up to date technology)	[94]
	Speed and accuracy of operation (rapid detection of urban and citizen needs and provision of contingency services)	[95]
	Extension and dynamism (providing a wide range of products and services)	[87]
Government support for innovation	The existence of necessary financial support from the government to develop innovation and creation of new goods and services.	[36]
	The existence of laws and regulations from the government to develop innovation	
	Organizing various classes by the government to train personnel of the organization.	
	Providing conditions and areas for marketing and selling new ideas of organization through the government.	

Phase II: **Determining Intuitionistic Fuzzy Weights Using the IF-AHP Technique:** The results obtained from this phase of research are shown in the following steps.

Step 1. Design of the Hierarchical Tree of the Research. Based on the factors identified in the first phase, the hierarchy tree is shown in Table 4.

Step 2. Formulation of Paired Comparative Matrix: Based on the identified factors, a questionnaire for comparative AHP research was designed and distributed among 15 experts in the Kerman (Iran) Hospital. Only four of them agreed to cooperate. In this questionnaire, the intuitionistic fuzzy numbers in Table 1 were used. After collecting data in the form of linguistic terms, using the fuzzy numbers shown in table two, linguistic terms were changed in intuitionistic fuzzy numbers.

Step 3. Determining the relative importance of experts' opinions: The importance of each of the experts based on linguistic terms of table 2 is shown in the table below.

Tab. 5. Importance of each expert

	$K_۱$	K_2	$K_۳$	$K_۴$
Linguistic terms	Middle important	Important	Very Important	Very Important

Weight of each expert (λ_k) was determined by converting the linguistic terms of mentioned table to intuitionistic fuzzy numbers of table 2 and then the Eq. (11) was used. The obtained weights are presented below.

λ_k	$K_۱$	$K_۲$	$K_۳$	$K_۴$
=	0.1585253	0.2110599	0.2986175	0.3317972

Step 4. Creating a Matrix of Aggregation of Experts' Views: An aggregation of expert opinions was done using Eq. (12). Table 10 shows the matrix of aggregation of paired comparisons of expert opinions.

Tab. 6. Matrix of aggregation of paired comparisons of expert opinions

	C1	C2	C3	C4	C5	C6	C7	C8
C1	(0.05, 0.580, 0.370)	(0.270, 0.618, 0.112)	(0.147, 0.776, 0.077)	(0.125, 0.757, 0.117)	(0.104, 0.762, 0.133)	(0.146, 0.756, 0.096)	(0.150, 0.718, 0.130)	(0.133, 0.794, 0.071)
C2	(0.316,0.574, 0.11)	(0.02,0.758, 0.222)	(0.270, 0.618, 0.112)	(0.106, 0.736, 0.157)	(0.100, 0.740, 0.158)	(0.139, 0.717, 0.143)	(0.142, 0.702, 0.155)	(0.131, 0.704, 0.163)
C3	(0.08, 0.235, 0.685)	(0.36, 0.474, 0.166)	(0.020, 0.758, 0.222)	(0.163, 0.687, 0.149)	(0.095, 0.744, 0.160)	(0.104, 0.752, 0.143)	(0.110, 0.727, 0.161)	(0.196, 0.616, 0.186)
C4	(0.608, 0.219, 0.173)	(0.134, 0.85, 0.284)	(0.474, 0.360, 0.166)	(0.02, 0.757, 0.222)	(0.224, 0.637, 0.138)	(0.161, 0.716, 0.122)	(0.126, 0.714, 0.159)	0.157, 0.690, 0.152)
C5	(0.568, 0.250, 0.181)	(0.539, 0.243, 0.217)	(0.544, 0.232, 0.223)	(0.446, 0.406, 0.147)	(0.02, 0.757, 0.222)	(0.257, 0.691, 0.051)	(0.161, 0.716, 0.122)	(0.172, 0.695, 0.132)
C6	(0.601, 0.229, 0.171)	(0.468, 0.283, 0.249)	(0.554, 0.251, 0.193)	(0.516, 0.295, 0.188)	(0.520, 0.373, 0.105)	(0.02, 0.757, 0.222)	(0.224, 0.637, 0.138)	0.149, 0.690, 0.159)
C7	(0.470, 0.302, 0.228)	(0.450, 0.289, 0.261)	(0.550, 0.227, 0.221)	(0.506, 0.293, 0.199)	(0.467, 0.319, 0.213)	(0.446, 0.406, 0.147)	(0.09, 0.357, 0.267)	(0.27, 0.618, 0.111)
C8	(1.00, 0.00, 0.00)	(0.494, 0.304, 0.202)	(0.504, 0.302, 0.193)	(0.436, 0.312, 0.251)	(0.442, 0.336, 0.221)	(0.506, 0.293, 0.199)	(0.359, 0.474, 0.165)	(0.02, 0.757, 0.222)

Step 5. **Investigating the compatibility of the paired comparative matrix**: In this step, using algorithms I and II, the compatibility of the paired comparative matrix (Table 6) was examined and an incompatibility improvement was made. The paired comparative matrix which was made compatible is shown in Table 7.

Tab. 7. Compatible paired comparative matrix.

	C1	C2	C3	C4	C5	C6	C7	C8
C1	(0.02, 0.758, 0.222)	(0.270, 0.618, 0.112)	(0.147, 0.776, 0.077)	(0.125, 0.757, 0.117)	(0.104, 0.762, 0.133)	(0.146, 0.756, 0.096)	(0.150, 0.718, 0.130)	(0.133, 0.794, 0.071)
C	(0.36,0.47	(0.02,0.75	(0.270,	(0.106,	(0.100,	(0.139,	(0.142,	(0.131,

