

Establishing Technology for Smart City Development in Jordan's Amman-King Hussain Business Park

Qotadeh Saber, Huda Ibrahim, Mawarny Md. Rejab

Abstract: *Global ever-increasing population and fast urbanization have created many problems. Many studies have identified smart city development as a vibrant solution to the problem. Review of the existing studies signified that smart cities' development have many models and dimensions. However, this study explored and identified technology-based smart city development model, given the fact that technology is regarded as an enabler that can connect physical distances in a many way, which consequently creates opportunities for quickened social and economic practices for people. This study used grounded theory because there no stander for smart city development framework. This study applies semi-structured interviews with 30 government officials, policy makers and regulators in several trips to the field to saturate categories. The result revealed the category "establishing technology" describing how Jordan's Amman, King Hussein Business Park(KHBP) is a blend of technology-based dimensions: technology infrastructure, smart facilities, international IT companies, and applications. Based on this result, technology could be considered a crucial process to achieve smart city development, and the discovery of new technology promotes technology infrastructure, smart facilities, and applications which could be facilitated by international IT companies. Overall, this study generates a model that could be tagged "a technology-based smart city development dimensions" which could be examined and adopted by future study.*

Keyword: *Smart City Development, technology, smart facilities, grounded theory, Jordan*

I. INTRODUCTION

The objectives regarding socio-economic development and quality of life are made difficult to achieve by the global ever-increasing population and fast urbanization. Which posed by the global ever-increasing population and fast urbanization are growing. These challenges include increasing demands on city services and infrastructure, heavy industrialization, unplanned urban sprawl and negative externalities in the form of deteriorating quality of life, waste disposal issues, strained government budgets, over-burdened healthcare delivery systems, pollution, crime, and traffic congestion (Chourabi et al., 2012).

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These challenges among others could be surmounted through smart cities. Smart city provides investments in human being and social capital and traditional transport and modern technology infrastructure that support sustainable growth of economy and a high quality of life, with creative management of natural resources, through the government participant which is partly lacked in the context of Jordan (Kramers, Anna, et al., 2014; Abuhmaid, 2011).

In the same vein, smart city development in Jordan is essential, especially that Jordan in the past years has done successive experience toward forced migration that have widely increased its population. Recently, Jordan accommodates more than 1.5 million Palestinian refugees, and more than 1.4 million Syrian refugees (Alnsour, 2016). This large number of added population with lack natural resources (such as water and energy) has resulted in numerous added problems, such as unofficial settlements, water deficiency, shortage of services, congestion, shortage of housing, pollution and environmental degradation, among others (Meaton&Alnsour, 2011). Such huge challenges associated with poor social and economic conditions have heavily impacted on smart city development which led to the direction, intensity and scope of smart city growth and its factors (Fassam, Copsey, & Gough, 2015). These challenges enhance the need to explore the phenomenon of smart city development in Jordan (Alawadhi et al., 2012).

II. SMART CITY DEVELOPMENT

Smart city represents a city that is capable of monitoring and integrating operations of every critical infrastructure, such as roads, tunnels, airways, waterways, railways and communication power supply, etc., maintenance tasks that control which can aid in the optimization of the resources, while monitoring security-related issues in parallel (Sujata et al., 2016). Smart Cities ensure sustainable environment with the help of Big Data and Internet of Things. The word "smart", in the "smart cities" show that cities should be more sustainable, livable and efficient. The smart city budget reaches about \$16 billion by the year 2020 as an annual spending (Pike Research, 2011). Explicitly, Hollands (2008) recognized smart city as an "urban labelling" phenomenon, particularly in terms of what the label ideologically reveals as well as hides, the label smart city is a fuzzy concept and is used in ways that are not always consistent, and this shows there is no standard for smart city development.



Although many studies have conceptualized and measured smart city development differently, this study will focus on technology-based smart city development dimensions. The existing literature has indicated the heterogeneity of the smart cities' development, in which many models and dimensions have been developed in the smart city research field. For example, Kourtit et al. (2014) in their research came up with smart city model or dimensions that involves global city performance measurement Indexes: economy, research and development, cultural interaction, liveability, environment, accessibility. In the research conducted by Desouza and Flanery (2013), smart city model composes resilience city evaluation and implementation framework and city factors which involve resources and processes (physical) citizen, institutions, activities (social). Da Cruz and Marques's (2014) smart city model focused on sustainable scorecard of local government involving social, economic, environment and government criteria.

