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Ranking the Information Technology dimensions using Sustainable Development Criteria

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ABSTRACT

The purpose of this research was to rank Information Technology (IT) dimensions using sustainable development criteria. The present research belongs to the category of applied research in terms of objective and descriptive survey in terms of data collection. To this end, the six dimensions of IT have been ranked according to three areas of sustainable development. Ratings were done using Gray Relational Analysis (GRA) through the GRAY RELATION software. It is worth noting that the statistical population included all managers of executive organizations in the northwest provinces of Iran. The result of using the GRA methodology to rank the IT components through sustainable development dimensions has ranked the six dimensions in terms of scores obtained as follows service quality, information quality, system satisfaction, perceived benefits, system quality, and IT usage.

Keywords: Service Quality, Information Quality, System Satisfaction, Perceived Benefits, System Quality and Information Technology Usage, Gray Relational Analysis

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Clasificación de las dimensiones de la tecnología de la información utilizando criterios de desarrollo sostenible

RESUMEN

El propósito de esta investigación fue clasificar las dimensiones de la Tecnología de la Información (TI) utilizando criterios de desarrollo sostenible. La presente investigación pertenece a la categoría de investigación aplicada en términos de encuesta objetiva y descriptiva en términos de recolección de datos. Con este fin, las seis dimensiones de TI se han clasificado de acuerdo con tres áreas de desarrollo sostenible. Las clasificaciones se realizaron utilizando el Análisis relacional de Gray (GRA) a través del software GRAY RELATION. Vale la pena señalar que la población estadística incluyó a todos los gerentes de organizaciones ejecutivas en las provincias del noroeste de Irán. El resultado de utilizar la metodología GRA para clasificar los componentes de TI a través de dimensiones de desarrollo sostenible ha clasificado las seis dimensiones en términos de puntajes obtenidos de la siguiente manera: calidad del servicio, calidad de la información, satisfacción del sistema, beneficios percibidos, calidad del sistema y uso de TI.

Palabras clave: Calidad del servicio, Calidad de la información, Satisfacción del sistema, Beneficios percibidos, Calidad del sistema y Uso de la tecnología de la información, Análisis relacional de grises

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INTRODUCTION

One of the most important current events predisposing government-citizen communication and sustainable urban development is the emergence of new information technologies, such as the Internet, and its widespread expansion in all areas whose growing deployment and other means of communication as subsets of information and communication technology (ICT) have brought new phenomena in the social, political and economic fields. The purpose of such technologies is to exploit modern methods to provide better services to citizens and also to internal reconstruction of organizations. Governments have entered into new areas for establishing their own effectiveness and efficacy in all arenas (Rahmanpur and Hajebi, 2013); therefore, achieving sustainable development or promoting it are of the most important concerns of societies, since the sustainable development leads to providing basic needs and improving living standards for all, better preserving and managing ecosystems and, in general, providing a safer and more prosperous future for humankind. Since the cities are regarded as the key instability factors in the world, the main themes of sustainable development are the sustainable urban development; therefore, achieving sustainable urban development is one of the most important priorities in obtaining the sustainable development (Mojtahedi and Litkohi, 2014).

Therefore, the ICT has developed widespread and dramatic growth across different countries. It has many benefits for countries (Mutual et al., 2006). The urban ICT, as the third millennium phenomenon, is a knowledge-oriented approach that transforms knowledge into ability. The ICT has transformed human life. Soon, managing a large part of human affairs without using this technology will not be possible (Moradi Mofrad et al., 2014). To capture the benefits of ICT, this technology must be implemented and used efficiently (Bridges, 2005). The ICT has undoubtedly led to widespread developments in all social and economic spheres of humanity. Its impact on human societies is such that modern world is rapidly becoming an information society, in which knowledge, accessibility and effective applications of knowledge have a central and decisive role. The scope and implications of ICT in various aspects of today and future life of human societies have become one of the most important current issues on the world and has focused on the attention of many countries of the world (Moradi Mofrad et al., 2014). Considering the IT dimensions with the sustainable development criteria in communities through organizations can be a source of significant advances in society. To this end, measures should be taken to monitor and rate IT dimensions through sustainability criteria. The research seeks to rank IT dimensions

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using the sustainable development criteria to provide an excellent way for executives in Northwest organizations in Iran.

