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The Relationship between Technology Readiness and Smart City Performance in Dubai

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ABSTRACT

Unlike any other city, Dubai is proactive in foreseeing the congestion issue popular among the cities. Therefore, the government supported the implementation of the smart city in Dubai. This research identifies a crucial factor that influences smart city performance. This factor is technology readiness. Focusing on Dubai, the objective of this paper is to determine the causal relationship between technology readiness and smart city performance. Due to the movement restriction during the data collection period, the researcher resorts to data collection via an online platform, where an online survey link was sent out to identified and targeted samples which consists of civil servants. The study employees Partial Least Squares Structural Equation Modelling (PLS-SEM) to determine the relationship between the constructs. The results revealed a significant relationship between technology readiness and smart city performance. The implication of this research showed that the availability of technology readiness is a crucial factor in ensuring smart city performance.

1. Introduction

Over the past few centuries that smart city ideas have resurfaced. However, the concept had been faced with several criticisms, one of which is the failure of smart city idea implementation. [15, 25]. Examples of the failed smart cities are not limited to the Eko Atlantic, Sidewalk Lab in Toronto, China's Ghost City (the Ordos), Lavasa in India, now dubbed as India's ghost city and Portuguese Silicon Valley [10,19].

Despite these beliefs on smart cities, there is a unanimous agreement that smart cities are futuristic cities that, after completion, has the capability and the ability to balance the economy, environment, and human social relationship [3].

Insights into the available literature on smart city reveals that several of these studies were conducted in the laboratories and engage several complex scientific terms difficult to comprehend

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[4]. Given this, investigations on smart city performance from the managerial view remain at its infancy stage. Hence, to fill the observed gap in this regard, the present study employs the Resource Based View (RBV) Theory as an underpinning theory for this investigation.

The rationale underlying the adoption of RBV Theory to investigate the influencing factors of smart city performance lies in the fact that RBV Theory encompasses all the internal factors a firm needed to succeed and effectively compete [16,28,30]. Therefore, examining these internal factors could at least give suggestions on why Dubai's smart city, within a short period between its policy formulation and implementation, performs beyond the expectations of smart city scholars and practitioners.

Given the internal factors available in Dubai, the management of Dubai has a foreseeable future of the congested city; thus, they are proactive in providing adequate solutions even before the problem of overcrowding arises via innovation, creativity, and technology by creating a smart city. Dubai succeeded in the performance of the smart city and it is rated among the top-rated performing smart city in the world [23, 17]. The idea of building smart cities is not a new concept to humankind. History has it that there have been several attempts by man to build cities which have everything, that is, resourceful, sustainable, environmentally friendly, capable of creating highly skilled employment opportunities as well as providing the necessary amenities to its occupants at ease [3, 29]. Before diving into the examples of earlier smart cities, there is a need to have an idea or description of smart cities.

According to Mori and Christodoulou [38], cities are pivotal in creating social and economic integration. Hence, the United Nations Population Fund concluded that people migrated from less urban areas into the nearest megacities, searching for a more social and economically inclined life. With this, the United Nations Department of Economic and Social Affairs (2017) predicts that more than half of the world population will migrate to the cities in the nearest future, making it congested and unhealthy to live in. Many earlier scholars defined the meaning of smart cities, what it entails and they argued that the concept itself is vague. Although there are no clear definitions and descriptions of what a smart city entails; nevertheless, observations from the literature reviewed reveal that a smart city is built upon two concepts: people (social) and environment integrated by technology. Most scholars observed technology as an independent factor [3,29], an independent factor contributing significantly to the idea of a smart city. On the other hand, insights into studies such as Albino *et al*., [3] Nam and Pardo [40], and Vidiasova *et al*., [29] agree with Gelmato that technology in the smart city is essential. However, these scholars stressed that technology is used to gather information from other dimensions listed, enabling enhanced governance, social and economic cohesion enabling innovation and creativity of smart city residents [21].

The present study adopts the smart city's objectives as presented by the Dubai government and similar descriptions from earlier works to describe a smart city. A city is said to be smart if the residence is innovative, happy, and creative and has easy access to quality public goods and services. As a result, they are integrating isolated areas via IoT tools.

Furthermore, theoretical insights into the available literature regarding the smart city concept reveal that technology readiness is among the critical factors influencing smart city performance, and incredibly congested cities [1, 14]. According to Amin and Giacomoni [42] and Neirotti *et al*., [18], smart city resource readiness in terms of security systems, finance to sponsor the smart city project, reduced bureaucracy through computerized robotic aid, rapid response to crises and issues to assist and enhance the lives of citizens thus, making them happy, solely depend on artificial intelligent (AI) algorithms and IoT produced by technology industry that are adept with high failure rate [9,11].

