UNCONNECTED TO GLOBAL NETWORK: THE EFFECTS OF INFRASTRUCTURAL DEFICIT IN SUB-SAHARAN AFRICA

Dr. Simeon E. Ifere
Department of Business Administration
University of Lagos
Akoka - Lagos
E-mail: **sifere@unilag.edu.ng**
Tel: 00234 (0) 8033144937

Dr. Richard B. Nyuur*
Department of Entrepreneurship, Innovation and Strategy
Newcastle Business School, Northumbria University,
City Campus East 1, Newcastle Upon Tyne
NE1 8ST, United Kingdom
Tel: +44 (0) 191 227 3336
Email: richard.nyuur@northumbria.ac.uk

Professor Joseph Amankwah-Amoah
Kent Business School, University of Kent,
Chatham, Kent ME4 4TE
TEL: +44 (0) 1634 (88)8870
E-mail: J.Amankwah-Amoah@kent.ac.uk

Dr Chinedu Ochie
Department of Entrepreneurship, Innovation and Strategy,
Newcastle Business School, Northumbria University,
City Campus East 1, Newcastle Upon Tyne
NE1 8ST, UK
Email: c.ochie@northumbria.ac.uk

***Corresponding author**

Abstract

Anchored in resource-based and institutional theories, this study examines how small-and medium-sized enterprises' (SMEs) activities are constrained and hindered from connecting to the global value chain. Specifically, we examine how domestic firms mobilize their innovative capabilities to respond to firms-level and market constraints. Drawing on a sample of 29 managers and owners of manufacturing SMEs in Nigeria, we uncovered that frequent power outages impose difficult additional cost and operational challenges which impeded their operational competitiveness for regional and global competition. We shed light on how resources-deficits and infrastructural impediments impact SMEs' operational activities and curtail their market competitiveness on the global stage. Further theoretical and practical implications are discussed.

Keywords: Africa; value chains; digitalisation, resources-deficits; innovative capabilities; SMEs.

Introduction

Economic liberalization, privatization and increasing technology adoption have ushered in new competitiveness within industries across the global south (Amankwah-Amoah et al., 2019; Osei et al., 2019). The international business and strategy literature has documented an array of challenges confronting emerging economies such as poor education system, inadequate information disclosures, and weak market supporting structures for business development (Peng, 2002; Peng, Sun, Pinkham & Chen, 2009). These challenges have prompted policymakers and government agencies to explore ways to power new ventures and established firms to be able to thrive in such resource-constrained and institutionally voided environments. These efforts have helped some domestic firms to become better connected to the global economy. Yet, many firms which seek to become connected or aligned to established global firms in their industries, remain largely unconnected and thus miss the essential opportunity to develop new capabilities and learn from other firms to improve their market competitiveness. Despite the potential opportunities to connect to the global economy, and growing streams of research on the global value chain (GVC) framework (De Marchi, Di Maria, Golini, Perri, 2020; Kano, Tsang & Yeung, 2020), there remain limited insights as to why many developing-country SMEs' remains unconnected to the global networks.

Although some studies have examined institutional constraints in determining outcomes of firms in emerging economies (Amankwah-Amoah et al., 2019; Peng et al., 2009; Peng, 2002), there is still insufficient analysis on how domestic firms navigate around these voids to maintain their survival. This is particularly important given that overcoming these challenges are crucial in enhancing their ability to leverage digital solutions and connect to the global value chains, a vital element in scaling up firms' operations and enabling them to develop capabilities. Kano et al. (2020) thus emphasised that more systematic research attention into firms' activities at this micro foundation level is required to enrich and advance the GVC research agenda.

Against this background, the purpose of this study is to examine how domestic firms navigate around institutional voids and resource impediments. Our study contributes to this literature by employing both the resource difference hypothesis (Barney, 1991; Barney & Clark, 2007) and institutional differences hypothesis (North, 1990; Peng, 2002; Julian & Ofori-Dankwa, 2013) to examine how domestic firms mobilize their innovative capabilities to respond to firms-level and market constraints.

The rest of the paper proceeds as follows. First, a review of the literature on institutions, resources and global value chains (GVCs) is presented followed by description of the methodology adopted for the study. The findings are presented and discussed. This leads to the implications of the study and conclusion.

Theoretical underpinning: institutions and resources

The global value chain (GVC) framework highlights the importance of institutional context in the development of firms and in upgrading their activities (Fernandez-Stark & Gereffi, 2019). Accordingly, institutional contexts shape how firms respond to threats and opportunities as well as innovate (Fernandez-Stark & Gereffi, 2019). As defined by North (1990:3), institutions denote "the rules of the game in a society or, more formally, are the humanly devised constraints that shape

human interaction." The institutional framework includes formal constraints such as regulatory barriers, laws and regulations and informal constraints such as culture, customs and behaviors (North, 1990; Peng, 2002; Julian & Ofori-Dankwa, 2013). Viewing constraints faced by firms from institutional perspective suggest that formal factors (i.e., political rules and regulations) and informal factors such as norms, are outside the firm through which managers have limited control and influence to curtail or shape them to their advantage. The institutional arrangements can confirm or deny legitimacy to an organization and its strategic actions (Child, & Tsai, 2005; Peng et al., 2009). Indeed, legitimacy is a vital resource for organizations operating and competing in resource- and institutionally constrained environments (Amankwah-Amoah & Debrah, 2017; Nyuur et al., 2016). The lack or weak enforcement of laws and regulations can underpin the motivations for organizations to adhere to strict regulatory and environmental standards (Child & Tsai, 2005). Similarly, these features can also motivate firms to seek creative ways to innovate or organize their operations in ways that turn the constraints into opportunities (Adomako et al., 2019).