2	4, 0.166)	8, 0.222)	0.618, 0.112)	0.736, 0.157)	0.740, 0.158)	0.717, 0.143)	0.702, 0.155)	0.704, 0.163)
C 3	(1.00, 0.00, 0.00)	(0.36, 0.474, 0.166)	(0.020, 0.758, 0.222)	(0.163, 0.687, 0.149)	(0.095, 0.744, 0.160)	(0.104, 0.752, 0.143)	(0.110, 0.727, 0.161)	(0.196, 0.616, 0.186)
C 4	(0.608, 0.219, 0.173)	(0.534, 0.255, 0.211)	(0.474, 0.360, 0.166)	(0.02, 0.757, 0.222)	(0.224, 0.637, 0.138)	(0.161, 0.716, 0.122)	(0.126, 0.714, 0.159)	0.157, 0.690, 0.152)
C 5	(0.568, 0.250, 0.181)	(0.539, 0.243, 0.217)	(0.544, 0.232, 0.223)	(0.446, 0.406, 0.147)	(0.02, 0.757, 0.222)	(0.257, 0.691, 0.051)	(0.161, 0.716, 0.122)	(0.172, 0.695, 0.132)
C 6	(0.601, 0.229, 0.171)	(0.468, 0.283, 0.249)	(0.554, 0.251, 0.193)	(0.516, 0.295, 0.188)	(0.520, 0.373, 0.105)	(0.02, 0.757, 0.222)	(0.224, 0.637, 0.138)	0.149, 0.690, 0.159)
C 7	(0.470, 0.302, 0.228)	(0.450, 0.289, 0.261)	(0.550, 0.227, 0.221)	(0.506, 0.293, 0.199)	(0.467, 0.319, 0.213)	(0.446, 0.406, 0.147)	(0.02, 0.757, 0.222)	(0.27, 0.618, 0.111)
C 8	(1.00, 0.00, 0.00)	(0.494, 0.304, 0.202)	(0.504, 0.302, 0.193)	(0.436, 0.312, 0.251)	(0.442, 0.336, 0.221)	(0.506, 0.293, 0.199)	(0.359, 0.474, 0.165)	(0.02, 0.757, 0.222)

Step 6. Calculating Priority Vector: Using the Eq. (14), the priority vector of the factors influencing the implementation of the innovation chain in healthcare was determined as shown in Table 8.

Step 7. Combination of weights: Based on Table 4, the hierarchy tree has two level. Thus the Combination of weights is not required.

Tab. 8. The final weights matrix of factors related to the target

Component	Final fuzzy weight	The final decisive weight components
Marketing Innovation	(0.036, 0.894, 0.069)	0.126104
Technological innovation	(0.042, 0.868, 0.088)	0.127632
Innovative Infrastructure	(0.068, 0.833, 0.098)	0.125252
Organizational Innovation	(0.076, 0.812, 0.110)	0.125532
Cooperation (inter-organizational partnership)	(0.090, 0.793, 0.115)	0.12425
Process Innovation	(0.101, 0.769, 0.128)	0.124099
Innovation in Service	(0.106, 0.753, 0.140)	0.124768
Government support for innovation	(0.125, 0.731, 0.143)	0.122362

The results of the above table indicated that among the identified factors, technological innovation with a coefficient (0.1276) has the highest definitive weight. Then, in turn, the dimensions of marketing innovation, organizational innovation, and infrastructure innovation were important.

Phase III: **Explaining the Relationship between Effective Factors on the Innovative SC in the Health Care Service Using the IF-DEMATEL Technique**

Step 8. Constructing the decision matrix: After determining the importance of the factors, the relationship between them was explained with the intuitionistic fuzzy DEMTAL method. For this purpose, the questionnaire related to the level of influence of each index on the other was prepared and distributed among experts. After collecting the views of experts and using Table 3, verbal data was changed to intuitionistic fuzzy numbers.

Step 9. Constructing aggregated intuitionistic fuzzy decision matrix based on experts' opinions (Direct Relation Matrix): The weights obtained for experts were used along with Eq. (18) to form the aggregated decision matrix ($\vec{R}(m \times m)$) as blow.

Tab. 9. Aggregated decision matrix $\vec{R}(m \times m)$

	C1	C2	C3	C4	C5	C6	C7	C8
C1	(0.1, 0.9, 0)	(0.410, 0.539, 0.05)	(0.385, 0.564, 0.050)	(0.410, 0.539, 0.050)	(0.549, 0.396, 0.05)	(0.385, 0.564, 0.050)	(0.385, 0.564, 0.050)	(0.385, 0.564, 0.050)
C2	(0.385, 0.564, 0.050)	(0.1, 0.9, 0)	(0.410, 0.539, 0.050)	(0.760, 0.205, 0.034)	(0.385, 0.564, 0.050)	(0.868, 0.123,0.008)	(0.705, 0.262, 0.032)	(0.410, 0.539, 0.050)
C3	(0.385, 0.564, 0.050)	(0.385, 0.564, 0.05)	(0.1, 0.9, 0)	(0.793, 0.172, 0.033)	(0.817, 0.167, 0.015)	(0.385, 0.564, 0.050)	(0.385, 0.564, 0.050)	(0.385, 0.564, 0.050)
C4	(0.385, 0.564, 0.05)	(0.884, 0.111, 0.004)	(0.385, 0.564, 0.050)	(0.1, 0.9, 0)	(0.633, 0.311, 0.054)	(0.746, 0.220, 0.033)	(0.760, 0.205, 0.034)	(0.385, 0.564, 0.050)
C5	(0.568, 0.379, 0.052)	(0.385, 0.564, 0.050)	(0.410, 0.539, 0.050)	(0.385, 0.564, 0.050)	(0.1, 0.9, 0)	(0.385, 0.564, 0.050)	(0.385, 0.564, 0.050)	(0.385, 0.564, 0.050)
C6	(0.568, 0.379, 0.052)	(0.385, 0.564, 0.050)	(0.410, 0.539, 0.050)	(0.549, 0.396, 0.053)	(0.385, 0.564, 0.050)	(0.1, 0.9, 0)	(0.410, 0.539, 0.050)	(0.385, 0.564, 0.050)
C7	(0.793, 0.172, 0.03)	(0.549, 0.396, 0.053)	(0.410, 0.539, 0.050)	(0.385, 0.564, 0.050)	(0.613, 0.333, 0.053)	(0.549, 0.396, 0.053)	(0.1, 0.9, 0)	(0.385, 0.564, 0.050)
C8	(0.385, 0.564, 0.050)	(0.385, 0.564, 0.050)	(0.868, 0.122, 0.008)	(0.760, 0.205, 0.034)	(0.410, 0.539, 0.050)	(0.385, 0.564, 0.050)	(0.410, 0.539, 0.050)	(0.1, 0.9, 0)

Step 10. Normalizing the direct relation matrix: In this step, Eq. (19)-(22) were used to normalize the direct relation matrix. This matrix is presented below.

