

AN ASSESSMENT OF THE BARRIERS TO SMART-CITY DEVELOPMENT PROJECTS IN NIGERIA FEDERAL CAPITAL CITY- ABUJA

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Abstract

This study examines the barriers of smart-city development projects in Abuja. Empirical data was collected using questionnaire administered to a sample size of 331 respondents derived from a study population of 1950. Data were analysed using descriptive statistics of frequency, percentage and mean scores. The study specifically revealed the three highest social barriers as 'digital divide (M=4.5423)', 'insufficient connection between social and technological infrastructure (M=4.4876)', and 'lack of trust (M= 4.4428)'. The three lowest social barriers as gentrification and social exclusion (M=4.0498), insufficient cultural diversification (3.8408), and absence of citizens' participation (M= 3.3383). The study also revealed the three highest economic barriers as absence of reliable and qualified human capital (M= 4.8259), unemployment and absence of equitable labour market access (M= 4.5224), and public and private institution weaknesses (M= 4.2537). The three lowest economic factors are competitiveness of the local and international markets (M=3.1045), resource management inefficiencies (M=2.1940), and insufficient funding and investment (M=2.1940). The three highest environmental barriers are absence of resource sharing with respect to financial and social distributions (M=4.5224), inefficient holistic approach towards sustainable environment (M=4.3284), waste management inefficiency (M= 3.7463), whereas the three lowest environmental barriers are climate change (M=3.1194), loss of natural habitat and biodiversity (M = 3.1045), and insufficient knowledge of ICT usage in energy consumption (M=2.1940). For general governance barriers the three highest factors are insufficient capacity (M=4.8259), absence of support due to political will (M= 4.6766), absence of project management (M =4.5224), whereas the three lowest factors are absence of requisite regulations and legislations (M =2.8955), insufficient operational capabilities (M= 2.1940), inequities of policies (M= 1.8955). Finally, for the urban governance barriers, the three highest factors are technological infrastructure deficit (M= 4.5274), deterioration of physical infrastructure (M= 4.5224), and technological obsolesce (M= 4.1045). The study revealed the three lowest urban governance barriers as absence of data integration (M= 3.0448), absence of efficient data management system in the face of huge data (M=3.0299), and inefficient quality of ICT-based services (M= 2.0448).

Keywords: Abuja, Barriers, Projects, Smart-city

INTRODUCTION

The African continent is rapidly urbanizing and this is evident in the growth of its megacities, smaller towns and smaller cities (Page, *et al.*, 2020). Sahel and OECD

(2020), states that Africa's urban transition is an opportunity to create new social, economic, and environmental development models, hence, a need for a new city infrastructure governance system through

smart cities (Gunalp, *et al.*, 2017). Burbano (2022), in emphasizing the imperatives of smart cities in Africa says 'it is a case between an emergency and a necessity'. Examples of smart cities in Africa, includes Kingali Innovation City - Rwanda, Cape Town -South Africa, Konza Technologies -Kenya, Eko Atlantic - Lagos, Nigeria. Smart cities play major roles in virtually all sectors and areas of human existence, including but not limited to health, education, energy, and transportation (Hasheem, *et. al* 2016). Government of nations are fast embracing smart city innovative and technology-driven infrastructure development system for improvement on citizen's living standards (Jimenez-Gomez, *et al.*, 2014). Smart-cities are characterized with sustainability, resilience, governance, improved quality of life, intelligent management of natural resources and city facilities (Al-Nuaimi, *et.al*, 2015). Researches by Chong-Wen (2022), Rana, *et al.* (2019), Koo *et al.* (2016), Albino *et al.* ((2015) views smart-cities as technologically advanced and modernized territory to develop superior infrastructure constituents and services. Global perspectives on positive impact of citizens by smart city development can be drawn from countries like Denmark, Switzerland, and Australia (Burbano, 2022), Unfortunately, same cannot be said of Nigeria's smart-cities. A plethora of social, economic, environmental, general governance, and urban governance barriers constitute challenges that plague smart-city development in Nigeria. Thus, the need for a study on the challenges of Nigeria's capital territory, Abuja, to achieve smart-city development is the driving force that underpins this research. Therefore, this study aims at evaluating the barriers of sustainable

Smart-city development projects in Abuja, Nigeria's Federal Capital City.

