

Characterisation of Critical Infrastructure Organisation in Nigeria

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ABSTRACT: *This paper presents the characterisation of critical infrastructures in Nigeria as an initial step towards development of a framework for the uniform designation of an infrastructure as a Critical National Infrastructure (CNI) in Nigeria. Notably, there is no globally acceptable criteria for the designation of an infrastructure as Critical National Infrastructure (CNI) or CNII. However, there is a consensus that CNIs are vital for a modern society, and drives economic growths and national prosperity. Although there are similarities in such infrastructures worldwide, every nation determines the value to attach to each CNI depending on its developmental goal, priorities and the level of dependency on such infrastructure. In Nigeria, there is no publicly available information on the categorisation of infrastructures as CNI or CNII. The mythological approach adopted was document scan, analysis and synthesis of publicly available information on CNI and CNII of some selected countries, followed by a comparative analysis. Five countries were selected from each of the six continents based on population size and adoption of Information and Communications Technology (ICT). The findings revealed that about 90% of the countries studied categorised energy, transportation, water, communications and health as sectors of CNI. Conceptually, based on the outcome, CNIs in Nigeria were characterised into twelve critical sectors. This initial study forms the first step towards development of a framework for the correct designation of an infrastructure as a CNII in Nigeria as opposed to arbitrary designation.*

Keywords: Critical National Infrastructure, Critical National Information Infrastructure, Critical Sectors, Analysis, Interdependence.

I. INTRODUCTION

Infrastructures can be seen as facilities, systems, services or resources that can be built, generated and maintained by an individual, organization or government appropriate for operation of sectors and production of goods and services [1][2]. An infrastructure can be physical or virtual and relevant to economic prosperity and general wellbeing of the society. Consequently, an infrastructure is considered to be critical if its obstruction or malfunction can affect national security, economic prosperity and wellbeing of the citizens [3][4]. In some cases, most of the infrastructures spread across an entire

country and thus can be considered to be Critical National Infrastructure (CNI). This work is sponsored by TETFund¹

The characterization of CNIs is increasing due to rapid urbanization and population growth, and is becoming a key requirement for the development of any modern society and the economy [1][5]. Although there are similarities in such infrastructures globally, every nation determines the value to attach to each infrastructure depending on its developmental goal, priorities and the level of dependency on such infrastructure. Several countries identified Electricity, Telecommunications, Water, Transportation, Health, Education as Critical Infrastructure (CI). Twelve countries categorised food, financial services and civil administration as CS. As a first step to the development of framework for the proper and transparent designation of an infrastructure as CNII in Nigeria, a comparative study of how other countries categorised their Critical Sectors (CS) is then imperative.

Thus, this paper presents comparative analysis of classification of CS in selected countries, which helped in the formal categorisation of CS in furtherance to ongoing research to develop a framework for the correct designation of an infrastructure, service or a function as CNII as opposed to uninformed designation. In conducting this research, five countries were selected from each of the six continents according to population size as well as level of adoption of Information and Communications Technology (ICT). The findings show that over 90% of the countries studied categorised energy, transportation, water, communications and health as sectors of CNI. Likewise, thirteen countries categorised food, financial services and civil administration as CNI. Conceptually, based on the insights gained from the characterisation of these critical sectors, and consideration to environmental factors, CNIs in Nigeria are grouped into twelve critical sectors, and organisations are allotted to these sectors accordingly. The basis for aligning sectorial organisations is based on their similarities, functions, operations or services in Nigeria. The insights into categorisation of sectors, and consequently alignment of organisations can stimulate a better understanding of sectorial issues relating to cybersecurity, and how to protect such CNII organisations based on sectorial peculiarities. This initial study forms the first step towards

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development of a framework for the proper designation of an infrastructure as a CNII in Nigeria as opposed to uninformed approach.

The rest of the paper is organized as follows: section 2 presents related works. Section 3 presents the methodology. Section 4 compares critical sectors in selected countries. Section 5 characterises the CNI in Nigeria, and Section 6 discusses the identified CNIs. Section 7 contains the conclusion and recommendations.

