International Journal of Economic Perspectives, 2017, Volume 11, Issue 3, 681-688.

Evaluating Infrastructure for Establishing Electronic City based on the Commercial Intelligence: Evidence from Tehran

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ABSTRACT

Fundamental role of information and communication technology in facilitating the process of transition of industrial society to information society and growth of information and communication technology gives the opportunity to the Governments provide better services to citizens by fundamental changes in their body. So, it is more than a decade that the projects of creating electronic cities is being done in different countries. In Iran also the government has taken steps to create such a city. This study identifying the infrastructures required for establishing business intelligence-based electronic city and develop a conceptual model in which infrastructures required for establishing business intelligence-based electronic city according to their nature will be classified.

JEL Classification: L64; L84; L88.

Keywords: Electronic City; Business Intelligence; Data Governance; Technology Maturity.

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1. INTRODUCTION

Expansion of urbanization and social needs, followed by a rise in demands of citizens and increasing trend of these needs have caused officials and governors to make these routine and social needs as simple as possible and by using the available facilities to citizens to minimize existing problems both for citizens and for the systems providing these services. Therefore, considering the age in which we live, i.e. the communication age, the information and communication technology (ICT) is the best solution for providing these services in a broad and inclusive level. In this context, we can point out to the emergence of E-city (Alonso et al., 2006).

Given the shortcomings of Management Information Systems (MIS) in meeting the expectations of organizational decision makers in competition in recent years, state of the art technologies such as business intelligence (BI) have become one of the most important concepts in MIS. To the extent that, they are integrated with the culture of leading organizations as well as they are placed at forefront of IT to support management in decision-making (Ebbers, 2007). BI system by using applied data via analytic tools provides multi-dimensional and in-depth information for planners and decision makers in organizations (Fitriana et al., 2011). In fact, BI is being used to understand the existing capabilities, modern trends, guidance on future market performance, optimum use of new technologies and better understanding of the environment surrounding the organization and better performance than competitors (Fred, 2011). Given the importance of E-city and the key role of technology, especially the leading technology of BI, this study identifies the necessary infrastructures for the establishment of E-city based BI in Tehran.

2. LITERATURE REVIEW

A quick look to the literture is presented below:

• E-city: it is a city in which administration of citizen's affairs including services, state services and private sector organizations are managed online, 24 hours a day and seven days a week with high quality and safety and by using the tools of ICT and its applications. In other words, it can be said that in E-city all services needed by residents is provided through information networks ((Fred, 2011).

• Business Intelligence: BI is a set of tools, abilities, technologies and strategies, which help managers for better understanding of business conditions. BI tools provide views from past, present and future for individuals (King, 2007). BI is the process of extraction, conversion, management and analysis of massive amounts of data using mathematical models to take complex decisions. The main components of BI are data warehouse, data mining and decision support system (Fuld, 1995).

• IT maturity: it is a long time from the first arrival of IT into organizations. Using IT maturity assessment models, we can assess the current state of IT in organizations. This helps in two main aspects to them. First, they understand that with regard to investments done in the IT sector, at what stage we are and second with regard to obtained strengths and weaknesses points, what path they should follow in future (Larson, 2012). There are several models for assessing the maturity of IT. One of these models is the COBIT maturity model. According to this model, the maturity level of IT changes from imaginary maturity level (0) to optimal maturity level (5). This five-level model is suitable for the use in ANP decision-making.

• Integrated urban management: integrated urban management means adopting a comprehensive approach and the design of a mechanism for following the approach in the management of the city. In order to achieve unity, the identification of factors affecting integration and segregation in urban management is essential. To achieve an integrated urban management, it is necessary to institutionalize the concept in city with a general admission so that various operating systems in urban spaces and environments to recognize that for coordinating the activities, it is necessary to follow a unique and integrated system for urban management. This unity, in spite of diversity of various activities that different organizations do, have common goals in a big city, which include integrated and sustainable urban development and the management of urban spaces so that providing suitable environments for the life of people (Muhammad and Jaffri, 2010).

• Data Center: Data Center is a central warehouse of data, either physical or virtual, for the storage, management, distribution and classification of data and information about different types of knowledge and those related to a specific trade. In fact, data center is part of organization or company that includes computer systems and associated equipment. Data entry and organization's programming might be done in this area. Data center as a control center monitor all things.