Therefore, Heater [44] cautioned on the over-reliance on these advance technologies. The question that arises is, if the technology companies can cease to exist, how smart city that relies on

their products will survive. To answer this question, stakeholders' perception (the civil servant working in the service industries) concerning technology readiness in sustaining Dubai smart city's performance is vital to this study. Given this, the present study investigates the influence of technology readiness on smart city performance.

Meanwhile, literary evidence from strategic management, RBV Theory, and firm performance scholars believed that technology readiness has an essential impact on firms' performance [7,12] hence, this study is conducted to determine the causal relationship between technology readiness and smart city performance. As such, the researchers of the present study find it significant to ascertain the role of technology readiness on the success of Dubai Smart City performance.

Technology readiness, as resource readiness, has been widely investigated in several spheres of work, specifically in the change management of organizations that seek to enhance their performances. Examples of these numerous studies include the study of Shea *et al*., [26], as well as Wen *et al*., [32], examining resource readiness in enhancing performance in organizations. Evidence from these studies shows that technology readiness is among the several facets of resource readiness. Resource readiness is a complicated and multi-facet construct intertwined between individuals at an organizational level [26]. This is because resource readiness cuts across the human capital and the financial resources to implement the intended change. Technology readiness in this research is treated as a single-dimensional construct, technology readiness. As the study of Azam [6] and Richey *et al*., [22] argues, technology adoption and usage provide the firm with oceans of information beneficial for both the economic and non-economic operations of the firm thus, leading to a competitive edge.

2. Literature Review

2.1 Smart City Performance

A smart city is said to be performing if it successfully incorporates the scientific solution to daily life chaos by integrating economic growth and modern infrastructure development with social infrastructure [20]. In comparison, Citykeys [58] described the smart city as a sustainable, efficient, and effective in-service delivery that encourages human participation, leading to quality work-life balance.

The objectives of initiating a smart city idea include integrating isolated areas to increase social servicing and accessibility to basic amenities [9, 11,]. Therefore, a performing smart city can be described as the city that fulfills its initiation and implementation nominally, socially, infrastructure, and environmentally integrating the isolated areas. Meanwhile, Shen *et al*. [47] described smart city performance as the effectiveness of mitigating urban diseases using technology.

Considering the given definitions, there is no consensus among scholars on which city is smart and which city is not [13]. The smartness of a city is therefore unique to its specific requirement. Nevertheless, smart city performance had been measured via several indicators based on the needs of the environment in which the smart city project is executed. Examples of such indicators include efficiency in transportation, an improvement in the quality of life, knowledge creation, enhance creativity and innovativeness, environmental protection, improve resource efficiency, and enhanced governance [3].

Measuring the performance of smart cities had over the years created some heated debates. According to some scholars, it is a difficult task to measure smart city performance due to several factors such as the degree of smartness, the city features as well as the city's topography, peoples' needs, mobility, and governance [2].

Nevertheless, to effectively measure a smart city's performance, Merli and Bonollo [49] posited that the measurement should not only focus on digital infrastructure, but it should capture human actions, society, government, and the environment. This is because human actions, society, government, and the environment made up the city, and the city serves them. Similarly, through some key performance indicators, Airaksinen *et al*., [2] argue that smart cities' performance can be quantified and measured.

Similarly, a study by Anthopoulos Reddick, Giannakidou, and Mavridis [50] conceptualizes and benchmarks smart city performance by streamlining the features of the already published articles on the available smart city performance measurements. The benchmarking methods detailed smart city performance and how it was assessed, progress measurement, monitoring, city capacity, resilience, sustainability, and policy evaluation. Finally, the study of Warnecke, Wittstock, and Teuteberg [31] developed a smart city maturity model and a web-based self-assessment tool. Their development's weakness is that their study only focuses on smart cities in the European zone, neglecting smart city performance indicators from other zones. Therefore, the adoption of these measurements in other areas needs a great deal of caution. Despite the innovative approaches adopted by Anthopoulos et al. [50] and Warnecke *et al*., [31], their measurement still revolves around the smart city's three basic concepts: technology, social, and environment.

Using the European Union zone smart city's five features to create a generic measurement framework, Airaksinen *et al*., [2] present two essential points: direct and indirect impacts. The direct impact of smart cities is the ability and the capabilities to set holistic targets and access their progress. Smart cities' indirect impact includes enhanced efficiencies in energy consumptions, renewable usages, improved work-life quality, low carbon emission, and new business opportunities. On account of Ambrosetti [52], the smart city's performance is measured in three dimensions. Logically, these performances are based on smart cities' benefits to the citizens on the social, economic contribution, and resource management. Table 1 summarizes various smart city definition as seen in earlier studies.