Theoretical foundations

The importance and challenges of information and communication technology

IT is said to be one of the biggest causes of changes in organizations. Many organizations and governments consider IT as a way of communicating with an external environment through globalization, competitiveness, customer mobility, and increasing customer expectations; therefore, IT investments in organizations are remarkable (Melian-Gonzalez & Bulchand-Gidumal, 2016). The current era is the period of rapid and unexpected changes. A manager must adapt the corresponding organization's structure to the environmental conditions and must obtain the necessary information for the organization to achieve organizational objectives in this vibrant and changing world. One of these factors constantly changing and revolving is the technologies used by the organization. Information technology provides the necessary facilities for collecting, storing, processing and distributing information. The necessity of technology to reach the objectives of any organization in the age of communication is undeniable. Different organizations, based on their nature and goals, should be helped by this tool in order to achieve their objectives as soon as possible. On the other hand, the speed of necessary alterations has made use of this tool to continue the survival of the organization. In contrast, today's organizations are forced to use information technology; otherwise, they will be deleted from the realm of activities in an environment where acceleration of change is evolving (Azizi et al, 2013). Shank in 2013 stated that the use of ICT in organizational relationships is important (Diaz et al., 2015). The ICT has been defined as an effective parameter in advancements, logistics and decision making (Jin & Moon Cho, 2015).

Hearn and Foth in 2005 stated that the ICT owing to software systems makes it possible to reduce the costs associated with knowledge and make easier the design of communication channels (Falch, 2014). Knowledge based on innovation and creativity is one of the components of the success of any organization that depends on IT usage. Weber & Zink in 2014 argued that the ICT, especially in certain industry sectors, provides powerful and compacted information in

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the service industry for organizations. It is very important to consider the widespread use of ICT for economic activities. First, the ICT directly leads to increased productivity and elevated economic growth of organizations. Secondly, it results in production and innovation, and the improvement of productivity and an important factor in advancing competitive advantage. Given the widespread use of information technology in business activities, governments are often portrayed in adaptation to the management practices experienced in the commercial world. The IT will play a dominant role in the new millennium, due to its very important capabilities, in improving the efficiency and effectiveness of the organizations' functional areas. Today, many developing countries are trying to adapt to the new environment and take advantage of it by developing and implementing e-government projects. The Internet revolution and related information technologies, in addition to the advent of electronic business, have also fueled the transformation of the structures and processes in the field of government performance. Innovations in information technology, alterations in expectations of citizens and enterprises, and investment of enterprises in the information technology sector are among the most important factors that make up the need for e-government. Information technology innovations lead to facilitating citizen servicing, minimizing government size, accelerating the acquisition of information and services from citizens, companies and government agencies, and facilitating work processes and reducing costs through the integration and elimination of parallel systems (Mohammadi and Amiri, 2013). Changes in various fields have become inevitable nowadays due to the advancements in information technology, the impact of this technology on different aspects of life and the advent of the digital age; the organization's incompatibility with these changes and innovations will reveal inefficiencies of organizations more than ever (Nour & Fadlalla, 2008). IT usage in daily activities has become a very common issue. Successful implementation of IT usage can be accompanied by an understanding of how to use it in the organization and accept technological change.

Relationship between information technology and the development of electronic cities

In the present age, information and informing are the most important strategic tools for the management and administration of all administrative, economic, social, cultural and political units. Given the growing use of information in various affairs, future cities will have a different face than today's cities. With regard to the abovementioned background, the development of e-

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cities will undoubtedly be one of the top priorities in reaching a global intelligence community. The e-city reflects new information and communication technologies in the field of urban management. In other words, these technologies provide the benefits and facilities for citizens and local organizations. The e-city project would not be successful if the citizens did not get enough culture issues, education levels and information resources to use e-services instead of traditional paper-based services. Therefore, in order to establish the e-city, electronic infrastructure must first be provided at a broad level and the necessary culture must be done in such a way that people have to go on spontaneously towards using this type of service. The scope of these new functions is constantly expanding, but this development will be correct and sustainable when implemented on the platform of electronic infrastructures and in all its dimensions. It is imperative to provide Internet access for citizens, but the development of local networks is among the e-city infrastructures. The online electronic services provided by government and non-governmental organizations are not all that makes e-city. The use of all new information and communication technologies to promote the level of participation and cooperation of people in the administration of city affairs is one of the key steps for the realization of the e-city. The key element in any application of IT, such as e-city, is the information that must be available to and adequately accessible to citizens in an appropriate manner, whenever needed, with the diversity needed for citizens and in various formats in accordance with the functions and tastes to provide knowledge of the city perspective and the formation of new ideas in the minds of the people (Pour Ahmad et al., 2010).