THEORETICAL REVIEW

Smart-City Urban Infrastructure Development System

Aghimen *et al.* (2019), states that smart cities have become a popular development option owing to the importance placed on human and socio-economic development, and in addressing the problems created by the ever-rising population and its impacts on city infrastructures. It was further stated that the increasing tendency for concentration of people in Nigeria's cities due to cities ability to create the needed settlement change, unfortunately puts severe pressure on the available resources with too many people depending on apparently little infrastructures. Gil-Garcia, *et al.*, (2015), conceptualizes smart-cities as 'an integrated and comprehensive vision of all components of urban life, including the economy, government, transport, green areas, health, and culture among several others. Malabi (2018), asserts that for smart-cities to be achieved, the elements of cohesion, education, and utilisation of green construction resources must come to play. This is corroborated by Madikizela (2018) study, which stated the idea of smart-cities can only be achieved by critically evaluating the problems and solving them accordingly. Chamber (2017), declared that 'either you disrupt it, or you get left behind' Notably, Africa's ecosystem (Nigeria inclusive) can serve as the take-off point for better, safer and smarter city development initiatives using green infrastructures. Yakubu (2018), study on the prospects and challenges of smart-city development in Nigeria interestingly declared that 'the concept of smart-cities would create opportunities for regions' and further

seeks to improve urban dweller's comfort by taking advantage of innovations introduced by advances in high technology.

Smart-city Developmental Challenges in Nigeria

Generally, the challenges faced by urban areas in Africa are among the biggest across global scale (Förster and Ammann, 2018). Observably, there is dearth of research on the barriers of smart-city development in Nigeria and in the Federal capital city - Abuja in particular.

Literature search showed that certain social barriers militate against the development of Smart-cities in Nigeria including but not limited to 'insufficient connection between social and technological infrastructure', 'lack of trust' and 'inequality of the citizenry. Mora *et al.* (2017), study identified sufficient interplay between technological and social factors as crucial factor for smart technologies in the areas of need. The continued insufficiency with respect to the relationship between the two triggers reduce quality of life (Weglarz, 2022; Van-Twist *et al.*, 2023) and does not encourage the existence of urbanization (Mortaheb & Jankowski, 2022).

Certain economic factors also constitute challenges to smart-city development projects in Nigeria including the absence of reliable and qualified human capital (Okpara, 2007), absence of an equitable labour market access, weaknesses in public and private institutions (Yagboyaju & Akinola, 2019), imbalances in the cost of urban infrastructure and investment levels (Uzochukwu *et al.*, 2017). Muhammed, *et al.* (2022), study stated that the existence of unreliable and qualified human capital

at best and absence of human capital at worst remains a challenge to the developmental strides of Abuja metropolis. The inability of the government to provide the enabling environment was largely responsible (Baharuddin, *et al.*, 2022). Other economic related challenges involve inconsistent macroeconomic factors including interest rate (Ifionu & Ibe, 2015), exchange rate (Muhammed & Adindu, 2021), inflation (Ifionu & Ibe, 2015).

The environmental barriers of Smart-city development projects in Nigeria includes 'absence of resource sharing' (Ramadhan, *et al.* 2022), 'inefficient holistic approach to sustainable environment' (Akinyode, *et al.*, 2014), 'waste management inefficiency (Rifaid, *et al.* 2023 and Zhang *et al.* 2019), and 'imbalance of the population growth triggered by environment changes'. The imbalance of population growth triggered by environment changes is also considered crucial to the smart city development.

The governance barriers militating against the development of Smart-cities in Nigeria includes insufficient capacity building, absence of support due the lack of political will, absence of project management, and absence of opportunities for engagement. This research unlike others will adopt a holistic approach in evaluating the social, economic, environmental, general governance, and urban governance barriers to smart-city development in Nigeria Federal capital city. Research by Akinwamide, *et al.*, (2022) and Usman & Ibrahim (2016), revealed that capacity building induces increased performance level of construction professionals in Nigeria. Shimamura & Mizunoya (2022) study, averred that the requisite knowledge of the construction

professionals is often not in tandem with the minimum tolerable and acceptable level globally. Ajayi *et al.*, (2016), posited that the absence of support due to a lack of political will of the government, affects the development of Nigeria in many cases. Furthermore, the absence of project management standards influences the developmental stride of Abuja metropolis (Kuprenas, 2012).