Table 1
Summary of Smart City Performance Definitions and Concept by Earlier Studies

No.	Definition of Smart City Performance	Source / Author
1	Technological cohesion of isolated areas in the urban centers so that the citizens (migrants and residences) in such places can have a comfortable and efficient life.	[21]
2	Efficiently and effectively mitigating urban diseases using technology.	[47]
3	A smart city is an urban city with available resources to address the social suitability needs that includes health care, security, the autonomy of urban governance, and cyber-security when they arise.	[41]
4	Cities are called smart cities if linked with enhanced security systems, reduced bureaucracy through computerized robotic aid, rapid response to crises and issues, among other features.	[18, 42]
5	A smart city is described as an innovative system aimed at reducing carbon dioxide emissions in an innovative, intelligent, open, and knowledgeable towards social and environmental sustainability.	[42]
6	The smart city is described as a sustainable, efficient, and effective in-service delivery that encourages human participation, encouraging quality work-life balance.	[45]

Measuring smart city performance can be a little bit complicated. Nevertheless, once the objective is known, the measurement can, therefore, be streamlined towards the degree or levels of progress made in achieving the preset smart city objectives, which revolve around the five unique or fundamental components of the smart city, namely, economy, environment, social life, technology, and happiness. Technology in smart cities, as described by Schaffers *et al*., [24], is used in connecting isolated areas, as well used in monitoring the activities in the related areas, while the people are the beneficiaries of the services of the connected areas using technologies. On the other hand, society includes the people, infrastructure, and the overall environment at large.

2.2 Technology Readiness and Smart City Performance

Over time, numerous studies are investigating organizational or firm resource readiness relative to their performance. This is because no firm or organization can survive without the needed resources to perform, create, or produce its products and services [8]. Technology readiness, as resource readiness, has been widely investigated in several spheres of work, specifically in the change management of organizations that seek to enhance their performances. Examples of these numerous studies include the study of Shea *et al*., [26], Wen *et al*., [32], and Schumm *et al*., [61] examining resource readiness in enhancing performance in organizations.

Technology readiness is crucial due to its significance in connecting the isolated areas and serving as a bridge for other areas [62]. Evidence points to the enormous technological investment made by the Dubai government to achieve the highest performing smart cities globally. As such, several available pieces of literature argue that technological readiness has a significant role in ensuring the performance and sustainability of smart city in achieving the pre-determined goals and objectives [18,29]. Evidence from practitioners and analysts present that the technology available to the Dubai government has given them the upper hand in transforming Dubai into a smart city within a short time.

The findings from the study of Vidiasova *et al*., [29] conclude a significant relationship between technology readiness and management on smart city performance. The degree of technology readiness varies among the available smart cities. On this note, the study of Pan *et al*. [64] found that despite the less smart city technology readiness in Taiwan, there is a significant contribution to citizens' satisfaction on smart city service enjoyed.

Considering the few literatures consulted works, Table 2 summarizes the findings between technology readiness and smart city performance.

Table 2
Summary of Findings on Contributions of Technology Readiness on Smart City Performance

No.	Findings	Source / Author
1	There is a significant relationship between resource readiness and management in smart city performance.	[26]
2	Although in Taiwan there is a less smart city resource readiness yet, there is a significant contribution of resources to citizens' satisfaction on smart city service.	[64]
3	There are contradictions in the popular argument about the positive relationship between human capital and employment growth in the urban city precisely because of a change in productivity.	
4	The resources available to the Dubai government have given them the upper hand in transforming Dubai into a smart city within a short time.	
5	Technology readiness has a significant role in ensuring the performance and sustainability of smart city in achieving the pre-determined goals and objectives.	[18, 29, 42]

Based on the RBV Theory and empirical evidences from the previous studies, the following hypothesis is offered:

H1: There is a significant relationship between technology readiness and smart city performance.

3. Research Method

3.1 Population and Sample

The population of the present study is civil servants who work in the service industries, including transportation, real estate, business services, hospitality, personal and social services. These service sectors contribute about 37.2% of the total GDP of Dubai's economy. Besides, those working in the service industries are directly affected by government decisions, and they are tasked mainly with Dubai's economic growth. The logic behind this chosen target population is that the employees working in Dubai service industries are those with firsthand information about Dubai smart city project, they implement it, and at the same time, they are also the users. Fortune [36] did not mention the civil servants' level who pays 1% fund towards smart city projects; hence, all levels are considered equal chances of being sampled.