In today's world that everything moves towards mechanization, face to face relationships no longer can resolve our problems. In today's cities, we are faced with increased population and as a result with increased urban traffic. The last bureaucratic procedures and former paperwork cannot be a good way to handle the citizens' administrative affairs. The major organizations including municipalities in big cities, which are somehow in the heart of the city, should remove their former procedure and should enter the world of electronics and virtual world, a world in which works are done much faster and safer and there is no need for the population density as occurs in the physical world. We must device solutions for to reduce urban traffic, the costs of doing work, attitudes and psychological distress, corruption and dozens of problems every day we are faced with in offices. The best solution is creation of virtual organization, which reduces the mentioned problems and even improves the process of doing works.

On the other hand, in urban area, E-cities and municipalities are emerging one after another so that in the near future the urban services will completely transform. Since the traditional life style of humanity is not compatible with the emerging Information Society, providing a suitable model of life for the Information Society given the social and cultural characteristics of the community is one of the most important concerns in e-cities (Negash, 2012). The first step to achieve the E-city is to distinguish between the correct and principal implementation of an E-city and the use of a set and attributing it to E-city. To implement a true E-city, different areas of a city should become electronic. In addition, there must be a structural and rational between all the components of these systems and situation culturally and technologically must be prepared for the creation of E-city (Olszak and Ziemba, 2007). Today, with the birth of new technologies in hardware and software levels, especially intelligent technologies such as online analytical processing systems and BI systems, few managers forget to use these technologies. So that at present age orientation towards the establishment of BI in each firm and each supply chain is being considered as the main strategy of managers (Peyrot et al., 2002). BI includes a broad class of applications and technologies for collection, access to and analysis of large volumes of data for taking effective business decisions by organization.

A BI technology in general includes the rules of modeling, classification of data, data warehouse and online analysis process. Background and fundamental objective of BI is in depth exploitation of huge of volume of data to create competitive advantage for organization. BI is cleverly and purposeful conversion of various data of numerous sources to new commercial and result-oriented information. BI often includes a combination of tools, databases and human resources for proper use of existing infrastructures to take the best decision in market. So far, literature lacks any independent study on the requirements and infrastructures of BI-based E-city. However, since the modern IT is placed at the center of all the studies in the field of E-city as well as and since BI is leading in information and communication systems, thus, we have examined the necessary infrastructures for BI-based E-city.

The necessary infrastructure for the establishment of the E-city or state by focusing on the area of smart business has two dimensions: technical and non-technical. In fact, the needed infrastructure for e-government or city or for the smart business is integrity in the processes and management (non-technical dimension). Technical dimension imply means that systems for data collection to be focused and data to be overall available and to create integrity of data in system. The main variables of the research are: Data Centers, Integrated Management of urban management, The centralized system for data collection, IT maturity in terms of software (personal knowledge) and IT maturity in terms of hardware (personal knowledge).

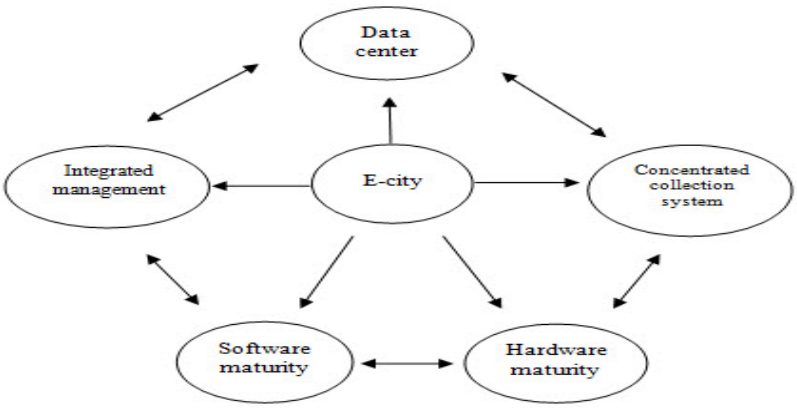

Figure 1.
Conceptual Model

Based on the literature and research framework hat mentioned above, the most necessary infrastructure items to establish a BI-based E-city in Tehran are:

A. Data center are important infrastructures to establish E-city in Tehran.

B. Integrated urban management is an important infrastructure to establish E-city in Tehran.

C. Centralized applied data collection systems are important infrastructures to establish E-city in Tehran.

D. The maturity of IT in software aspects (individual knowledge) is important infrastructure to establish E-city in Tehran.