Tab. 10. Normalized direct relation matrix $N(m \times m)$

Items	C1	C2	C3	C4	C5	C6	C7	C8
C1	(0.821, 0.921)	(0.497, 0.620)	(0.521, 0.642)	(0.497, 0.620)	(0.370, 0.489)	(0.521, 0.642)	(0.521, 0.642)	(0.521, 0.643)
C2	(0.521, 0.642)	(0.831, 0.921)	(0.497, 0.620)	(0.190, 0.294)	(0.521, 0.642)	(0.103, 0.198)	(0.236, 0.355)	(0.497, 0.620)
C3	(0.521, 0.642)	(0.521, 0.642)	(0.831, 0.921)	(0.163, 0.257)	(0.144, 0.251)	(0.521, 0.642)	(0.521, 0.642)	(0.521, 0.643)
C4	(0.521, 0.642)	(0.090, 0.183)	(0.521, 0.642)	(0.831, 0.921)	(0.296, 0.406)	(0.202, 0.310)	(0.190, 0.294)	(0.521, 0.643)
C5	(0.354, 0.472)	(0.521, 0.642)	(0.497, 0.620)	(0.521, 0.642)	(0.831, 0.921)	(0.521, 0.642)	(0.521, 0.642)	(0.521, 0.643
C6	(0.354, 0.472)	(0.521, 0.642)	(0.497, 0.620)	(0.370, 0.489)	(0.521, 0.642)	(0.831, 0.921)	(0.497, 0.620)	(0.521, 0.643)
C7	(0.163, 0.257)	(0.370, 0.489)	(0.497, 0.620)	(0.521, 0.642)	(0.314, 0.427)	(0.370, 0.489)	0.831, 0.921)	(0.521, 0.643
C8	(0.521, 0.642)	(0.521, 0.642)	(0.103, 0.198)	()0.190, 0.294	(0.497, 0.620)	(0.521, 0.642)	(0.497, 0.620)	(0.831, 0.921)

Step 11. Defuzzification of normalized matrix: In this step, preference risk coefficient (β) and Eq. (23) was used to defuzzify the normalized direct relation matrix. This resulting defuzzified matrix is presented in Table 11 (note that at this stage $\beta = 0.5$).

Tab. 11. Defuzzified normalized direct relation matrix

Items	C1	C2	C3	C4	C5	C6	C7	C8
C1	-0.0905604	-0.1228535	-0.1212415	-0.1228535	-0.1194221	-0.1212415	-0.1212415	-0.1212415
C2	-0.1212415	-0.0905604	-0.1228535	-0.1037148	-0.1212415	-0.094821	-0.1186105	-0.1228535
C3	-0.1212415	-0.1212415	-0.0905604	-0.0941963	-0.1069744	-0.1212415	-0.1212415	-0.1212415
C4	-0.1212415	-0.093117	-0.1212415	-0.0905604	-0.1091707	-0.1083308	-0.1037148	-0.1212415
C5	-0.1186464	-0.1212415	-0.1228535	-0.1212415	-0.0905604	-0.1212415	-0.1212415	-0.1212415
C6	-0.1186464	-0.1212415	-0.1228535	-0.1194221	-0.1212415	-0.0905604	-0.1228535	-0.1212415
C7	-0.0941963	-0.1194221	-0.1228535	-0.1212415	-0.1130999	-0.1194221	-0.0905604	-0.1212415
C8	-0.1212415	-0.1212415	-0.094821	-0.1037148	-0.1228535	-0.1212415	-0.1228535	-0.0905604

Step 12. Calculating the Total Relation Matrix (T): In this step, Eq. (24) and the identity matrix (*I*) were used to calculating the total relation matrix. Results of this step are presented in Table 12.

Tab. 12. Total relation matrix (T)

Items	C1	C2	C3	C4	C5	C6	C7	C8
C1	-0.033904	-0.0671434	-0.0646945	-0.0692994	-0.0638442	-0.0662792	-0.0646246	-0.0632932
C2	-0.0685309	-0.0363034	-0.0696028	-0.0521455	-0.0686672	-0.0409839	-0.0645812	-0.068038
C3	-0.0685481	-0.0675772	-0.036076	-0.0418901	-0.0532656	-0.0688757	-0.0670661	-0.0662375
C4	-0.0699925	-0.0404079	-0.0697849	-0.0405167	-0.0577917	-0.0566851	-0.0508211	-0.0682009
C5	-0.062968	-0.0655523	-0.0665775	-0.0677791	-0.0342972	-0.06638	-0.0647565	-0.0634599
C6	-0.0630339	-0.0655182	-0.0665937	-0.0658612	-0.0659587	-0.0347229	-0.0664558	-0.0634784
C7	-0.039375	-0.0661107	-0.0690242	-0.0703179	-0.0597013	-0.0668745	-0.0355241	-0.0658363
C8	-0.0686322	-0.0678386	-0.0395641	-0.0512265	-0.0698706	-0.0689978	-0.0689381	-0.0345719

Step 13. Combining fuzzy weights and E(W): According to the Eq. (25), by multiplying, the significance of the determined factors, in significance amount and criterion effect, new values $D_i - R_i$ and $D_i + R_i$ were determined. The results are shown in Table (13).