II. RELATED WORKS

Critical infrastructure, critical sector, critical national infrastructure, critical national information infrastructure are all buzzer words in the lexicon in attempt to describe infrastructural structures germane to modern way of living. These words are used in many literatures interchangeably, and in some cases are confounding. Consequently, scanning through relevant literatures relating to the subject matter became necessary. In [6], Saladin stated the obvious inadequate protection of electrical power in Nigeria and recommended for the development of a framework for suitable protection of power sector facilities as a critical sector. This study concentrated on power sector alone and restricted to the city of Abuja, the Federal Capital Territory (FCT). In [7], five countries i.e. Australia, Canada, New Zealand, United Kingdom and United States agreed to have a common understanding on critical infrastructures as it can affect economic growths. The authors established that the success of modern economies and national prosperity hinge on well-organised and effective functioning of critical infrastructures.

Between 2010 and 2013, in an attempt to understand vital infrastructures in Nigeria, African Development Bank Group (AfDB), commissioned a study that investigated the then current state of infrastructures in Nigeria. Four sectors i.e. Transportation, Water and Sanitation, Electric Power, and ICT were studied [8]. The findings exposed the unacceptable condition of these infrastructures, and made recommendations as to need to upgrade the infrastructures to serve Nigerians. The intolerable state was attributed to government's neglect and lack of national policy on the protection and sustainability of such critical infrastructures of national importance.

The Nigeria Security and Civil Defence Corps (NSCDC) act as amended in the NSCDC ACT 2007, mandates the organisation to protect CNI and its assets [9]. In the act, infrastructures such as oil pipe lines, power transmission lines and waterboard pipes were emphasised as vital infrastructures that require special protections. However, there is no publicly available information on this subject matter even at NSCDC public website [10], this obviously has some implications to the state.

III. METHODOLOGY

Firstly, we scanned critical infrastructure relevant documents from selected countries in six continents based on population size [11] and level of ICT adoption. Secondly, the documents were filtered and minimum of five countries from

each continent were selected. Thirdly, synthesis and comparative analysis of the CS of these selected countries were carried out in order to situate and reflect the global characterisation of CS. The selection was based on the countries that their CNI are in the public domain. The CNI of all the countries studied were analysed in-depth, followed by brainstorm session of the research team and selected Subject Matter Experts (SME), which aided in the characterisation and conceptualisation of critical sectors contextually in Nigeria.

IV. COMPARATIVE VIEW OF CRITICAL SECTORS IN SELECTED COUNTRIES

Table 1 shows the status of critical infrastructures in each of the selected countries studied. The USA topped the table with 18 designated infrastructural sectors, followed by India with 12 sectors, that is a margin of 6. Other countries including Ghana, France, Estonia, Germany and Malaysia have 10 each. In addition, Cuba recognised 2 sectors, and in Nigeria, there was no publicly available information. Based on the comparative analysis, most developed countries identified energy, transportation, water, health, finance, food (agriculture), ICT and civil administration as CNI sectors. Equally, energy, transportation and water top the list. It was further exposed that some countries are yet to appropriately designate CNI sectors.

Table 1: CNI in Selected Countries

Country	No. of sectors
United State of America (USA)	18
India	12
Ghana	11
South Africa	11
Malaysia	10
Germany	10
Estonia	10
France	10
Canada	10
United Kingdom (UK)	9
Japan	8
Spain	8
Australia	8
China	7
Mexico	7
Kenya	5
Egypt	4
Bahamas	4
Brazil	4
Colombia	4
Fiji	4
South Island	4
Indonesia	3
Argentina	3
Peru	3
Venezuela	3
Cuba	2
P. New Guinea	1
New Zealand	1
Nigeria	0

Figure 1 shows the ranking of the countries based on the number of designated critical infrastructure sectors. It shows that Nigeria has no publicly available information on the characterisation and designation of any such critical sectors. Although, these infrastructures do exist in Nigeria, the unavailability of such information in the public domain may have some socio-economic implications. In [12], the Industry Working Group (IWG) setup by the Nigerian Communications Commission (NCC), reported that Telecommunication infrastructure should be designated as CNI

