

# A Fuzzy ISM Approach for Analyzing the Implementation Obstacles of Electronic Government in Iran

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**Abstract-** “E-Government (EG)” refers to the use by government agencies of information technologies (such as Wide Area Networks, the Internet, and mobile computing) that have the ability to transform relations with citizens, businesses, and other arms of government. These technologies can serve a variety of different ends: better delivery of government services to citizens, improved interactions with business and industry, citizen empowerment through access to information, or more efficient government management. In order to have a successful implementation of electronic government strategy and benefiting from its complete potential and benefits and generally for establishment and applying of electronic government, it is necessary to have different infrastructures as the basics of electronic government with lack of which it is impossible to benefit from mentioned services. For this purpose, in this paper we have managed to recognize relevant obstacles for establishment of electronic government in Iran. All required data for recognition of obstacles were collected from statistical society of involved specialists of Ministry of Communications & Information Technology of Iran and Information Technology Organization of Tehran Municipality through questionnaire. According to the results, mentioned obstacles for applying of electronic government in Iran are as follows: Technical & technological problems, Legal, judicial & safety problems, Economic problems, Organizational Problems and Humanistic Problems. After identifying the key obstacles to successful implementation of EG in Iran through literature review and interviews with experts, 5 main obstacles detected. Then the relationship and sequence of barriers were determined with Fuzzy Interpretive Structural Modeling and MICMAC analysis.

**Keywords:** Electronic Government, Information Technology, Obstacles, Fuzzy Interpretive Structural Modeling, Iran.

## I. INTRODUCTION

IT (Information Technology) development and communications in all fields of human being life may lead to change of communicative ways of people

with society, methods and procedures in which all persons are related to each other for performing their works. Due to these changes, we can name present time as the time of “Information & Communications Technology” by which human societies changed into scientific societies and citizens into users of information networks [1].

One of the most important chances provided by modern technologies for governmental authorities and managers is the possibility of “Re-engineering of government architecture” and increasing the access and output and reliability. Any benefit from re-engineering of architecture [2], government and other above-mentioned facilities in governing process may cause the creation of a reality in the name of Electronic government may lead to electronic governance both as the pre-requisite of governing on information societies governments. This means that it is impossible to govern on information societies only with traditional and expired structures and processes. Electronic government means different methods by which all governmental managers could provide relation with their citizens through digital tools such as internet positions, electronic post, video conference, audio post and internet. Electronic government may provide the following items: (1) More access to governmental information, (2) Betterment of civil partnership through enrichment of all people for contraction with governmental authorities through network relations, (3) Reliability of government through better and clearer activities and reducing of corruption possibilities, (4) Creation of developing chances in rural & deprived areas [3, 4].

By the way, any benefit from electronic government facilities may cause better submission of governmental services to citizens and more access of all citizens along with effective relations with involved parties and enriching of citizens and totally

create a more effective governmental management. Some of the expected results of this process are reduction of administrative corruption and more clearance of affairs, increasing the responsibility rate, permanent betterment of processes, more comforts, increasing of resources and reduction of services costs. By creation of information & communication technologies there is a close relation between servicing centers and customers in which all persons may receive their own services through personal computers. In addition, electronic government may cause an economy in time and costs of government, citizens and labors. Globalization may also make governments to establish electronic government for better selling of their own goods and services and export of culture and introducing of themselves to other cultures and civilizations. [5, 6, 7]. In this study, 5 key obstacles are identified according to literature and experts opinions. Then the relationships between obstacles were determined by using of fuzzy interpretive structural modeling. Finally these obstacles clustered by MICMAC analysis to four clusters.

## **II. THE THEORETICAL BASED OF THE RESEARCH**

### ***A. Description of government***

In its wide meaning, Government means different organizations with legal powers for applying in specific and determined scope of people. The government may provide its exclusive power for providing discipline in mentioned scope of powers through governmental organizations [8].

### ***B. Major duties of government***

Government must/must not do some things. Anderson has written a suitable and applicable set of general roles of government under seven titles as follows: [9]

1. Supply of economic infrastructure
2. Supply of public goods and services
3. Settlement of group challenges
4. Keeping of competition
5. Maintenance of public resources
6. Supply of minimum goods and services for people
7. Economy fixed condition

### ***C. Definitions of electronic government***

There are a lot of definitions for electronic government as follows: [10, 11, 12, 13]

- Electronic government means easy benefiting from information technology for direct/day & night distribution of governmental services.