E. The maturity of IT in hardware aspects is important infrastructure to establish E-city in Tehran.

3. METHODOLOGY

The main goal of this research is to identify infrastructure items necessary for the establishment of BI-based E-city, thus, it can be said that the present study is terms of objective is an applied-developing method. In order to collect data, the library and field methods were used. In this study, to collect data, we used interviews with experts and questionnaires. In other words, in the first stage, to identify and refine infrastructures of BI-based E-city, specialized and semi-structured interviews as well as Brainstorming and Nominal Group techniques were used. A combination of ten experts with various specialties were selected for interview and in the second stage to identify

the relationships between variables, DEMATEL techniques was used. In fact, using the technique of DEMATEL and the developed questionnaire, in addition to clear reflection of relationships between variables and the direction and intensity of their effects on each other, the structure of complex factors in terms of cause and effect groups are reviewed and better understanding of relationships for decision-makers is provided. Accordingly, greater understanding of the status of factors and their role in mutual process of decision-making obtains.

Table 1. Factors and Indicators of Research's Questionnaire

Symbol	Main factor	Indicators
C1	maturity of technology in terms of hardware	The possibility of linkage of programs in the organization's internal network, appropriate hardware to run software existing in organization, possibility of providing proper hardware for data aggregation software, possibility of providing proper hardware for aggregated databases
C2	maturity of technology in terms of software	Storing available information of organization in databases, storing available information of organization in spreadsheet files, software infrastructures to connect different applications, automated operational systems for collecting data
C3	Integration in firm-level	The possibility of integration of processes, standards such as ISO for organization and documentation of processes, the same definitions of common concepts in organization, definition of organizational access levels to integrated information
C4	Data governance	Organization to determine levels of access to data, organization to determine the responsibility of each department, coordinating the management of various organizations to provide the necessary information, specifying the data required for urban management
C5	Data centers	Presence of data centers for the assembly and maintenance of the organization's processed data, data centers for integrated servicing to system's stakeholders or customers, data centers for creating services needed in e-government and data centers for supporting software and hardware infrastructures of E-city
C6	integrated urban management	Presence of integrated urban management to make similar the processes between organizations, presence of integrated urban management to standardize processes, presence of integrated urban management to resolve conflicts between organizations, presence of integrated urban management to determine the needs of the BI system

To identify and refine infrastructures of BI-based E-city, specialized and semi-structured interviews were used. Interviews were done by a combination of ten experts of different specialties. Criteria for the selection of experts included having at least a master degree or higher in the field of IT and preferably IT management, having experience of establishing BI or working with BI-based systems, and having the experience of management or activity in municipality. Accordingly, the selection circle became very limited and we selected some experts from municipality and Magfa Company who had several years the experience of establishing BI-based systems as well as the experience of working in Tehran municipality.

4. RESULTS AND DISCUSSION

The main objective of the present study was to identify the necessary infrastructures for the establishment of BI-based E-city in Tehran. As clearly stated in the research literature, no academic and scientific research in this context is available and the principles obtained during the study in this sense are the greatest achievements of the present study. To identify these requirements, detailed interviews were conducted and the results of interviews were categorized in the following form:

The necessary infrastructures for the establishment of the E-city or state by focusing on BI have two dimensions: technical and non-technical. Technical dimension imply on systems for data collection in a focused manner and that data to be available overall as well as to create data integrity in system. In non-technical dimension, there must be integrity in processes and management. The pattern of causal relationships among the key factors affecting the establishment of BI-based E-city using DEMATEL technique is examined. The results show the amount of effective of variables on each other. DEMATEL technique is the first step in calculating the Direct-Relation Matrix (M) and when it is used from the view of several experts, the simple arithmetic mean of comments can be used and the Direct-Relation Matrix (M) will be formed.

Table 2. The Main Criteria for Direct-Relation Matrix (M)

	maturity of technology in terms of hardware	maturity of technology in terms of software	Integration in firm-level	Data governance	Data centers	integrated urban management
maturity of technology in terms of hardware	0	3.2	2.2	1.2	3.2	2.2
maturity of technology in terms of software	2.2	0	3.8	3.6	3.8	3.8
Integration in firm-level	0.6	0.2	0	3.8	0.4	3.8
Data governance	0.2	0.2	2.0	0	0.4	3.0
Data centers	0.4	0.2	4.0	4.0	0	3.8
integrated urban management	0.2	0.2	0.2	0.8	1.0	0

The next stage is calculating normal Direct-Relation Matrix (N=K×M). Accordingly, first, the sum of all rows and columns is calculated and then the reverse of the greatest number in row and column k determines. According to Table 2, the greater number is 17.2 and to make the matrix normal, all values in the table multiply by the inverse of this number.