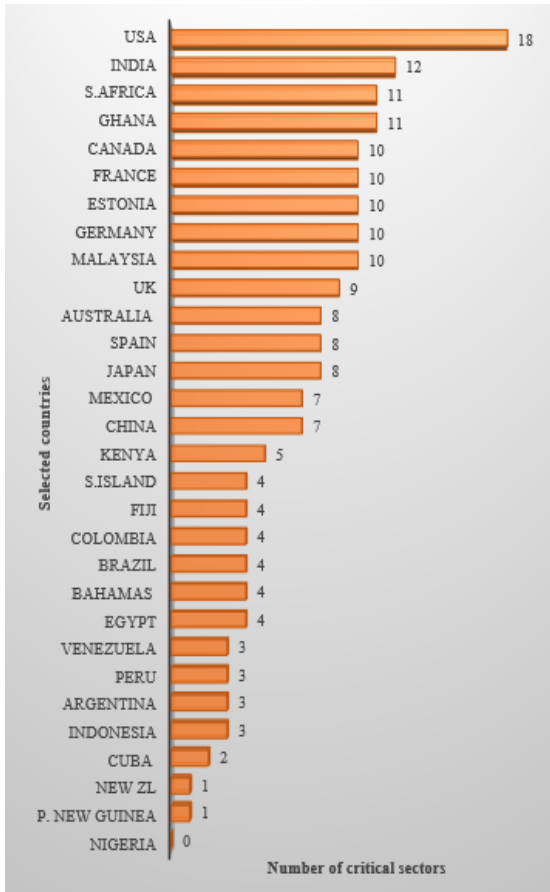


Figure 1: Numbers of Sectors per country

V. CHARACTERISATION OF CNI IN NIGERIA

Table 2 shows the sectors of CNIs and number of countries that adopt such sector as critical sector. Figure 2 shows a chart of sectors and number of countries that designated such particular CNI, depicting table 2.

The effort to characterise critical infrastructure sectors in Nigeria took into consideration environmental factors, similarity of operations amongst other criteria. Furthermore, the product of the comparative analysis of selected countries combined with the environmental factors aided in the

characterisation and conceptualisation of 12 critical sectors in Nigeria.

The sectors are: Energy, Transport, Information Technology, Water, Health, Education, Finance, Food and Agriculture, Security and Safety, Communication and Media, Industry and Commerce, and Auxiliary sector. These are the sectors that the

Table 2: CNI Categorisation

Sector	No. of Countries
Energy	27
Transportation	25
Water	24
Health	16
ICT	13
Food	13
Financial	13
Civil Admin	12
Communications	8
Pub/Legal/Order	5
Defense	5
Info. Tech.	4
Emergency Services	4
Manufacturing	4
Safety	3
Irrigation	2
Chemical	2
Nuclear	1
Dams	1
Mining & Tourism	1
Postal/Shipping	1
Nat. Monument	1
E - Govt.	1
Space & Research	1
Rescue Services	1
Industry	1
Strategic Facilities	1
Comm. Facilities	1
Info. & Culture	1
Cybersecurity	1

effect of not paying enough attention to by the government is already affecting the wellbeing of the people. The Auxiliary sector, is crafted to cater for critical infrastructure that its affiliation to other sectors proved difficult to justify. Figure 3 depicts the proposed sectors in Nigeria. Each sector has subsectors and organisations, which are cautiously allotted based on relevance in operation. For instance, the Energy sector has Oil and Gas, Electricity, Renewable Energy as well as MDAs that play in such sectors. This characterisation will put Nigeria ahead of Ghana and South Africa.