Changes in IT indicators in Iran

In recent years, many economists and international economic-industrial organizations have believed that the main problem for developing countries is the low performance of their productivity rates. It has always been a question of how these functions can be improved through market-oriented reforms. One of the key factors as a criterion for measuring in this regard is the increase in manufacturing value added per capita or exports per capita, as well as the level of technology considered in manufacturing value added per capita or exports per capita. Countries that have been better equipped to succeed in acquiring skills, technology, information and knowledge have been able to not only operate their economic growth rates but also achieve higher levels of growth rates. Although the capacity of science and technology is positively

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correlated with economic growth, the extent of their dependence is unclear. Further, many fields of science have little connection with economic development and many areas of economic growth are not relying on science and technology. In addition, the review of economic history in many respects states that technology-based economic growth facilitates the development of a national scientific system, meaning that science and technology act as a catalyst for development. The attention was already focused on improving the inflation or balance of trade between countries as a factor in improving productivity; today it is clear that productivity cannot be improved by these factors alone. According to a study by the World Bank on the grouping of countries based on national technology learning patterns, the indicators related to the quantification of technology in countries prepared by different global organizations can be summarized as follows (Mowahedi, 2008).

Technology Achievement Index by the United Nations Development Program (UNDP)

Competitive Industrial Performance Index by the United Nations Industrial Development Organization (UNIDO)

Knowledge Economy Index by the World Bank (WB)

Innovation Capability Index by the United Nations Conference on Trade and Development (UNCTAD)

Science and Technology Capacity Index by Francisco Sagasti

Since each of the quantitative indicators of science and technology focuses on a variety of aspects, they have their own strengths and weaknesses, because each reveals some dimensions of this highly complex phenomenon that can be used in accordance with the type of objective. Some measures focus on "inputs" to the national science and technology development system, and quantify "technology efforts" or "potential capacity of technology", such as the number of scientists and engineers, research and development (R & D) costs, or the number of employees in the R & D department. However, some other measures focus on "outputs" of the national science and technology development system, and measure "technological gains" or "revealed capacity of science and technology", such as "technology performance" such as the share of the most advanced industries in exports and the share of these industries in manufacturing value added. It is clear that the "input-oriented" measures are weakened by the lack of attention to the quality of

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these inputs and their efficiency, which vary widely in different countries, while "output-oriented" measures can lead to misleading results, because technology performance measures are simply and even temporarily influenced by the presence of multinational companies that are not necessarily related to the rest of the economy. In calculating the indices, "absolute size of inputs" is as important as "input intensity" due to scale savings and "Critical Mass Effect" (Mowahedi, 2008).

RESULTS

Ranking for Information Technology dimensions with Sustainable Development Criteria

The GRA method has been used to rank the IT dimensions with sustainability criteria as follows:

Step 1- Formation of the decision matrix

Formation of decision matrix: The decision matrix of this method is the decision matrix of TOPSIS or VIKOR methods; that is, the matrix that consists of criteria and alternatives (rows are alternatives and columns are criteria).

Table 1- Decision matrix

Matrix	Economic factors	Social factors	Environmental factors
System quality	2.86	3.06	2.53
Information quality	2.86	2.73	3.66
Service quality	3.6	2.93	3.33
Information technology usage	2.93	2.26	2.93
System satisfaction	3.53	2.8	3.1

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Perceived benefits	2.53	3.06	3
Criterion direction	The bigger the better	The bigger the better	The bigger the better
Criterion weight	2.93	3.4	3

Step 2- Normalization of decision matrix

The normalization must be done using the following equations. As shown below, there is a separate equation for the optimal criteria.

$$x_{ij} = \frac{y_{ij} - \min(y_{ij})}{\max(y_{ij}) - \min(y_{ij})}$$ هر چه بزرگتر بهتر

$$x_{ij} = \frac{\max(y_{ij}) - y_{ij}}{\max(y_{ij}) - \min(y_{ij})}$$ هر چه کوچکتر بهتر

$$x_{ij} = \frac{|y_{ij} - y^*|}{\max\{\max(y_{ij}) - y^*, y^* - \min(y_{ij})\}}$$ هر چه به ارزش مطلوب y^* نزدیکتر بهتر

The GRA was obtained in the preceding step of the normal matrix, whose numbers are between zero and one; the closer to the one, the greater the likelihood of the option. In this step, the reference goal has all the layers; the normalized matrix of this research is as Table 2.

