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Evaluation of factors contributing to the failure of information systems in public universities: The case of Iran

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ABSTRACT

In this paper, we evaluate the reasons for the failure of information systems in public universities. To that end, we start by presenting a hierarchical structure of criteria after reviewing related studies, and dividing the criteria into the categories of *project management, organizational management, human-related, organizational* and *technical*. To assess the weight of the criteria in the proposed framework, we collect the opinions of a sample of information technology experts working in different public universities in Iran, using an online questionnaire that is based on the best–worst method (BWM). By analyzing the weight of the criteria, we can reveal that *misfit of information systems software* (closely followed by *lack of top management support* and *unsuccessful monitoring and measurement*) has the greatest impact on the failure of information systems in the public universities of Iran. The methodology proposed in this paper can be used in other countries facing the same problem.

1. Introduction

Information is the cornerstone of all the activities of any organization. Therefore, the existence of information systems (IS) is essential for the production and management of information [1]. An IS is a database that is designed and built to store, process and analyze information that helps an organization make effective decisions [2,3]. These organized systems are composed of people, hardware, software, communication networks and data sources that collect, transfer and send information within an organization [4].

The implementation and use of information systems by organizations could result in them gaining a competitive advantage, in that it would improve the organization's performance and profitability [5,6], and result in efficient business processes [7]. Information technology (IT) is constantly changing and, when implementing an information system in any organization, there are several potential problems [8], which, in a number of cases, when done incorrectly, is likely to result in failure [9,10]. According to literature, 25% of all large IS projects are disbanded, while 60% go over budget, 75% do not have the intended quality, and fewer than 1% are delivered below the agreed budget and time, and deliver the intended quality [11]. There are also numerous examples of failure in the implementation of IS [12] that have had negative consequences, particularly in financial terms [13], notable the failure of Nike in 2000, which resulted in a 20% drop in stock prices, or HP in 2004, leading to a financial loss of US$ 160 million dollars [14,15].

In recent decades, there has been a growing willingness on the part of private and public organizations to use IT, and in particular information systems. However, in many cases, their implementation has been associated with failures, especially when we look at state-run organizations [16]. In fact, only about 10% of all IT projects in Iran (representing 1% of the country's total annual budget) are completed successfully. However, 64% of all projects fail, while the remaining 26% all faced problems [17], in particular in the area of education [18]. However, to develop and manage educational processes, Iran needs information systems, so it is important to pay attention to the causes and impact of the failed implementation of such costly IT projects.

Most universities in Iran use an integrated information system, the aim being to include all the processes that take place at the universities. By collecting and storing data in a central database, these systems reduce the circulation time of documents [19]. In fact, registration, easy access to information provided by students, professors, instructors, researchers and other personnel at a university, and linking that university to other organizations

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constitute some of the main advantages of IS used at universities in Iran.

There are a number of reasons for the failure of information systems in Iran's educational system, which can be divided into the categories of *project management, organization management, human-related, organizational* and *technical*. By identifying these factors and measuring their impact, it may be possible to provide a solution for future projects, which is the main contribution of this study. We try to identify, categorize and rank the different criteria that affecting the failure of information systems at the public universities of Iran. We think that the framework proposed in this paper can be used to manage the failure of IS/IT projects that are carried out in governmental and nongovernmental organizations in other countries as well.

The remainder of this paper is organized as follows. In Section 2, we start by reviewing relevant existing literature and then propose a framework of criteria that contribute to the failure of information systems. In Section 3, we discuss the methodology used in this study and discuss the results of weighting the criteria that play a role in the failure of information systems at the public universities of Iran in Section 4. Suggestions on how to improve the implementation of information systems at the universities of Iran is presented in Section 5 and we present our conclusions and suggestions for further research in Section 6.

2. Literature review

To identify the factors contributing to the failure of IS, we reviewed different studies within the context of success/failure of IT in general and information systems in particular, which resulted in a hierarchical structure of criteria that plat have a role in that success or failure (see Table 1). It is worth mentioning here that we did not limit our search to information systems and public universities, but decided instead to include all IT systems and all organizations in different countries. That does not mean that the criteria we identified play the same role across different IT systems, different organizations and different countries, but by broadening our scope, likelihood of overlooking relevant criteria is minimized. Later, in our methodology, we apply a mechanism to ensure that the criteria we consider for our case are indeed relevant. To divide the criteria, we identified in the literature review into the categories of *project management, organization management, human-related, organization* and *technical*, different references were used. Because studies that apply multi-criteria decision-making (MCDM) methods to assess the weight of effective criteria in the failure of IT are closely related to this study, they are discussed below.