- Electronic government means any benefit of government and other governmental organizations from information technology and creates a change in relation with citizens, trading centers and other cases in challenge with government.
- Electronic government is a method for governments to use information technology and new technologies that provide necessary facilities for suitable access to governmental information and services, betterment of their quality and providing of wide chances for cooperation in public processes and symbols.
- Electronic government may receive/deliver the information and services easily and quickly by depending upon internet and other modern technologies with an applicable and low cost method.
- Electronic government means on time, exact and applicable information and servicing through 24 hours in 7 days of a week and all days of the year through different communicative tools such as telephone and internet.

In other definitions we have other aspects like reliability, responsibility, clearing and so on. As a result electronic government is a set of electronic relation among government, companies and citizens.

### ***D. The importance of creating an Electronic Government***

The expectation of people about services and products and quality /manner of presentation is under changing with daily increase basis. Government should reply all these needs and expectations. They require increasing working hours of governmental institutes in order to perform their works without any long queues and receive high quality and cheaper services, therefore the most reliable form of a government for all these needs is electronic government. All governments are competing with each other for attraction of capitals, labors and occupation of professional workers and tourists then for this purpose they need new facilities which may be provided by electronic government.

As a result, electronic government may not only integrate with society but also make the government to focus on more required resources. Electronic government may develop Self Service culture in a way that all citizens could help themselves and reduce any wasting of costs and times [14].

### ***E. The records of electronic government in pioneer countries [15, 16]***

**Singapore (%47):** A country with a population more than 3.5 million persons and internet interference

coefficient of %47 follows civil services in a way that if it possible to provide any linear services it should necessarily provide on line basis. Singapore has developed a wide range of transaction services in different governmental organizations. One of the aspects may show Singapore government as a lead of electronic government is that Singapore was the first country that has used electronic transactions law with allocation of required credits and official situations for companies to benefit from digital documents.

**U.S.A: (%66):** From 2001, USA has applied various functions for developing of electronic government. For instance, appointing a manager for information technology and electronic government, a similar position with master technology manager and a modern attitude of electronic government for focusing on citizens (Citizen focused). The real goal of government by electronic government was obtaining different ideals such as qualitative services, reducing of prices, clearer situation and easier access to electronic services especially for disable citizens. Today government considers a central entrance of [www.firstgove.gov](http://www.firstgove.gov) which has been constructed according to the needs of citizens. In addition, the government is active in parallel with development of electronic signature and creating an economic entrance of [www.fdbizapps.gov](http://www.fdbizapps.gov) with the goal of facilitating of value channel management.

**England (%40):** England has established different agreements in the field of electronic government as follows: 1). Establishment of a unique structure for development of electronic government, 2). Executive designing in private sections, 3). Effective relation with citizens, 4). Controlling & following up the supervision on progresses of electronic government. England has prepared a program in the name of electronic officer for modernization of governmental services. The key aspect of this program is to establish an administration for electronic officer to accept responsibility of program tools including preliminaries of electronic trade & electronic government. This administration includes two groups. A policy making group responsible for strategic designing of infrastructures and operations and delivery group for performing different projects of electronic officer (like [unkon.ine.gov.uk](http://unkon.ine.gov.uk)). This electronic officer would be led by electronic ministry. The other key aspect of electronic government in England is designing of executive programs through an executive online plan which provided %94 of partial proposals in 25 groups.

#### ***F. Iranian Electronic Government in comparison with developed nations***

Electronic government has been applied in different countries with different forms and mainly in accordance with their political/social needs. Most of developed countries are encouraged by international organizations like UN to develop electronic government. By the way most of non-developed countries are not sure about it. According to the UN report, any development and applying of electronic government may not necessarily increase the life quality in a country. But the reality is that electronic government is considered as a strategic key for benefiting from competing profit and as a central tool for governmental modifications by all countries of the world. The major property of developed countries against electronic government is social/political news. For example, Zang explains that such a description of electronic government is not a sampling of U.S.A for encouraging and enriching of democratic cooperation [17].

Better democratic cooperation and overcoming on political alienation are two major factors with more challenges than other factors for under-progress countries with an attitude for developing of electronic government. Needless to stat that mentioned challenge is lower than developed countries with considerable democratic progress which may lead to more efforts for upgrading of operation quality of systems and users.