Tab. 13. The importance and effectiveness of criteria

Criteria	Component	$D_i - R_i$	$D_i + R_i$	IF Weight -AHP	$(D_i + R_i)_{New}$	$(D_i - R_i)_{New}$
C1	Marketing Innovation	0.12610	0.15702	0.12610	0.01980	-0.00228
C2	Technological innovation	0.12763	0.17978	0.12763	0.02295	0.00097
C3	Innovative Infrastructure	0.12525	0.17363	0.12525	0.02175	0.00155
C4	Organizational Innovation	0.12553	0.21185	0.12553	0.02659	0.00061

C5	Cooperation (inter-organizational partnership)	0.12425	0.15992	0.12425	0.01987	-0.00228
C6	Process Innovation	0.12410	0.16367	0.12410	0.02031	-0.00271
C7	Innovation in Service	0.12477	0.16956	0.12477	0.02116	0.00125
C8	Government support for innovation	0.12236	0.16233	0.12236	0.01986	0.00287

Step 14. developing the causal diagram: On the bases $D_i - R_{i(new)}$ and $D_i + R_{i(new)}$ Fig. (2) were plotted on the basis of the cause and effect values (Figure 2).

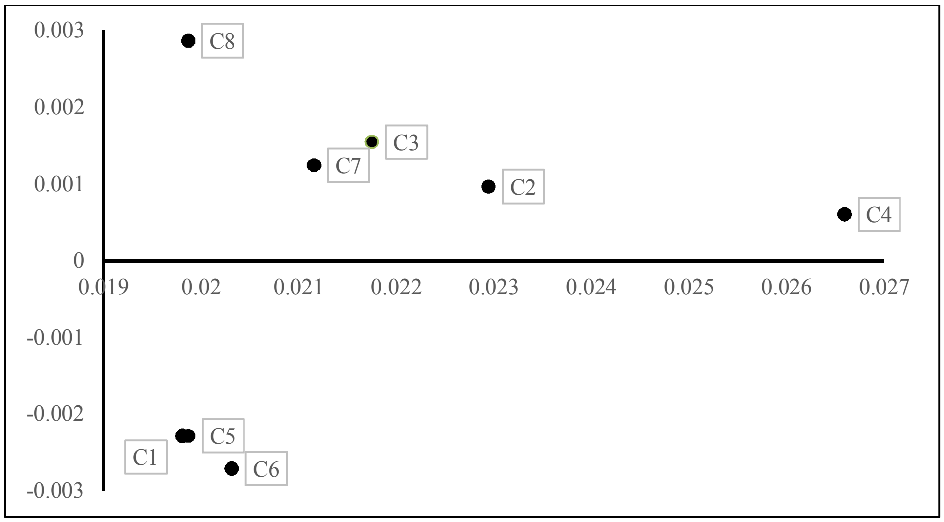

Fig. 2. Effective factors on the innovative SC in the healthcare sector

5. Discussion

The purpose of this study was to identify the effective factors on the innovative SC in the services sector in the hospitals of Kerman (Iran). To this end, according to the literature of research and interview with experts, 49 criteria were identified and categorized in 8 dimensions (Table4). Then, with special attention to the existence of causal relationships between them and the importance of each index, the combined approach of the two methods of AHP and DEMATEL decision-making in the intuitionistic fuzzy environment has been used. In this study, using the AHP method, the weight of the dimensions was determined; then, using the DIMETL techniques, the causal relations between the dimensions and the degree of influencing(effecting) and being influenced (being effected) of each dimension was determined. The results of the analysis of the research data in Table 13 and Fig. 2 indicate organizational innovation dimension with 0.026 ($= D_i + R_{i\ NEW}$) which is recognized as the most important dimension. Subsequently, the dimensions of technological innovation, infrastructure innovation, service innovation, process innovation, inter-organizational collaboration, government support for innovation, and finally marketing innovation are important, respectively. In other words, the three dimensions of inter-organizational cooperation, government support for innovation, and marketing innovation are not very significant. In this way, among the dimensions identified, the dimension of organizational innovation is of paramount importance. In this way, it can be admitted that in the innovative SC in the service sector, organizational innovation is potentially important. In the innovative SC, innovation can be seen as the participation of all parts of the organization in the development of new products and services that result in product innovation, service innovation, and marketing innovation. In fact, organizational innovation in the SC leads to innovation in daily operations, procedures, and processes such as innovation in management information systems, innovation in HRM, innovation in quality management systems, and production and innovation in the organizational structure. Ultimately, when supported by organizational creativity and when these initiatives are appropriate for the organization, they gain a competitive advantage through innovation in shaping new products, services, new processes, and new marketing or a combination of both.

On other hand, the government support for innovation with ($D_i - R_{i\ new}$)= 0.0028 was an affective dimension. Also Innovation in Infrastructure with ($D_i - R_{i\ new}$) = 0.0015 and innovation in services with ($D_i - R_{i\ new}$) = 0.0012 were affective dimensions respectively.

Government support for innovation due to the creation of a suitable foundation for SC supply has more effect on other dimensions. Government support can include government funding for the development of innovation. But government support is not limited to financial support for the development of innovation and the creation of new goods and services, it can include providing conditions and areas for marketing and providing new ideas from the government. The government can also provide a variety of training courses for the organization's staff in the SC. In addition, government support includes laws and regulations related to the development of innovations in the supply of services. After government support, the dimensions of innovation in infrastructure, innovation in support, technological innovation, and organizational innovation, because of the positive ($D_i - R_{i\ NEW}$), have an effect on the innovative SC in the service sector. But the basic point is that organizational innovation has the least effect among influential factors.

Also, innovation in the process with the lowest value (NEW) has been identified as the most effective dimension. In fact, innovation in the process through the use of new methods and processes in the production of products or services to reduce the cost of factors of production, elimination of waste activities in the process of product or service, the speed of delivery of products or the provision of services to customers need a suitable foundation; that can be achieved through factors such as government support for innovation, infrastructure innovation, service innovation, technological innovation, and organizational innovation. Thus, based on the results obtained, it can be stated that government innovation support dimensions, service innovation, infrastructure innovation, technological innovation, and organizational innovation, and the dimensions of marketing innovation, inter-organizational collaboration, and process innovation are components which are influenced.