Chou et al. [20] conducted a study to identify criteria affecting the implementation of ISs, the results of which indicated that criteria like *goal conflict, clear vision, risk management, availability of resources*, and *team interactions* ranked among the most important factors to be considered. Kaplan and Salamone [21], after reviewing existing literature and interviewing 50 experts in the field, identified factors like *poor quality of testing, poor vendor* and *project technical complexity* as the main factors affecting the failure and success of information systems in the United States. Amalnick et al. [22] evaluated critical success factors (CSFs), after looking the causal relationship among CSFs affecting the successful implementation of enterprise resource planning (ERP) systems and using the decision-making trial and valuation laboratory (DEMATEL) and analytical network process (ANP) to study the largest refrigerator production company in Iran, with their results showing that *project team, management, ERP vendor selection, project/business plan and business model* and *budgeting* made up the top five CSFs. Mehregan et al. [23] introduced an approach to assess e-learning systems in Iran. They started by identifying the critical success criteria and then prioritized those criteria using the fuzzy analytic hierarchy process (AHP). The results showed that *student characteristics* and *IT quality* were the most important categories, and that *financial support, learning community, computer skill* and *motivation* were the most important criteria.

Bharathi et al. [24] proposed a framework to prioritize and rank CSFs using the analytical hierarchy process (AHP) in a study in which *proprietor/partner's commitment, existing IT compatibility, cost–benefit analysis, culture and receptiveness of SME (small and medium-sized enterprise),* vendor analysis, periodical and timely communication, project planning and scheduling, software package selection and *evaluation* were identified as being the most important success factors in the implementation of information systems in India. Rouhani et al. [25] conducted a study involving an Iranian steel company, with the aim of evaluating CSFs in ERP project implementation, proposing a hybrid model based on fuzzy AHP and fuzzy DEMATEL (decision making trial and evaluation laboratory). The results showed that criteria like *clear project plan, training and education, project champion, project team competence* and *organizational culture* were among the most important factors to be considered. A study conducted in India by Kaur and Aggrawal [26] also examined the reasons for the failure of ISs, and study showed that *users' resistance to change, improper change management, inadequate training of users, lack of top management support* and *project team's lack of required skills* were among the most important explanatory factors.

Van Dijk et al. [27] examined the criteria affecting the failure of information and communication technology (ICT) in the Netherlands by taking a closer look at nine ICT projects, with *inadequate training of users, ineffective project management, project technical complexity* and *lack of top management support* emerging as the most important factors explaining the failure of the projects involved. In a study by Ibrahim et al. [28] involving factors that played a role in the failure of IS projects in Malaysia, *lack of user participation, ineffective project management, low quality of business processes reengineering* and *lack of top management support* proved to be the most important factors. Ogunyemi and Olofinsao [29] conducted a study to analyze the criteria of success and failure of ERP systems in Nigeria, identifying *improper change management, hostile company culture, lack of top management support, inadequate training of users, reduction of team interactions* and *poor vendor* as the most relevant factors, while Gunawardhana and Perera [30] also examined the main causes of failure of information systems. They concluded that *improper organizational structure, ambiguous vision and objectives, problems included in the software, improper definitions of roles and responsibilities, hostile company culture* and *weak management of requirements* were the most important factors explaining the failure of information systems.

Sweis [1] conducted a study in Jordan aimed at ranking criteria affecting the failure of information systems. A literature review yielded criteria like *lack of user participation, improper change management, improper organizational structure, hostile company culture, poor risk management* and *poor consultants*. Ziemba and Kolasa [31] conducted a study to identify risk factors involving IS projects in Polish government organizations. They reviewed existing studies and identified 52 factors, including *unavailability of resources, reduction of team interactions, lack of proper tests, lack of knowledge transfer* and *problems included in the software* as having the greatest impact on the failure of information systems. In a study conducted by Ahmadi et al. [32], critical factors regarding the successful adoption of the complete Malaysian hospital information system were prioritized using fuzzy AHP. The results showed that the most important factors were *technology* and *organization*, respectively, while the most important subcriteria were *compatibility, top management support* and *presence of champions.*

Nilashi et al. [33] conducted a study to determine at determining the most important criteria among the four categories involving the adoption of the hospital information system within the context of Malaysian public hospitals using a fuzzy ANP, which showed that *hospitals with compatibility, complexity, mimetic pressure* and *vendor support* were more likely to adopt HIS. Hughes et al. [34] identified 15 crucial criteria that play a role in the failure of ISs, using interpretive structural modeling (ISM) to formalize the relationships between the selected factors. Of the criteria they identified, *post-modern process, executive support and project sponsorship process* and *evaluation or pilot stage* turned out to be the most influential factors. Rodríguez et al. [35] proposed a risk assessment method based on a combination of fuzzy AHP and fuzzy inference system. Their new model was appropriate for the evaluation of IT development projects, where many interrelated risk factors can be particularly uncertain. By examining 120 IT offices in the Indonesian capital, Zhu et al. [36] were able to rank the criteria involved in the failure of IT projects in developing countries. They used ISM, to identify factors like *unmotivated team members, lack of user participation, users' resistance to change* and *improper change management* as playing an important role in the failure of information systems. Masiero [37] also conducted a study to examine why information systems fail, in this case in India, identifying *project team's lack of required skills, ineffective project management, lack of knowledge transfer, lack of top management support* and *insufficient IT infrastructure systems* as being among the most important factors.