Another important stream of research is the resource difference hypothesis, which contends that variation in firm performance and action can be attributed to the unique resources and expertise possessed by the organization (Barney, 2001). This resource difference hypothesis asserts that firms' market competitiveness can be explained by unique ways through which the firm acquires and deploys valuable tangible and intangible resources, and capabilities (Ray, Barney & Muhanna, 2004). The tangible resources include physical resources (e.g., firm's plant, raw materials and equipment), technological resources (e.g., patents and trademarks) (Barney, 1991; Barney & Clark, 2007; Hitt, Ireland & Hoskisson, 2020). On the other hand, intangible resources include things such as Human Resources (e.g., firm market and local knowledge, unique processes and routines) and innovation resources (such as ideas and scientific capabilities), and reputational resources (including ties and reputation with customers and brand name) (Barney & Clark, 2007; Hitt et al., 2020; Hall, 1992). Taken together, at the organizational level and institutional level, a host of factors are likely to interact to shape firms' response and effects of the environment.

The GVC framework further provides an understanding of how value is created, captured, sustained, and leveraged within and across all types of firms, industries and geographical locations (Chen, 2019; Gereffi and Lee, 2016). The bottom-up perspective of GVC explains how individual firms as critical actors might climb the value chain from various manufacturing activities particularly in countries of institutional weakness (De Marchi et al., 2020). Weak institutions tend to impede knowledge transformation into innovative products and processes within firms (Jean, 2014). Nevertheless, firms' strategic responses and activities could help them overcome challenges and capture more or higher value. This may involve the introduction of improved production approaches or sophisticated products (Sako & Zylberberg, 2017) as well as leveraging the spread of information and communication technologies (Kano et al., 2020). Digital economy in particular has become an engine of economic growth (Tang, 2021; UNCTD, 2019a) and for greater participation in GVCs by companies (Li et al, 2020; Strange & Zucchella 2017; Tang 2021). Notably, companies participating in GVC are leveraging on novel digital technologies including IoT, and cloud computing in expanding and enhancing their value creation through collaborative ecosystem rather than a simple on linear value chains approaches (Frederick et al, 2018; Li et al, 2020; Strange & Zucchella 2017; Zeidy, 2020).

In the context of Africa, poor infrastructure, weak institutions, and difficulties in nurturing knowledge-based economy especially in the higher value stages of manufacturing and or services are suggested to be constraining firms' participation and contribution to GVCs (Zeidy, 2020). The European Investment Bank (EIB) (2021) for instance highlight that, an estimated 900 million people in Africa are still not connected to the internet, and for those that are even connected, about 29% (360 million) of the youth population (18–24-year-olds) have no access to high-speed internet and are excluded from the emerging digital technology. The EIB (2021) report further indicates that the continent's average broadband penetration remains low at only 39% and in some countries, 3G remains the main access technology. In other words, more access to internet, robust and upgraded technology is required in the continent for the upgrading and scaling up of firms' innovation and

manufacturing activities (EIB, 2021; Zeidy, 2020). Another significant challenge inhibiting firms' contribution to the GVCs is the unstable power supply in many African countries. According to the EIB (2021: 10), Africa's mobile telecom operators are "facing difficulties in powering their existing networks due to unreliable power supplies and heavy reliance on expensive and diesel generator power which pollutes the environment". Based on these situations in Africa, we seek to explore how SMEs mobilize their innovative capabilities and manage their strategic operations to respond to these constraints and contribute to the GVCs.

Methodology

The research context.

The research context is Nigeria, an emerging economy, with the biggest economy in Africa (Bloomberg, 2020; Amankwah-Amoah, Nyuur, & Ifere, 2017) and projected to be the 14th largest global economy by 2050 (PWC, 2017). Besides, Nigeria is Africa's most populated country with about 208 million people and is estimated that the country will be the third most populous country in the world by 2050 (IMF, 15 March 2018; Ochie, 2019). Moreover, Nigeria is endowed with abundant natural and human resources (Azolukwam & Perkins, 2009; Oseghale et al., 2018), and tends to attract substantial interests and investments from multinational corporations (MNCs) (Amankwah-Amoah, Ifere, & Nyuur, 2017). Nevertheless, Nigeria's economic development and business operations are particularly affected by political instability, insecurity, weak institutions, poor infrastructure, and corruption (Adegbite et al, 2020; Azolukwam & Perkins, 2009; Nakpodia et al, 2018).

It is argued that inadequate and erratic power supply for transportation, manufacturing and household use is one of the most apparent setbacks of the Nigerian economy. Ifere (2013) notes that transportation in Nigeria runs completely on petroleum products and both firms and households depend virtually on petroleum products rather than electricity for their energy needs. Firms in the country see inadequate electricity infrastructure as the most significant challenge they face, and

attribute competitive disadvantage of goods manufactured in the country to the high cost resulting from self-generated electricity (Gerald, 2001). About 86% of firms, including SMEs, run operations with their own electricity generators, which accounts for over 40% of the production cost. Aside from business, less than 45 percent of the population has access to the national grid and less than 57% has access to electricity in 2018 (Quadri, 2018) and below 56% has access to electricity in 2019 (World Bank, 2019).