Table 3. The Normalized Matrix (N) of the Main Criteria

	maturity of technology in terms of hardware	maturity of technology in terms of software	Integration in firm-level	Data governance	Data centers	integrated urban management
maturity of technology in terms of hardware	0	0.1860	0.1279	0.0698	0.1860	0.1279
maturity of technology in terms of software	0.1279	0	0.2209	0.2093	0.2209	0.2209
Integration in firm-level	0.0349	0.0116	0	0.2209	0.0233	0.2209
Data governance	0.0116	0.0116	0.1163	0	0.0233	0.1744
Data centers	0.0233	0.0116	0.2326	0.2326	0	0.2209
integrated urban management	0.0116	0.0116	0.0116	0.0465	0.0581	0

The full correlation matrix is then calculated. To calculate full correlation matrix, first, the identity matrix (I) is formed. Then the identity matrix is subtracted from the normal matrix and the resulting matrix is reversed. Finally, the normal matrix is multiplied by in inverse matrix:

Table 4. Full Connection Matrix (T) of the Main Criteria

	maturity of technology in terms of hardware	maturity of technology in terms of software	Integration in firm-level	Data governance	Data centers	integrated urban management
maturity of technology in terms of hardware	0.0498	0.2088	0.2782	0.2583	0.2741	0.3475
maturity of technology in terms of software	0.1648	0.0489	0.3775	0.4083	0.3083	0.4755
Integration in firm-level	0.0491	0.0290	0.0632	0.2738	0.0646	0.3096
Data governance	0.0242	0.0219	0.1460	0.0614	0.0512	0.2366
Data centers	0.0475	0.0328	0.3019	0.3390	0.0526	0.3717
integrated urban management	0.0186	0.0179	0.0443	0.0800	0.0711	0.0458

Then we show the Network Relation Map (NRM). In order to determine NRM, the threshold value should be calculated. This way, we can skip partial relationships and draw the network of reliable relationships. The only relationships that their values in matrix T are greater than the threshold value will be displayed in NRM. To calculate the threshold value of relationships, it is enough to calculate the mean values of matrix T. After the intensity threshold was determined, all values in matrix T that are lower than the threshold value turn to zero, i.e. it removes from the causal relationships. In this study, the threshold value is obtained 0.165. Thus, the pattern of significant relationships is as follows:

Table 5. The Pattern of Significant Relationships of the Main Criteria

	maturity of technology in terms of hardware	maturity of technology in terms of software	Integration in firm-level	Data governance	Data centers	integrated urban management
maturity of technology in terms of hardware	×	0.2088	0.2782	0.2583	0.2741	0.3475
maturity of technology in terms of software	×	×	0.3775	0.4083	0.3083	0.4755
Integration in firm-level	×	×	×	0.2738	×	0.3096
Data governance	×	×	×	×	×	0.2366
Data centers	×	×	0.3019	0.3390	×	0.3717
integrated urban management	×	×	×	×	×	×

Based on the pattern of relationships, we can draw the causal diagram the based on Table 6.

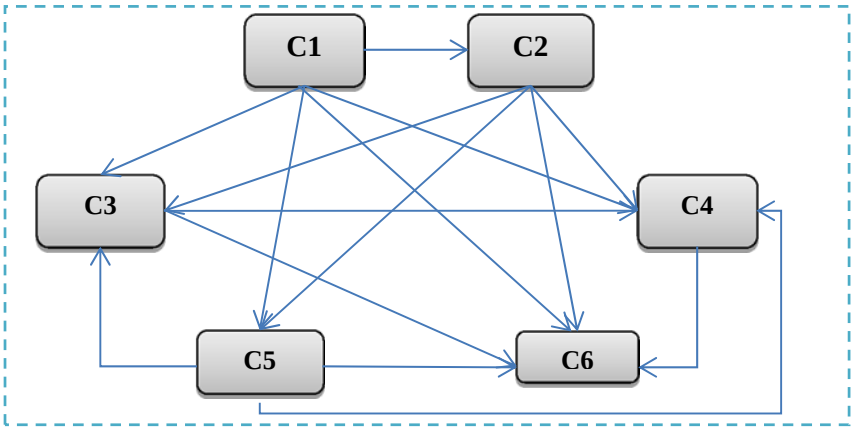

Figure 2.
Pattern of Internal Relationships

Based on Table 6:

 The sum of each row (D) indicates the effectiveness of that factor on other factors of systems. Accordingly, IT maturity from the software aspect has the greatest impact. IT maturity in terms of hardware stands in second place. Data centers are in the next degrees of influencing. Integrated urban management has the least effect.