In a study conducted by Moura [38], *top management support* was identified as the most important factor in the success of ISs project in micro- and small companies in Brazil. Zare et al. [39] conducted a study to identify the most important factors in the failure of ERP systems in Iran, in which 27 criteria were identified, concluding that *conflicts between organization and consultants/vendor, poor internal communication, lack of a performance measurement system* and *project technical complexity* play the most important role in the failure of the implementation of these projects, while, Baykasoğlu and Gölcük [40] proposed a two-phase structural model to evaluate CSFs of ERP. They used ISM in the first phase in a hierarchical form. In the next phase, by using fuzzy cognitive maps, hierarchically structured CSFs were evaluated. Finally, they applied their model to one of Turkey's biggest ERP vendors. Wolters et al. [41] conducted a study to identify CSFs for low-level customized ERP system implementations in SMEs. The results of that study showed that criteria like *motivation system* and *project team empowerment* were more important within that given context.

Based on the result of the literature review, all the criteria we identified as having an impact on the failure of IT/IS are presented in Table 1. The number of references for each criterion can be used as a proxy of the importance of these criteria according to existing studies. The proposed framework is useful to evaluate different types of success/failure involving information systems.

The table shows a two-level hierarchy of criteria. However, with regard to all the second level criteria, we identified the following sub-criteria for *complexity of project* [80]:

- Size
- Technology
- Globalization and context dependence
- Diversity

As indicated in the literature review, most studies focused on the managerial and human aspects when examining the causes of failure, while we address the problem based on the five dimensions shown in Table 1. Our literature review also revealed that the problem of weighting the criteria that contribute to the failure of IS in government organizations (e.g. public universities) has received less attention. Furthermore, this study is one of the few studies that looks at the failure of information systems in Iran, a developing country.

3. The research methodology

This study was conducted in three stages. First, we conducted a literature review to identify the criteria that play a role in the success or failure of IT/IS, dividing them into the categories of *project management, organization management, human-related, organizational* and *technical*.

We screened the criteria identified in the first step (see Table 1) by 10 experts, using an online questionnaire with a five-point Likert scale. Increasing both the discrimination power of the experts [81] and reliability of competition between the criteria [82] evaluated in the third step are the main reasons for screening the criteria. After collecting the expert opinions, the number of 3 was used as a threshold for screening the criteria in the second step, because that approximately maintained the balance among the sub-criteria and improved the discriminatory power of the experts [83]. The result of the second step is presented in Fig. 1. Finally, in the third step, we evaluated the screened criteria using the BWM, for which we gathered the opinions of 45 experts through an online questionnaire. It is noteworthy that the respondents employed in the steps two and three had been working as IT experts at the public universities of Iran for more than 10 years and, to aggregate their opinions in the second and third steps, a geometric mean was used.

Best–worst method (BWM)

We decided to use the Best–worst method because in, compared to similar methods, it (i) provides more reliable pairwise comparisons, (ii) reduces possible anchoring bias that may occur during the weighting process by respondents, (iii) is the most data-efficient method and (vi) provides multiple optimal solution, which increases the flexibility when it comes to accessing the best point of weight [84]. BWM uses pairwise comparisons to determine the optimal weight of criteria and it has been used in a variety of contexts, including education [85], location [86,87], technology [88], energy [89,90], supply chain management [91–93] water resource management [94] and many others. The process of weighting by BWM is summarized in five steps, as follows [82,95].

1. Determine a set of evaluation criteria $c_1, c_2, \ldots, c_n$ by the experts/decision-makers
2. Identify the most important (Best, B) and the least important (Worst, W) criteria by the experts/decision-makers, each of whom might have their own Best and Worst.
3. Determine the preference of the Best over all the other criteria with a number from 1 to 9 (where 1 represents equally important and 9 represents extremely more important). The result of Best-to-others comparisons is the vector $A_B = \left(a_{B1}, a_{B2}, \ldots, a_{Bj}, \ldots, a_{Bn}\right)$, where a_{Bj} shows the preference of B over j. *This is done by individual experts/decision-makers.*
4. Determine the preference of all the decision criteria over the Worst. The result of others-to- Worst comparisons is the vector $A_w = \left(a_{1W}, a_{2W}, \ldots, a_{jW}, \ldots, a_{nW}\right)$, where a_{jW} denotes the preference of the indicator j over W.
5. Compute the optimal weights $\left(w_1^*, w_2^*, \ldots, w_n^*\right)$
   The optimal weights are calculated by minimizing the maximum absolute difference of $\left\{\left|w_B - a_{Bj} w_j\right|, \left|w_j - a_{jW} w_W\right|\right\}$ for all j which is translated into the following optimization problem:

Table 1
A hierarchical structure of criteria contributing to the failure of information systems (ISs)