Power generation (production of electricity), transmission (high voltage, long distance), and distribution (low voltage, local networks) were undertaken by the government until persistent inadequate and erratic power supply over decades led to the commercialization of the government power monopoly (National Electric Power Authority - NEPA) in 1989 and renamed Power Holding Company (PHCN). According to the Bureau of Public Enterprises (BPE, 2020a/b), the government agency charged with privatising public enterprises, the PHCN was partially privatised in 2005 and electricity generation and distribution were unbundled. As a result, 60 percent of assets for generation and distribution were sold to private firms, consisting of 6 generating firms and 11 distribution firms respectively, while the government retained 40 percent equity interest. Management contracting-out model was adopted for transmission and outsourced to a Canadian firm – Manitoba. However, these firms operated as State Owned Enterprises (SOEs) from 2006 to 2013 when the successful bidders took over their operations. The key objective of the power sector's reform was to engender greater participation by citizens in resolving the national electricity challenge. It was also expected that the reforms would stimulate competition, enhance efficiency and lead to adequate provision of electricity to the citizenry (BPE, 2019b).

The outcome of the reforms seems counterintuitive for a number of reasons. More power is generated than supplied to consumers because investment and transformation of the transmission and distribution systems were lagging behind generation (BPE, 2020), and as Bardhan (1990) and Datta-Chaudhri (1990) note, investments are often not successful if they are not coordinated with

other related investments. For example, an investment in an electricity generating plant requires corresponding investment in transmission and distribution networks to be successful. The former chairman of the Nigeria Electricity Regulation Commission (NERC), Sam Amadi, argues that the privatisation of the power sector was designed to fail because the power assets were sold to investors who lacked the financial and technical capacity (BPE, 2020b). The unsuccessful outcome is also attributed to government regulations through the Nigeria Electricity Regulatory Commission (NERC), lack of metering equipment, and skills gap (Quadri, 2018). This background makes Nigeria the appropriate context to examine how SMEs mobilize their innovative capabilities to respond to the constraints of erratic power supply and connect to the value chain in order to survive and compete.

Sampling and data collection

Considering the lack of research on this issue, a qualitative inductive approach was employed in this study to ensure a detailed exploration and in-depth analysis of how infrequent electricity supply inhibits firms' value chain operations and connectedness, and the type of dynamic capabilities firms develop to stay competitive.

We used a variety of methods to contact and access managers and owners of manufacturing SMEs including through small-business associations, direct approach, social networks and snowballing. We then selected manufacturing small and medium enterprises that rely on value chain activities in their manufacturing operations. Nevertheless, we purposefully focused on SMEs that are manufacturing different products to obtain multiple perspectives on their experiences and responses to erratic electricity supply. One of the researchers made contacts with manufacturing SMEs in the country and solicited their involvement in this study. Considering the topic of the research and the experiences these firms were going through, there was a positive response from managers and owners of SMEs. We initially identified a total of 55 SMEs as potential participants but ended up interviewing 29 SMEs that were willing and made time to participate in the study.

The actual primary data collection took place between June 2020 and December 2020. This consisted of semi-structured interviews as consistent with most inductive research (Gephart, 2013; Gioia et al., 2013). We therefore interviewed managers and owners of manufacturing SMEs to ensure the generation of reliable responses as they are the key decision makers of their firms (Taylor & Helfat, 2009). Before every interview, each participant was assured of their anonymity and the sole purpose of the data collection, in order to obtain their consent for participation. Guided by our interview protocol, we asked respondents questions developed a priori and those that emerged as interviews unfolded (William & Shepherd, 2016). The main questions centred on the background of the firms, and the nature of products they manufacture. Next, we explored with them about the nature and frequency of electricity supply for their firms' operations and how that affected their production activities and general business operations. This was to help us uncover the extent to which infrequent electricity supply limits their ability to connect fully to their value chains and operate fully. Finally, we sought their views regarding their strategic responses to overcome the liability of erratic electricity supply and remain competitive. All the interviews were conducted in Lagos by one of the authors, audio recorded and transcribed. Each interview lasted between 45 minutes to 1 hour on average. We complemented these interviews with secondary data from different sources such as news articles, press releases, and media reports. Besides, some informants shared things like organisational documents, reports, and business plans. These secondary sources ensured triangulation of the data and enhanced the validity of our findings (Denzin & Lincoln, 2011; Yin, 2009). Table 1 depicts an overview of the sample firms and the respondents.

Insert Table 1 about here

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Data analysis

In analysing our transcribed primary and secondary data, we followed the approach described by Gioia, Corley and Hamilton (2013), and successfully used by recent studies (Huy, Corley, & Kraatz, 2014; Sonenshein, 2014). It is a thematic analytical approach (Braun & Clarke, 2006) involving structured coding processes and reflecting established theoretical constructs (Strauss & Corbin, 1998; Zimmermann et al., 2018).