Table 2- Normalized decision matrix

Scale-free Matrix	Economic factors	Social factors	Environmental factors
System quality	0.308411	1	0
Information quality	0.308411	0.5875	1
Service quality	1	0.8375	0.707965
Information technology usage	0.373832	0	0.353982

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System satisfaction	0.934579	0.675	0.504425
Perceived benefits	0	1	0.415929

Step 3- Define reference goal series

After generating GRA relations using the above equations, all functional values, such as when the x_{ij} concept of normalization is used, will fall between zero and one. The closer to 1, the utility will be higher. As a result, a comparative series with all options equal to 1 will be the best choice. The reference goal is a series whose all functional values is equal to 1 and is defined as follows:

$$X_o = (x_{o1}, x_{o2}, \ldots, x_{oj}, \ldots, x_{on}) = (1,1,\ldots,1,\ldots,1)$$

The more the comparative series will be closer to the reference series, the utility will be more. In this research, the reference goal series were obtained as Table 3.

Table 3- Reference goal series matrix

Reference goal series	Economic factors	Social factors	Environmental factors
System quality	0.691589	0	1
Information quality	0.691589	0.4125	0
Service quality	0	0.1625	0.292035
Information technology usage	0.626168	1	0.646018
System satisfaction	0.065421	0.325	0.495575
Perceived benefits	1	0	0.584071

Step 4- Effect of Gray Relational Coefficient (GRC)

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The GRC was calculated using the equation below, r = 0.5 in this equation.

$$\gamma(x_{oj}, x_{ij}) = \frac{\Delta \min - r\Delta \max}{\Delta_{ij} - r\Delta \max}$$

The resulting matrix can be analyzed in Table 4.

Table 4- Gray relational coefficient matrix

GRC effect	Economic factors	Social factors	Environmental factors
System quality	0.366438	1	0.285714
Information quality	0.366438	0.492308	1
Service quality	1	0.711111	0.578005
Information technology usage	0.3898	0.285714	0.382403
System satisfaction	0.859438	0.551724	0.44664
Perceived benefits	0.285714	1	0.406475

Step 5- Gray relational rating

It was simply enough to calculate the final score of the options in this step using the equation below and to rank those options.

$$\Gamma(x_o, x_i) = \sum_{j}^{n} w_j \gamma(x_{oj}, x_{ij})$$

This equation shows the rate of correlation between the reference goal series and the comparative series.

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Where, W is the weight of indices computed by techniques such as AHP or entropy or calculated as expert opinion. The reference goal series on each indicator represents the best performance that can be achieved in the comparative series; therefore, if a comparative series for one option has the highest gray relational rate with the reference goal series, this will mean that the comparative series has the most similarity to the reference goal series and so this option will be the best choice.

Table 5- Gray relational ranking matrix

Ranks	Economic factors	Social factors	Environmental factors
System quality	1.073664	3.4	0.857143
Information quality	1.073664	1.673846	3
Service quality	2.93	2.417778	1.734015
Information technology usage	1.142113	0.971429	1.147208
System satisfaction	2.518153	1.875862	1.339921
Perceived benefits	0.837143	3.4	1.219424

Step 6- Final score based on gray relational analysis ranking

Finally, factor ranking was according to GRA method presented in Table 6.

Table 6- Final scores according to gray relational analysis ranking

Results	Scores
service quality	7.081793
information quality	5.747511

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system satisfaction	5.733936
perceived benefits	5.456567
system quality	5.330807
Information technology usage	3.26075

This ranking is shown in Figure 1.