This study aims to focus on smart city development dimensions from the ICT, given the fact that despite that technology is regarded as an enabler that can connect physical aspects in many ways, which consequently creates opportunities for accelerated social and economic activities for people, the role of technology growth smart city development is not adequately researched. There is a need to investigate technology role in the development of smart city (Appelman, Jaco H., Anwar Osseyran, & Martijn Warnier, 2013). Bifulco, Tregua, Amitrano, and D'Auria, (2016) emphasized the need to show the impact of technology growth on smart-city development. Nonetheless, the issues remain the identification of the constituents of smart-city development, and how its related definition and examination or assessment, and the kind of the relationship existing between the technological growth and the development of smart-city remain an unresolved research issue (Wolfram, 2012; Al Bakri, 2013).

Additionally, a further research towards comprehension of technology as the basis for smart-city development has been recommended by the MIS Quarterly June 2015 issue focusing on research based on Information system within some developing countries comprising of 4/5th of the world's populations. Even though the unique promise of vital economic and social transformations resulting from technology is easy to be made. Also, few academic research demonstrates smart-city development within the concept of technology growth.

Moreover, there is a need to focus in the governance in the role in the field of economic development and growth to build policies in order share the internet widely. Several researches emphasized the relations between the internet, economic and the social development in the community and the industries. Thus, presenting the need to focus more in the infrastructure, the technology and the internet which can only be reliably achieved with the aid of an accelerated projects comprising of smart cities project in Jordan (IT annual report, 2016), consequently, there is a need for an accelerated smart city project by the Jordan government.

Furthermore, the existing population-related and environmental challenges in Jordan alongside the poor social and economic conditions have greatly influenced the development of smart city, leading to the direction,

intensified growth and the scope of the smart-city as well as the associated factors (Fassam, Copsey, & Gough, 2015). Therefore, prompting the necessity for the investigation of technology growth towards smart city development, especially in Jordan (Alawadhi et al., 2012). In addition, Cocchia (2014) opined that there is a need to develop a unifying theme that integrates the concept of technology growth towards smart-city development (Cocchia, 2014). To the best of researcher's knowledge there is no solid theoretical foundation that examine technology-based smart city development dimensions.

For large corporations, such as IBM, Cisco Systems, as well as Siemens AG, the features of the technology represents a pertinent element of smart-city (Albino et al., 2015). Essentially, importance attached to some cities as a result of the growing economic, social and environmental has led to the global increase in urban development projects. Consequently, Smart city can denote "a city which systematically uses technology to convert its surplus into resources, encourages the integration of multifunctional solutions, and enhances its level of mobility and connectivity. This task are ensured with the aid of participatory governance based on collaboration and knowledge based on open source." Specifically, the distinguished differences between Smart City and 'Sustainable Cities' or 'ECO cities' is as a result of its emphatic approach in ensuring the connectivity and systems beyond vast smart device within modern cities to public sectors, businesses, the institutions of learning, and the inhabitants in the city. By this concept, the Smart City denotes an ideal future idea associated with collaborative approach, openness, as well as sharing (Komninos, 2013).

Technology is a significant part of smart-city development. There is an extensive approach that technology can be crucial for economic development, poverty alleviation, GDP (gross domestic product) development, organizational restructuring, volume development, employment, productivity, and autonomous citizens' participation (Wakabi & Grönlund, 2015). Technology is also anticipated to have an imperative influence on upgraded transparency and responsiveness of governmental agencies, broadly accessible education and healthcare prospects, cultural creativity, and social integration of individuals with different abilities and groups with diverse cultural backgrounds. However, few researchers demonstrate that these objectives can be achieved by technology growth (Morandi & Rolando, 2016).

Similarly, a novel platform aimed at motivating individuals and organizations has been made by the ICT, this enables an unparalleled chances of smart city development through the technologies. Bossaerts, Frydman, & Ledyard (2014) depending on the theory guiding the information and markets, growing the access to technology can attain substantial results from economic development efforts. Where "digital provide" are used for their argument which supports the concept of technology, which is the main determinant of growth within smart cities.