Musa, *et al.* (2019), declared that the urban governance barriers militating against Smart-city development projects in Abuja capital city, includes 'technological infrastructure deficit, 'deterioration of the physical infrastructure' and 'technological obsolescence'. Ogunmakinde & Umeh (2018), study further asserts that technological advancement is key to the performance of the construction sector the world over, and the challenge of technological obsolescence a militating factor against the success of the smart-city development projects in Nigeria (Söderström, 2021; Das & Zhang, 2021). This assertion is further corroborated by Ahad *et al.* (2020) study which revealed the non- adoption of recent, contemporary as well as advanced technologies including Building Information Modelling (BIM) (Franz & Messner, 2019), drones (Hayajneh *et al.*, 2016), internet of things (Pardini *et al.*, 2020; Enotse *et al.*, 2022) and so on. The effect being that it would reduce the capacity of construction professionals to attain smart-city development goals. These researches were evaluated using mainly Abuja capital city as the unit of study, but this study shall adopt a much broader perspective by evaluating the five FCT area councils, namely - Gawagwalada, Bwari, Abaji, Kuje and Municipal, and this is the distinctive difference.

RESEARCH METHODOLOGY

Research Design

The study adopted a quantitative research methodology in which empirical data were obtained from a group of respondents. The instrument of data collection was by means of structured questionnaire administered to sample frame drawn from a population involving practicing quantity surveyors, builders and architects. The unit of analysis is the five area councils of the FCT namely, Gawagwalada, Bwari, Abaji, Kuje and Municipal.

Target Population and Sample size

The target respondents consisted of construction professionals engaged in building construction projects in Abuja metropolis. The total number of practicing quantity surveyors, builders and architects as at May 2023 in Abuja, Nigeria, was put at 1,950. This population of study (N) was sourced from Nigeria Institute of Quantity Surveyors (NIQS), Nigeria Institute of Builders (NIOB), and Nigeria Institute of Architects (NIA) offices. The sample size (n) for this study was calculated using a simplified version of Yamane's (1973) formula,

$$n = \frac{N}{1 + N(e)^2} = 331$$

From the above result, 331 respondents were selected for the study.

The Study Area

The Federal Capital Territory is situated in the central area of Nigeria and it is the capital of the country comprising of many elites, professionals, skilled and unskilled laborers that does the work of construction (Albert, et. al., (2021). FCT area was created in the year 1976 developed from the then Kwara state with a landmass engraved out of Niger state.

Unlike other states of the nation separated into local government areas, FCT is divided into area councils, namely;- Gawagwalada, Bwari, Abaji, Kuje and Municipal area councils (Odunsi, 2018).

Sampling technique and data collection instrument:

Empirical data was collected from a population size of 1950, comprising of practicing quantity surveyors, builders and architects in the FCT five area councils. From this population, a sample size of 331 was scientifically determined using Taro Yemane formula and data purposively collected using study questionnaire.

