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Prioritization of Factors Affecting the Success of Information Systems with AHP (A Case study of Industries and Mines Organization of Isfahan Province)

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Abstract Decisions in today's competitive and turbulent environments without access to information can confuse managers. The information system, which is planning, design and deployment as efficient and effective way, can help to improve the organization and create competitive advantage. One of the success factors and effectiveness of information systems in organizations is the organizational factors. In this research, organizational factors such as top management support, resource allocation, decision-making structure, management style and alignment of goals and knowledge of IT management, that affects the success factors of information systems (System quality, user satisfaction, perceived usefulness and quality of information), were analyzed and prioritized by Analytic Hierarchy Process (AHP) in Industries and Mines Organization of Isfahan Province. After gathering information and analysis by using the Expert Choice, it was found that among success factors of information systems, and user satisfaction is the most important factor, and the most important factor affecting success of organizational information system is the top management support.

Keywords Information, Organizational Factors, Analytic Hierarchy Process and Industries and Mines Organization.

1 Introduction

In today's world, Information and resources are not only known as one of the main assets of any organizations, but they are considered as tools for effective management of other resources and assets of organizations such as financial resources, human resources, etc. Today, Organizations use information systems to achieve strategic advantage, financial and business benefits.

Despite lagging behind its private counterpart, there have been signs indicating that the public sector's conservative approach to using information systems has begun to change. The traditional information systems are gradually being replaced by modern systems with more sophisticated software and hardware applications. Furthermore, the advent of communication technologies such as the Internet in the environment have resulted in better inter and intra agency collaboration in the public sector. These developments have apparently forced

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governments to re-evaluate and re-assess their information systems effectiveness. For over two decades, information systems (IS) success was the primary focus in IS literature [1].

One of the highly significant contributions to the literature was the study done by DeLone and McLean (1992) which resulted in a proposed information systems success model. This model has become instrumental towards contributing to a universal model, which many employed when looking at information systems performance. Further attempts have been made to produce enhanced models [2]. In validating their proposed IS success model, Rai *et al.* [2] made use of six dimensions namely system use, system quality, user satisfaction, information quality, individual impact, and organizational impact. The model was updated in 2003 to allow application in the e-commerce context.

In reviewing the success of information systems, many studies have been performed. Some of these studies sought to identify the criteria influencing the success of information systems, and some of them followed the evaluation of information systems. Some initial studies showed that organizational factors are the most important issues that should be considered during implementing of computer based information systems.

In this research analyzing and prioritizing organizational factors affecting the success of information systems have been studied. Analytic Hierarchy Process (AHP) in Industries and Mines Organization of Isfahan Province has been applied.

2 Other literature review

The impact of the organizational dimension on IS success has continued to be researched using multiple perspectives. Some of the researches have used different terminologies including contexts, variables, and factors when referring to organizational dimension. Lu & Wang [3] for example, used management style as a measure of organizational context. Saunders & Jones [4] identified organizational variables as: Mission, size, goals, top management support, IS executive hierarchical placement, maturity of IS function, size of IS function, management philosophy/style, evaluator perspective, culture, and IS budget size. In addition, Ang *et al.* [5] identified organizational factors that influence IT usage as organizational structure, organizational size, managerial IT knowledge, top management support, financial resources, goal alignment and budgeting method.

Based on a comprehensive list of organizational factors from related studies (Grover and Ang et al [5], [6] six organizational factors that influence IS success were identified to be used in this study. The six factors are: Decision-making structure, top management support, goal alignment ,managerial IT knowledge, management style, and resources allocation that are presented in Fig. 1.

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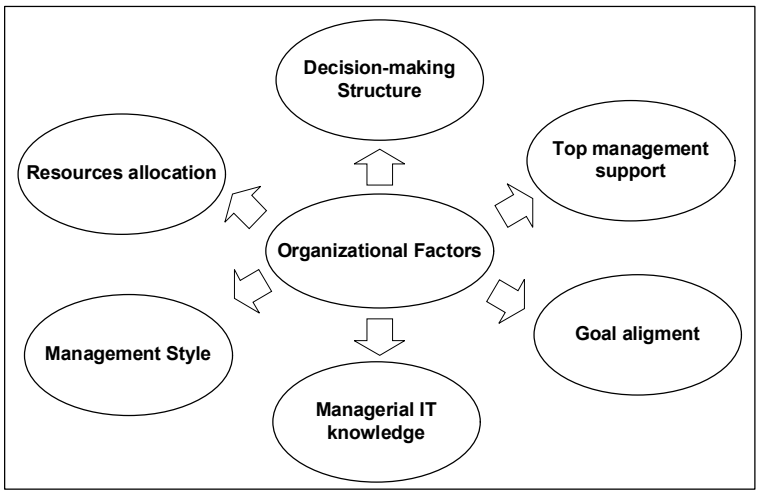