VI. DISCUSSIONS

It can be subscribed that there is a consensus that critical infrastructure is vital for a contemporary society, especially in this so much touted digital environment. Undoubtedly, it drives economic growths, national prosperity and general wellbeing

of citizens amongst others. Furthermore, it can be alluded that there exist similarities in such infrastructures amongst nation states worldwide, yet there are no globally acceptable criteria for uniform designation or alignment of organisations to such sectors. Consequently, the onus is in every country to fashion out the factors for determining critical sectors and alignment. One such factor may be the value attached to a critical infrastructure, which is likely to be based on developmental goals, priorities and the level of dependency on such infrastructure. In Nigeria, there is no such publicly available information on the categorisation of critical infrastructure, and sectors can be said to be arbitrarily defined. Thus, the characterisation and designation of Critical National Information Infrastructure (CNII), can be extended based on defined criteria, metrics and indicators in order to have a uniform classification. Consequently, the formalisation of critical sectors categorisation has become imperative due to unabating cyber threats, and the risks. It will help in direct and focused protection strategy that is sectorial based.

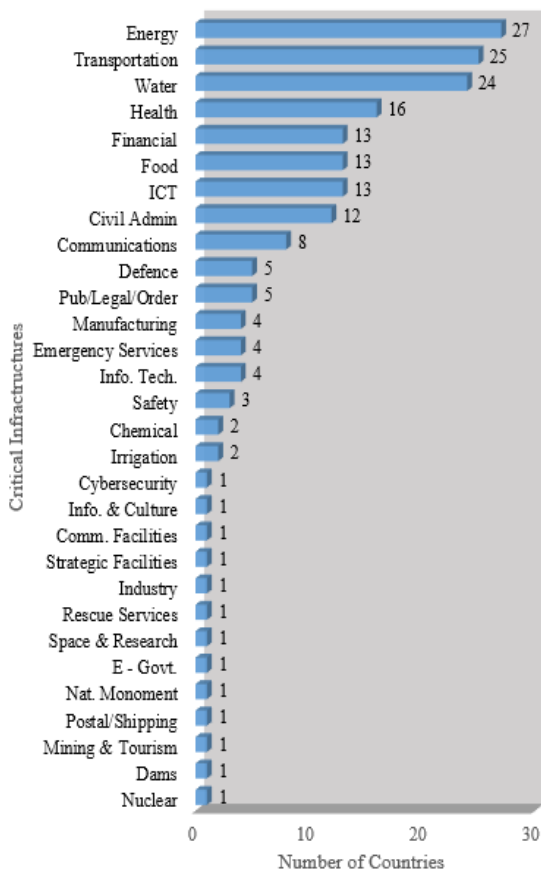


Figure 2: Critical Infrastructure Sectors and Number of countries

VII. CONCLUSION AND RECOMMENDATION

Critical infrastructure has become a prime target to cyberattacks. The risks associated with ineffective or uncoordinated efforts to protect these assets termed critical can adversely affect the nation in terms of

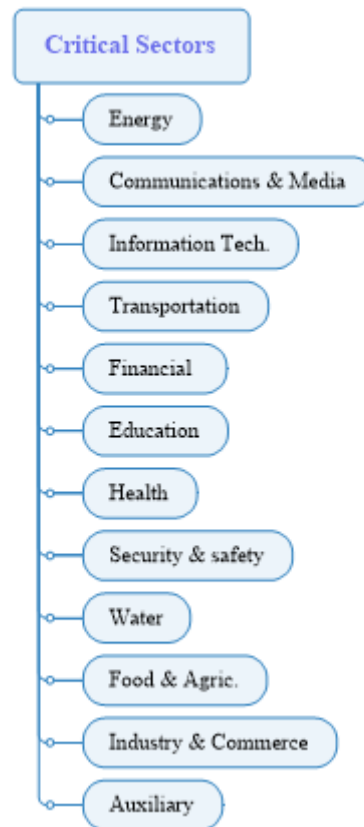


Figure 3: Conceptual CNII category in Nigeria

economic prosperity, national security and the wellbeing of ordinary citizens. In the growing scarcity of resources, it is impossible to apply the same level of protection to all assets. This research has proposed a formal way to categorise CNII in a well-defined structure in Nigeria. This is significant in order to focus national effort in a well-coordinated protection of CNII against malicious interests. It is strongly recommended that the government take cybersecurity threats very seriously, as deliberate and targeted attacks against critical sectors may be very devastating to the country.

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