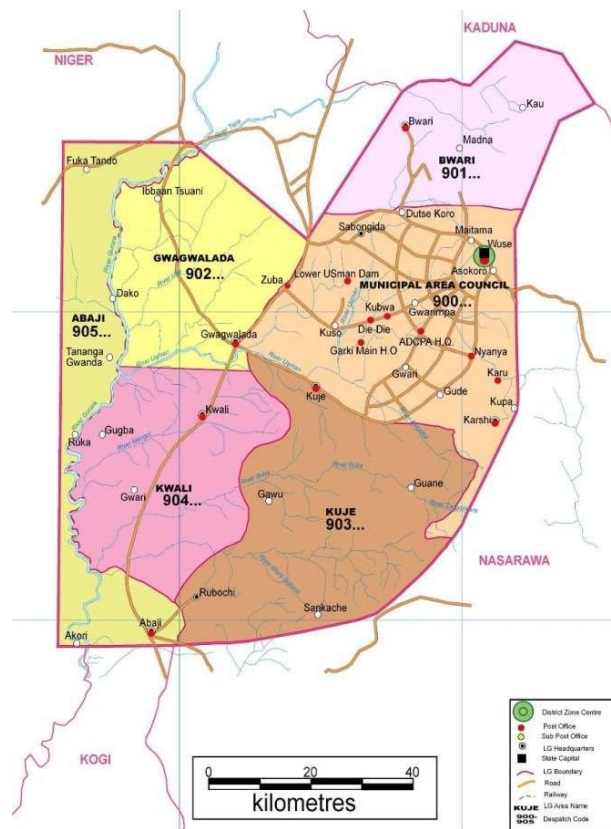


Figure 3.1: Map of Abuja showing all the Area Councils and the Boundary States
Source: Obi – Anike *et al.* (2017 p. 4)

RESULTS AND DISCUSSION

Table 4.1: Descriptive Statistics of the Respondents Background Information

	Frequency	Valid Percent	Cumulative Percent
Gender			
Male	144	71.6	71.6
Female	57	28.4	100.0
Total	201	100.0	
Age			
20-30 years	48	23.9	23.9
31-40 years	46	22.9	46.8
41-50 years	55	27.4	74.2
51-60 years	37	18.4	92.5
61 and above	15	7.5	100.0
Total	201	100.0	
Level of Education			
National Diploma	11	5.5	5.5
Higher National Diploma	48	23.9	29.4
First Degree	65	32.3	61.7
Master's Degree	73	36.3	98.0
PhD	4	2.0	100.0
Total	201	100.0	
Profession of Respondents			
Project Manager	32	15.9	15.9
Quantity Surveyor	30	14.9	30.8
Architects	22	10.9	41.8
Engineers	25	12.4	54.2
Site Manager	51	25.4	79.6
Estate Surveyor	22	10.9	90.5
Builder	19	9.5	100.0
Total	201	100.0	
General Experience of Respondents in Construction Works			
Less than 3 years	5	2.5	2.5
3-7 years	78	38.8	41.3
Above 7 years	118	58.7	100.0
Total	201	100.0	
Company Status of the Respondents			
Contracting Firms	44	21.9	21.9
Consulting Firms	49	24.4	46.3
Client Organization	63	31.3	77.6
Government	35	17.4	95.0
Ministry/Parastatals/Institutions	10	5.0	100.0
Building Material Manufacturers/Vendors	10	5.0	100.0
Total	201	100.0	
Staff Profile of the Respondent			
Permanent Staff	93	46.3	46.3
Contract Staff	68	33.8	80.1
Part-Time Staff	40	19.9	100.0
Total	201	100.0	
Professional Qualification of Respondents			
Graduate Member	27	13.4	13.4

Associate Member	70	34.8	48.3
Fellow Member	104	51.7	100.0
	201	100.0	
Longevity with the Current Company			
Less than 3 years	5	2.5	2.5
3-7 years	78	38.8	41.3
Above 7 years	118	58.7	100.0
	201	100.0	
How many Buildings Construction Projects have you delivered			
Less than 5	79	39.3	39.3
5 – 10	117	58.2	97.5
Above 10	5	2.5	100.0
	201	100.0	

Source: Authors Field Survey, (2023)

Challenges Militating against the Development of Smart-city Development Projects in Abuja Capital City

Social Barriers

Table 4.2: Descriptive Statistics for Social Barriers

FACTORS	Mean	SD
Digital divide	4.5423	.9162
Insufficient connection between social and technological infrastructure	4.4876	1.000
Lack of trust	4.4428	1.143
Inequality of the citizenry	4.3433	1.173
Change resistance	4.2289	1.291
Inefficient social awareness	4.0846	1.337
Gentrification and social exclusion	4.0498	1.567
Insufficient cultural diversification	3.8408	1.644
Absence of citizens participation	3.3383	1.305

Source: Authors Field Survey, (2023)