Iranian attitude about electronic government is in fact similar to other under-progress countries. The operation of government and its betterment are more considerable. In fact the major problem of Iranian Electronic Government is not political/ social aspects. These programs have considerable effect on society and are under pressure of social conditions of government. Iranian Electronic government found 44<sup>th</sup> grade in 2001 among 169 countries which were under consideration and study of World Market Researches Center. Also it found %33 grades and position 107 among 173 countries in another study by UN in 2003. This tangible reduction was a result of program limitations out of political/social reactions against any changes in electronic government. Religious organizations and incorrect rules create a situation for controlling information technologies and internet and any distribution of it [18].

In fact there is a type of hegemony for distribution of information and ideologies in some countries. Religious government is current in Saudi Arabia and Iran and as a method for maintenance of society against non-behavioral effects of internet. But it is rate these strengths could prevent from any

movement towards development of electronic government but may reduce its speed and make some delays. At present it is obvious in Iran. The message of world society is completely understandable by under-developing countries for benefiting from new information & communicative technologies and reducing any gaps between developed & non-developed countries. While Kalatil & Boas explain: It has been proved that electronic government may bear a lot of benefits even for powerful regimes [19].

### ***G. The Role of e-Governance in Bridging the Digital Divide***

The concept of the digital divide has been evolving over the years, being generally defined as a social issue linked to the different amount of information between those individuals who have access to the information society and information and communication technologies (ICTs) and those who do not. It also refers to countries, regions, cities, and businesses that are at a differentiated socio-economic and cultural level with regard to ICT accessibility.

The involvement of Governments and suitable e-government tools could become leading actors in bridging the gap. Governmental ICT applications could play a crucial part in diminishing the digital divide between the young and elderly, women and men, the illiterate and the educated, or even between less developed regions and countries.

The key elements in developing e-governance as a defining factor in bridging the digital divide are [20]:

- International, national and regional cooperation.
- Harmonization of the legal framework and regulation.
- Ensuring a minimal package of interconnected and interoperable e-services.
- Promoting ICT skills and digital literacy in a non-discriminative manner.
- Educating and preparing the population of less-developed regions for the Information Society and encouraging e-readiness.
- Running pilot e-services in less-developed regions together with the proper technical assistance.
- Developing e-learning and suitable ICT content.
- Developing e-participation and the inclusion of various social categories in policymaking and decision making, even by using new media technologies, such as social networks.
- Usage of mobile communication as infrastructure for the dissemination of e-services.
- Increasing the transparency in decision making and budget spending by implementing e-services.

- Involving the citizens in all aspects of local and national public administration processes.
- Increasing the quality of life in all its aspects through better e-services and access to knowledge.

### ***H. Problems, obstacles and challenges for establishment of an electronic government***

In spite of a simple meaning, electronic government has a lot of problems for governments. The major problem is not in designing method but the first item for governments is presenting of services with suitable method. As a powerful group, Governments should be able to receive digital information along with providing required technical fields for communications of different units with each other and cooperation of private & governmental sections. The other problem is mentality and culture of people. It is so much costly to change mentality and traditional culture of people. The other problems are providing a suitable space, preventing from non-suitable usages and lack of necessary specialty for quick changes in information technology.

The second basic problem of governments is providing suitable legal methods for electronic trade. Since the world is going towards digital world economy, any legal discrepancies are highlighted in international trades. In this way, governments are facing with relevant problems of tax on electronic trade and manner of controlling it, electronic signing of trade contracts and controlling of powerful coding programs.

Third problem of governments which is a potential problem is daily-increasing necessity to democracy and lack of democratic usage of digital systems. By any increase of digital economy, we will have neutralization and/or incorrect usage of technology from democratic point of view. As a result there will be no more variety and this may encourage people to benefit from new worldwide methods. Also it is necessary to consider that a lot of obstacles are on the way of creation of electronic government as follows:

- 1) Lack of necessity to electronic government
- 2) Lack of supports by master management of organizations
- 3) Disability in specifying any limits between confidential information and public information for any access of citizens and economic agencies
- 4) Expensiveness of any establishment, maintenance and development of information networks and data bases
- 5) Lack of information technology specialty in some countries. [21, 22]