6. Results

In this study, the combination of AHP and DEMATEL techniques was used in an intuitionistic fuzzy environment. The advantages of this method are to prioritize and determine the importance of the indices, which enables decision-makers to manage their time and money to address the results and continue their work in a guided fashion. Since it is important for service managers and planners in the SC to know which indicators are effective on the innovative SC in services, the indicators are effective (cause), using the intuitionistic fuzzy DEMATEL technique, the status of each dimension and index in terms of cause or effect is examined and the results are shown in table (13). In such a way that indicators that have D-R positive values are cause indices, D-R with negative values are effect indicators. It means that according to the results obtained, whenever decision-makers, depending on the subject of the research, seek to achieve early, but superficial results, they can focus on the priorities of the affected group. Now, if these decision-makers aim to take basic steps or focus on the main and basis of the subject, they can focus on the priorities of the influential layer or causes and set their plans accordingly. This issue becomes more accurate and more reliable when compared to an intuitionistic fuzzy approach. The achievements of this research can lead to the development of literature on the innovative SC in the service sector, including health care institutions. In addition, the results of this research can be considered important services for various groups, including managers in different SC categories, and serve as guidance for managers of these institutions. Based on the results of this study, it is suggested to managers of health care institutions, especially in the SC, to develop and provide innovative services and use of tools and practices that improve service SC performance, try to improve innovation in the SC services sector. Also, providing a comprehensive model based on the factors affecting the efficiency and effectiveness of an innovative SC would make managers aware of the importance of these factors. Despite the innovative research opportunities in the field of innovative SC in the service sector, unfortunately, this field has not received much attention from researchers. It is suggested that researchers explore the challenges and opportunities for increasing the awareness and knowledge of the benefits of the innovative SC in the services. The present research is essentially limited to the innovative SC in health services and terms of spatial domain in Kerman (Iran) and terms of data analysis method, it is limited to AHP techniques and DMTEL intuitionistic fuzzy.

Reference

[1] D. J. Goebel, G. W. Marshall, and W. B. Locander, "Enhancing purchasing's strategic reputation: Evidence and recommendations for future research," *Journal of Supply Chain Management,* Vol. 39, No. 1, (2003), pp. 4-14.

[2] J. N. Pearson, L. M. Ellram, and C. R. Carter, "Status and recognition of the purchasing function in the electronics industry," *International Journal of Purchasing and Materials Management,* Vol. 32, No. 1, (1996), pp. 30-36.

[3] C. A. Soosay, P. W. Hyland, and M. Ferrer, "Supply chain collaboration: capabilities for continuous innovation," *Supply chain management: An international journal,* (2008).

[4] K. Tannous and S. Yoon, "Summarizing risk, sustainability and collaboration in global supply chain management," *International Journal of Supply and Operations Management,* Vol. 5, No. 2, (2018), pp. 192-196.

[5] M. Fakhrzad, H. Hossaini Nasab, and A. Mostafaeipour, "Integration of P-Hub Location Problem and 3M Supply Chain," *International Journal of Supply and Operations Management,* Vol. 6, No. 1, (2019), pp. 11-29.

[6] A. Chansamut and P. Piriyasurawong, "Supply Chain Management Information System for Curriculum Management Based on The National Qualifications Framework for Higher Education," *International Journal of Supply and Operations Management,* Vol. 6, No. 1, (2019), pp. 88-93.

[7] J.-H. Lee, H.-D. Kim, Y. J. Ko, and M. Sagas, "The influence of service quality on satisfaction and intention: A gender segmentation strategy," *Sport Management Review,* Vol. 14, No. 1, (2011), pp. 54-63.

[8] E. S. Schneller and L. R. Smeltzer, "Strategic management of the health care supply chain," (2006).

[9] A. D. White and M. B. Mohdzain, "An innovative model of supply chain management: a single case study in the electronic sector," *International Journal of Information Technology and Management,* Vol. 8, No. 1, (2009), pp. 69-84.

[10] F. T. Chan, H. K. Chan, H. C. Lau, and R. W. Ip, "Critical success factors in managing global supply chains," *International journal of manufacturing technology and management,* Vol. 15, No. 1, (2008), pp. 28-44.

[11] S. E. Fawcett, G. M. Magnan, and M. W. McCarter, "Benefits, barriers, and bridges to effective supply chain management," *Supply chain management: An international journal,* (2008).

[12] A. Kumar, L. Ozdamar, and C. N. Zhang, "Supply chain redesign in the healthcare industry of Singapore," *Supply Chain Management: An International Journal,* (2008).

[13] S. H. Shin, E. M. Edwards, and T. Heeren, "Child abuse and neglect: Relations to adolescent binge drinking in the national longitudinal study of Adolescent Health (AddHealth) Study," *Addictive behaviors,* Vol. 34, No. 3, (2009), pp. 277-280.

[14] S. N. Turhan and O. Vayvay, "Modeling of VMI implementation via SOA in a healthcare supply chain," in *European and Mediterranean Conference on Information Systems*, (2009): Citeseer, pp. 1-2.

[15] D. A. Pitta and M. V. Laric, "Value chains in health care," *Journal of Consumer Marketing,* (2004).

[16] K. F. Doerner and M. Reimann, "Logistics of health care management," *Computers and Operations Research,* Vol. 3, No. 34, (2007), pp. 621-623.

[17] D. C. Bello, R. Lohtia, and V. Sangtani, "An institutional analysis of supply chain innovations in global marketing channels," *Industrial Marketing Management,* Vol. 33, No. 1, (2004), pp. 57-64.

[18] D. J. Flint, E. Larsson, and B. Gammelgaard, "Exploring processes for customer value insights, supply chain learning and innovation: an international study," *Journal of Business Logistics,* Vol. 29, No. 1, (2008), pp. 257-281.

[19] M. Nazam, J. Xu, Z. Tao, J. Ahmad, and M. Hashim, "A fuzzy AHP-TOPSIS framework for the risk assessment of green supply chain implementation in the textile industry," *International Journal of Supply and Operations Management,* Vol. 2, No. 1, (2015), pp. 548-568.

[20] M. E. Porter, "The competitive advantage of nations The Free Press," *New York,* Vol. 564, (1990).

[21] K. H. Tan, Y. Zhan, G. Ji, F. Ye, and C. Chang, "Harvesting big data to enhance supply chain innovation capabilities: An analytic infrastructure based on deduction graph," *International Journal of Production Economics,* Vol. 165, (2015), pp. 223-233.

