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Original Research

Analysis of the Factors Affecting the Adoption of Management Information Systems

Hossein Sayyadi Sooranloo
Associate Prof., Management Faculty, Meybod University, Meybod, Iran.
Corresponding Author: h.sayyadi@meybod.ac.ir
ORCID iD: https://orcid.org/0000-0001-9418-8187

Sepideh Saghafi
Ph.D. Student, Department of Public Administration, University of Tehran, Kish International Campus, Tehran, Iran.
S.sepideh2@yahoo.com
ORCID iD: https:orcid.org/0000-0001-5837-5946

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Abstract

The present study was conducted to identify and rank the factors affecting the successful adoption of management information systems in medical centers of Kerman (Iran). For this purpose, based on research literature and experts' interviews 27 criteria were identified in four dimensions and categorized. Then, considering the causal relationships between them and the importance of each indicator, the AHP and DEMATEL multi-criteria decision-making approach was used in the Intuitionistic fuzzy environment. In the present study, the weight of dimensions was determined using the AHP method and then the causal relationships between dimensions and the degree of influence and effectiveness of each dimension were determined using the DEMTEL technique. The results obtained that the dimension of senior management support is identified as the most important dimension. Then, the dimensions of information quality, system quality, and finally the user experience are important.

Keywords: Management Information Systems (MIS), Medical Centers, Intuitionistic Fuzzy Set.

Introduction

Over the past 20 years, a variety of ISs related to business needs has been developed for different purposes (Al-Mamary, Shamsuddin & Aziati, 2014c, 2015; Laudon & Laudon, 2015) each playing an important role in the organization and management hierarchy (Al-Mamary et al., 2014c, 2015). In this regard, Management information systems have become more widely used. MIS is defined as a type of IS that converts data into information and summarizes information meaningfully and is applied in management decisions (Hasan, Shamsuddin & Aziati, 2013; Munirat, Sanni & Kazeem, 2014; O'Brien & Marakas, 2006). MIS entails the process of collecting, processing, storing, marketing, and communicating relevant information for effective management and business planning in any organization (Hasan et al., 2013). Therefore, MIS plays a key role in the lives of organizations providing the right information at the right time to support management activities (Al-Mamary et al., 2014c). MIS is one of the most important tools in any organization that aims to provide reliable, accurate, complete, accessible, understandable, timely, and relevant information to managers and professionals to enhance the performance of the organization (Al-Mamary, Shamsuddin, & Aziati, 2014a, 2014b; Al-Mamary et al., 2014c, 2015; Munirat et al., 2014). It provides top-level data and information to help the board and executives make strategic decisions (senior management decisions, long-term decisions) and other levels. Data and information are to assist company activities including monitoring and control and are distributed among managers, supervisors, and professionals (Munirat et al., 2014). In addition, MIS allows information between departments to be moved immediately and reduces the need for face-to-face communication between employees. Thus, accountability in the organization increases (Al-Mamary et al., 2014a; Nath & Badgujar, 2013). Thus, it can be stated that MIS takes into account, the study of individuals, technology, and organization and how they are related to one another (Almutairi & Sathiyanarayanan, 2015; Whitney & Daniels, 2013). However, it can be argued that MIS has changed the physical layout of work to implement integrated systems for organizations (Munirat et al., 2014). The health sector also is no exception. Medical centers as a provider of care services to their clients face a high volume of patient data (medical records) and personnel data (including salaries, etc.) in their daily operations. Therefore, all staff's work in a hospital must be managed according to the right principles and accurate and timely information.

For every organization, including the health field, the advancement of technology has changed the way people work from manual to automatic (Astuti, Herdiyanti, & Iriandani, 2015). As is evident in MIS, the emphasis is on service delivery through technology (Almutairi & Sathiyanarayanan, 2015). That is, before IT, this data was manually managed, which required a lot of resources and time (Astuti et al., 2015). But MIS provides the hospital's critical information processing to manage all data and information in a timely and accurate manner (Astuti et al., 2015; Whitney & Daniels, 2013). The purpose of MIS is to simplify complex hospital processes so that they can provide better care to their patients (Astuti et al., 2015). Therefore, by using MIS significant benefits can be achieved (Almutairi & Sathiyanarayanan, 2015). It is believed that the hospital using MIS will benefit patients, staff, and itself (Astuti et al., 2015). But despite all the advantages and using MIS, its successful implementation has faced failure (Almutairi & Sathiyanarayanan, 2015; Astuti et al., 2015). According to Petter, DeLone, and McLean (2008) and Al-Mamary et al (2014a), the successful adoption of technology in organizations depends on the features of technology, project, organization, users, and work characteristics (Al-Mamary et al., 2014a). When users are not able to use the system, they cannot easily benefit from the system. In addition, some aspects of the system have still failed to meet the expectations that the ability of the system to operate and succeed is based on the skill and expertise of the organization (Almutairi & Sathiyanarayanan, 2015). In addition, some political processes can also lead to the failure of MIS (Almutairi & Sathiyanarayanan, 2015; Sweis, 2015). However, investing in information technology is relatively expensive, time-consuming, and risky, which may be a reason for rejecting MIS (Almutairi & Sathiyanarayanan, 2015; Bartis & Mitev, 2008). While the failure of IS projects is a waste of resources, which is a major obstacle to the investment of an organization (Nauman, Aziz & Ishaq, 2005), organizations cannot make their desired benefits from these systems. It is, therefore, necessary to identify what factors lead to successful MIS adoption. Therefore, it is necessary to identify the factors that lead to the successful adoption of MIS. In line with this necessity, this article intends to analyze the factors affecting the adoption of management information systems. For this purpose, Theoretical framework section, the definitions related to management information systems have been explained theoretically and the research background has been reviewed. Then, the proposed research approach is presented to identify and evaluate the factors affecting the successful adoption of management information systems by combining AHP and DEMATEL techniques in an intuitionistic fuzzy environment. In the findings section, while identifying the factors affecting the successful adoption of management information systems in medical centers, using interviews with research experts, these factors have been analyzed with the proposed approach. Finally, the results were discussed.

Theoretical framework

Management Information Systems (MIS)

Nowadays, organizations are constantly increasing their capabilities to deliver better services and be successful in their business. Accordingly, organizations are trying to increase their level of agility by improving the decision-making process to be more efficient and effective (Karim, 2011). Decision-making is an integral part of any business. Because the majority of operations in an organization focus on decisions made by management and other key people in the organization. To make good decisions, a proper information system is vital (Nowduri, 2011). To achieve this and facilitate the provision of services, the use of management information systems is inevitable (Karim, 2011). MIS can be used as management support to provide a competitive advantage (Munirat et al., 2014).