### III. CONCEPTUAL MODEL

According to the literature of research and study of different books and papers and also interview and leading of familiar people with electronic government, it was revealed that various factors are effective in establishment of electronic government in Iran. Although there are a lot of different factors, but it is possible to divide them into five groups as follows:

- 1) Relevant problems & obstacles of economic factors
- 2) Relevant problems & obstacles of human factors
- 3) Relevant problems & obstacles of organizational factors
- 4) Relevant problems of technical / technological factors
- 5) Relevant problems of legal, judicial and safety factors

Following Conceptual model of mentioned obstacles have been presented in figure 1:

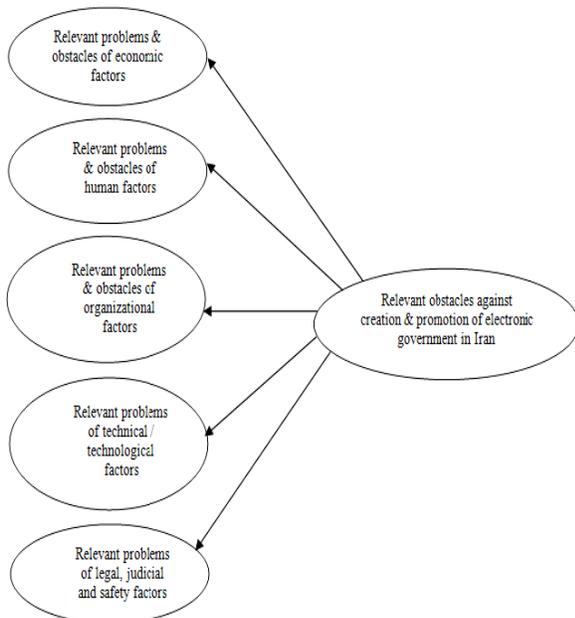


Figure 1. Conceptual model of relevant obstacles against creation & promotion of electronic government in Iran

### IV. INTERPRETIVE STRUCTURAL MODELING

ISM is based on group judgment on the extent and nature of relationship among the elements. The interpretations of the group have been used to draw the overall structure from the complex set of elements. The final structure has been portrayed in a digraph [23]. ISM is an interactive learning process [24]. In this, a set of different directly and indirectly

related elements are structured into a comprehensive systemic model [25, 23]. The model so formed portrays the structure of a complex issue, a system of a field of study, in a carefully designed pattern employing graphics as well as words [26]. ISM methodology helps to understand the order and direction on the complexity of relationships among elements of the case problem [23] structural flexibility in the SCs, thereby affecting their productivity. The direct and indirect relationships among various elements depict the situation more accurately than the case when an individual factor is considered in a stand-alone mode. ISM develops insights into the collective understanding of these relationships. ISM is interpretive as the judgment of the group of experts decides whether and how the variables are related. It is structural, as on the basis of the relationship an overall structure is extracted from a complex set of variables. It is a modeling technique as the overall structure and specific relationships are portrayed in a graphical model. It is primarily intended as a group learning process but can also be used individually.

Steps of this approach are summarized as below [27, 28, 29]:

**Step 1:** Pair comparison of variables (Obstacles) using of variables as Table I:

TABLE I  
DEFINITION OF VARIABLES IN FISM

Triangular number	Verbal variable	Symbol
(0.75,1,1)	Very strong	AR
(0.5,0.75,1)	Strong	SR
(0.25,0.5,0.75)	Relatively	FR
(0.0,0.25,0.5)	Weak	LR
(0,0,0.25)	Very weak	UN

**Step 2:** Gathering of expert's opinions using geometric mean method [29].

**Step 3:** Defuzzification of fuzzy numbers using of centroid method as below:

$$\pi_{ij} = \frac{l_i + m_i + u_i}{3}$$

**Step 4:** Formatting of initial reachability matrix using of relation as below:

$$\text{if } \pi_{ij} \geq t \rightarrow \pi_{ij} = 1$$

$$\text{if } \pi_{ij} < t \rightarrow \pi_{ij} = 0$$

**Step 5:** Formatting of final reachability matrix using of relation as below:

$$M = D + I$$

$$M^* = M^k = M^{k+1} \quad k > 1$$

**Step 6:** Drawing of ISM diagram

**Step 7:** MICMAC analysis

### V. FUZZY ISM

Fuzzy ISM gives a pictorial representation of the interrelationships between the elements in the cluster. Instead of representing the relationships by 0 and 1, clear quantified relationships always give a better value addition. A picture is thousand times worthy than an enumeration. In this regard, a three dimensional view of Fuzzy ISM is plotted using the software MATLAB. The Fuzzy ISM thus is plotted and is shown in Fig. 2. X and Y axes indicate the elements. Their interrelationships in terms of intensity on a Likert scale of 0–10 are shown on the Z axis. The interrelationships are expressed by the term intensity in the figure 2. The elements having no interrelationship have the intensity values of 0 (zero) [30].