Category	Criteria	Reference
Project management	Improper relationship between the organization and project manager	[34,39,42–48]
	Lack of proper tests to evaluate the accuracy of IS projects	[39,43,44,46,49–54]
	Poor risk management	[20,34,39,42–44,49,50,52,55–61]
	Weak management of requirement	[1,27,31,34,37,39,42,46,48,50,52–54,56–59,61–66]
	Replacement of the contractor	[48,66]
	Ineffective project management	[31,34,36,39–44,46–54,58–60,63,67–73]
	Unrealistic schedules	[1,31,48,49,51–54,56,57,59,61,62,67,74]
	Improper definitions of roles and responsibilities	[20,28,31,45,48,52,59,65]
	Inappropriate software vendor	[39–42,44,46,48,50,53,54,60,67,70,73]
	Inaccuracy of cost estimate	[37,42,43,45,46,49–51,54,55,59,62,67,68,73,75]
	Failure to identify critical activities	[31,44,52]
Organization management	Lack of a performance measurement system	[31,39,42,44,52,54,60,61]
	Lack of top management support	[28,30,31,34,39,40,42–44,47–55,59,63,66–68,70,72–76]
	Improper change management	[34,39,40,42,43,46–49,52–54,58,59,61,62,67,68,70,71,73]
	Unsuccessful monitoring and measurement	[31,40,41,44,48–50,52,53,55,59,67,74]
	Ambiguous vision and objectives	[20,31,39,41–43,45,46,48–50,52,53,55,59,61,62,67,68,70]
	Reduction of team interactions	[49,50,54,63]
Human-related	Unmotivated team members	[31,41,44,48,50,52,53,56–59,67]
	Users' resistance to change	[31,34,42–45,49,51,52,54,62–64,66,77,78]
	Inadequate training of users	[21,31,34,39,40,42–44,46,48–50,52,54,59,62,64,68,70,71,73,77]
	Lack of user participation	[1,30,31,39,40,42–46,50–54,56,57,59,61,62,67,70,73,75,77]
	Lack of user commitment	[31,49,52,62]
	Key staff changes	[1,31,34,42,45,48,61,62]
	Project team's lack of required skills	[21,31,34,39–42,44,47,50–53,55–57,59,61–63,67,69,73,76,77]
Organizational	Insufficient IT Infrastructure	[41,44,46,50,51,53–55,59,62,63,67,69]
	Misfits between IT and business strategies	[31,39,42,48,52,62,66,73]
	Lack of capable consultants in IS projects	[35,39,42,46,50,51,53,59,62,67,73]
	Poor business process reengineering	[39,42,45,47,50,51,53,54,67,71,73]
	Hostile company culture	[31,37,39,42,46,48,56,57,63,65,67,71,77]
	Poor relationship between the implementation consultant and managers	[1,27,28,31,34,39,42,44–51,53,54,56–59,61,66–68,70,71,73,74,76]
	Improper organizational structures	[28,31,36,37,39,42,46,55,60,66–68,70,73,77]
	Lack of agile progress tracking mechanisms	[31,52,53,59,63]
	New legal regulations	[48,50,66,69]
	Organizational experience	[20,40,43,46,75]
	Rapid organizational growth	[62]
Technical	Complexity of project	[28,31,35,37,39,43–45,48,50,52,53,56–59,62–64,66,73,77]
	Misfit of the IS software	[30,39,40,43,46,49,51,53,56,57,61,64,70,73–75,79]
	Legacy systems	[41,49,50,53,67,73,74]