Different researchers have given different definitions of MIS. However, there is no universal definition of MIS and what is in the literature is only the researchers' perceptions (Adeoti-Adekeye, 1997; Karim, 2011). (Burns, 1998) and (Koontz & Weihrich, 2001) define MIS as a functional system for collecting, comparing, analyzing, and dispersing external and internal information to participate in a timely, effective, and efficient manner. Lee (2001) defines MIS as "the system or process that provides the information needed to manage an organization effectively." Laudon and Laudon (2016) in their study identified MIS as an information system focusing on uses of business and management. Also, Dos Santos (1991) and Lauden and Lauden (2003) define MIS as a system of planning, collection, storage, and dispersion of data in the form of information needs for management use. The above definitions indicate that MIS is an integrated system that is basically related to the process of collecting, processing, storing and transmitting relevant information to support management operations (planning, control, and decision making) within each organization (Adeoti-Adekeye, 1997; Senn, 1990). MIS as a system helps to manage the organization even at low levels by providing appropriate information and data from internal and external sources so that they can make timely and effective decisions and achieve the goals of the organization (Argyris, 1971; Karim, 2011). In fact, MIS is an information system that summarizes data and provides meaningful and useful information for management reports, decisions, and other activities (Al-Mamary et al., 2014a; Moh’d Al-adaileh, 2009; Munirat et al., 2014). According to Robert J. (2000), the purpose of MIS is to provide acceptable information at all levels, at the right time and at the appropriate cost, that this information is used in the decision-making process to correct the current situation of the organization with appropriate action (Munirat et al., 2014). MIS covers a wide range of technical and managerial activities that affect the use of information systems within an organization (Dinpanah & Javanmard, 2013). For instance, issues like top management commitment (Earl, 1989, 1993; McFarlan, McKenney & Pyburn, 1983; Porter & Millar, 1985) and strategic planning (Baets, 1996; Heckman, 2003; Järveläinen, 2013; Moody, 2003; Sabherwal & Chan, 2001; Venkatraman, Henderson & Oldach, 1993). As such, the features of MIS in practice are: centralizing information designed for managers in an organization; structured information flow; integrating data processing such as MIS personnel, etc., and generating reports usually from a database (Adeoti-Adekeye, 1997). However, it can be stated that MIS offers various advantages to the business of an organization, entailing: providing an appropriate response to the organization's position, efficient and effective coordination across departments at all levels of the organization, accessing relevant data and documents, managing daily activities, improving organizational techniques, receiving general or partial reports (currently, monthly, annually, etc.) (Al-Mamary et al., 2014a; Nath & Badgujar, 2013). Finally, creating the right conditions for effective and timely decision-making to predict the future of the organization and outline the prospects for achieving the goal (Al-Mamary et al., 2014a). Therefore, according to Linda (2003), successful implementation of MIS reduces costs, improves information processing with more accurate results, and improves the work environment and job satisfaction. Accordingly, the successful implementation of MIS brings many benefits to the organization. However, computer-based MIS, despite its many advantages, is not easily implemented in the organization, and technology problems, user resistance, and resistance from company executives are some of the factors that make implementation difficult. Dixon [1970] stated in his study that factors such as user participation and communication between team members influence the implementation and implementation of MIS. He also stated that implementing a new MIS would result in changes in different units of the organization and would modify the work of the manager so that the old methods would not be applied. Murdick and Manson (1986) cited eleven fear of using MIS in an organization, out of these eleven reasons some are related to managers, such as isolation, change in power relations, a threat to position, and personality threat. Batangar (1991) during his research identified a lack of skilled manpower and management professionals as a critical challenge of MIS in developing countries. Adeoti-Adekeye (1997) cited the failure of management to intervene in MIS design, inappropriate computer MIS system, and lack of senior management support as reasons for failure to implement MIS. Lorenzi et al (1997) discussed the importance of organizational factors such as organizational culture, employees' skills development, commitment, and management initiative to implement MIS. They pointed out that culture could have a significant impact on the management style and nature of an organization. According to Karahanna, Straub & Chervany (1999) using technology acceptance is the first step. Agarwal and Prasad (1999) in their project related to individual features that are effective in the success of managing information systems found three types of demographic variables, cognitive variables, and personality variables. Lee et al (2005) in their research to examine the propensity of computer systems application and the impact of organizational support and encouragement on suppliers examined the impact of employees' positive attitude on technology application. The findings show that not only technical characteristics, such as ease of use and utility, play a key role in employee acceptance, but also two factors organizational support and encouragement of market providers, reinforce the relationship between technical characteristics and employees' tendency to use technology before to implementing MIS, it should be ensured that the system is compatible with the organization. This will not only help avoid inappropriate choices but will also save time and money (Karim, 2011). The impact of the system also depends on the position of the organization and its internal structure (Qazi & Ali, 2009).

Implementing IS in the field of human services is not only related to the technical knowledge needed for designing these systems but also to the ability to overcome organizational obstacles that hinder the successful use of information in decision making. The success or failure of MIS depends not only on technical considerations (McIntyre, Attkisson, & Keller, 1974) but also on organizational and political implications. We need to understand how broader system management issues influence the development of effective decision support systems. Thus, in this regard, the importance of MIS failure and preventive practices has led researchers to investigate the factors affecting the successful adoption of management information systems in medical centers. For this purpose, the factors affecting the successful adoption of management information systems are identified in 4 dimensions: system quality, information quality, and senior management support and user experience. Which, will be discussed in detail.

- **System Quality:** System quality is one of the desirable features of an information system (Al-Mamary et al., 2014a; Petter et al., 2008) which is the cause to improve system performance and refers to how the software, hardware, policies, and procedures of the information system are fully capable of providing the information required for users (Astuti et al., 2015; DeLone & McLean, 1992). According, the quality of the MIS system affects information throughout the organization. The high quality of MIS ultimately enhances the quality of management decisions (Hasan et al., 2013). It is characterized by features such as ease of use, system flexibility, (certainty and reliability) system reliability, easy-to-learn system, timely system responsiveness, users' requirements (users' expectations or users' requirements), and system integration which, will be discussed in detail.
- **Information Quality:** Information quality has a significant effect on management decisions. To help decision makers make the right decision, information must be accurate and error-free, complete, or contain all the details needed in a short, relevant form (Hasan et al., 2013). As such, information quality is a desirable feature of MIS output (ibid). The information output of the system is generated about the value, benefits, relevance, and urgency of information (Astuti et al., 2015; Pitt, Watson & Kavan, 1995) which is described with features such as understandability of information, the accuracy of the information, completeness of information, consistency of information, timeliness of information, accessibility - usability of information, the brevity of information, relevance of information, objectivity of information, reliability of information and information security.
- **Senior Management Support:** On Endorse of management and its continuous support not only during the IS project implementation but also during the operational phase of the system (Al-Mamary et al., 2014a; Hasan et al., 2013) and for understanding the importance of IS performance and its extent in IS activities have been referred (Hasan et al., 2013; Ragu-Nathan, Apigian, Ragu-Nathan & Tu, 2004). It is a service that when more senior managers allocate resources to support IT, they tend to make more use of IS within the enterprise. If senior managers support the use of IS may be some benefits are also generated. Rewards such as encouraging staff to use IS. Considering these conditions, employees tend to use it satisfactorily if they encounter an IS. Eventually, the overall performance of the company will increase (Cho & Shen, 2007). Accordingly, senior management support is described with features such as management support for system use for related tasks, management support for empowering employees to use the system, management support for adopting new technology, and management support to access any need for hard resources.
- **Users' Experience:** User experience is people's prior experience with a specific