These benefits and the associated controversies dwelling within the concept are crucial facets focused this research, which in turn, fills the gap between anecdotal examples and theory development.

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Based on the above discussion, it could be concluded upon that the issue remains on the constituents of smart-city development, the manner of its definition and its measurement, and that there is shortage of research on ICT-based smart city development dimensions, despite the indispensability of technology in smart city development. From the practical aspect, the above discussion signifies that the existing population-related and environmental challenges in Jordan together with poor social and economic conditions necessitates technology-based smart city development dimensions.

Thus, this research aims to develop an integrated model of technology-based smart city development dimensions in king Hussein Business Park, Jordan. Specifically, the current study aims to investigate the dimensions of smart-city development. The structure of the present study involves: Introduction, methodology, findings and conclusion.

III. METHODOLOGY

The inductive approach concerned on generating a theory that is emerging from the available data. Consequently, this depend on this inductive approach in the collection the data procedure (Corbin & Strauss, 1990). Thus, these data are reading the smart-city dimensions, which are correlated with the technology growth were obtained. Whereby, the Grounded Theory functioning as the process of the theory development based on inductive analysis of data, where the quality of a theory can be assessed with the aid of the approach by which a theory is constructed (Corbin & Strauss, 1990).

According to Hollands (2008), which refers smart city as an "urban labelling" phenomenon, essentially in terms of what are hidden as well as what are revealed by the label ideology, the notion of smart city is a fuzzy-based concept which is utilized in ways that are not always consistent, and this demonstrates the fact that the smart city development is not based on any standardized model. Therefore, ground

theory can be employed to determine the processes of theory development to get the smart city development model.

Grounded theory is regarded appropriate in this present study, since it is a general approach with systematic guidelines for data collection and analysis towards the generation of middle-range theory. The name "grounded theory" mirrors its vital premise that there is a need for the researchers to develop theory from accurate analyses of empirical data (Charmaz& Belgrave, 2015). Similarly, Grounded theory approaches produce systematic procedures for shaping and managing rich qualitative resources, and it allows an efficient and efficient conduct of qualitative research by structuring and organizing data-gathering and analysis (Charmaz, 1990).

Alawadhi et al., 2012 used the interview protocol, all interviews were recorded and transcribed, while the interview data was analysed using an inductive logic approach as well as the grounded theory techniques to explore the model of smart city framework, essentially, this equally demonstrates the feasibility of adopting grounded theory for the development of a smart city project.

Data Collection

Based on Grounded theory, interview is the method used for data collection in this study, because interview remains the most common method of data gathering in qualitative research field (King, 2004). The researchers conducted semi-structured interviews with 30 government officials, policy makers and regulators in various visits to the field to saturate categories and table 1 show the 30 participants from king Hussein business park. Categories denote the ideas considered saturated when no additional information can be acquired by conducting over than 70 interviews Creswell (1998). Categories are considered units of information which may be encompassed in events, occurrences, as well as instances. The interviewees for this section of the research is corroborates with the recommendation made by Creswell (1998).

Data Analysis

In Grounded theory, data collection and analysis are essential as this will enable emergence of new theory (Corbin & Strauss, 1990). Key point coding was used to analyze the interview transcripts comprehensively. The researchers organized the main ideas by examining phrases, words, sentences from the transcripts of the interview (G. Allan, 2003). Then, the researchers constructed codes by rephrasing key points with meaningful labels.

After coding, data were organized and managed as the interviews were transcribed to increase familiarity with the data this was done. Reading and memo-ing the data were done. Also did the data description. In addition, classified and defined the categories and patterns within the data. Then, attributed meaning to the identified patterns.

The final step was the visual-based model design explaining the case. This approach encourages interests for any cases of outlier or analytical patterns that are unsuitable

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towards the categories in the research. This aids in ensuring trustworthiness of the research.