Our data analysis was systematic and iterative as is common in inductive research and overlapped with the actual data collection. Our analysis further progressed through three main phases - first-order categories, second-order categories, and the main themes (Gioia, Corley, and Hamilton, 2013). The first phase of the thematic analysis involves openly coding keywords reflecting respondents' views of the nature of electricity supply and how that influences their firms' manufacturing and operational activities. During this phase, we allowed the data to speak to us and through this process our initial codes emerged, covering a range of topics. These initial codes covered a range of topics, including the very frequent power outage, unreliable and less dependable electricity supply, and so forth. These enabled us to develop our initial classification as the first-order codes. These codes depict the prevailing nature of electricity supply for business operations in Nigeria. Following the first-order codes, we further explored the dataset and observed statements around the consequences or impact of the erratic electricity supply on their operations and value chain connections. Furthermore, views about SMEs responses to the erratic electric supply were also coded. These views on the impact were coded into higher-order themes and formed our second-order themes. Finally, these second-order themes were further abstracted into higher-order conceptual and theoretical dimensions in the third phase. Overall, four overarching conceptual and theoretical dimensions emerged in this final third phase and formed the foundation of our model. Through the iterations between data and extant theory, inferences, and refinements, we developed the theoretical framework and contribution of this study. Table 2 and Figure 1 below depict the coding frame/processes used in our data analysis.

Insert Table 2 about here

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Findings

The data analysis yielded key themes around the nature of electricity supply and the associated impact on business operations, the cost implications, and the various strategic responses deployed by SMEs to ensure continuous operations, competitiveness, and connections to their value chains. We first discuss the nature of electricity supply and the implication for their value chains and digitalisation. All the respondents revealed that electricity supply for manufacturing and general business operations is a big problem and used terms such as "erratic, irregular, unreliable, epileptic, unstable, and non-standard" among others to describe the nature of power supply. They emphasised the frequency of power outages which tends to disrupt manufacturing activities as one of the greatest challenges to businesses in the country. Accordingly, there could be steady electricity for two to six hours and then goes off suddenly to be switched on again later in the day. At times, the electricity gets switched back on the following day or a few days later. One of the informants explained that:

> "*intermittent power outages are very frequent … there could be electricity say between 8.00am to 9.00am which suddenly goes off to be restored before 10.00am… The outage could also occur between 7.00am to 8.00am and be restored later… and then between 2.00pm to 3.00pm, another electricity failure could occur again to be restored around 4.00pm or 5.00pm*" [RESP B].

Other respondents similarly explained that:

> *"Electricity supply is very poor and unreliable…. The frequency of power outages is very high…On average electricity availability could be just 2 hours in a day…and sometimes there will be no power for business operations for a whole week".* [RESP C].

"The frequency of power outages is high, sometimes it could take up to one month before it is restored… This week there has been no light… Averagely, there will be only 4 months of supply and 8 months of power outage in a year." [RESP D].

Insert Figure 1 about here

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For all the respondents, the erratic nature of power supply leads to high cost of operations. The bills tend to be very high. Besides, many respondents indicated the additional cost they incur in procuring and maintaining alternative sources of power. There is also a high cost associated with buying fuel to operate the generators and other alternative sources of electricity generation for the manufacturing activities. These together increase the operating costs of SMEs, reduce their profits, and make them less competitive. One of the informants [RESP C] told us that "we use industrial meters, and the bills are terrible… There is also the additional cost of securing the armoured cables from criminals. Efforts have been made to secure a 500kva transformer which is expensive, and the problem persists". Two other informants further revealed that:

"The cost of repairing the generator is enormous, and that adds to the high cost of production, which is not good for business." [RESP B]

The cost is huge and many of us are losing businesses because of the cost of running generators and other alternative energy sources. [RESP G]

As we interrogated our dataset, we observed that our informants further had concerns about the quality of the electricity supply and the impact on both the machines and the operational activities. Accordingly, the public electricity supply is characterised by voltage volatility which causes damage to machines and other equipment. Both high and low voltages damage most of the electrical components of the automated machines and lead to partial or total breakdown of the production processes. One informant highlighted that "most of our machines are 3 phases and when there is

supply for 2-phase instead of 3-phase, we cannot work … the voltage may be too high or too low which damages a lot of the machines" [RESP G]. The frequent and sudden power outage coupled with the volatile voltage affect operational times negatively especially for systems that are programmed. The memory of the control system of such automated machines may take time to be reprogrammed, thereby impeding digitalisation, and losing useful working hours. Besides, "it causes a lot of down time and makes turnaround time slow and reduces productivity" [RESP X]. Another informant reinforced this saying:

> *At times, the voltage will be stable, at times very low and at other times the voltage will be very high… this destroys the machines especially the automatic and programmed ones…the memory of the control system of such automated machines get affect …. takes time to reconfigure and leads to the loss of useful working hours*. [RESP C]

For those SMEs processing perishable goods, the lack of reliable and stable electricity to preserve them leads to such inputs or products perishing. When generators are used to solve this problem, they also cause both noise and air pollution. Taken together, the above depicts the nature of the electricity situation in the research context and the impact on SME manufacturing operations and competitiveness. We posit that, the immensity of these challenges, inhibit manufacturing SMEs capability to fully develop and adequately connect with their GVCs. Moreover, it impedes efforts towards digitalisation of their value chain operations, since digitalization relies heavily on reliable and stable electricity supply. These SMEs therefore had to develop strategic responses and interventions in order to reduce the impact of unreliable and stable energy supply and remain competitive. These strategic responses provided a platform to develop the appropriate capability and enhance the propensity to connect and digitise their value chains. We uncovered four main dimensions that informants deployed as appropriate strategic responses. These major dimensions that emerged from our analysis of the data are reported in the sections below.