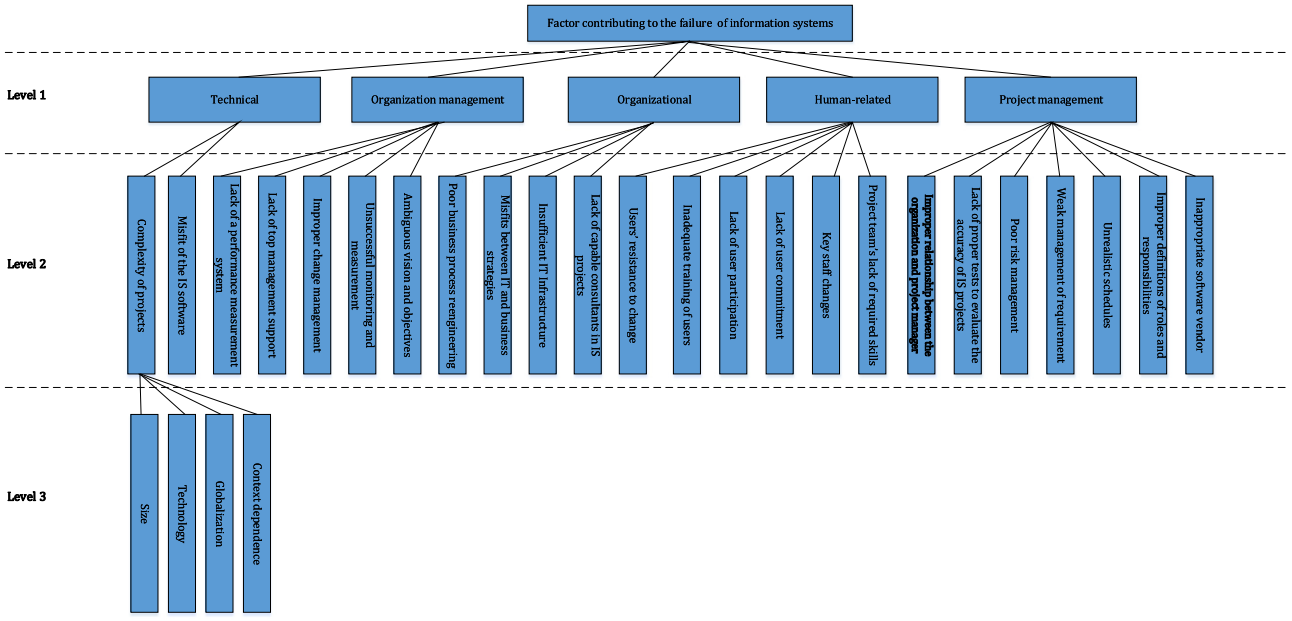

Fig. 1. The hierarchical tree for the criteria.

$$\min \max_j \left\{ \left| w_B - a_{Bj} w_j \right|, \left| w_j - a_{jW} w_W \right| \right\}$$

s.t.

$$\sum_{j=1}^{n} w_j = 1$$

$$w_j \geq 0, \text{ for all } j \quad (1)$$

Model (1) is converted into:

$$\min \xi$$

such that

$$\left| w_B - a_{Bj} w_j \right| \leq \xi, \text{ for all } j$$

$$\left| w_j - a_{jW} w_W \right| \leq \xi, \text{ for all } j$$

$$\sum_{j=1}^{n} w_j = 1$$

$$w_j \geq 0, \text{ for all } j \quad (2)$$

The results of Model 2, ξ^* and $w^* = \left(w_1^*, w_2^*, \ldots, w_n^*\right)$, indicate the consistency and optimal weight of the criteria at each level respectively. If ξ^* becomes close to zero, it means that there is a high level of consistency in the pairwise comparison provided by the respondent.

When there is more than one level in the hierarchical tree for the criteria, the w^* that is calculated for each level is called local weight. Thus, the global weight of the sub-criteria in the last level is calculated by multiplying the local weights of criteria belonging to one branch by each other.

4. Results and discussion

In this section, the weights of the criteria contributing to the failure of IS projects in Iran's public universities, are evaluated based on *project management, organization management,* and *technical, human-related* and *organizational* aspects and then, using global weights, the sub-criteria are ranked. Based on the results of the expert opinions, in the first level, *organization management*, *project management*, and *human-related* emerge as the most important criteria, respectively, with slight differences (see Table 2). The role of organization management is to determine the strategies, goals and policies of public education organizations, so as to justify this type of weighting. In Iran's public universities, many IS projects fail due to continuous changes in the strategies and goals of the universities involved, resulting from instability, indicating the importance of organization management in the success of IS projects [96].

The importance of *organization management* has also been highlighted in other studies. For instance, Nilashi et al. argue that organization management by providing required resources and creating a positive atmosphere, plays a significant role in the implementation of IS projects [33]. In another study, Zhu et al., pointed out that to design the structure of decision making for IS projects, the role of organization management is inevitable [36].

At this level, the *organizational* dimension is also the least important criterion according to the experts, because at most of the public universities in Iran, problems and issues related to organizational structure and culture are less visible and can be addressed by the supervision and direction of the organizations' managers [97].

At the second level, of the sub-criteria in the *project management* category, *lack of proper tests to evaluate the accuracy of IS projects* was identified by the experts as being the most important factor (see Table 3). The lack of appropriate analysis and testing in the early and intermediate phases of a project was attributed to a lack of proper understanding of a project's position and ignorance of its weaknesses, resulting in a waste of time and money [98]. To summarize, this is a crucial factor in explaining the success or failure of IS projects. Other researchers also argue that proper tests during the time of customizing IS software are necessary [41]. In this category, *weak management of requirements*, *improper definitions of roles and responsibilities, unrealistic schedules*, *poor risk management*, *improper relationship between the organization and project manager* and *inappropriate software vendor* were ranked second to seventh, respectively (see Table 3). With regard to the relatively minor importance of the *improper software vendor* criterion, it can be noted that the quality of software in Iran is high, thanks to the many software producers and vendors and the existence of a competitive market, which means that there is sufficient information available to select suitable vendors for particular educational projects [99].

Table 2
The weight of the main criteria.