Table. 1 Research Participants from King Hussein Business Park (KHBP)

Person	Position	Company name or job	Business Domain
P1	Chairman	KHBP	Management Of KHBP
P2	Chief executive officer	KHBP	Management Of KHBP
P3	IT manager	KHBP	IT Manager Of KHBP
P4	Marketing manager	KHBP	Marketing Of KHBP
P5	Engineer	KHBP	Management Of KHBP
P6	Engineer	KHBP	Management Of KHBP
P7	Engineer	KHBP	Management Of KHBP
P8	Engineer	KHBP	Management Of KHBP
P9	Engineer	KHBP	Management Of KHBP
P10	Engineer	Arab weather	Weather
P11	Chief executive officer	Madfowatkom	Payment solution
P12	Engineer	Iman1 for Super computer	Support innovation
P13	Engineer	Nama	Intelligent solution
P14	Chief executive officer	Booking app	Applications
P15	Chief executive officer	Trust	Payment solution
P16	Engineer	Prince Hussein Technical University	Education
P17	Doctor	Prince Hussein Technical University	Education
P18	Doctor	Prince Hussein Technical University	Education
P19	Doctor	Prince Hussein Technical University	Education
P20	Engineer	Prince Hussein Technical University	Education
P21	Engineer	Prince Hussein Technical University	Education
P22	Owner	Tomatm	Entrepreneurship
P23	Administrative coordinator	Grow	Entrepreneurship
P24	Degree	Prince Hussein Technical University	Education
P25	Degree	Prince Hussein Technical University	Education
P26	CER	Zain Telecom company	Provider and entrepreneurship
P27	CEO office	Orange Telecom company	Entrepreneurship and education project manager
P28	Chief executive officer	NAMA	Intelligent solution
P29	Engineer	Prince Hussein Technical University	Education
P30	Engineer	Prince Hussein Technical University	Education

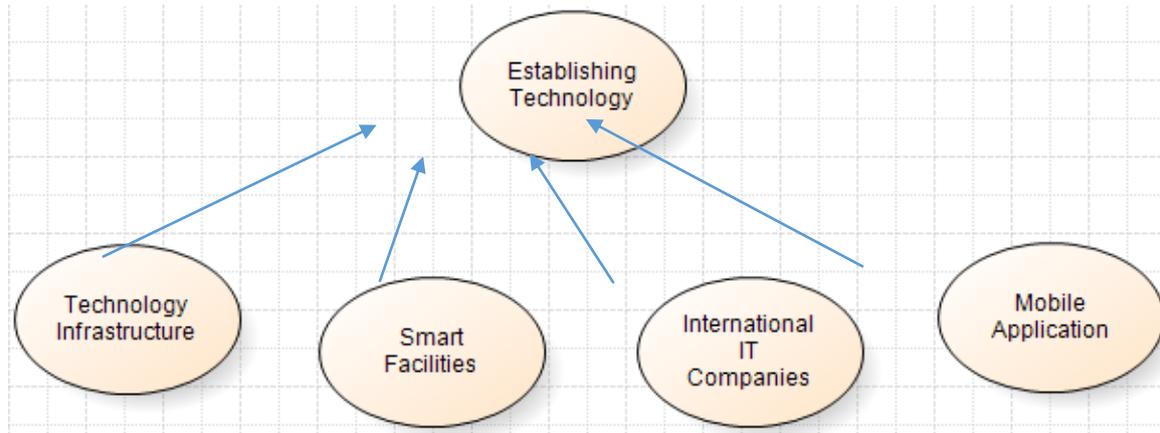


Fig. 1 category “establishing technology” designed from underlying concepts

To design the category “establishing technology”, the researchers grouped the identical codes as well as identical themes together to form an idea. From this process, many concepts arise, and constant comparison is repeated until concepts form the category “establishing technology” as depicted in Figure 1.

IV. FINDINGS

From the data analysis, four dimensions of smart city development emerged from the category “establishing technology” describing how Smart City development show the dimensions in Jordan, Amman, King Hussein Business Park. The four dimensions are technology infrastructure, smart facilities, international IT companies, and applications (Figure 1).

Technology Infrastructure

The participants highlighted the importance of technological infrastructure. They described technological infrastructure as a unique part of the King Hussein Business Park (KHBP) that can show the infrastructure in the city are good to have smart city, and this dimension come after many semi-structure interviews with multi-level (Corbin & Strauss, 1990). From the perspectives of the participants, technology infrastructure plays important roles in making KHBP a ready and energy efficient place allowing fast and accessibility to services and information digitization.