Table 6. The Pattern of Causal Relationships

	D	R	D+R	D-R
maturity of technology in terms of hardware	1.417	0.354	1.771	1.063
maturity of technology in terms of software	1.783	0.359	2.143	1.424
Integration in firm-level	0.789	1.211	2.000	-0.422
Data governance	0.541	1.421	1.962	-0.880
Data centers	1.145	0.822	1.967	0.323
integrated urban management	0.278	1.787	2.064	-1.509

 The sum of entries in column (R) for each factor shows the extent to which that factor affects by other factors of system. In this sense, integrated urban management has great impact. Integration at the enterprise level and data governance is also of enormous effect. IT maturity in terms of hardware and software has least affected by other criteria.

 Horizontal vector (D+R) shows effectiveness and impact of intended factor on system. In other words, whatever the value of D+R factor increases, it would have higher interaction with other factors of system. Accordingly, It maturity from software aspects has the most interaction with the studied criteria. IT maturity in terms of hardware has the lowest interaction with other variables.

 Vertical vector (D-R) indicates the effectiveness power of each factor. Generally, if D-R is positive, the variable is a cause variable and if it is negative the variable is an effect variable. In this model, data centers and IT Maturity in terms of hardware and software are cause variables, whereas integrated urban management at the enterprise level and data governance are effect variables.

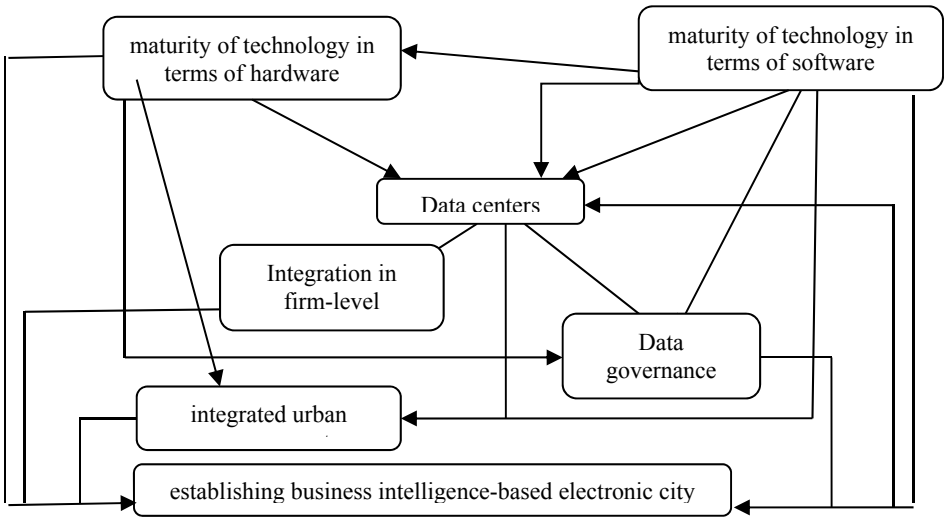

Figure 3.
The Ultimate Model of the Research

According to this model, it is clear that software maturity, hardware maturity, data centers, data integration, data governance and integrated management are the main pillars and the basic infrastructures for the establishment BI-based E-city. The pattern of causal relationships among these variables is shown in Figure 4. Whatever, the element is placed at higher a level, the higher is its causal property.

5. CONCLUSION

This study identifying the infrastructures required for establishing business intelligence-based electronic city and develop a conceptual model in which infrastructures required for establishing business intelligence-based electronic city according to their nature will be classified. Since the E-city is part of the project of e-government so that in the view of some experts it is the starting point for e-government, it is one of the main and very important pillars of e-government. Since the world is moving towards being an electronic world, to continue our interaction and our social, economic and political life, we are inevitably forced to join this process, which is almost impossible without having E-city.

In other words, many cities have become electronic and their interactions are done through networks. Among these cities, cities like Tehran because of their congestion and population density, the difference between the night and day populations, widespread light, sound, air and space pollutions and traffic are seeking to find solutions to reduce the problems of citizens. The main problem in these cities is the population movement. Population movement means the movement of people by vehicles or the population congestion. With the emergence of simultaneous communications industry and computer, followed by network connections in the form of the Internet, a new space in cities created that is called virtual city. In fact, creation of real space and cyberspace is type of the control and management of urban population movement that attempts by rationalizing the movement of population to make a calmer, less expensive city that benefits of urban security and mental security for citizens. In the virtual city, information services provide without any time and space limitation. For the fundamental and accurate implementation of E-city in Iran, consideration of infrastructures and causal relationships between them is of great importance. Therefore, conducting research of this kind can be a milestone in the proper recognition of the necessary infrastructures for the development of E-cities in Iran and developing a conceptual model of E-city based on the necessary infrastructures for E-city.

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