[22] M. V. Tatikonda and S. R. Rosenthal, "Technology novelty, project complexity, and product development project execution success: a deeper look at task uncertainty in product innovation," *IEEE Transactions on engineering management,* Vol. 47, No. 1, (2000), pp. 74-87.

[23] X. Li, T. J. Goldsby, and C. W. Holsapple, "Supply chain agility: scale development," *The International Journal of Logistics Management,* (2009).

[24] D.-W. Kwak, Y.-J. Seo, and R. Mason, "Investigating the relationship between supply chain innovation, risk management capabilities and competitive advantage in global supply chains," *International Journal of Operations & Production Management,* (2018).

[25] J. Arlbjørn, H. Haas, and K. Munksgaard, "Exploring supply chain innovation, Logistics Research Vol. 3, No. 1, (2011), pp. 3-18.

[26] W. Hyll and G. Pippel, "Types of cooperation partners as determinants of innovation failures," *Technology Analysis & Strategic Management,* Vol. 28, No. 4, (2016), pp. 462-476.

[27] T. Baltacioglu, E. Ada, M. D. Kaplan, O. Yurt And, and Y. Cem Kaplan, "A new framework for service supply chains," *The Service Industries Journal,* Vol. 27, No. 2, (2007), pp. 105-124.

[28] S. Boon-Itt, C. Y. Wong, and C. W. Wong, "Service supply chain management process capabilities: Measurement development," *International Journal of Production Economics,* Vol. 193, (2017), pp. 1-11.

[29] H. Akkermans and B. Vos, "Amplification in service supply chains: An exploratory case study from the telecom industry," *Production and operations management,* Vol. 12, No. 2, (2003), pp. 204-223.

[30] J. S. Arlbjørn, H. de Haas, and K. B. Munksgaard, "Exploring supply chain innovation," *Logistics research,*Vol. 3, No. 1, (2011), pp. 3-18.

[31] S. Boon-itt and C. Pongpanarat, "Measuring service supply chain management processes: The application of the Q-sort technique," *International Journal of Innovation, Management and Technology,* Vol. 2, No. 3, (2011), p. 217.

[32] L. M. Ellram, W. L. Tate, and C. Billington, "Understanding and managing

the services supply chain," *Journal of Supply Chain Management,* Vol. 40, No. 3, (2004), pp. 17-32.

[33] D. W. Cho, Y. H. Lee, S. H. Ahn, and M. K. Hwang, "A framework for measuring the performance of service supply chain management," *Computers & Industrial Engineering,* Vol. 62, No. 3, (2012), pp. 801-818.

[34] G. J. Kim, S. S. Park, and D. S. Jang, "Technology forecasting using topic-based patent analysis," (2015).

[35] L. Gumusluoglu and A. Ilsev, "Transformational leadership, creativity, and organizational innovation," *Journal of business research,* Vol. 62, No. 4, (2009), pp. 461-473.

[36] T. Lin, "Product flow based auto-ID infrastructure," ed: Google Patents, (2007).

[37] P. Drucker, "Creating strategies of innovation," *Planning review,* (1985).

[38] C. L. Wang and P. K. Ahmed, "Leveraging knowledge in the innovation and learning process at GKN," *International Journal of Technology Management,* Vol. 27, No. 6-7, (2004), pp. 674-688.

[39] T. Schmidt and C. Rammer, "Non-technological and technological innovation: strange bedfellows?," *ZEW-Centre for European Economic Research Discussion Paper,* No. 07-052, (2007).

[40] G. Gunday, G. Ulusoy, K. Kilic, and L. Alpkan, "Effects of innovation types on firm performance," *International Journal of production economics,* Vol. 133, No. 2, (2011), pp. 662-676.

[41] J. Blackhurst*, C. W. Craighead, D. Elkins, and R. B. Handfield, "An empirically derived agenda of critical research issues for managing supply-chain disruptions," *International journal of production research,* Vol. 43, No. 19, (2005), pp. 4067-4081.

[42] Y. Sabri, G. J. Micheli, and C. Nuur, "Exploring the impact of innovation implementation on supply chain configuration," *Journal of Engineering and Technology Management,* Vol. 49, (2018). pp. 60-75.

[43] P. J. Singh and A. J. Smith, "Relationship between TQM and innovation: an empirical study," *Journal of Manufacturing Technology Management,* (2004).

[44] R. Hartono and M. L. Sheng, "Knowledge sharing and firm performance: the role of social networking site and innovation capability," *Technology Analysis & Strategic Management,* Vol. 28, No. 3, (2016), pp. 335-347.

[45] M. E. Porter and V. E. Millar, "How information gives you competitive advantage," ed: Harvard Business Review Reprint Service, (1985).

[46] M. L. Fisher, "What is the right supply chain for your product?," *Harvard business review,* Vol. 75, (1997), pp. 105-117.

[47] C.-Y. C. Lin, "Estimating supply and demand in the world oil market," *the Journal of Energy and Development,* Vol. 34, No. 1/2, (2008), pp. 1-32.

[48] H. Shin, D. A. Collier, and D. D. Wilson, "Supply management orientation and supplier/buyer performance," *Journal of operations management,* Vol. 18, No. 3, (2000), pp. 317-333.

[49] A. Tejaningrum, "Quality culture and capabilities process supply chain of SMEs," *International Journal of Organizational Innovation (Online),* Vol. 9, No. 2, (2016), p. 214.

[50] A. L. Potts, G. R. Warman, and B. J. Anderson, "Dexmedetomidine disposition in children: a population analysis," *Pediatric Anesthesia,* Vol. 18, No. 8, (2008), pp. 722-730.

[51] M. Borup, N. Brown, K. Konrad, and H. Van Lente, "The sociology of expectations in science and technology," *Technology analysis & strategic management,* Vol. 18, No. 3-4, (2006), pp. 285-298.

[52] G. Seyfang and N. Longhurst, "Grassroots innovation for sustainability: a niche analysis of community currencies," *Science, society & sustainability, Working Paper,* Vol. 10, (2012).

[53] S. Chapman, A. Blain, R. Ivison, and I. R. Smail, "A median redshift of 2.4 for galaxies bright at submillimetre wavelengths," *Nature,* Vol. 422, No. 6933, (2003), pp. 695-698.