The result of this study showed that ‘digital divide (M=4.5423)’, ‘insufficient connection between social and technological infrastructure (M= 4.4876)’, ‘lack of trust (M= 4.4428)’ and ‘inequality of the citizenry (M= 4.3433)’ are the top social barriers militating against the Development of Smart-city Development Projects in Abuja Capital City, and are therefore, ranked 1st, 2nd, 3rd and 4th respectively (see table 4.2). This is in line with the outcome of the study of Mora *et al.* (2017), which stated that ‘sufficient interplay between technological and social factors’ induces smart technologies in the areas of need’. However, the

continued insufficiency with respect to the relationship between the two triggers reduce quality of life (Weglarz, 2022; Van-Twist *et al.*, 2023) and does not encourage the existence of urbanization (Mortaheb & Jankowski, 2022). Another social barrier challenge of Smartcity development in Nigeria is the high cost of construction project in Nigeria when compared to other developed or developing countries of the world (Aliyu *et al.*, 2017; Opoko & Oluwatayo, 2014). This is explained by the prevalence of corruption (Adindu, *et al.*, 2019; Alutu, *et al.*, 2007), kickbacks (Mbamali & Okotie, 2012), and rebate (Adamu, *et al.*, 2012) as the case may be in the Nigerian construction sector.

Economic Barriers

Table 4.3: Descriptive Statistics for Economic Barriers

FACTORS	Mean	SD
Absence of reliable and qualified human capital	4.8259	.38017
Unemployment and absence of labour market access equitably	4.5224	.50075
Public and private institution weaknesses	4.2537	1.30011
Inconsistencies in the cost of urban infrastructure and investment imbalance	4.1013	1.30011
Mono-sectoral economy	3.7463	.96969
Global economy volatility	3.1194	1.45453
Competitiveness of the local and international markets	3.1045	1.26255
Resource management inefficiencies	2.1940	1.83498
Insufficient funding and investment	2.1940	1.83498

Source: Authors Field Survey, (2023)

The study results also revealed the topmost economic barriers militating against the development of Smart-city projects in Abuja Capital City are ‘absence of reliable and qualified human capital (M= 4.8259)’, ‘unemployment and absence of labour market access equitably (M=4.5224)’, ‘public and private institution weaknesses (M=4.2537)’ and ‘inconsistencies in the cost of urban

infrastructure and investment imbalance (M=4.1013)’ and ranked 1st, 2nd, 3rd and 4th correspondingly (see table 4.3). In corroboration with the study of Muhammed, *et al.*, (2022), the existence of unreliable and qualified human capital at best, and absence of human capital at worst remains a challenge to the developmental stride of Abuja metropolis.

Environmental Barriers

Table 4.4: Descriptive Statistics for Environmental Barriers

FACTORS	Mean	SD
Absence of resource sharing with respect to financial and social distributions	4.5224	.50075
Inefficient holistic approach sustainable environment	4.3284	1.31211
Waste management inefficiency	3.7463	.96969
Imbalance of the population growth triggered by environment changes	3.7463	.96969
Increased pollution level	3.1194	1.45453
Climate change	3.1194	1.45453
Loss of natural habitat and biodiversity	3.1045	1.26255
Insufficient knowledge of ICT usage in energy consumption	2.1940	1.83498

Source: Authors Field Survey, (2023)

For the environmental barriers, the study results showed the topmost factors militating against Smart-city development projects in Abuja Capital City included ‘absence of resource sharing with respect to financial and social distributions (M=4.5224)’, ‘inefficient holistic approach to sustainable environment (M=4.3284)’,

‘waste management inefficiency (M= 3.7463)’ and ‘imbalance of the population growth triggered by environment changes (M=3.4463)’, and ranked 1st, 2nd, 3rd and 4th correspondingly (see Table 4.4). This outcome corroborates with the study of Ramadhan, *et al.* (2022), which stated that absence of resource sharing with

respect to financial and social distributions, inhibits the performances of the construction professionals and the

need to bring about sustainable smart-city development in Nigeria and above metropolis.