Manufacturing SMEs' strategic responses to electricity supply challenges

Developing a dual approach to electricity supply

One of the main strategic responses deployed by manufacturing SMEs to deal with the chronic power failure and the impact on their business operations is the adoption of a dual and in some cases multiple approaches to support their energy needs and power generation from the national grid. Informants described how they had to acquire various alternative sources of energy including the procurement of standby generators, transformers, solar panels, inverters, etc. These served as backup power sources to facilitate the continuation of manufacturing activities in the event of power failure. One of the informants emphasised that "because most of the machines are industrial, we cannot work without electricity and so we use other alternatives like generators and inventers" [RESP Q]. Other informants further highlighted that they procured the alternative energy sources to supply power when there is power failure by stating that:

> *Our first response was to buy a generator as backup and finally decided to use only a generator to ensure that we work without disruption…For the past five years, we have been running on generators only, to have confidence to meet our customers' orders*. [RESP G]

> *We have built our own fuel stations… and don't face the problem of diesel scarcity for our (electricity) generators anymore because we reserve from the diesel we sell in our station for our use in the plant*. [RESP J].

> *We have been forced to switch to the use of an inverter and solar systems for power supply and they are very effective and efficient*. [RESP Q].

The deployment of alternative energy sources is to also ensure that machines and other equipment are not damaged, and that the firms are able to automate, connect with their value chains and produce to meet customer demands. For instance, a respondent emphasised that "Due to frequent and

inconsistent power supply, there were serious damages to our machines and maintenance was very expensive… so, the company disconnected itself from the national power grid entirely and are operating the company solely on our generators" [RESP B]. These dual approaches to meeting the energy needs enable manufacturing SMEs to timely meet their customer orders. We therefore posit that procuring alternative power sources provide operational stability for these firms and accentuate their ability to meaningfully connect with their value chains as well pursue digitalization of their value chain activities in order to be more competitive and scale up their operations. Base on this we propose that:

> **Proposition 1:** *The adoption of dual/multiple energy sources provide stabilising capability for manufacturing SMEs and enhance their propensity to connect and digitalize their value chain activities.*

Costs and down-time minimisation strategies

Our dataset revealed that the procurement of alternative energy sources, their operation and maintenance added another layer of costs that affected their profitability and competitiveness. Besides, there are operational failures resulting from the erratic power supply leading to things like delay in production, low output, and low sales. As a result, many manufacturing SMEs introduced several strategic interventions in order to reduce the cost burden, operational failures and enhance their opportunity to survive and remain in operation. Some of these strategic interventions include the reduction of overheads through staff layoffs, procuring cheap raw materials, buying from international competitors to resell, and using traditional or manual machines that do not require the use of electricity. For instance, an informant opined that "in response to the high cost and operational challenges, we reduced the overhead cost by laying off some of our staff… and reduced

staff salary by about 20%... as well as sourcing cheap raw materials for production" [RESP B]. Some other informants narrated that:

> *Because of the operational challenges due to the power outage and the high cost of energy, many businesses are beginning to import finished products from outside the country instead of actually producing them here in Nigeria… that's why China with low-cost products has an advantage*. [RESP G]

> *Sometimes we use local remedies like charcoal iron and manual machines that can be used with or without electricity and reduces our cost of operation*. [RESP Q].

By adopting these strategies, SMEs are able to manage the cost burden of their operations imposed by the procurement of alternative sources of energy to stabilise their manufacturing activities. Arguably, stabilising the manufacturing activities enable SMEs to develop and sustain connection with their value chain activities. These firms also reconfigure their value chain connections to those that will relieve the level of burden. Besides, by laying off staff to minimise cost, SMEs may further pursue digitalisation of their value chain activities to remain competitive. Based on the above we posit that:

> **Proposition 2:** *SMEs deploy cost and down-time minimisation strategies to sustain their value chain connection and enhance digitalisation*.

Technological improvement for stabilizing power

During our data collection and analysis, we were struck by the level of technological improvements SMEs made to sustain the power supply. Indeed, many SMEs installed new technology systems to steady the voltage which causes damage to equipment and the breakdown of operations when volatile. Some of these technological improvements include the procurement and installation of transformers, stabilizers, uninterrupted power supply (UPS), synchronising panels, control panels with circuit breakers, change over boxes, and other safety devices. Others replaced all sockets with new power surge sockets to achieve the same objective. The installation of these systems ensures

that interruption of power supply is minimised and helps reduce the risk of any equipment from getting damaged due to power surge or volatility. An informant explained this situation by stating that "we bought a transformer … to avoid the low voltage…. So, there is nothing like low voltage for us, when there is light (power), it is stable [RESP F]. Another respondent highlighted that "we use synchronising panels which regulate the amount of voltage… to avoid spark from the high tension [RESP D]. Besides these, other informants supported these narratives by stating that:

> *We have installed safety devices to protect machines in the factory… the devices trip off the electricity supply when the voltage is low or there is a surge*. [RESP H].