Fig. 1 Organizational Factors dimension

2.1 Decision-Making structure

Decision-making structure is defined as type of control or delegation of decision-making authority throughout the organization and the extent of participation by organizational members in decision-making pertaining to IT/IS [7]. Previous studies have found that decentralized decision-making is one of the strongest facilitators for adoption of Customer-based inter-organizational system (CIOS) [6], and IT system in large and complex organizations [8]. On the other hand, other studies have indicated that highly centralized organizational design can result in better management effectiveness for end user computing [9] and is likely to produce more successful strategic information systems applications [10].

2.2 Top management support

Top management support is conceptualized as involvement and participation of the executive or top-level management of the organization in IT/IS activities [11]. It is not surprising to discover that top management support has been one of the most widely discussed organizational factors in several IT/IS success studies. For example, top management support has been investigated in several studies link: its influence on IT/IS use [9], [5] IT/IS adoption [6]; CBIS implementation [12], strategic use of IS [13]; IS success [14] and other related IS studies. In addition King and Teo [13] clearly pointed out that top management support facilitated the successful deployment of strategic IS applications, while lack of top management support inhibited the strategic use of IT/IS. Grover [6] had earlier asserted that support factors have the most predictive ability in CIOS adoption. Both studies provided further evidence to support Jarvenpaa & Ives [11] whose study was focused on the role of executive support in relation to progressive use of IT .From the point of view of end-users, Igbaria, *et al.* [15] found the importance of organizational support on most of the factors investigated – perceived usefulness, perceived complexity, social pressure, perceived fun and system usage. Using a structural equation modeling Igbaria, *et al.* [14] concluded that management support has positive direct effects on the perceived usefulness and perceived ease of use factors on personal computing adoption in small firms .

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2.3 Goal alignment

Goal alignment involves the linking together of the business goals and the corporate IT goals . According to Saunders and Jones [4], to promote the achievement of organizational goals the IS plans must be tied to the overall organizational plans. The research interest focusing on goal or strategy alignment continues to grow among researchers and practitioners in both public and private sectors [16].

In the Malaysian private sector context, Ahlan [16] in his study of the Malaysian banking industry found that inadequate strategy alignment may lead to highly problematic IT implementations. Some of the strategy alignment inadequacies identified in that study include lack of organization wide strategy, lack of authority in strategy formulations, top management not well exposed to viable technology in formulating long term IT goals, and unclear strategic direction to steer technology deployment .With particular reference to the Malaysian public sector, Ang, *et al.* [5] investigated the impact of organizational factors together with other factors on the IT usage .

2.4 Managerial IT knowledge

Managerial IT knowledge refers to senior management experience and knowledge concerning information technology. Earlier studies showed that the managerial IT knowledge can be attributed to the background of the managers, their experience and awareness in IT/IS activities, their recognition towards IT/IS potentials, as well as their ability to plan strategically [8], [5]. In the Malaysian public sector, Mohamed [17] in her study has specifically highlighted the pressing need for the public sector IS/IT personnel skills to be relevant to the sector's transformation requirements. This is in accordance with Jarvenpaa & Ives [11] who argue that executives with relevant skills and knowledge background tend to be more productive, more proactive, and more participative in IT/IS projects, and have more favorable views of IT .

Studies have also found that managerial IT knowledge has an impact on IT utilization . Boynton *et al.* [8] investigated the influence of IT management practice on IT use in large organizations. They asserted that managerial IT knowledge directly and positively influence the extent of IT use in an organization. They have used managerial IT knowledge construct to reflect firstly, the knowledge IT managers have on strategic business issues and – secondly , the knowledge line managers have on potential opportunities of IT/IS to improve firm's productivity.