“The technology is important for smart city that it is based on building a smart city and in KHBP they focus on IT company to make everything related to technology [sic.]” - P1, CEO.

The technology infrastructure is important. If high speed internet is installed around KHBP, it will definitely make all the process speedy to get more investors in the KHBP. To get smart city development, there is need to install technological infrastructure as this will make the existing infrastructure to be stronger, safe and smart. With the provision of technology infrastructure, provision of smart solutions, including smart parking, smart traffic management, smart health management, smart waste management and smart mobility will be facilitated, because technology infrastructure can facilitate life with every information by a single digital touch.

The participants showed that in KHBP, BMS building management system was used to build the city in the right way, CCTV was installed everywhere in KHBP to monitor the city from inside and outside, and WIFI was installed everywhere to make KHBP looks smarter. In addition, the participants made a case for more technology that can ensure high level of living and make the citizen more creative and motivated to get more knowledge about the new technology.

From the collected sets of data, technology infrastructure emerges an important dimension of category “establishing technology”. This is because technological infrastructure can trigger sustainable economic growth and enhances the quality of life. Provision of technology infrastructure could optimize management of resources, enhance preventive maintenance activities, and monitor security aspects while enhances services to the citizens. Technology infrastructure has a significant influence in urbanization and the manner of ensuring the smartness and intelligence of a city.

Smart Facilities

The participants stated that smart facilities are the new dimension in KHBP. The participants stated that in each building of the KHBP have a modern and smart facilities can make the life for the people easier and providing a clear environment. This dimension resulting from semi-structure interviews with multi-level. Moreover, smart facilities allow a creation of the environment to information-sharing, collaboration, interoperability, as well as, seamless experiences for people in KHBP.

“The technology can help management, companies and citizen to be smarter. Smart facilities could make the city smarter like smart building, smart living, smart machine and smart solution” - P2, CEO.

All these smart facilities facilitated that the business park attract all the companies in the IT [sic.]” - P4, Marketing Manager.

The participants indicated that installing smart facilities could improve electrical, transportation, and other logistical

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operations supporting daily life, thus improving the quality of life for the citizens. This finding has emphasized the role of smart facilities in reshaping the decision-making process, enabling new sites of experimentation and stimulating sustainable and inclusive urban infrastructure.

The participants stated that provision of technology facilities allows the creation of communication medium between the citizens and Government. The technology facilities help the Government analyzing the pattern of demand within the state, and consequently, forming a pool of resources to be addressed online. The electronic medium of communication within a community aids in the creation of a collective intelligence, deployable for resource optimization utilizing both analytics and deep learning.

International IT Companies

Participants signified the importance of KHBP as a technology-based hub as the international IT companies concentrate in KHBP. They observed that the IT companies, which comprise some Cisco, Oracle, and Huawei, have helped the city become smarter.,

"In IT Company, you will relief yourself of the day-to-day operations and you will be in a secure space provided by multiple layers of security that meets the international standards for you to sustain your IT business [sic]" - P2, Marketing Manager.

The participants also observed that the international IT companies in KHBP in making it become smarter. Traffic solution within the park become smarter and it helps commuters by providing them with a real-time traffic information. Also, smart parking enables the citizens to identify where the parking lot is available and so that they can park their vehicle conveniently. Also, the companies help enhance technology infrastructure and help improve educational system by providing labs for students to make practical.

With the presence of international IT companies in the city, technology could become the core role in smart city development, based on the intelligent technology and ICT-intensive solutions, enabling the public services for health, education, security, and governance. These companies could help in building smart urban spaces which are regarded as a combination of spatial intelligence with ICT-based infrastructure, a place where services and applications can be delivered more efficiently in a specific area.

The international IT companies can provide new technologies such as cloud computing, Internet of Things (IoT), big data and sensing system etc., and thus enhancing the development of innovative solutions, services and standardization of applications and effectively reduce the costs for cities functioning.

Mobile Applications

The participants opined that in the modern life, there is need to make citizens' life easier as found in KHBP where main applications are provided for all citizen. Necessary facilities are provided. Visitors are let in through e-entrance application system which record cars' numbers and any other details. Part of the applications considered important in KHBP is online payment application which are provided by the companies as it saves citizens' time and resources.