technology (Al-Mamary et al., 2014a). Since information is simply not available, decision makers must use their experiences in a variety of past contexts. In this computer system, there is the opportunity to learn from experiences and thus facilitate the user experience in using ISs. These features include user experience in the system, user experience in word processing, user experience in requirements analysis, user experience in programming languages, and user participation in MIS computer design.

Hospital Information Systems

HIS refers to a computer system of day-to-day medical service workflows, facilitating administrative and clinical data management, and processing of health insurance and healthcare equipment (Liu, Yang, Yeh & Wang, 2006). For this reason, HIS is defined as the hospital's social-technical subsystems include all relevant information-processing systems (Handayani, Hidayanto, Ayuningtyas & Budi, 2016),which serve other goals (conflicting goals such as optimal use of resources and improving performance) (Reichertz, 2006). According to Chen and Hsiao (2012), HIS is an integrated information system that plays a key role in supporting hospital affairs using IT (Handayani et al, 2016). HIS can help improve the health care organization's operational efficiency, reduce risk, and control costs (Sayyadi Tooranloo, Saghafi & Ayatollah, 2021). Many researchers have conducted studies in this field, including Rochmah, Fakhruzzaman & Yustiawan (2020) in their study entitled Acceptance of Management Information Systems by Hospital Staff concluded that hospital staff does not yet have a strong understanding of the benefits of using hospital information systems. In addition, Alsalman et al. (2021) in a study entitled "Implementation modes of health information systems in the hospital" concluded that hospitals are implementing health information systems in stages, but half of the steps in hospitals are not fully implemented.

Intuitionistic fuzzy set (IFS)

An intuitionistic fuzzy set (IFS) is one of the generalizations of fuzzy sets theory (Zadeh, 1965). Out of several higher-order fuzzy sets, IFS, first introduced by Atanassov (1983), is 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 (Atanassov, 1999). Presently, IFSs are being studied and used in different fields of science. Among the research works on IFS, we can mention Atanassov (1989, 1999), Atanassov and Gargov (1998), Szmidt and Kacprzyk (2000), Ban (2006), Deschrijver, Cornelis and Kerre (2002) .

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

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

In the above definition, $u_A(x), v_A(x)$ are the degree of membership and non-membership respectively, which are defined as and satisfy $0 \le u_{ij}(x) + v_{ij}(x) \le 1$. In addition, each $x \in X$, the intuitionistic index π_x is defined as $\pi_x = 1 - u_x - v_x$ (KT Atanassov, 1983).

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

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

It must be noted that although the intuitionistic fuzzy number is similar (in appearance) to the triangular fuzzy number (a,b,c), it is quite different. A 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 $u_{ij}(x), v_{ij}(x), \pi_{ij}(x)$ (Szmidt & Kacprzyk, 2001). Atanassov & Gargov (1998) and Gau & Buehre (1993) have described the 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:

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

These numbers are better suited to deal with uncertainty and provide a more logical-mathematical framework to deal with inexact facts and incomplete information (Zhang, Jiang, Jia & Luo, 2010). 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 $\mu_{ij}(x)$ are numbers in the range [0,1]. $\pi_{ij}(x)$ and $v_{ij}(x)$ ،

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 (Xu & Cai, 2012)the following relationships are defined:

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

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

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

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

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

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

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

Where is a positive integer.

Designing a Model of Factors Affecting Successful Adoption of Management Information Systems in Medical Centers Using AHP and DEMATEL Techniques in Intuitionistic Fuzzy Environment

This study aims to identify and rank the factors affecting the successful adoption of management information systems in medical centers. To identify the factors from the literature and similar studies, a survey of experts was used. On this basis, 27 criteria were determined in four 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, which will be presented in continuation. Figure (1) depicts a general outline of the research methodology stages, separated into three phases.