2.5 Management style

Management style deals with the way in which management tends to influence, coordinate, and direct people's activities towards a group's objectives [18]. It had been pointed out by Lu & Wang [3] that many studies have categorized management into people-oriented and task-oriented styles. People-oriented managers emphasize inter-personal relationship and are concerned with mutual trust, friendship, respect and warmth. On the other hand, task-oriented managers tend to focus more on task aspect of jobs and deals with defining and organizing tasks for goal attainment .In their study, Lu & Wang [3] investigated the relationship between management styles with user participation and systems success over MIS growth stages. Their

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findings produced mixed results. On one hand they found that management styles were related to system success differently over the MIS growth stages. For example, at the development stage and the maturity stage, both people-oriented and task-oriented styles had a positive significant relationship with system success. On the other hand both styles have no effect on system success at the initiation stage. They argued that at the initiation stage, computers are being introduced to the organization and users must learn the new technology on their own . This, in turn ended up creating dissatisfaction among the users .One of the important components of management style is the leadership style.

2.6 Resources Allocation

The final factor is concerned with allocating resources. Resources may be categorized into money, people, and time. According to Ein-Dor & Segev [19], resources include money, people and time that are required to successfully complete a project. Resources lead to a better organizational commitment and also overcome organizational obstacles [20]. Sufficient resources also lead to organizational implementation success and project implementation success [21] .Ein-Dor & Segev [19] and Wixom & Watson [21] have found a significant relationship between resources and IT project implementation. They observed that having sufficient funds, appropriate people and enough time have had a positive effect on a project's outcome. Based on the above arguments, this study suggests that resources allocated to IT projects may have important impacts on IS success.

3 IS success factors

3.1 Information quality

Information quality refers to the quality of the data that are available from the data warehouse. This factor has received considerable research attention regarding its definition, component measures, and importance [22]. Information quality is frequently discussed in the data warehousing literature as well as providing high-quality data to decision makers is the fundamental reason for a building a warehouse [23]. More specifically, data accuracy, completeness, and consistency are critical aspects of data quality in a warehouse [24]. The desirable characteristics of the system outputs i.e. management reports and Web pages. For example: relevance, understandability, accuracy, conciseness, completeness, understandability, currency, timeliness, and usability [25].

3.2 User Satisfaction

User satisfaction can be defined as the extent to which users believe the information system available to them meets their requirements [26]. User satisfaction is considered a useful assessment of system effectiveness [27]. It is one of the most frequently used criteria, and may be seen as a measure of both system quality and user acceptance. Among the reasons for its frequent use is that satisfaction of users with their information systems is a potentially measurable, and generally acceptable, surrogate for utility in decision-making.

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3.3 System quality

System quality relates to hardware and software quality such as reliability, responsiveness and user-friendliness. With system quality, the focus is on the system itself. Commonly used performance measures include system flexibility, integration, response time, and reliability [28].The desirable characteristics of an information system. For example: ease of use, system flexibility, system reliability, and ease of learning, as well as system features of intuitiveness, sophistication, flexibility, and response times.

3.4 Perceived usefulness

Perceived usefulness is defined here as "the degree to which a person believes that using a particular system would enhance his or her job performance." This follows from the definition of the word useful: "capable of being used advantageously." Within an organizational context, people are generally reinforced for good performance by raises, promotions, bonuses, and other rewards [29]. A system high in perceived usefulness, in turn, is one for which a user believes in the existence of a positive use-performance relationship.

4 The AHP method

AHP, developed by Saaty [30], addresses how to determine the relative importance of a set of activities in a multi-criteria decision problem. The process makes it possible to incorporate judgments on intangible qualitative criteria alongside tangible quantitative criteria [31]. The AHP method is based on three principles: first, structure of the model; second, comparative judgment of the alternatives and the criteria; third, synthesis of the priorities. In the literature, AHP has been widely used in solving many complicated decision-making problems [32]. In the first step, a complex decision problem is structured as a hierarchy. AHP initially breaks down a complex multi-criteria decision-making problem into a hierarchy of interrelated decision criteria, decision alternatives. With the AHP, the objectives, criteria and alternatives are arranged in a hierarchical structure similar to a family tree. A hierarchy has at least three levels: overall goal of the problem at the top, multiple criteria that define alternatives in the middle, and decision alternatives at the bottom [33]. The second step is the comparison of the alternatives and the criteria. Once the problem has been decomposed and the hierarchy is constructed, prioritization procedure starts in order to determine the relative importance of the criteria within each level. The pair wise judgment starts from the second level and finishes in the lowest level, alternatives. In each level, the criteria are compared pair wise according to their levels of influence and based on the specified criteria in the higher level [33]. In AHP, multiple pair wise comparisons are based on a standardized comparison scale of nine levels (Table 1). Let C = {Cj | j = 1, 2,…, n} be the set of criteria. The result of the pair wise comparison on n criteria can be summarized in an (n_n) evaluation matrix A in which every element a_{ij} (i,j = 1,2,..., n) is the quotient of weights of the criteria, as shown:

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$$A=\begin{pmatrix} a_{11} & .... & a_{1n} \\ . & & . \\ . & .... & . \\ . & & . \\ a_{n1} & .... & a_{nn} \end{pmatrix} \qquad a_{ij}=1, a_{ji}=\frac{1}{a_{ij}}, a_{ij}\neq 0 \tag{1}$$

At the last step, the mathematical process commences to normalize and finds the relative weights for each matrix. The relative weights are given by the right eigenvector (w) corresponding to the largest Eigen value $\lambda_{\max}$ as:

$$A_w=\lambda_{\max} w \tag{2}$$

If the pair wise comparisons are completely consistent, the matrix A has rank 1 and $\lambda_{\max}=n$. In this case; weights can be obtained by normalizing any of the rows or columns of A Wang and Yang [34]. It should be noted that the quality of the output of the AHP is strictly related to the consistency of the pair wise comparison judgments. The consistency is defined by the relation between the entries of $A: a_{ij}\times a_{jk}=a_{ik}$.

The consistency index CI is:

$$CI=\left(\lambda_{\max}-n\right)/\left(n-1\right) \tag{3}$$

Table 1 Nine –point intensity important scale

Definition	Intensely of importance
Equally important	1
Moderately more important	3
Strongly more important	5
Very Strongly more important	7
Extremely more important	9
Intermediate more important	2,4,6,8

The final consistency ratio (CR), usage of which let someone to conclude whether the evaluations are sufficiently consistent, is calculated as the ratio of the CI and the random index (RI), as indicated.

$$CR=CI/RI \tag{4}$$

The number 0.1 is the accepted upper limit for CR. If the final consistency ratio exceeds this value, the evaluation procedure has to be repeated to improve consistency. The measurement of consistency can be used to evaluate the consistency of decision-makers as well as the consistency of overall hierarchy [34].

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5 Methodology

In this study, the AHP approach has been used for identifying and ranking of success and organizational factors on information systems in the Industries and Mines Organization of Isfahan Province. The views of top and middle managers that selected considering purpose of the research, has been used in this approach. Research's hierarchical model has three levels and is presented in fig.2. The levels are as follows:

- Level1: The main purpose (success of information systems).
- Level2: The main criteria for success of information systems (system quality (C1), perceived usefulness (C2), user satisfaction (C3) and information quality (C4)).
- Level3: Alternatives or organizational factors affecting the success of information systems(Resources Allocation(A_1),Management Style(A_2),Managerial IT Knowledge (A_3),Goal Alignment (A_4),Top Management Support (A_5),Decision-making Structure (A_6)).

In this research collecting views of respondents was performed using questionnaire which includes: Paired comparisons, criteria and options, views were reviewed with Expert Choice. For ranking organizational success factors with information systems in Industries and Mines Organization of Isfahan Province, the pairwise comparison matrix was established based on judgment of experts using nine point scale shown in Table 1. Once the pairwise comparison matrices are formed the AHP is employed to determine the criterion weights utilizing the eigenvector method shown in Eq.(2). The criteria pairwise comparison matrix was established using a nine-point scale (see Table 2). Then, the weight for each criterion was determined by using the eigenvector method (see Column 6 of Table 2). Then alternatives were compared based on different criteria and the four matrices (the order of the matrices is6×6). The weight of each alternative was then determined using the eigenvector method (see Table 3).