"Basically, we are creating our online platform in order to connecting and serving bank users for bill payment switch benefits around the kingdom in order to helping them paying bills for electricity for example or water bills [sic]" - P11, CEO.

As noted by the participants, the applications installed in KHBP provide smart solutions which involve smart parking, smart traffic management, smart health management, smart waste management and smart mobility. Data from all domains are collected and correlated for better functioning. With the installation of smart applications, operations are decentralized, and citizens can get all information of the city services at one touch, where they can interact with one another. Technological applications are essentials in making a city more adapted to its citizens' need. In addition, introduction of new and innovative technology application can accelerate the integration within a smart city development and interoperability of all active objects. The variety of emerging technologies encourages the construction of the process of smart city.

Technology applications could serve as the foundation for smart city planning which allows the connectivity and accessibility for every user. The installation of the applications in the city could facilitate the development of the smart city and innovative procedure for new prospects. Smart applications penetration in city level are a fundamental element in building smart city, and they aid in the access to public services with the aid of a wireless facility and correspondingly, promote the city management.

V. DISCUSSION

Based on the result, technology is a crucial process to achieve smart city development Lazaroiu&Roscia, (2012). The discovery of new technology promotes technology infrastructure, smart facilities, and applications which could be facilitated by international IT companies. Technology constitutes an integral aspect of smart city development (Barrionuevo Berrone, & Ricart, 2012). Establishing technology in the urban and smart city could responds to the need of infrastructure, smart facilities, and applications solutions in the city management, thus realizing the Smart City concept (Eger, 2009).

For instance, the KHBP uses facilities like BMS (building management system) system to create the city in the right way. Technology infrastructure also assisted in the provision of CCTV to KHP in order monitor the city from both inside and outside. The company provides WIFI and LED lights for citizen in order to be creative and acquire more knowledge through technological advancement. This knowledge acquired by the citizens would guide them on how to use the available infrastructure judiciously. Similarly, to do good infrastructure that would meet the smart city development required standard, there is need to provide for investment technology than can take care of the services needed by the people in the society. Provision of these basic infrastructure would add value to living standard of the citizen.



This finding is consistent with the findings of Zhang (2017). The aim of novel urbanization is to proffer a solution towards the social issues and the idea of the smart city is the technological approach and solution in urban construction which will ensure the acceleration of development in various cities (Zhang, 2017). In smart city, technology infrastructure proffering more efficient services for the dwellers while promoting the social and economic innovation, as well as urban and regional space alteration (Zhang, 2017; Albino, Berardi, & Dangelico, 2015).

VI. CONCLUSION

In this study, it has been indicated that smart city development is a prerequisite for surmounting the challenges posed by the global ever-increasing population and fast urbanization which include increasing demands on city services and infrastructure, heavy industrialization, unplanned urban sprawl and negative externalities in the form of deteriorating quality of life, waste disposal issues, strained government budgets, over-burdened healthcare delivery systems, pollution, crime, and traffic congestion. While the existing literature indicated the heterogeneity of the smart cities' development, in which many models and dimensions have been developed in the smart city research field, this study explored and identified smart city development dimensions, given the fact that technology is regarded as an enabler that can close physical distances in a several ways, which consequently creates opportunities for the acceleration of social and economic activities around people.

Furthermore, the review of literature in this study underscores the importance of technology in smart city development. Thus, this study explored and identified technology-based smart city development dimensions. To do this, Grounded theory was employed, and data were collected via interviews and analyzed. The overall findings signified four technology-based dimensions of smart city development emerged from the category "establishing technology" describing how smart city development show the dimensions in Jordan's Amman, King Hussein Business Park. The four dimensions are technology infrastructure, smart facilities, international IT companies, and applications.

Overall, this research, which was conducted in the context of Jordan's Amman, King Hussein Business Park, has generated a model that could be tagged "a smart city development dimension" which could be examined and adopted by the future study in other areas in the same context, Jordan. It is noteworthy here that the challenges identified in the process of smart city development will be fixed by KHBP. The findings of this study identified technology as a significant dimension of smart city development, however, this is not an exhaustive dimensions of smart city development, Future research should identify and explore other dimensions of smart city development.

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