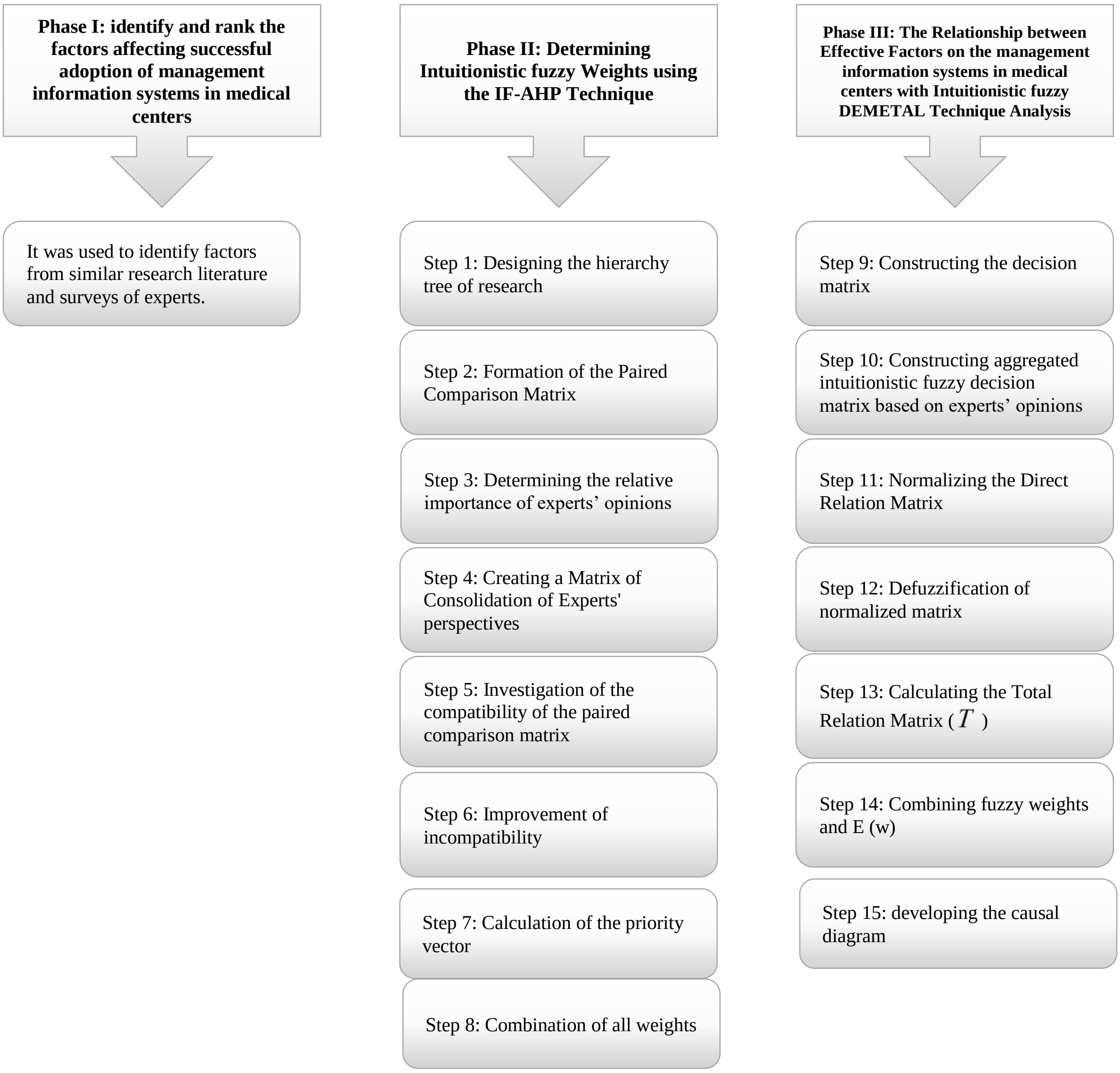

Figure 1: A general overview of the research methodology steps

Phase I: Identify and rank the factors affecting the successful adoption of management information systems in medical centers: Applying the library resources, similar studies, and expert perspectives, factors affecting the successful adoption of management information systems are determined.

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. The AHP method is a method used to solve multi-criteria decision-making problems with a hierarchical structure (Buckley, 1985). There are several intuitionistic fuzzy AHP methods. In this study, (Zhou, Deng, Deng & Mahadevan, 2017)

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, which Wind and Saaty (1980) suggested. 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).

Table 1
Linguistic terms for the inference of fuzzy numbers (Abdullah & Najib, 2014)

Preference for pairwise comparisons	intuitionistic fuzzy numbers	The inverse value of intuitionistic
Equal priority	(0.02, 0.18, 0.80)	(0.02, 0.18, 0.80)
Intermediate value	(0.06, 0.23, 0.70)	(0.23, 0.06, 0.70)
Fairly preferred	(0.13, 0.27, 0.60)	(0.27, 0.13, 0.60)
Intermediate value	(0.22, 0.28, 0.50)	(0.28, 0.22, 0.50)
Strong preference	(0.33, 0.27, 0.40)	(0.27, 0.33, 0.40)
Intermediate value	(0.47, 0.23, 0.30)	(0.23, 0.47, 0.30)
Very strong preference	(0.62, 0.18, 0.20)	(0.18, 0.62, 0.20)
Intermediate value	(0.80, 0.10, 0.10)	(0.10, 0.80, 0.10)
Quite strong preference	(1, 0, 0)	(0, 1, 0)

Zhou, Zhao & Wei (2014) 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 will be done **(** $\tilde{R} = \left(\tilde{r}_{ij}\right)_{n\times n}$**)**. 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 linguistic terms and intuitionistic fuzzy numbers are shown in table (2) to express the importance of each expert.

Table 2
Linguistic terms ranking 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 follows:

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

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

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

$$\begin{aligned} r_{ij} &= IFWA_{\lambda}\left(r_{ij}^{(1)}, r_{ij}^{(2)}, \ldots, r_{ij}^{(l)}\right) \\ &= \lambda_1 r_{ij}^{(1)} \oplus \lambda_2 r_{ij}^{(2)} \oplus \lambda_3 r_{ij}^{(3)} \oplus \ldots \oplus \lambda_l r_{ij}^{(l)} \\ &= \left[1 - \prod_{k=1}^{l}\left(1-\mu_{ij}^{(k)}\right)^{\lambda_k}, \prod_{k=1}^{l}\left(v_{ij}^{(k)}\right)^{\lambda_k}, \prod_{k=1}^{l}\left(1-\mu_{ij}^{(k)}\right)^{\lambda_k} - \prod_{k=1}^{l}\left(v_{ij}^{(k)}\right)^{\lambda_k}\right] \end{aligned} \qquad \textbf{(12)}$$

Step 5: Investigation of the compatibility of the paired comparison matrix: every Inference Preference Relationship preference based on (13), if all the intuitive parenting relationships have acceptable compatibility, then we go to step 7; otherwise, step 5 should be done.

$$d\left(R, \tilde{R}\right) < \tau \qquad (13)$$

Description of the parameters mentioned has been said in the continuation.

Step 6: Improvement of incompatibility: In the event of an inconsistency, the intuitionistic fuzzy preference relations are modified based on algorithm II and then proceed to the next step. The algorithm I is the prerequisite for using this algorithm.

Algorithm I:

Step A - For, k> I, suppose $\bar{r}_{ik} = \left(\bar{\mu}_{ik}, \bar{v}_{ik}\right)$

$$\tilde{\mu}_{ik} = \frac{\left(\mu_{ik}\right)^{1-\sigma}\left(\tilde{\mu}_{ik}\right)^{\sigma}}{\left(\mu_{ik}\right)^{1-\sigma}\left(\tilde{\mu}_{ik}\right)^{\sigma} + \left(1-\mu_{ik}\right)^{1-\sigma}\left(1-\tilde{\mu}_{ik}\right)^{\sigma}}, \quad i, k = 1, 2, \ldots, n$$

$$\tilde{v}_{ik} = \frac{\left(v_{ik}\right)^{1-\sigma}\left(\tilde{v}_{ik}\right)^{\sigma}}{\left(v_{ik}\right)^{1-\sigma}\left(\tilde{v}_{ik}\right)^{\sigma} + \left(1-v_{ik}\right)^{1-\sigma}\left(1-\tilde{v}_{ik}\right)^{\sigma}}, \quad i, k = 1, 2, \ldots, n$$

Step B - For $k = i + 1$, suppose $\bar{r}_{ik} = r_{ik}$

Step C - For $k < i$, suppose $\bar{r}_{ik} = \left(\bar{v}_{ki}, \bar{\mu}_{ki}\right)$

Algorithm II:

Step D - Suppose for p you have a numerator. Consider the construction of Invoice Preference Relationship Multiplicative Adjustment $\overline{R}$ from $R^{(p)}$ using the algorithm **I** and consider ρ=1.