From the estimated sample estimated using the power analysis tool presented in Figure 1, the estimated sample size of the present study is 107. It should be recalled that 5 service sectors are chosen; therefore, the total questionnaire to be distributed will be 107*5 = 535 questionnaires. However, to prevent a low response rate, the researcher plans to distribute 750 questionnaires, 150 respondents from each identified service sector.

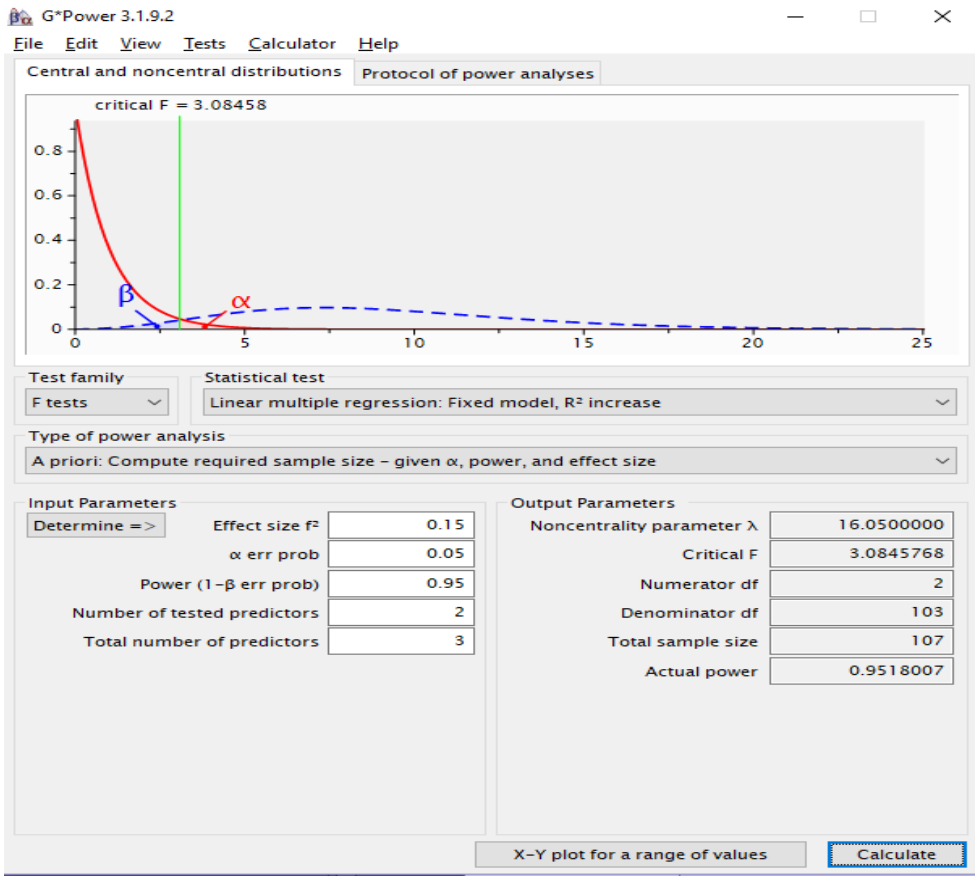

Fig. 1. G-Power Analysis Output

3.2 Data Collection Method

The present study employs a questionnaire survey method of data collection. The pros of using a survey research method, according to Sincero [27], includes high representativeness of samples and convenience in data collection. The close-ended structured questionnaire adapted from past studies with high-reliability measure was administered to the research subjects. The items contained in the questionnaire aimed to measure Dubai's smart city's performance and the examined determinant (technology readiness). The 5-point Likert scale was used to measure all of the items. The questionnaire was validated in two stages (i.e. pretest and pilot test) before proceed to the actual survey.

A pre-test was conducted by 11 experts. Six of those are from academia. They validate the concepts, content, and theories used. Simultaneously, the other 5 other experts are practitioners chosen from the 5 service industries selected. The experts commented on the items' wordings, redundant questions, double-barreled items, and the developed items' flow. The questionnaire was improved based on these comments. After the pre-test stage, the questionnaire was distributed to the police department in Dubai to conduct the pilot test. The questionnaire was electronically distributed to 50 police officers randomly. About 30 responses were received and further analyzed. Even though the development of the proposed questionnaire was reliable and valid, the item's reliability was still verified. According to Zikmund et al., a variable is said to have high internal reliability if the Cronbach alpha should be at least .6 and above. With this, Zikmund *et al*. proposed the "rule of thumb" for reliability presented in Table 3.