General Governance Barriers

Table 4.5: Descriptive Statistics for General Governance Barriers

FACTORS	Mean	SD
Insufficient capacity	4.8259	.38017
Absence of support due the lack of political will	4.6766	.60819
Absence of project management	4.5224	.50075
Absence of opportunities for engagement	4.4478	.49851
Inefficient knowledge of IT amongst urban planners	4.3284	1.31211
Absence of transparency and trust	4.1045	1.42970
Conflict of interest and lack of agreement	3.6716	.90644
Absence of performance measuring standards	3.5970	.91749
Level of government support for e-procurement uptake	3.3284	1.31211
Lack of planning owing to ineffective vision and strategy	3.3284	1.31211
Absence of data governance	3.2537	1.24109
Absence of capacity/ training	3.1194	1.45453
Absence of requisite regulations and legislations	2.8955	1.37624
Inefficient operational capabilities	2.1940	1.83498
Inequities of policies	1.8955	1.67154

Source: Authors Field Survey, (2023)

The general governance barriers militating against the development of smart-city projects in Abuja capital city showed the topmost factors as ‘insufficient capacity (M=4.8259)’, ‘absence of support due the lack of political will (M=4.6766)’, ‘absence of project management (M=4.5224)’ and ‘absence of opportunities for engagement (M=4.4478)’, thus, are

ranked 1st, 2nd, 3rd and 4th correspondingly (see table 4.5). In line with the outcomes of the studies of Akinwamide, *et al.*, (2022) and Usman & Ibrahim (2016), capacity development remains a development challenge that has triggered the requisite performance level of the construction professionals in Abuja metropolis.

Urban Governance Barriers

Table 4.6: Descriptive Statistics for Urban Governance Barriers

FACTORS	Mean	SD
Technological Infrastructure Deficit	4.5274	1.07261
Deterioration of the Physical Infrastructure	4.5224	.50075
Technological Obsolescence	4.1045	1.42970
Prevalence of Vendor locking	3.7463	.96969
Absence of Data Integration	3.0448	1.37949
Absence of efficient data management system in the face of huge data	3.0299	1.35244
Inefficient Quality of ICT-based services	2.0448	1.67421

Source: Authors Field Survey, (2023)

For the urban governance barriers militating against smart city development projects in Abuja capital city, this study

revealed the topmost factors as ‘technological infrastructure deficit (M=4.5274)’, ‘deterioration of the

physical infrastructure (M=4.5224)' and 'technological obsolescence (M=4.1045)' are ranked 1st, 2nd and 3rd correspondingly (see table 4.6). The study results align with Ogunmakinde & Umeh (2018), study which stated need for technological advancement as key for the performances of the construction sector the world over. This is further corroborated with the studies of Söderström, 2021; Das & Zhang, 2021; and Ahad, *et. al*, 2020, which stated technological development as important to the success of the smart city development project. The study also aligned with the position of other scholars which declared that the absence of adoption of advanced technologies including building information modelling (BIM) (Franz & Messner, 2019), drones (Hayajneh, *et. al.*, 2016), internet of things (Pardini, *et al.*, 2020; Enotse, *et. al.*, 2022) and so on, would reduce the capacity of the construction professionals to reach the smart-city development goals.

CONCLUSION AND RECOMMENDATIONS

Despite the adoption of Smart-cities by many nations as a contemporary city development project option, the same cannot be said of Nigeria amidst rising population and surge to her city areas. Aside Lagos, the former capital of Nigeria, there is observably a slow growth of smart-cities in Nigeria's Federal Capital city-Abuja in spite of massive agglomeration by people seeking for better economic conditions. This study has examined the barriers of smart-city development projects in Abuja and also assessed the level of smart-city development project knowledge-base amongst Abuja capital city developers. The study reveals that social barriers, economic barriers, environmental

barriers, general governance barriers, and urban governance barriers are the inherent factors militating against the development of smart-cities in Abuja capital city. The study concludes that digital divide ranked most amongst social barriers; absence of reliable and qualified human capital ranked most for economic barriers; absence of resource sharing ranked most for environmental barriers; insufficient capacity ranked most for general governance barriers; whereas technological infrastructure deficit ranked most for urban governance barriers.

This study recommends governments intervention by providing advanced digital technologies, exposure of construction professionals to advanced technologies, efficient and reliable power supply, and a bridge to critical technological infrastructure deficit that would accelerate smart-city development in Abuja capital city. This study is however, limited to the five area councils of the Federal Capital territory, namely; Gawagwalada, Bwari, Abaji, Kuje and Municipal. Further research on barriers of smart-city development is suggested in the six geo-political zones of Nigeria for a more nation-wide study of this subject.

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