Step H. Calculate the distance between $\overline{R}$ and $R^{(p)}$ using the following equation:

$$d\left(\bar{R},R^{(p)}\right)=\frac{1}{2(n-1)(n-2)}\sum_{i=1}^{n}\sum_{k=1}^{n}\left(\left|\tilde{\mu}_{ik}-\mu_{ik}^{(p)}\right|+\left|\tilde{v}_{ik}-v_{ik}^{(p)}\right|+\left|\tilde{\pi}_{ik}-\pi_{ik}^{(p)}\right|\right) \quad (14)$$

If $d\left(\bar{R},R^{(p)}\right)<\tau$, then the matrix $R^{(p)}$ is compatible; otherwise, we will go to the next step.

Step V: formation of integrated intuitionistic fuzzy preference relationship using the following relationships $\tilde{R}^{(p)}=\left(\tilde{r}_{ik}^{(p)}\right)_{n\times n},\left(\tilde{r}_{ik}^{(p)}=\left(\tilde{\mu}_{ik}^{(p)},\tilde{v}_{ik}^{(p)}\right)\right)$:

$$\tilde{\mu}_{ik}^{(P)}=\frac{\left(\mu_{ik}^{(P)}\right)^{1-\sigma}\left(\tilde{\mu}_{ik}\right)^{\sigma}}{\left(\mu_{ik}^{(P)}\right)^{1-\sigma}\left(\tilde{\mu}_{ik}\right)^{\sigma}+\left(1-\mu_{ik}^{(P)}\right)^{1-\sigma}\left(1-\tilde{\mu}_{ik}\right)^{\sigma}}\ ,\ i,k=1,2,\ldots,n \quad (15)$$

$$\tilde{v}_{ik}^{(P)}=\frac{\left(v_{ik}^{(P)}\right)^{1-\sigma}\left(\tilde{v}_{ik}\right)^{\sigma}}{\left(v_{ik}^{(P)}\right)^{1-\sigma}\left(\tilde{v}_{ik}\right)^{\sigma}+\left(1-v_{ik}^{(P)}\right)^{1-\sigma}\left(1-\tilde{v}_{ik}\right)^{\sigma}}\ ,\ i,k=1,2,\ldots,n \quad (16)$$

σ is a control parameter determined by the decision maker; the closest distance between $\tilde{R}^{(p)}$ and $R^{(p)}$ is equal to the smallest value of σ Considering the following assumptions, we go to step 2:

- $R^{(p+1)}=\tilde{R}^{(p)}$ For example, $\mu_{ik}^{(P+1)}=\tilde{\mu}_{ik}^{(P)}$ and $v_{ik}^{(P+1)}=\tilde{v}_{ik}^{(P)}$ and
- $p=p+1$

Through this algorithm, it is possible to improve the compatibility level of any relationship of intuitive preference relationship in an automated manner, without losing the main information. From the comparison of this algorithm with the interactive method, it is assumed that the process used here needs less time to reach compatible matrices. In fact, in this algorithm, based on the information of the primitive paired matrix, it is proposed to create a matched coupling matrix.

Step 7: Calculation of the priority vector: In this step, the priority vector, that is any intuitive preference relationship, is calculated through a relationship (17).

$$\omega_i=\left(\frac{\sum_{k=1}^{n}\mu_{ik}}{\sum_{i=1}^{n}\sum_{k=1}^{n}\left(1-v_{ik}\right)},1-\frac{\sum_{k=1}^{n}\left(1-v_{ik}\right)}{\sum_{i=1}^{n}\sum_{k=1}^{n}\mu_{ik}}\right)\ ,\ i=1,2,\ldots,n \quad (17)$$

Step 8. Combination of all weights: From the lowest to the highest level, using the operator (18), the combined weights, and ranking of the total weights are calculated using equation (19). Then you can choose the best option.

$$W_i=\bigoplus_{j=1}^{m}\left(\omega_j\otimes\omega_{ij}\right) \quad (18)$$

$$\rho(\alpha)=0/5\left(1+\pi_{\alpha}\right)\left(1-\mu_{\alpha}\right) \quad (19)$$

Phase III: The Relationship between factors affecting the successful adoption of

management information systems in medical centers with Intuitionistic fuzzy DEMETAL Technique Analysis

Step 9: Constructing the decision matrix: The present study aims to explain the causal relationships between the key factors in affecting the successful adoption of management information systems in medical centers with the IF-DEMATEL technique. In this regard, the $n \times n$ decision matrix is formed to evaluate the factors identified in the previous step. This matrix is as follows.

$$x_{ij} = \left[\pi_{ij}\left(C_j\right), v_{ij}\left(C_j\right), \ \pi_{ij}\left(C_j\right)\right]$$
$$D_k = \begin{bmatrix} x_{11}^k & \cdots & x_{1j}^k \\ \vdots & \ddots & \vdots \\ x_{i1}^k & \cdots & x_{ij}^k \end{bmatrix} \quad (20)$$

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

Table 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 are converted into corresponding intuitionistic fuzzy numbers and construct an intuitionistic fuzzy matrix of evaluation of each expert.

Step 10: Construction aggregated intuitionistic fuzzy decision matrix based on experts' opinions (Direct Relation Matrix): Suppose that $R^{(k)} = \left(r_{ij}^k\right)_{m\times m}$ 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 the IFWA operator provided by (Xu, 2007). In this case $R = \left(r_{ij}^k\right)_{m\times m}$, and we have:

$$\begin{aligned} r_{ij} &= IFWA_{\lambda}\left(r_{ij}^{(1)}, r_{ij}^{(2)}, \ldots, r_{ij}^{(l)}\right) \\ &= q_1 r_{ij}^{(1)} \oplus q_2 r_{ij}^{(2)} \oplus q_3 r_{ij}^{(3)} \oplus \ldots \oplus q_l r_{ij}^{(l)} \\ &= \left[1-\prod_{k=1}^{l}\left(1-\mu_{ij}^{(k)}\right)^{q_k}, \prod_{k=1}^{l}\left(v_{ij}^{(k)}\right)^{q_k}, \prod_{k=1}^{l}\left(1-\mu_{ij}^{(k)}\right)^{q_k} - \prod_{k=1}^{l}\left(v_{ij}^{(k)}\right)^{q_k}\right] \end{aligned} \tag{21}$$

Where: $r_{ij} = \left(\mu_{C_i}(C_j), v_{C_i}(C_j), \pi_{C_i}(C_j)\right)\ (i = j = ۱,۲,\ldots,m)$

The aggregated intuitionistic fuzzy decision matrix will be as shown below:

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

Step 11: Normalizing the Direct Relation Matrix: In this step, the concept of function score is used to normalize the direct relation matrix. To do so, the first equation (22) is used to obtain the sum of entries in each column of the direct relation matrix. Then, the following equation is used to determine the function score for the summation of each column.