> *We use electric bulbs (for each phase) to detect when there is low voltage, high voltage or no light (power)… we also use a power alarm to know when power goes off. [RESP J]*

> *We installed stabilizers and circuit-breakers on our equipment in case the voltage is low or too high. [RESP T]*

Other manufacturing SMEs however actively engage with the national power generation agency officials to discuss how they can help provide some level of stable electricity on a regular basis for their operations. For instance, an informant revealed that "we used to inform PHCN that the voltage is low, and sometimes they would respond [RESP D]. This approach, however, has not fully resolved the occurring volatile power supply situation and the impact on SMEs operations. We therefore argue that the installation of digital technological improvements allowed them to have a stable power supply for business operations. The regularity and stability of the power supply also enable manufacturing SMEs to connect with their value chains meaningfully and appropriately. Furthermore, stable electricity supply accentuates SMEs ability and capability to further digitalise their value chain activities. Based on this argument, we propose that:

> **Proposition 3:** *The deployment of technological improvement influences manufacturing SMEs ability to effectively connect with and digitalise their value chain operations.*

On-and-off with speed strategy

Furthermore, we found that reconfiguring operational processes constituted another strategic response in minimising the impact of power outage on unintended operational shutdowns and down times. Some of these activities involved performing routine checks and constantly servicing machines to prevent sudden operational failure. Machines are reprogrammed at standardised operational speed to ensure that they shut down properly when there is sudden power failure. Some manufacturing SMEs further reschedule their operational activities to ensure that staff are fully deployed to focus on manufacturing when electricity is provided, and then swiftly switched to other tasks such as sorting and packaging when the power suddenly shuts down. Staff are therefore organised to multitask daily in order to ensure operational efficiency and reduce costs as well. For instance, two informants revealed that "we reduced the number of staff and used the same personnel for the production and packaging process [RESP X]. This enhances efficiency in operation and enables us to meet targets and reduce breakdown time" [RESP W]. Another respondent further explained that:

> *Machines are programmed at standard operational speed limit and the procedure timed using UPS so that the machines can shut down properly during power failure; … we also reconfigure our operational schedules so that manual activities are done when the electricity is shut down; … thereby maximizing labour productivity by multi-tasking of staff*. [RESP C].
>
> *Our engineers are always available to immediately fix the generator if there is a fault*. [RESP S].

This operational flexibility enables manufacturing SMEs to maximise production capacity and still meet production targets. The approach further allows SMEs to circumvent the full impact of a sudden power failure and flexibly connect with their value chains. It also provides space for flexible digitalisation of their operations and value chain activities. Based on the above, we propose that:

> **Proposition 4:** *SMEs adoption of on-and-off with speed strategy during power outage enhances their value chain connectedness and digitalisation capabilities.*

Discussion, implications and conclusion

In this paper, we examined how domestic firms mobilize their innovative capabilities to respond to firms-level and market constraints. Although questions on how institutional weaknesses and infrastructural deficit affect business operations in general (Kano et al., 2020), we do not yet know how manufacturing SMEs respond to these challenges. Using insights from 29 managers and owners of manufacturing SMEs in Nigeria, the study uncovered that electricity supply for industrial operation is unreliable, erratic, and prone to voltage surge. The frequent power outages impose difficult operational challenges and high-cost implications requiring flexible strategic responses to manage. Our study makes three main contributions. First, the study shed light on the nature of infrastructural deficit in the form of power outage, the impact on manufacturing SMEs operational activities, and the strategic responses deployed to overcome the challenges and pursue value chain connectedness and digitalisation. Specifically, we demonstrate how infrastructural deficits in terms of infrequent electricity supply risks hamper the potentials of manufacturing SMEs from being connected to the digital GVCs and value derived from that. Our study also responds to earlier calls more robust research attention into firms' activities at this micro foundation level to enrich and advance the GVC research agenda (Kano et al., 2020).

Second, our study contributes to the GVC framework, the bottom-up perspective and the institutional theoretical lens (Chen, 2019; De Marchi et al., 2020; Gereffi and Lee, 2016), by demonstrating how infrastructural deficits in a weak institutional setting reduce the prospects of SMEs scaling up their digitalisation activities, and at the same time trigger automation of certain operational activities in such weak institutional settings to overcome the constraints and climb the value chain. The study therefore unpacked four main strategic responses deployed by manufacturing SMEs to survive the challenges, enhance their value chain connectedness and digitalisation. These strategies include developing a dual approach to electricity supply; costs and time minimisation strategies; technological improvement and supplier engagement; and on-and-off strategic flexibility

with speed. Based on this, we develop a framework through which SMEs overcome macro institutional challenges.

Finally, our paper contributes to the resource differential perspective (Barney, 2001) by demonstrating how SMEs with different resource and capability levels deploy different strategic and operational responses to address the constraints. Moreover, the study further enriches both the global value chain and digitalisation literature by highlighting the strategies SMEs creatively and flexibly deploy under conditions of environmental challenges to remain connected or reconnect with their GVCs. Besides, the findings offer insights regarding how SMEs strategically stabilise their operational activities in turbulent circumstances in order to develop and upscale their digitisation capabilities.

The findings of the study also have practical implications. Notably, they provide practical strategic responses that SMEs in Nigeria and in other similar weak institutional contexts can deploy to overcome environmental challenges and connect to GVCs as well as survive. Besides, the findings demonstrate the importance of governments providing stable and uninterrupted electricity or institutional support systems to empower entrepreneurs and their business operations. By doing so, SMEs cost of operations will reduce, and they would be able to effectively connect with their value chains and be more competitive. Despite these important findings, there are a number of limitations. First, the study is based on one country and therefore, suffers from generalisability to other settings. Further studies in different settings and perhaps using different methodological approaches would help enhance our understanding.