[54] S. N. Yoon, D. Lee, and M. Schniederjans, "Effects of innovation leadership and supply chain innovation on supply chain efficiency: Focusing on hospital size," *Technological Forecasting and Social Change,* Vol. 113, (2016), pp. 412-421.

[55] J. Howells *et al.*, "Innovation in Services: Issues at Stake and Trends," European Commission, (2004).

[56] R. Miles, *Racism*. Routledge, (2004).

[57] E. Mazzola, M. Bruccoleri, and G. Perrone, "Supply chain of innovation and new product development," *Journal of purchasing and supply management,* Vol. 21, No. 4, (2015), pp. 273-284.

[58] M. A. Bellamy, S. Ghosh, and M. Hora, "The influence of supply network structure on firm innovation," *Journal of Operations Management,* Vol. 32, No. 6, (2014), pp. 357-373.

[59] Q. Zhu, J. Sarkis, and K.-h. Lai, "Institutional-based antecedents and performance outcomes of internal and external green supply chain management practices," *Journal of Purchasing and Supply Management,* Vol. 19, No. 2, (2013), pp. 106-117.

[60] R. Zimmermann, L. M. D. Ferreira, and A. C. Moreira, "The influence of supply chain on the innovation process: a systematic literature review," *Supply Chain Management: An International Journal,* (2016).

[61] B. T. Hazen, R. E. Overstreet, and C. G. Cegielski, "Supply chain innovation diffusion: going beyond adoption," *The International Journal of Logistics Management,* (2012).

[62] R. A. Paton and S. McLaughlin, "Services innovation:: Knowledge transfer and the supply chain," *European Management Journal,* Vol. 26, No. 2, (2008), pp. 77-83.

[63] D. Jiménez-Jiménez and R. Sanz-Valle, "Innovation, organizational learning, and performance," *Journal of business research,* Vol. 64, No. 4, (2011), pp. 408-417.

[64] J.-A. Johannessen and B. Olsen, "The future of value creation and innovations: Aspects of a theory of value creation and innovation in a global knowledge economy," *International Journal of Information Management,* Vol. 30, No. 6, (2010), pp. 502-511.

[65] J. Weerawardena, A. O'Cass, and C. Julian, "Does industry matter? Examining the role of industry structure and organizational learning in innovation and brand performance," *Journal of business research,* Vol. 59, No. 1, (2006), pp. 37-45.

[66] L. Yuan, S. Zhongfeng, and L. Yi, "Can strategic flexibility help firms profit from product innovation?," *Technovation,* Vol. 30, No. 5-6, (2010), pp. 300-309.

[67] O. Manual, "Guidelines for collecting and interpreting innovation data," ed: oecd Paris, France:, (2005).

[68] L. Ren, G. Xie, and K. Krabbendam, "Sustainable competitive advantage and marketing innovation within firms: A

pragmatic approach for Chinese firms," *Management research review,* (2010).

[69] M. V. Türker, "A model proposal oriented to measure technological innovation capabilities of business firms– a research on automotive industry," *Procedia-social and behavioral sciences,* Vol. 41, (2012), pp. 147-159.

[70] D. A. Filipescu, S. Prashantham, A. Rialp, and J. Rialp, "Technological innovation and exports: Unpacking their reciprocal causality," *Journal of International Marketing,* Vol. 21, No. 1, (2013), pp. 23-38.

[71] J.-L. Chong, A. Y.-L. Chong, K.-B. Ooi, and B. Lin, "An empirical analysis of the adoption of m-learning in Malaysia," *International Journal of Mobile Communications,* Vol. 9, No. 1, (2011), pp. 1-18.

[72] D. I. Prajogo and A. S. Sohal, "The relationship between TQM practices, quality performance, and innovation performance: An empirical examination," *International journal of quality & reliability management,* (2003).

[73] I. D'Attoma and M. Ieva, "Determinants of technological innovation success and failure: Does marketing innovation matter?," *Industrial Marketing Management,* Vol. 91, (2020), pp. 64-81.

[74] J. L. Furman, M. E. Porter, and S. Stern, "The determinants of national innovative capacity," *Research policy,* Vol. 31, No. 6, (2002), pp. 899-933.

[75] G. B. Jurado, R. Matson, R. Harrington, J.-R. Baars, and M. Kelly-Quinn, "Macroinvertebrate diversity in constructed ponds: community structure and driving environmental factors," *Internationale Vereinigung für theoretische und angewandte Limnologie: Verhandlungen,* Vol. 30, No. 3, (2008), pp. 489-492.

[76] F. Damanpour and D. Aravind, "Managerial innovation: Conceptions, processes and antecedents," *Management and organization review,* Vol. 8, No. 2, (2012), pp. 423-454.

[77] F. Damanpour, R. M. Walker, and C. N. Avellaneda, "Combinative effects of innovation types and organizational performance: A longitudinal study of service organizations," *Journal of management studies,* Vol. 46, No. 4, (2009), pp. 650-675.

[78] T.-T. Lu and J.-C. Chen, "Incremental or radical? A study of organizational innovation: An artificial world approach," *Expert Systems with Applications,* Vol. 37, No. 12, (2010), pp. 8193-8200. doi:https://doi.org/10.1016/j.eswa.2010.05.067.

[79] F. Donbesuur, G. O. A. Ampong, D. Owusu-Yirenkyi, and I. Chu, "Technological innovation, organizational innovation and international performance of SMEs: The moderating role of domestic institutional environment," *Technological Forecasting and Social Change,* Vol. 161, (2020), p. 120252.

[80] B. Shen, X. Xu, H. L. Chan, and T.-M. Choi, "Collaborative innovation in supply chain systems: Value creation and leadership structure," *International Journal of Production Economics,* Vol. 235, (2021), p. 108068.

[81] W. R. Meek, B. Davis–Sramek, M. S. Baucus, and R. N. Germain, "Commitment in franchising: The role of collaborative communication and a franchisee's propensity to leave," *Entrepreneurship Theory and Practice,* Vol. 35, No. 3, (2011), pp. 559-581.