$$\begin{aligned} \tilde{\alpha}_1 + \tilde{\alpha}_2 &= \left(\mu_{ij1}(C_j) + \mu_{ij2}(C_j) - \mu_{ij1}(C_j) \times \mu_{ij2}(C_j), v_{ij1}(C_j) \times v_{ij2}(C_j)\right) \\ \pi &= 1 - \left(\mu_{ij1}(C_j) + \mu_{ij2}(C_j) - \mu_{ij1}(C_j) \times \mu_{ij2}(C_j)\right) - \left(v_{ij1}(C_j) \times v_{ij2}(C_j)\right) \end{aligned} \tag{22}$$

$$S_{ij} = \mu_{ij}(C_j) - v_{ij}(C_j) \tag{23}$$

Now assume that $N_{ij} = \left(\tilde{n}_{ij}\right)_{m\times m}$ is the normalized matrix, L is the inverse of the maximum function score in the direct relation matrix(R); on this basis, the normalized matrix can be obtained by the following equation:

$$\left(N_{ij}\right)_{m\times m} = L \times \left(R_{ij}\right)_{m\times m} \tag{23}$$

Where:

$$\tilde{n}_{ij} = \left(\left[1-\left(1-\mu_{ij}(C_j)\right)^{L}\right], \left[v_{ij}(C_j)^{L}\right]\right) \tag{24}$$

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

Step 12: Defuzzification of the normalized matrix: To defuzzify the normalized matrix, we use the preference risk coefficient (β); this coefficient is proposed and described by (Xie, Qi, Hse & Shupe, 2014)as below:

The preference risk coefficient $\beta \in [0,1]$ represents an expert's uncertainty in a decision; so $1-\beta$ is the certainty of the expert regarding the decision. A indicates that decision-maker is willing to take risks, and higher represent 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.

$$\bar{n}_{ij} = \mu_{ij}(C_j) - v_{ij}(C_j) + (2\beta - 1)\pi_{ij}(C_j) \quad (25)$$

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

Step 13: Calculating the Total Relation Matrix (T): After defuzzifying the normalized direct relation matrix (R), we obtain the total relation matrix (T) via the following equation:

$$(T_{ij})_{m\times m} = (N_{ij})_{m\times m} \times (I - N_{ij})^{-1} \quad (26)$$

Where I is the identity matrix.

Step 14: Combining fuzzy weights and E (w): Fuzzy weights from 6 in phase 2 are combined with E (W). The new expected value is obtained using the multiplication operation as Qq. (26).

$$E(W)_{new} = w_i \otimes E(W) \quad (27)$$

Step 15: 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, we plot a Cartesian coordinate system, where the longitudinal axis represents and transverse axis represents $D - R$; so the status of each variable is represented by a point with coordinates $(D + R, D - R)$.

Results

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 successful adoption of management information systems in medical centers using library resources and similar studies, and academic and industrial experts' effective factors on the successful adoption of management information systems in medical centers. In this way, the component factors for successful adoption of management information systems in four dimensions are identified including System quality, Quality of the information, senior management support, and Designing User Experience. The factors mentioned are shown in Table (4).

Table 4

Factors on the successful adoption of management information systems in medical centers

Dimension	Criteria	References

System quality	1. Ease of use (easy access to the system) 2. Flexibility of the system 3. Reliability of the system (reliability and credibility) 4. Easy to learn system 5. Timely response of the system 6. User Requirements (User Expectations or User Requirements) 7. System Integration	(DeLone & McLean, 1992; Green, Hevner, & Collins, 2005; Hussein, Selamat, Anom, Karim, & Mamat, 2005; Kamal, 2006; LE & HAN, 2015; Petter et al., 2008; Sepahvand & Arefnezhad, 2013)
Quality of the information	8. Understandable information 9. Accuracy of information 10. Completeness of information 11. Information compatibility 12. Timeliness of information 13. Accessibility - Usability of information 14. Summary of information 15. Relevance of information 16. Information objectivity 17. Acceptability of the information 18. Security of the information	(DeLone & McLean, 1992; Jarvenpaa & Ives, 1991; Kamal, 2006; LE & HAN, 2015; Petter et al., 2008)
Senior management support	19. Management support in using the system for related 20. Management support to empower employees Management support to enable employees to use the system 21. Management support in adopting new technology 22. Management Support to access any need for hardware and software resources,	(Ang, Davies, & Finlay, 2001; Brown & Bostrom, 1994; Grover, 1993; Hussein et al., 2005; Igbaria, Parasuraman, & Baroudi, 1996; Igbaria, Zinatelli, Cragg, & Cavaye, 1997; Jarvenpaa & Ives, 1991; King & Teo, 1996; LE & HAN, 2015; Leonard-Barton & Deschamps, 1988; Petter et al., 2008; Sargent, Hyland, & Sawang, 2012; Sepahvand & Arefnezhad, 2013)
User Experience	23. Users' experience in using the system 24. Users' experience in using word processing 25. Users' participation in requirements analysis 26. Users' experience in Programming Languages 27. User Participation in MIS Computer	(Karahanna & Straub, 1999; LE & HAN, 2015; Leonard-Barton & Deschamps, 1988; Petter et al., 2008)

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 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) have been used. After collecting data in the form of linguistic terms, using the fuzzy numbers shown in table two, linguistic terms were changed into intuitionistic fuzzy numbers.

Step 3: Determining the relative importance of experts' opinions: The importance of each of the experts based on linguistic terms in table 2 is shown in the Table (5).

Table 5

Importance of each expert

	K_1	K_2	K_3	K_4
Linguistic terms	Middle	Important	Very	Very

	important		Important	Important

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

$\lambda_k =$	$K_{۱}$	$K_{۲}$	$K_{۳}$	$K_{۴}$
	0.3317972	0.2110599	0.1585253	0.2986175

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

Table 6

Matrix of aggregation of paired comparisons of expert opinions

	C1	C2	C3	C4
C1	(0.02,0.596,0.384)	(0.568,0.263,0.169)	(0.384,0.568,0.263)	(0.234,0.567,0.199)
C2	(0.229,0.635,0.136)	(0.02,0.596,0.384)	(0.126,0.02,0.536)	(0.198,0.698,0.104)
C3	(0.473,0.275,0.252)	(0.605,0.229,0.136)	(0.252,0.635,0.229)	(0.02,0.596,0.384)
C4	(0.288,0.358,0.354)	(0.424,0.335,0.241)	(0.354,0.424,0.335)	(0.349,0.429,0.222)

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

Table 7

Compatible paired comparative matrix

	C1	C2	C3	C4
C1	(0.02,0.596,0.384)	(0.568,0.263,0.169)	(0.384,0.568,0.263)	(0.234,0.567,0.199)
C2	(0.229,0.635,0.136)	(0.02,0.596,0.384)	(0.136,0.02,0.596)	(0.198,0.698,0.104)
C3	(0.473,0.275,0.252)	(0.635,0.229,0.136)	(0.252,0.635,0.229)	(0.02,0.596,0.384)
C4	(0.288,0.358,0.354)	(0.424,0.335,0.241)	(0.354,0.424,0.335)	(0.349,0.429,0.222)

Steps 7 and 8: Calculating Priority Vector and Combination of all weights: Using the relationship (17), the priority vector of the factors influencing the implementation of the innovation chain in healthcare was determined as shown in table (8).