Criteria	Weight	Rank
Project management	0.238	2
Organization management	0.252	1
Human-related	0.210	3
Organizational	0.144	5
Technical	0.156	4

In the category of *organization management*, *lack of top management support,* with a wright of 0.259, is the most important (see Table 3). It is also one of the most important factors in the failure of ISs in the studies by Kaur and Aggrawal [26], Ibrahim et al. [28] and Moura [38]. The lack of a systematic approach among government organizations in Iran explains the high weight of *lack of top management support.* In other words, because management plays a less important role due to the political aspects involving which activities need to be prioritized, management takes a backseat in government organizations of Iran [100]. But as pointed out in other works, creating a positive atmosphere to implement IS projects [32], transforming IS projects into the organization's strategy, resolving disputes [26], and developing a periodically control system that motivates users to identify the gaps of IS projects [38] without top management support is almost impossible. Furthermore, as Garg and Khurana [101] stated, top management support plays an essential role in all stages of IS project developments including introduction, definition of needs, implementation, and after implementation. They also argue that the top management support could be effective in improving the institutional communications and organizational integrity [101].

In this category, *improper change management* is the least important compared to the other sub-criteria. Typically, policies and procedures tend to shift all the time in government organizations in Iran. As a result, the implementation of IS has the lowest impact on the structural changes dimension [102]. *Unsuccessful monitoring and measurement*, *lack of a performance measurement system* and *ambiguous vision and objectives* are the other important criteria in this category.

Based on the expert opinions, *users' resistance to change* is the most important sub-criterion within *human* dimension (see Table 3). Although universities have a dynamic environment, the results show that, in Iran's public universities, employees are reluctant to collaborate and adapt to change, due to a difference in views or a lack of understanding of management objectives in the organizations involved, due to the absence of an appropriate relationship between managers and employees [16].

Some studies have also highlighted the role of *users resistant to change* in the failure of IS/IT projects. Klaus [103] argues that low resistance to change can decelerate IT projects, and high

Table 3
The weight of the sub-criteria for the economic dimension at the second level.

Dimensions	Sub-criteria	Weight	Rank
Project management	Improper relationship between the organization and project manager	0.114	6
	Lack of proper tests to evaluate the accuracy of IS projects	0.167	1
	Poor risk management	0.143	5
	Weak management of requirement	0.162	2
	Unrealistic schedules	0.154	4
	Improper definitions of roles and responsibilities	0.157	3
	Inappropriate software vendor	0.103	7
Organization management	Lack of a performance measurement system	0.196	3
	Lack of top management support	0.259	1
	Improper change management	0.163	5
	Unsuccessful monitoring and measurement	0.205	2
	Ambiguous vision and objectives	0.177	4
Human	Users' resistance to change	0.210	1
	Inadequate training of users	0.180	2
	Lack of user participation	0.173	3
	Lack of user commitment	0.157	5
	Key staff changes	0.150	6
	Project team's lack of required skills	0.169	4
Organizational	Insufficient IT infrastructure	0.313	1
	Misfits between IT and business strategies	0.238	3
	Lack of capable consultants in IS projects	0.274	2
	Poor business process reengineering	0.175	4
Technical	Complexity of projects	0.524	1
	Misfit of the IS Software	0.476	2

resistance will force managers to withdraw from the project. Maurer [104] considered the low return on investment as one of the main consequences of the users' resistance to change. According to Garg and Khuranas, users' resistance to change makes them unwilling to exchange information [101].The lack of users' awareness about the benefits of IS, the non-involvement of users in the implementation of IS projects and the lack of knowledge to use the software developed are other reasons presented in similar studies [34]. Moreover, in this category, the *key staff changes* dimension emerged as the least important criterion, after *inadequate training of users*, *lack of user participation*, *project team's lack of required skills* and *lack of user commitment* criteria (see Table 3). The strict rules governing the selection of personnel at the public universities of Iran can help explain the lower weight of *key staff changes* compared to the other criteria in the *human* dimension.

Among the *organizational* sub-criteria, the *inappropriate infrastructure* dimension is the most important one according to the experts (see Table 3). Because the existence of databases and data centers, as well as the appropriate hardware technology, have an extremely high impact on the extent to which information systems are being used [105], the absence of these conditions in Iran's public universities can help explain the failure of information systems. Researchers from information technology also suggest that organizations' capability to implement IS projects from economic aspect and the flexibility of related businesses to accept the possible changes, depend on the IT infrastructure [41]. Another reason which confirms the importance of this factor is the impracticality of IS/IT projects development without proper IT infrastructure [101].

In Iran's government organizations, there is a great emphasis on the organizational culture [106], in which managers generally speaking do not believe in fundamental changes in the existing structure and processes when new projects are implemented. As such, this can be related to the low ranking of the *poor business process reengineering* criterion when it comes to the failure of information systems in such organizations. *A lack of capable consultants in IS projects* and *misfits between IT and business strategies* are among the other important sub-criteria in this category (see Table 3).

Table 4
The weight of the sub-criteria for the economic dimension at the third level.