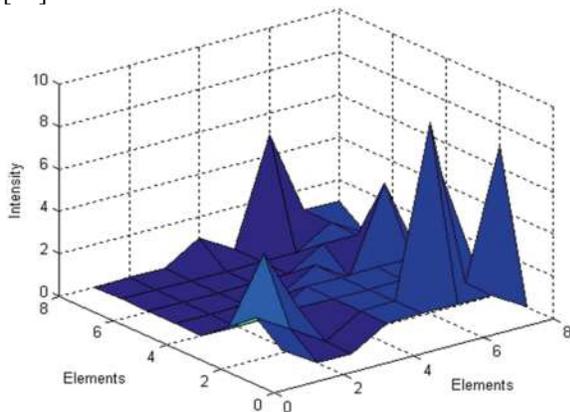


Figure 2. Fuzzy ISM [30]

### VI. FINDINGS OF RESEARCH

Interpretive structural modeling is an interactional learning process which a set of different and related elements are organized in a systematic model in it. ISM not only provides a vision on the relationship among the different elements of a system, but also suggests a structure according to the importance and influence of the elements on each other and it also offers a visual representation [31, 32].

TABLE II  
THE INITIAL REACHABILITY MATRIX

Factors	Row	C1	C2	C3	C4	C5	Driving power
Economic factors	C1	1	0	1	1	1	4
Human Force factors	C2	1	0	1	1	0	3
Organizational factors	C3	0	0	1	1	0	2
Technical/ Technological factors	C4	0	1	1	0	0	2
Legal, Juridical and Security factors	C5	1	0	0	0	1	2
<b>Dependence power</b>		3	1	4	3	2	1*

In this research, in order to level partition and determine the relationship among the obstacles of employing e-government, after reviewing the related literature and the experts' opinions, five main obstacles were identified. According to the obtained matrix and mentioned rules, the initial reachability matrix was calculated and the final reachability matrix was obtained after multiplying the initial reachability matrix by power of four shown in Tables II and III. It should be mentioned that the numbers with asterisk in the final matrix depict relations obtained after fitting the initial matrix and extending relations.

TABLE III  
THE FINAL REACHABILITY MATRIX

Row	C1	C2	C3	C4	C5
C1	1	0	1	1	1
C2	1	0	1	1	1*
C3	1*	0	1	1	0
C4	0	1	1	1*	0
C5	1	0	1*	1*	1

Level Partition of factors is done using final reachability matrix shown in the Table IV:

TABLE IV  
LEVEL PARTITION OF FACTORS

Factor	Intersection set	Antecedent set	Reachability	Level
1	1	1	1	2
2	1-2-3-5	1-2-3-4-5	1-2-3-5	1
3	2-3-5	1-2-3-4-5	2-3-5	1
4	1	4	4	2
5	1-2-3-5	1-2-3-5	1-2-3-5	1

Figure 3 shows the research ISM obtained after determining the grade of all obstacles. According to the figure 3, and also removing extending relation and final diagram, the technical or technologic, human force and legal, juridical and security obstacles are placed in a level and the economic and organizational obstacles are located in the second level.

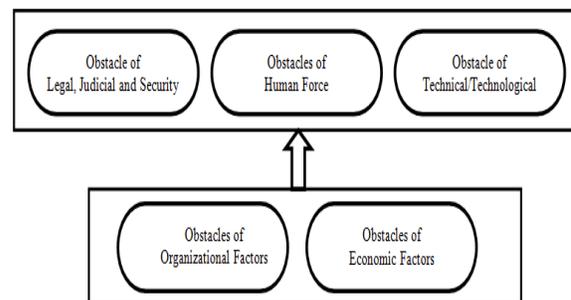
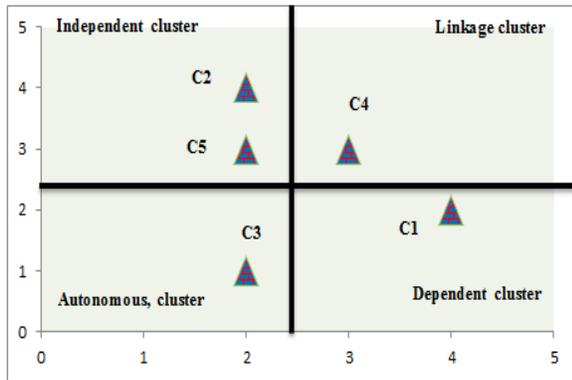