Table 8

The final weights matrix of factors related to the target

Component	Final fuzzy weight	The final decisive weight components
System quality	(0.138,0.501)	0.249289

Quality of the information	(0.083,0.64)	0.249094
Senior management support	(0.17,0.447)	0.243674
User Experience	(0.127,0.482)	0.257944

The results of the above table indicate that among the identified factors, User Experience with a coefficient (0.2579) has the highest definitive weight. Then, in turn, the dimensions of system quality, quality of the information, and senior management support are important.

Phase III: **Explaining the Relationship between the factors affecting the successful adoption of management information systems in medical centers using the IF-DEMATEL Technique**

Step 9: 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 10: Constructing aggregated intuitionistic fuzzy decision matrix based on experts' opinions (Direct Relation Matrix): The weights obtained for experts were used along with equation (21) to form the aggregated decision matrix ($\vec{R}(m \times m)$) as blow.

Table 9

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

	C1	C2	C3	C4
C1	(0.1,0.9,0)	(0.837,0.154,0.009)	(0.707,0.268,0.024)	(0.785,0.2,0.015)
C2	(0.763,0.215,0.022)	(0.1,0.9,0)	(0.694,0.286,0.02)	(0.879,0.116,0.006)
C3	(0.804,0.181,0.015)	(0.726,0.24,0.034)	(0.1,0.9,0)	(0.786,0.189,0.025)
C4	(0.192,0.787,0.021)	(0.475,0.477,0.048)	(0.653,0.316,0.031)	(0.1,0.9,0)

Step 11: Normalizing the direct relation matrix: In this step, equations (22) to (24) were used to normalize the direct relation matrix. This matrix is presented below.

Table 10

Normalized direct relation matrix $N(m \times m)$

Items	C1	C2	C3	C4
C1	(0.077,0.923,0)	(0.749,0.24,0.011)	(0.608,0.367,0.025)	(0.69,0.293,0.017)
C2	(0.667,0.309,0.024)	(0.077,0.923,0)	(0.595,0.385,0.02)	(0.8,0.193,0.007)
C3	(0.711,0.272,0.017)	(0.627,0.336,0.036)	(0.077,0.923,0)	(0.692,0.28,0.028)
C4	(0.15,0.833,0.017)	(0.388,0.569,0.043)	(0.554,0.415,0.031)	(0.077,0.923,0)

Step 12: Defuzzification of the normalized matrix: In this step, preference risk coefficient (β) and equation (25) were used to defuzzify the normalized direct relation matrix. This resulting defuzzified matrix is presented below (note that at this stage $\beta = 0.5$).

Table 11

Defuzzified normalized direct relation matrix

Items	C1	C2	C3	C4
C1	-0.845530107	0.509409899	0.241660939	0.396870656
C2	0.357126898	-0.845530107	0.210483551	0.606935551
C3	0.439449597	0.290993054	-0.845530107	0.412027022
C4	-0.682553423	-0.180380785	0.139414274	-0.845530107

Step 13: Calculating the Total Relation Matrix (T): In this step, equation (26) and the identity matrix (*I*) were used to calculate the total relation matrix. The results of this step are presented below.

Table 12

Total Relation Matrix (T)

Items	C1	C2	C3	C4
C1	-0.474306303	0.14289629	0.09889138	0.182119577
C2	0.048708263	-0.451837646	0.084734644	0.209664997
C3	0.089903007	0.098355544	-0.421500099	0.180833102
C4	-0.192392583	-0.098996023	-0.001155228	-0.532337709

Step 14. Combining fuzzy weights and E(W): According to the relationship (27), by multiplying, the significance of the determining factors, in significance amount and criterion effect, new values and were determined. The results are shown in Table (13).

Table 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	System quality	0.9174	0.1191	0.2493	3.6802	0.4777
C2	Quality of the information	0.9566	0.0500	0.2491	3.8404	0.2009
C3	Senior management support	0.9667	0.0455	0.2437	3.9673	0.1866
C4	User Experience	0.8961	-0.2232	0.2579	3.4741	-0.8652

Step 15: Developing the causal diagram: On the bases $D_i - R_{i(new)}$ and $D_i + R_{i(new)}$ figure. (2) was plotted based on the cause and effect values.

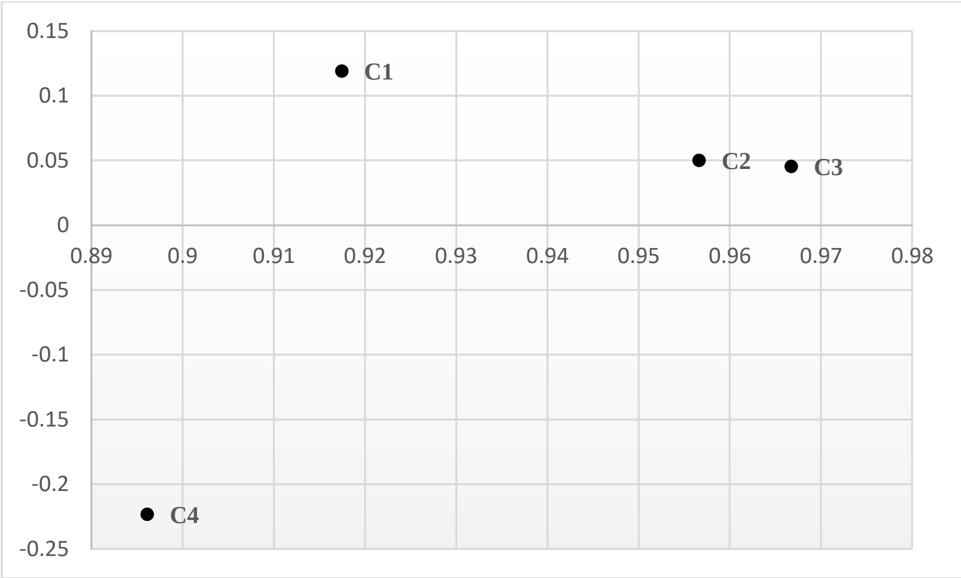

Figure. 2: *The factors affecting the successful adoption of management information systems in medical centers*