[82] K.-H. Tsai and J.-C. Wang, "External technology sourcing and innovation performance in LMT sectors: An analysis based on the Taiwanese Technological Innovation Survey," *Research Policy,* Vol. 38, No. 3, (2009), pp. 518-526.

[83] C.-T. Su, Y.-H. Chen, and D. Y.-J. Sha, "Managing product and customer

knowledge in innovative new product development," *International Journal of Technology Management,* Vol. 39, No. 1-2, (2007), pp. 105-130.

[84] D. Jiménez-Jimenez, R. S. Valle, and M. Hernandez-Espallardo, "Fostering innovation: the role of market orientation and organizational learning," *European Journal of innovation management,* (2008).

[85] J. A. Jiménez, V. Gracia, H. I. Valdemoro, E. T. Mendoza, and A. Sánchez-Arcilla, "Managing erosion-induced problems in NW Mediterranean urban beaches," *Ocean & Coastal Management,* Vol. 54, No. 12, (2011), pp. 907-918.

[86] J. A. Siguaw, P. M. Simpson, and C. A. Enz, "Conceptualizing innovation orientation: A framework for study and integration of innovation research," *Journal of product innovation management,* Vol. 23, No. 6, (2006), pp. 556-574.

[87] P. Dolog, H. Stuckenschmidt, H. Wache, and J. Diederich, "Relaxing RDF queries based on user and domain preferences," *Journal of Intelligent Information Systems,* Vol. 33, No. 3, (2009), p. 239.

[88] L. B. Cardinal, "Technological innovation in the pharmaceutical industry: The use of organizational control in managing research and development," *Organization science,* Vol. 12, No. 1, (2001), pp. 19-36.

[89] R. M. Grant, "Prospering in dynamically-competitive environments: Organizational capability as knowledge integration," *Organization science,* Vol. 7, No. 4, (1996), pp. 375-387.

[90] J. Darroch, "Knowledge management, innovation and firm performance," *Journal of knowledge management,* (2005).

[91] J. N. Gupta and S. K. Sharma, *Creating knowledge based organizations*. Igi Global, (2004).

[92] P. De Giovanni and A. Cariola, "Process innovation through industry 4.0 technologies, lean practices and green supply chains," *Research in Transportation Economics,* (2020), p. 100869.

[93] B. Robbins, "Actually existing cosmopolitanism," *Cosmopolitics: Thinking and feeling beyond the nation,* (1998), pp. 1-19.

[94] S. U. Choi, "Nanofluids: A new field of scientific research and innovative applications," ed: Taylor & Francis, (2008).

[95] V. Vaccaro, S. Ahlawat, and D. Cohn, "Diffusion of innovation, marketing strategies, and global consumer values for a high technology product," *International Journal of Business Strategy,* Vol. 10, No. 3, (2010), pp. 113-128.

[96] M. Mazzucato, "The entrepreneurial state," *Soundings,* Vol. 49, No. 49, (2011), pp. 131-142.

[97] A. Holl and R. Rama, "Technology sourcing: Are biotechnology firms different? An exploratory study of the Spanish case," *Science and public policy,* Vol. 39, No. 3, (2012), pp. 304-317.

[98] K.-N. Kang and H. Park, "Influence of government R&D support and inter-firm collaborations on innovation in Korean biotechnology SMEs," *Technovation,* Vol. 32, No. 1, (2012), pp. 68-78.

[99] X. Qiu, M. Cano-Kollmann, and R. Mudambi, "Competitiveness and connectivity in design innovation: a study of Norwegian furniture industry," *Competitiveness Review: An International Business Journal,* (2017).

[100] H. Etzkowitz and M. Klofsten, "The innovating region: toward a theory of

knowledge-based regional development," *R&D Management,* Vol. 35, No. 3, (2005), pp. 243-255.

[101] S. Fabiani and R. Sbragia, "Tax incentives for technological business innovation in Brazil: the use of the Good Law-Lei do Bem (Law No. 11196/2005)," *Journal of technology management & innovation,* Vol. 9, No. 4, (2014), pp. 53-63.

[102] J. Matias-Pereira and I. Kruglianskas, "Gestão de inovação: a lei de inovação tecnológica como ferramenta de apoio às políticas industrial e tecnológica do Brasil," *RAE eletrônica,* Vol. 4, No. 2, (2005).

[103] S. Savage and A. Monroy-Hernández, "Participatory Militias: An Analysis of an Armed Movement's Online Audience," in *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing*, (2015), pp. 724-733.

[104] L. A. Zadeh, "Fuzzy sets," in *Fuzzy sets, fuzzy logic, and fuzzy systems: selected papers by Lotfi A Zadeh*: World Scientific, (1996), pp. 394-432.

[105] K. Atanassov, "Intuitionistic fuzzy sets VII ITKR's Session," *Sofia, June,* Vol. 1, (1983), p. 983.

[106] K. T. Atanassov, "On a second new generalization of the Fibonacci sequence," (1986).

[107] K. T. Atanassov, "Intuitionistic fuzzy sets," in *Intuitionistic fuzzy sets*: Springer, (1999), pp. 1-137.

[108] K. T. Atanassov, "Two theorems for intuitionistic fuzzy sets," *Fuzzy sets and systems,* Vol. 110, No. 2, (2000), pp. 267-269.

[109] E. Szmidt and J. Kacprzyk, "Distances between intuitionistic fuzzy sets," *Fuzzy sets and systems,* Vol. 114, No. 3, (2000), pp. 505-518.

[110] Q.-s. Zhang, S. Jiang, B. Jia, and S. Luo, "Some information measures for interval-valued intuitionistic fuzzy sets," *Information sciences,* Vol. 180, No. 24, (2010), pp. 5130-5145.

[111] M. Zhou, T. Park, and J. Yi, "Commonalities and differences between service and manufacturing supply chains: Combining operations management studies with supply chain management," *California Journal of Operations Management,* Vol. 7, No. 1, (2009), p. 136.

[112] D. T. Hoang, B. Igel, and T. Laosirihongthong, "The impact of total quality management on innovation: Findings from a developing country," *International journal of quality & reliability management,* (2006).

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