Sub-criteria	Weight	Rank
Technology	0.304	1
Diversity	0.257	2
Globalization and context dependence	0.233	3
Size	0.205	4

In the technical category, the criterion *complexity of the project* is considered to be more important than the *misfit of IS software* (see Table 3). Larger projects, due to the interconnected and different modules that are sometimes identified during the implementation of a project, generate a higher level of complexity and require greater coordination between various project implementation processes [107]. The reason this criterion is considered to be important by the experts can be related to the increase in projects costs in terms of time and money as the size of the project increases [108]. It has been found that in Malaysia, the *complexity of the project* plays an important role in failing ISs. Risk of scheduling and budgeting affected by the complexity [34] could lead to less satisfaction of stockholders and also resistance in the implementation and application of IS in organizations [33]. Researchers also found consider that project complexity has indispensable effects on project planning, coordination, control, goal setting, and choosing an appropriate project organization form [80]. Dewar and Hage [109] considered the technology as the main determinant of the scale of the tasks. In other words, technology estimates the scales of the tasks that should be performed. According to Lyytinen [110], the complexity of the project culminates in an increasing growth in requests for reform and technological evolution.

Finally, at the third level, *technology* was weighted as main the sub-criteria of in terms of complexity (see Table 4). Technology is used to convert input to output using materials, methods, knowledge and expertise. As such, reducing the complexity of IS projects requires the use of more advanced technology [107]. However, due to economic restrictions and sanctions, access to that kind of technology is usually difficult in Iran. The *technology* was also pointed out by Cristóbal et al., [80] and Ahmadi et al., [32] as a main factor in IS projects. *Globalization and context*

Table 5
The global weight of the sub-criteria.

Sub-criteria	Weight	Rank
Misfit of the IS Software	0.072	1
Lack of top management support	0.064	2
Unsuccessful monitoring and measurement	0.052	3
Lack of a performance measurement system	0.049	4
Insufficient IT Infrastructure	0.045	5
Ambiguous vision and objectives	0.044	6
Users' resistance to change	0.042	7
Improper change management	0.040	8
Lack of proper tests to evaluate the accuracy of IS projects	0.040	9
Lack of capable consultants in IS projects	0.039	10
Weak management of requirements	0.039	11
Inadequate training of users	0.038	12
Improper definitions of roles and Responsibilities	0.037	13
Unrealistic schedules	0.037	14
Lack of user participation	0.036	15
Project team's lacks of required skills	0.035	16
Misfits between IT and business strategies	0.034	17
Poor risk management	0.034	18
Lack of user commitment	0.033	19
Key staff changes	0.031	20
Improper relationship between the organization and project manager	0.027	21
Poor business process reengineering	0.025	22
Inappropriate software vendor	0.025	23
Technology	0.024	25
Globalization and context dependence	0.021	26
Diversity	0.019	27
Size	0.016	28

dependence, diversity and *size* are among the other important criteria in this category.

The global weight of the criteria

By calculating the global weight, we found that the top 10 sub-criteria in the ranking of the criteria affecting the failure of IS projects in Iran's public universities account for 48.7% of the total weight (see Table 5). In this ranking, the criterion *misfit of IS software* was identified as being the most important factor explaining the failure of information system projects in Iran's public universities. In some cases, a lack of proper understanding of a company's financial, organizational and technical conditions leads to a mismatch between the software being used and the organization's actual requirements, which would result in the failure of IS projects [98].

Another sub-criterion affecting the success or failure of IS projects at Iran's public universities is a *lack of top management support*. Given the authority and responsibilities of an organization's management in providing the resources needed to achieve goals, a lack of management support can play a major role in the failure of IS projects. On the other hand, in this ranking, the *size* of the project identified as being the least important factor, which can be explained by the fact that Iran's public universities tend to be similar in terms of both structure and personnel-related aspects.

Of the sub-criteria listed in Level 2, *inappropriate software vendor* was identified as being the least important factor in the failure of IS projects (see Table 5). Nasir et al. [59] also ranked this sub-criterion as one of the least important factors. In both cases, this may have to do with the relatively high standards of the available software companies and products in Iran.

Another less important sub-criterion in this ranking is *improper relationship between the organization and project manager,* which can be explained by the lack of outsourcing of IS projects in Iran. In Iran's government organizations, IS projects are generally not outsourced and one person manager is appointed as the project manager [111]. As a result, communication between the organization and the project manager is relatively easy and straightforward. This could explain the lower importance of *improper relationship between the organization and project manager*.

Validation of the results provided by BWM

In this section, to validate the results of BWM, we interviewed 15 experts who participated in the BWM-based weighting process. All the experts worked in the information and communication technology center centers of public universities in Iran, and had sufficient experience with regard to the implementation of information systems. Each interview lasted approximately 15 min. We asked the experts to explain why they agree/disagree with the result provided by BWM and to give us their opinions regarding the rank of (i) the criteria in Level 1 (ii) the sub-criteria categorized into the five dimensions, and (iii) the sub-criteria in Level 3. The results of the interviews are presented in Table 6.

With regard to the ranking of the seven, *organization management*, *complexity* and *lack of top management support,* with 15, 13 and 11 (out of 15) votes, respectively, received the highest scores. As presented in Table 6, it is only with regard to *lack of proper tests to evaluate the accuracy of IS projects* and *users' resistance to change,* that the experts disagree more than they agree. However, as indicated in the column of Negative reasons, the respondents appeared to be unable to reach a consensus on any given criterion. In other words, compared to the other criteria, a majority of the respondents agree with the criterion ranked using the BWM.