Discussion

The purpose of this study was to identify and rank the factors affecting the successful adoption of management information systems in medical centers of Kerman city (Iran). For this purpose, based on research literature and experts' interviews 27 criteria were identified and categorized into four dimensions (Table 4). Then, considering the causal relationships between them and the importance each indicator has, the Integration of two AHP and DEMATEL Multi-Criteria decision making methods was used in the Intuitionistic fuzzy environment. In the present study, using the AHP method the weight of dimensions was determined, and then by using the DEMATEL technique, causal relationships between dimensions and degree of effect and degree of influence of each dimension were determined. The results of the analysis of the research data in Table 13 and Figureure 2 indicate that the dimension of senior management support with ($D_i + R_{i\ NEW}$) = 0.9667 is known as the most important dimension. Afterward, the dimensions of information quality, system quality, and ultimately the users' experience are important. As such, it can be acknowledged that for the successful adoption of management information systems in healthcare centers support of senior managers is potentially important. Senior management support implies that when resources are allocated to support IT and IS within the organization, they tend to use them more within the organization. If senior executives support the use of IS, acceptance by colleagues and others in the organization will also be easier and more satisfying. Finally causes the company to increase its total performance (Cho & Shen, 2007). As such, senior management support in accepting successful adoption of management information systems in medical centers includes features such as management support in using the system for related tasks, management support in empowering employees to use the system, management support in adopting new technology, and management support to access any needed hardware and software resources.

On the other hand quality of the system by ($D_i - R_{i\ NEW}$) = 0.1190 is the most influential dimension and after, respectively, the quality information with ($D_i - R_{i\ NEW}$) = 0.050 and senior management support with ($D_i - R_{i\ NEW}$) = 0.0454 are known as impressive dimensions. On the other hand quality of the system by ($D_i - R_{i\ NEW}$) = 0.1190 is the most influential dimension and after respectively, the quality information with ($D_i - R_{i\ NEW}$)= 0.050 and senior management support with ($D_i - R_{i\ NEW}$) = 0.0454 They are known as the most influencing dimensions. The quality of the system has more impact on other aspects due to the improved performance of the MIS system on the successful adoption of management information systems in medical centers. System quality can include ease of use, system flexibility, system reliability (reliability and credibility), easy-to-learn system, timely system responsiveness, user requirements (user expectations or user requirements), and system integration. As mentioned, after the quality of the system, respectively, the dimensions of information quality and senior management support for being positive ($D_i - R_{i\ NEW}$) have an impact on the successful adoption of management information systems in medical centers. But the basic point is that top management support among the influencing factors has the least influence. The user's experience with the least value ($D_i - R_{i\ NEW}$) has also been identified as the most influential dimension. User's experience is the previous experience of a person related to new technology in the organization, with features such as user's experience in system use, user's experience in word processing, user participation in requirements analysis (necessities), user's experience in languages programming and user's participation in MIS computer designing. Thus, based on the results achieved, it can be stated that the dimensions of system quality, information quality, and senior management support are the cause and then the user's experience is one of the effects (influence).

In addition, based on the results obtained in the analysis of each dimension, it can be stated that in the quality dimension of the system, system integration is among the most influencing factors), and the system's ease of learning, ease of use, and flexibility are among the factors which were the most influenced one. Also, system integrity, ease of use, and user's requirements were identified as one of the most important factors in the quality of the system.

In terms of information quality, information relevance, information completeness, and accuracy of information are the most influencing factors, and information consistency, information objectivity, and information acceptability are the most influenced Usability, consistency, and comprehensibility of information were identified as among the most important factors in the dimension of information quality.

But in terms of senior management support, manager support for access to any hardware and software needs, and support for adopting new technology are among the most influencing factors, and management support for using the system for related tasks is most influenced (that is they are under influence). In addition, management support was identified as one of the most important factors in senior management support to empower employees to use the system.

Finally, in terms of users' participation experience, requirements analysis and user's experience in the use of word processing are among the most influencing factors (they put the influence) and user experience in programming languages and system use are among the most influenced. Finally, the user's experience in using the system and the use of word processing were identified as one of the most important factors in the user's experience dimension.

Conclusion

In this study, AHP and DEMATEL integration technique was used in an Intuitionistic fuzzy environment. One of the benefits of this method is the prioritization and importance of indicators, which enables decision makers to devote their time and capital to manage the results of management, and continue and maintain their work in a guided way. As for managers, organizations, and programmers in the MIS field it is important to know which, factors are affecting (cause). Using DEMATEL Intuitionistic fuzzy techniques, the condition of each dimension and index taking cause or effect into consideration was investigated and the results are given in Table 13. Indices, which had a D-R value positive, were cause indices, and D-R with negative values were cause indices. Taking into account the achieved results, whenever decision makers related to the subject of research want to satisfyingly figure on early results, but get it superficially can take preference into consideration and focus on influenced groups. However, if the goal of this decision maker’s performance is basic proceedings or if it is focused on main and bases of the subject, can consider preference, focus on layers of influencing or cause, and formulate the program accordingly. When techniques are intergraded wa ith fuzzy intuitive approach, this issue will produce more accuracy and credibility, and present results that are more rational.

The accomplishments of this study can lead to the development of a literature relevant to successful adoption of management information systems in medical centers. In addition, the results of this study can be an important treatment for different groups, including managers in different categories of health care centers, and serve as a guide for managers of these institutions. Based on the results of this study, it is suggested to managers of medical centers, especially in the field of MIS, by developing and improving MIS systems and using tools and practices that will improve their performance in medical centers, strive to promote and improve the successful adoption of management information systems in these centers. In addition, providing a comprehensive model based on affecting factors on more efficiency and effectiveness of management information systems, cause the managers to be aware of the importance of these factors. Medical centers to better serve and succeed in their field of activity should increase their level of agility by improving the decision-making process to be more efficient and effective and strive to achieve this and facilitate the presentation fundamentally related to the collection process, MIS is inevitable. Because MIS in any organization is for better and paramount services, application of processing, storing and transmitting relevant information to support management operations (planning, control, and decision making) so that they can make timely and effective decisions and accomplish the goals of the organization. Finally, it creates the conditions for effective and timely decision-making to predict the future of the organization; in MIS health, organizations’ depiction of perspective is to achieve the goals.

Unfortunately, this area has not received much attention from researchers despite the potential for applied research in MIS in medical centers. It is suggested that researchers increase the awareness and information and the benefits and examine the challenges and opportunities in the MIS medical centers.

The limitations of this study can be referred to as the intrinsic limitations of the questionnaire, thus, respondents' views may not be accurately reflected. Of course, there are other limitations to this type of research, including that due to the nature of the research, its results are directly dependent on the views of the interviewees and their understanding of the characteristics of MIS in medical centers. Accessing the experts and explaining the process of completing the questionnaire was also a difficult part of the research.

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