Figure 3. FISM Model

As it is seen in the model, the first level obstacles are influenced and dominated by others. Economic and organizational obstacles have the highest effect and they are located in the second level of the proposed model. These obstacles are clustered by MICMAC.

### **MICMAC Analysis**

After determining the motivating power and dependency of the e-government executive bottlenecks, all obstacles can be placed in one of the four clusters of functional cross-reference matrix multiplication method (Fig. 4).



**Figure 4. MICMAC Clustering**

As it is seen, human force and legal, juridical and security obstacles are in an independent cluster. These obstacles have had the highest influence on other obstacles and being influenced less. Indeed, they cause to bottlenecks in other level which requires the serious attention of the managers. Specially, human force is one of the main obstacles of the e-government. Technical or technologic obstacles are in the relational cluster. Organizational obstacles are in an independent cluster. The measures of independent cluster should be analyzed individually, hence they have less effect on other measures and also they are less influenced. Economic obstacles are in dependent cluster. Indeed, they are being influenced than influence others.

### **VII. CONCLUSION AND RECOMMENDATIONS**

Electronic Government is one of the special concepts which have been performed successfully within recent decades. Electronic government is a digital, wall-free government with a virtual organization for presenting of online governmental services and further cooperation in different political/social activities. Electronic government is resulted from technical changes especially information technology in one side and organizational compliance with information & digital changes on the other hand. In case of accepting the strategic management thought

in governmental scope, the philosophy of electronic government will be easily acceptable for agencies. In this research, after reviewing related literature on the obstacles of employing e-government in Iran and interview with the experts of the Ministry of Information Technology and Communications, five main obstacles were identified which constitute the dimensions of this research proposed model including “economic factors”, “human force factors”, “organizational factors”, “technical or technological factors” and “legal, juridical and security factors”. In the following, using FISIM and also the opinions of the experts, the association and succession of the obstacles were determined and the obstacles were placed in the first level (human force, technical or technological, legal, juridical and security factors) and second level (economic and organizational factors). However, the obtained structural model has helped the Iranian governmental organizations to choose the obstacles or levels in case of implementing e-government system for improving customer service providing.

Also, it is recommended to path analysis (the second order factor analysis) and structural equation modeling by software SPLS in the future research for confirming and fitness of the relations among obstacles in the proposed fuzzy interpretative structural model.

### **REFERENCES**

- [1] Telali Yam and K. Farandez, “Technology, Culture & Competition”, Translator: Nasser Moafaghian, Tehran, Iran Research & Knowledge Institute, PP. 13-201, 2003
- [2] A. Gidens, “Speeches about Globalization”, Translated by Ali Asghar Saeidi, Science & Literature Publication, 2000
- [3] Sholt, “Art: a Glance To Globalization”, translated by Masoud Karbasian, Scientific & Cultural publication Basirat, Meisam, IT, Municipalities Monthly Letter, No. 50, 2003
- [4] Ameli Saeid Reza, “Double Worlds and Future of the Worlds”, Social Sciences Monthly Book, No. 69, pp. 143-174, 2000
- [5] Ameli Saeid Reza, “Double Spaces of City, Virtual City & Basic Needs For Great Cities of Iran”, [Available online at] [www.arabianjbm.com/pdfs/ng\\_vol\\_2\\_5/1.pdf](http://www.arabianjbm.com/pdfs/ng_vol_2_5/1.pdf)
- [6] Fakouhi Nasser, “Civil Humanity”, Nei Publication, 2004
- [7] Tale Elvin, “Third Wave”, translated by Shahindokht Kharazmi, 9<sup>th</sup> Edition, 2004