5. Managerial implications

In this study, we examined the factors contributing to the failure of information system projects at the public universities of Iran, using the best–worst method as a research tool. As a result, we are able to include several suggestions for managers:

- Based on the results of this study, the manager of the public universities of Iran needs to design a useful approach to evaluate the performance of information system project teams, in the form of a comprehensive performance measurement system. In addition, it is also recommended that managers keep in touch with the project team to stay informed about the project's conditions and respond to the project's requirements in a timely manner.

Table 6
Results of interview.

Dimensions	Category	No. of agree	No. of disagree	Positive reasons	Negative reasons
Organization management	Main factors	15	0	• The failure of each project directly related to the organization management. • Decisions and policy of an organization are made by the organization management.	–
Lack of proper tests to evaluate the accuracy of IS projects	Project management	7	8	• Suitable testing can assist the project managers to have adequate information about project which leads accurate analysis.	• Misunderstanding of requirements of IS projects and improper definitions of responsibilities play more important role in the IS projects failure.
Lack of top management support	Organization management	11	4	• Full support of management is useful to have an efficient control on IS project.	• Unclear goals are the main reason of the lack of the management support.
Users' resistance to change	Human-related	7	8	• Users' resistance which is rotted in the culture of an organization is a serious factor in IS project failure.	• Inadequate training and also lack of user commitment cause lack of users' tendency to participation.
Insufficient IT Infrastructure	Organizational	10	5	• Lack of adequate IT infrastructure in Iran is one of the most important reason of IS project failure.	• Consultant effectiveness can compensate the disadvantages of lack of IT infrastructure.
Complexity	Technical	13	2	• Complexity of projects increases both implementation and analysis time of IS project's in Iran.	• With effective management the complexity of project becomes less significant.
Technology	Complexity	10	5	• Complex of technology in the most cases causes some serious failures.	• Globalization is a crucial task which needs to high level of concentration.

- At Iran's public universities, people's resistance to change is one of the main reasons why information systems often fail, mainly due to (i) a lack of understanding of the needs and expectations of users, (ii) a failure to include their comments in the system design phase, and (iii) a lack of proper training to use of information system in question. Identifying the needs and expectations of the users, creating a sense of need among the users and providing some training to increase their awareness of IS's functions can improve the success of IS projects at the public universities of Iran.
- Managing the project requirements is another recommendation with regard to the implementation of IS projects at the public universities of Iran. To that end, it is important to anticipate the needs of IS projects by using consultants with the necessary experience in the implementation of information systems in educational organizations.
- Using a comprehensive strategic plan can also help improve the success of IS projects at Iran's public universities, applying the strategic plan and its components and requirements at each step of the IS project. In addition, it is recommended using the experience of national/international organizations to prepare the strategic plan.
- A lack of proper understanding of the activities and needs of personnel also has a highly negative effect on the implementation of IS project at Iran's public university. In other words, a lack of proper understanding regarding the number of processes and activities involved in IS projects increases the degree of complexity in terms of the implementation of such projects. Providing a detailed organizational chart including the activities involved at in each level will help make the process of the IS project more transparent for the IS team.

6. Conclusion and further research

The aim of this study has been to identify, categorize and prioritize the most important criteria governing the failure of information system projects at the public universities of Iran. To that end, a hierarchical structure was created by identifying and classifying criteria that affect the success or failure of IS projects in existing literature. To prioritize the resulting criteria, we created an online questionnaire using BWM, on the basis of which, at the first level, sub-criteria in the category of *organization management* turn out to have the greatest impact on the failure of IS projects the public universities of Iran. According to the expert opinions, *a lack of proper tests to evaluate the accuracy of IS projects* is the most important sub-criterion in the *project management* category. In addition, the experts considered *lack of top management support* to be the main sub-criterion in the category *organization management*. In the *human* category, *users' resistance to change* and *inadequate training of users* have the most important factors explaining the failure of IS projects. In the *organizational* and *technical* dimensions, according to the experts, *insufficient IT infrastructure* and *complexity of projects* have the greatest impact. At level 3 of the proposed framework, the experts indicated that *technology* was selected is the sub-criterion in the category *complexity of projects,* while the experts indicated that *misfit of IS software* has the greatest impact on the failure of information system projects at Iran's public universities.

It is noteworthy that, since the proposed framework presents all failure factors together, it provides important insights for presidents of universities and for public policy-makers in Iran, which may help them save time and money throughout the decision-making process.

The framework proposed in this paper can also be used to prioritize factors that affect the success/failure of risk management in IS projects in many government and private organizations, which could be a valuable avenue for future research.

To increase the accuracy of weighing criteria, future studies could to calculate the interaction among criteria that were omitted in this study for the sake of simplifying the evaluation process, by combination of DEMATEL and structural equations modeling.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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