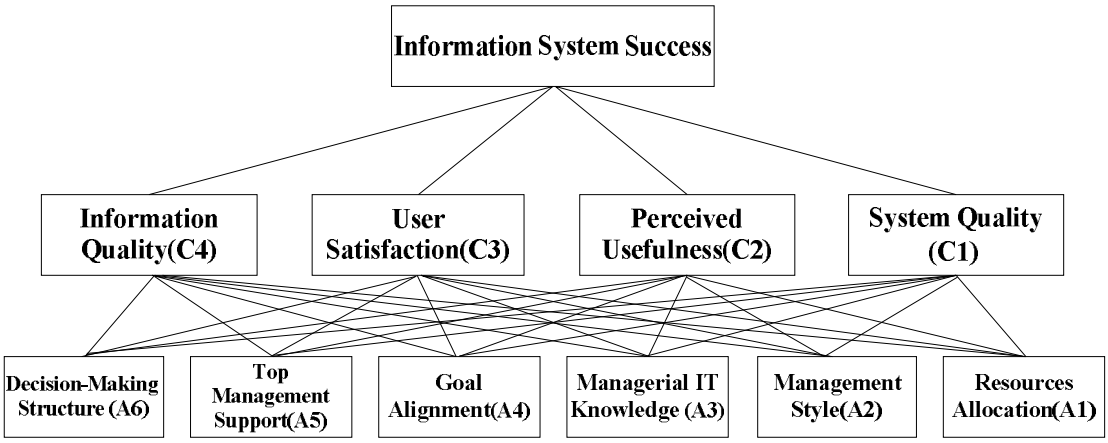


Fig. 2 Research Framework Model

Table 2 Criteria Pairwise comparison matrix

	C_1	C_2	C_3	C_4	Weight
C_1	1	5	2	1/2	0.310
C_2	1/5	1	4	6	0.059
C_3	1/2	1/4	1	1	0.246
C_4	2	1/6	1	1	0.386

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Table 3 Comparisons of the alternatives with reference to C1~C4

		A_1	A_2	A_3	A_4	A_5	A_6	Weight
C_1	A_1	1	1/3	1/2	1/2	1/5	1	0.077
	A_2	3	1	1	2	1/2	1	0.171
	A_3	2	1	1	1	1/3	1/2	0.120
	A_4	2	1/2	1	1	1/4	1/2	0.101
	A_5	5	2	3	4	1	3	0.375
	A_6	1	1	2	2	1/3	1	0.156
C_2	A_1	1	1/2	1/3	1/4	1/5	1/2	0.059
	A_2	2	1	1/2	1	1/2	1	0.126
	A_3	3	2	1	2	1/2	1	0.190
	A_4	4	1	1/2	1	1/4	1/2	0.119
	A_5	5	2	2	4	1	3	0.355
	A_6	2	1	1	2	1/3	1	0.151
C_3	A_1	1	1/2	1/2	1/2	1/5	1/2	0.069
	A_2	2	1	3	2	1/2	2	0.221
	A_3	2	1/3	1	1	1/3	2	0.126
	A_4	2	1/2	1	1	1/3	2	0.132
	A_5	5	2	3	3	1	3	0.356
	A_6	2	1/2	1/2	1/2	1/3	1	0.096
C_4	A_1	1	2	1/2	2	2	2	0.216
	A_2	2	1	1/2	1/2	1/2	1/2	0.082
	A_3	2	2	1	3	1/3	3	0.236
	A_4	2	2	1/3	1	1/2	1/2	0.096
	A_5	3	2	3	2	1	2	0.251
	A_6	1	2	1/3	2	1/2	1	0.119

Once the component weights are calculated, they were synthesized to obtain the rank scores of each alternative. The weights were are synthesized from the highest level down by multiplying the weights by their corresponding parent component from the level above and then adding them for each component within a level according to the component it affects. The results for the ranking organizational success factors on information systems are tabulated in Table 4 where it can be seen that alternative A_5 (Top Management Support) has the highest weight.

Table 4 Criteria Pairwise comparison matrix

	Weight	A_1	A_2	A_3	A_4	A_5	A_6
C_1	0.310	0.077	0.171	0.120	0.101	0.375	0.156
C_2	0.059	0.059	0.126	0.190	0.119	0.355	0.151
C_3	0.246	0.069	0.221	0.126	0.132	0.356	0.096
C_4	0.386	0.216	0.082	0.236	0.096	0.251	0.119
Overall priority		0.141	0.137	0.180	0.106	0.311	0.125

6 Consistency ratios

The judgments used in the process of deciding on the most suitable alternative were validated from the consistency ratios. According to this result the calculated inconsistency ratio is below 10% and the prepared selecting matrices may be considered consistent.

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7 Conclusions

Today, not only top managers and executives, but all segments of society such as researchers and scholars, and businessmen inevitably use information. Information systems play an essential role in all fields of a company. The study show that successful companies implemented information systems effectively and efficiently. Information systems are considered as a valuable resource that increase the ability of managers and employees and lead to effective realization of the organization goals. In this research, organizational factors such as top management support, resource allocation, decision-making structure, the management style and alignment of goals and knowledge of IT management, that affects the success factors of information systems (System quality, user satisfaction, perceived usefulness and quality of information), were analyzed and prioritized with Analytic Hierarchy Process (AHP) in Industries and Mines Organization of Isfahan Province. After gathering information and analysis them using the Expert Choice, It was found that through the success factors of information systems, user satisfaction is the most important one, and the most important factor affecting success of organizational information system is the top management support.

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