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Table 1: Sample firms, sector, and respondents

Respondent	**Year**	**Sector**	**Respondent**
Resp-A	2019	Manufacturing of Clothes	Teaching fashion & garment construction
Resp- B	1992	Manufacturing of Clothes/fashion	Accounts Officer & business developer
Resp-C	1950	Paper manufacturing	Engineering manager
Resp-D	1997	Manufacturing of Pharmaceutical products	Managing Director
Resp-E	1970	Manufacturing - liquid detergent solutions	Factory manager
Resp-F	2007	Manufacturing - Trucks & Fuel tanks.	MD/CEO
Resp-G	1992	Manufacturing - Steel manufacturing	MD/CEO
Resp-H	1980	Manufacturing - Bakery, poultry & poultry feeds.	Owner/MD
Resp-I	1980	Manufacturing - general goods	General Manager
Resp-J	1990	Manufacturing - Trucks & Fuel tanks.	MD
Resp-K	2010	Oil & Gas depot - Nitrogen gas manufacturing	Team lead in control room
Resp-L	2012	Manufacturing - Fashion design	General manager
Resp-M	1991	Manufacturing - Wood sawmill	General Manager
Resp-N	1993	Manufacturing - furniture (doors, chairs, beds, etc)	Owner & Chief carpenter
Resp-O	2010	Manufacturing of metal gates, doors, cages	Owner/MD
Resp-P	2015	Manufacturing - fashion design	Owner/MD
Resp-Q	2012	Manufacturing - Fashion industry	CEO
Resp-R	2007	Manufacturing - Bakery	Owner/Chief caterer & baker
Resp-S	2017	Manufacturing - water	Branch manager
Resp-T	2016	Manufacturing	Owner/MD
Resp-U	2014	Manufacturing	Owner/CEO
Resp-V	2014	Manufacturing - Furniture making	CEO/MD
Resp-W	2005	Manufacturing - Nitrogen Plant (oil & gas servicing)	General manager
Resp-X	2001	Manufacturing - Pharmaceutical manufacturing firm	Chairman/CEO
Resp-Y	2015	Business incubation centre -Manufacturer of cosmetics, food & inverters	CEO
Resp-Z	2002	Manufacturing and Installation	CEO
Resp-AA	2016	Manufacturing - Clothing (Fashion industry)	MD
Resp-AB	2015	Manufacturing - Clothing	owner - Manager
Resp-AC	2012	Services - Laundry	Secretary to the owner /CEO

Figure 1: Framework and pathways of resolving the impact of power outage through strategic response.

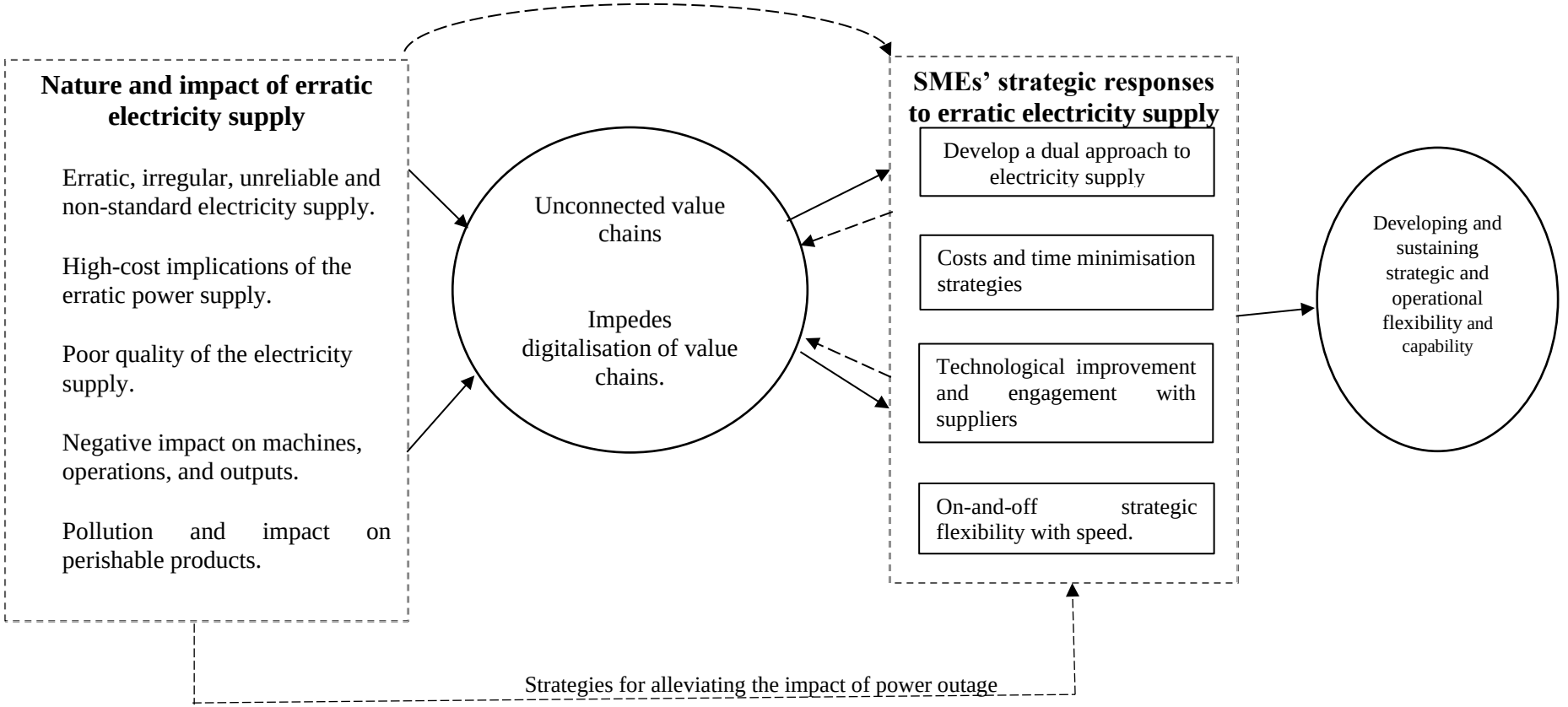

Table 2. Coding frame used in our data analysis.