- [8] Jamali Arman, "Electronic City, a Field of Entrance to Cybernetic Age Competitions and an Inevitable Necessity of Virtual City", 2006
- [9] Soroor Rahim, "Chaining of the Meaning of Place & Space in Globalization", *Shahr Negar*, No. 24
- [10] Papli Yazdi, and Hossein Varjabi Sanajerdi, "Hossein-City & Suburb hypotheses", *Samt* 2003
- [11] Safari Hossein et al., "Mature Model of Electronic Government of Iranian Ministry of Commerce", *Managerial Knowledge*, No. 63, winter 2004
- [12] Moradi Noor, Zeinab, and Asr-e-Ertebat, "Glance of Malaysia Electronic Government, Management of IT, Administrative Technology & Renovation Center", *Weekly Letter*, 30 Dec. 2007
- [13] Ali Akbar Jalali, "Electronic City, Tehran, Iran Science & Industry", University, Publications Center, 2004
- [14] Ardeshir Javadi, "Civil Management in Iran, Tops & Downs", *Municipalities Magazine*, No. 47, 4<sup>th</sup> year, Apr. 2003
- [15] Linch Kewin, "Theory of Good Form of a City", Translated by Seyed Hossein Bahreini, Tehran, Tehran University, 2002
- [16] Mosleh Kia, Alireza, "Considering the Management Structure & Civil Programming in Virtual Cities", Thesis of Master of Science of Urban Planning, Tehran, 2002
- [17] Report, "The Way Forward", National Workshop on Indicators for Urban Environment Management, The Gulmohart India Habitat Centre, New Delhi 20-21 March 2001.
- [18] Hari Srinivas, "Use of Internet for Citizen's Participation in Urban Management: A View from Japan", Report, Tokyo Institute of Technology, Tokyo, Japan
- [19] Hari Srinivas, "Urban Planning and the Internet: An exploration", Report, Tokyo Institute of Technology, Tokyo, Japan.
- [20] <http://unchronicle.un.org/article/role-e-governance-bridging-digital-divide/>
- [20] E- Government: The Next Steps to Benefit the Citizen, [Online available at] [www.gossinteractive.com](http://www.gossinteractive.com)
- [21] Debble Barrett, "Electronic city may be built on shaky ground Technology in Government", Report, Apr 2000
- [22] A. P. Sage, "Interpretive Structural Modeling: Methodology for Large Scale Systems", McGraw- Hill: New York, 1977
- [23] V. R. Pramod, D. K. Banwet, "ISM for the Inhibitors of Service Supply Chain: A Case Study in a Safety Health Environment and Risk Consultancy Service Sector", *International Journal of Logistics Economics and Globalization*, Volume 2, Issue 2, pp. 151-175, 2010
- [24] J. W. Warfield, "Developing Interconnected Matrices in Structural Modeling", *IEEE Transactions on Systems, Man, and Cybernetics*, Volume 4, Issue 1, pp. 81-87, 1974
- [25] J. Thakkar, A. Kanda and S. G. Deshmukh, "Interpretive Structural Modeling (ISM) of IT-Enablers for Indian Manufacturing SMEs", *Information Management Computer Security*, Volume 16, Issue 2, pp. 113-136, 2008
- [26] H. Liu, J. You, C. Lu, and Y. Chen, "Evaluating health-care waste treatment technologies using a hybrid multi-criteria decision making model", *Renewable and Sustainable Energy*, Volume 41, pp. 932-942, 2015
- [27] R. K. Ragade, "Fuzzy Interpretive Structural Modeling", *Journal of Cybernetics*, Volume 6(3-4), 189-211, 1976
- [28] M. L. Tseng, "Modeling Sustainable Production Indicators with Linguistic Preferences", *Journal of Cleaner Production*, Volume 40, pp. 46-56, 2013
- [29] P. R. S. Sharma and V. R. Pramod, "Structural Flexibility in Supply Chains: TISM and FISM Approach", *Flexible Systems Management*, DOI10.1007/978-81-322-2151-7\_19, Springer India, 2015
- [30] S. Kumar Sharma and A. Bhat, "Modeling Supply Chain Agility Enablers using ISM," *Journal Modeling in Management*, Volume 9, Issue 2, pp. 200-214, 2014
- [31] S. J. Gorane and R. Kant, "Modeling the SCM Enablers: an Integrated ISM-fuzzy MICMAC Approach," *Asia Pacific Journal of Marketing and Logistics*, Volume 25, Issue 2, pp. 263-286, 2013