Table 3
Rule of Thumb for Cronbach Alpha

Alpha Coefficient Range	Strength of Association
Below .60	Poor
.60 to .70	Moderate
.71 -.80	Good
.80 to .90	Very Good
Above .91	Excellent

The result of the pilot test is shown in Table 4.

Table 4
Pilot Test Results

Constructs	Number of Item	Cronbach's Alpha
Smart City Performance		
Economy	4	.907
Environment	4	.908
Social Life	5	.788
Technology	4	.792
Happiness	4	.741
Technology Readiness	6	.789

Table 4 depicted that the Cronbach's alpha for all the variables under investigation has all recorded above the threshold of .60. Therefore, all the variables possess internal reliability and consistency. To this end, however, this indicates that no item will be drop or substituted. Having

confirmed the validity and reliability, the questionnaire was then used for the actual survey in this study.

4. Data Analysis and Results

This section examines the direct relationship between the exogenous and the endogenous variables, that is, the causal relationship between technology readiness and smart city performance. The Partial Least Squares Structural Equation Modeling (PLS-SEM) was used to determine the relationship between the variables. The two-step approach in PLS-SEM was applied in this study in which separately examines the measurement and structural models.

Firstly, convergent validity, discriminant validity, and reliability were evaluated of the measurement model. Convergent validity is achieved by observing the constructs' loadings which must be greater than 0.7, composite reliability (CR) must be greater than 0.7 and the average variance extracted (AVE) must be greater than 0.5. Next, to achieve discriminant validity, the average variance shared between each construct and its measures should be greater than the variance shared between the construct and other constructs.

The structural model was tested after the measurement model. The bootstrapping method was used to determine the significant level of the constructs' loadings and path coefficient. The researcher adheres to Chin's proposition in running the bootstrapping technique. A minimum of 5000 samples was selected to test the hypothesis of the study. The result of this relationship is presented in Table 5.

Table 5
Structural Model Assessment Result

Relationship	Beta (β)	STD	T Stat (β/STD)	P Values	Decision
TR -> SMP	0.264	0.044	5.950	0.000	Accepted

Note: SMP = Smart City Performance; TR = Technology Readiness

The hypothesis in this research is that a significant relationship exists between technology readiness and smart city performance. Surely enough, the analyzed data upheld this argument having a significant relationship between technology readiness and smart city performance ($\beta = 0.264$, t-value = 5.950), $p < .05$. This means that finding reveal that there is a positive relationship between technology readiness and smart city performance. On this note, the hypothesis of this study was accepted, which means that there exist a positive relationship between technology readiness and smart city performance in Dubai.

5. Discussion and Conclusion

The hypothesis in this research posited a significant relationship between technology readiness and smart city performance. The observed result agrees with the hypothesis confirming that technology readiness relates significantly to smart city performance. The result is consistent with earlier investigations Dewi et al. [62], Jacobs *et al*., [26], Wen *et al*., [32], Schumm *et al*. [61], and Vidiasova *et al*., [29] all who found a significant positive relationship between technology readiness and smart city performance.

Technology readiness is synonymous with resources needed in terms of infrastructure, cloud computing, human power such as programmers, and spare part backup should be readily available in case of an emergency. Having these technologies at reach will allow smart city operations' smooth

running [29,32]. Therefore, Technology readiness significantly contributes to smart city performance in Dubai.

The finding of this study support the stance that technological readiness is crucial internal resources needed to ensure a smart city's performance. In this regard, the finding pointed to investigate other potential factors beyond this research scope that might influence a smart city's Dubai performance. Nevertheless, the finding reveal that to ensure the smart city's performance, the influence of technology readiness is crucial, yet other factors need to me examined.

This study is of high importance to both academic and practice in the ways discussed below. The theoretical contribution of this research is numerous. The first contribution of this research is explicitly adding to the body of knowledge. Although there are several published materials on smart cities, however, only several academic journals can be found. Those available in this regard do not discuss in detail the academic knowledge contribution to smart cities. Hence, this research is vital in enlarging the coast of academic literature on smart cities, specifically in a context with a short time frame between smart policy formulation and reality implementation.

Furthermore, this research is among the first of its kind to explore the factors that influence smart city performance from the managerial view and employed RBV Theory, the successful completion of this research reveals that investigations on smart cities should not only be based on scientific jargons but should be made comprehensible for anyone interested in such research to explore. This research theoretically reveals that to witness smart city performance, both internal and external factors need to be given full consideration. This research also gives empirical and statistical evidence on the relationship between technology readiness and smart city performance.

The relationship between technology readiness and smart city performance can be empirically proven in Dubai, which is the context of this study. The findings in this regard thus will help smart city stakeholders to have rational thoughts and critical insights on critical factors that are needed to ensure a performing smart city.

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