First order themes Nature of electricity supply and impact on business operations	Second Order themes SMEs' strategic responses	Overarching Dimensions (Main themes)
▪ Electricity supply is epileptic, erratic, irregular, not up to the standard, and not reliable for industrial use. ▪ Power is more frequently off on a daily basis, than is on. ▪ Electricity is provided only between 3 to 6 hours a day and there will be no power for the rest of the day, and sometimes no supply for up to 2 days. ▪ Power outage is regular and not stable - more times of no supply than there is supply. ▪ Electricity is mostly supplied during the night; it is minimal in the day.	▪ Dual approach to energy supply by using alternative sources of power supply- through the acquisition of generators, transformers, solar panels, inverters, etc. ▪ Established company's own electricity generation based on gas and diesel. ▪ Disconnected completely from the public power grid entirely.	**Developing a dual approach to electricity supply** Swiftly look for alternatives to ensure that production is not stalled.
▪ It increases cost of production through the acquisition and use of alternative energy sources – e.g., generator, solar panels, invertors, transformers, control stabilizers, and other equipment e.g., fuse etc. ▪ We are forced to spend so much on buying fuel for generators and maintenance of generator and other alternative energy sources. ▪ Use industrial meters and the effect of power outage is high - the bills are very high. ▪ There is also the additional cost of securing the armoured cables from criminals.	▪ Import finished products from other countries like China to meet demand and maintain good customer relations. ▪ Reduction of overhead cost by laying off staff, reduction of staff salary by about 20%. ▪ Sourcing of cheap raw materials for production.	**Costs and time minimisation strategies**
▪ The quality of the electricity is low (available current is very volatile and not uniform). ▪ The high and low voltage damage most of the electrical components of the automated machines. ▪ There is poor electricity distribution and operation. ▪ There is poor response time from the electricity authorities.	▪ Acquisition of stabilizers; acquisition of control panels with circuit breakers; use of electric bulbs (for different phases) to detect low voltage to prevent damage to equipment. ▪ Meet with the power officials to discuss how they can help provide some level of electricity on a regular basis. ▪ Complain and redistribute the lines.	**Technological improvement and supplier engagement**
▪ It hinders the proper functioning of machines and electrical appliances. ▪ Sudden and frequent power outages negatively affect and reduce the operational time especially for systems that are programmed. ▪ It leads to partial or total breakdown of the smooth running of the production process and might affect the memory of the control system of our automated machines. ▪ It takes time to reconfigure (reset) the machines (reconfiguration) after a sudden power outage, thereby losing useful working hours. ▪ Delay in production, low output, low sales etc. For our response,	▪ Minimise down hours by constantly maintaining machines and doing routine checks. ▪ Maximise the use of power- by only doing jobs that do not require power during shut down e.g., quality control, sorting, packaging. ▪ Downsizing or making the workers more efficient- few doing the work of many (multi-tasking) to save operation cost. ▪ Use of stabilizers e.g., UPS for the machines to shut down properly during power failure.	**On and off with speed** ***Strategic flexibility*** *Swift switch as a Dynamic Capability*

Table 3. Summary of themes and representative quotations by the firms.

Main themes on SMEs' strategic responses to erratic electricity supply
Develop a dual approach to electricity supply ▪ *We have been experiencing erratic power supply and we have made alternative arrangements to support by investing in a Diesel Generating Set… we make Diesel Generator our main stay for production. However, we also do a combination of power from the national grid and Diesel Generator.* [RESP E] ▪ *We purchased (electricity) generators – 1 x 250 KVA, 1 x 350 KVA, 2 x 500 KVA and 1 x 600 KVA…. We also bought transformers together with cables and poles to help ease the erratic power supply.* [RESP F]
Costs and time minimisation strategies ▪ *We have diverted our operations to the importation of raw materials (as input for steel products) and into farming… because electricity is not much needed in farming.* [RESP G] ▪ *We have adopted the use of mini electric iron that works with generator and consumes low voltage for the purpose of ironing clothes.* [RESP A]
Technological improvement and supplier engagement ▪ *We bought transformer for NEPA (DISCO) to avoid low voltage… so there is nothing like low voltage for us, if there is light (power), it is stable*. - [RESP F] ▪ *Use of synchronising panels which regulate the amount of voltage; … RMU- Ring Mean Unit, a safety devise to avoid spark from the high tension*. - [RESP D] ▪ *We have installed safety devices to protect machines in the factory… the devices trip off electricity supply when the voltage is low or there is a surge*. - [RESP H]
On and off strategic flexibility with speed. ▪ *We use creative ways of managing the business… we try to become more efficient in the use of power by scheduling or arranging the work that need power to when the generator is on, and those tasks that do not require no power, to when the generator is shut down; ... We also ensure reduction of down time by making the workers more efficient etc.* - [RESP C] ▪ *We have standby generators for production when there is sudden power outage… and also have extra working hours for staff to meet the day's target.* - [RESP D] ▪ *We have realised that power is switched on in the evening times… so sometimes, we close late so that we can do some work with the electricity.* - [RESP O]

- *We always try to prevent operational failures because of power so our generator is always serviced. We have a standby technician in case of such issue.* - [RESP S]