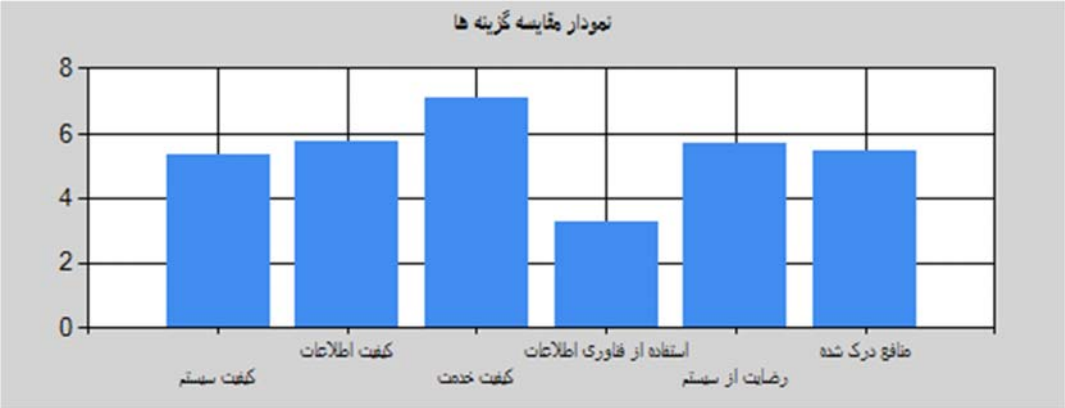

Fig 1- Ranking the information technology dimensions

DISCUSSION AND CONCLUSION

Information is similar to the blood circulating in the body of organization and gives the life. Information can feed the decision-making process about structure, technology and innovation. Information is like a vital vessel that connects the organization to raw material suppliers and customers. The IT development, such as computers and electronic communications, has changed the nature of many things. Of these phenomena (IT), it may be inferred that large organizations become smaller and tend to be more flexible and organizational downsizing. The IT can also lead to relatively modest changes internationally because IT and computers can have a profound impact on economic and social functions and global relationships.

On the one hand, IT and its manifestation are now problematic for many organizations, as the fastest growing factor in the economy. On the other hand, this technology is rapidly optimizing,

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and costs are decreasing significantly. The scope of its application is very wide and its impact in most industries on the price of the product is very important in terms of the share of human resources costs. The use of these information technologies in organizations is also one of the most valuable resources and assets of an organization, and it is imperative to choose the right strategy for its application. Firstly, this is unacceptable for many corporate managers, and it is not easy to deal with information in the judgment of the aligned source, such as manpower, raw materials, financial resources, and sometimes even more so. It is also difficult to even consider that the intangible element to be the main source of vital facilities for many executive executives; but if we look closely, we can see how these intangible elements affect the productivity and profitability of each organization and the optimization of decision making by strategic leaders. Information can play an important role in any organization's life. In fact, information is a device that provides better and more appropriate use of the organization's tangible resources for management. Information in the organization is often not effectively managed. While information is associated with advanced technology in many organizations and complex automated systems are used for information services as well as office automation systems in a wide range, there is still no detailed discussion on the management of these systems and information service centers and how and how much these technologies are used and information resources management in line with the benefits to society, the first step for the use of information technology can be to increase the knowledge of managers about its potential value. The service quality provided in organizations in the context of IT usage should be placed in a proper position and in accordance with the organizational strategy of executive agencies. If the organizations are aware of the issues of sustainable development with the application of IT dimensions, they will have a flourishing organization and, in the end, a flourishing society. Therefore, the more active management of IT should make easier to apply its principles and science. Knowledge should be enhanced by rewarding the role of information in the organization in the IT usage as well as the role of information in managerial decisions and strategies and how to use it. Moreover, administrators of executive agencies should try to use IT in administrative affairs in order to reduce paperwork and palpable documentation, in planning to reduce the time spent on manpower, in controlling the production in order to pay particular attention to the environmental impacts of organizational output, in making decisions in order to have a successful organization consistent with organizational goals. In the context of sustainable development, and the characteristics and dimensions of IT, the organizations can act successfully and sustainably, and can contribute to a leading and successful society. Concerning studies in line with the findings of

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this research, it can be said that our study is consistent with the studies by Sarabandi in 2011 to investigate and identify the impact of the use of IT dimensions on the excellence of small organizations, Sohrabi and Kiakojouri in 2016 on the role of IT dimensions in improving organizational performance.

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