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Electricity Sector Reform: Sourcing and Cost Management of Electricity for Steel Manufacturing in Nigeria

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This is to certify that the doctoral study by

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Abstract

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MBA, University of Nigeria, 2005

B. Eng., University of Nigeria, 1988

Doctoral Study Submitted in Partial Fulfillment

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Abstract

In 2014, Lazard levelized cost of energy analysis model priced diesel powered systems at $0.225 – $0.404/KWh and a range of $0.165 – $0.242/KWh for gas-powered systems. The model gave a range of $0.28 – $0.33/kWh for diesel and a range of $0.14/kWh – $0.16/kW for gas fired. Nigeria has an abundance of gas reserves, but heavy gas flaring by oil companies perpetuates power failure across Nigeria. What has resulted is an unreliable electricity infrastructure and a high cost of alternative energy. The Electricity Power Sector Reform Act of 2005 started the reform process. Guided by decision theory, the purpose of this multiple case study was to understand the perceptions of business leaders at the steel manufacturing businesses on how the use of multiple supply sources of electricity might lead to survival, growth, and profitability. The study's population consisted of 10 steel manufacturing companies in the Southwest region of Nigeria. The data were collected via semistructured interviews with the leaders who source energy, a review of archival records, and observations of company officials placing orders from multiple sources. The van Kaam method of data analysis generated 5 themes: cost of generating electricity and the investment in alternative sources of energy, erratic power supply and its impact on the steel production industry, quality of power supply relative to the capacity and its impact on profits, electricity factor in the steel production process, and use of multiple sources. These findings may contribute to social change by increasing employment opportunities for members of the local community, who will have an enhanced understanding about steel and seize entrepreneurial opportunities.

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Dedication

I dedicate this study to God Almighty for inspiration and sususstenance, and to Karen Chioma, Kennedy Chukwuka, Adrian Chineme and Christopher Chinedu, for the encouragement, support, and sacrifices.

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Section 1: Foundation of the Study

The transformation of Nigeria's electricity industry occurred in the early 1980s. The state had owned and operated the industry in the form of monopolistic enterprises. The transformation led to private ownership. Consequently, the structure, ownership, and administration of the industry companies rested in the hands of such private entities (Makwe, Akinwale, & Atoyebi, 2012). Electricity distribution entities in Lagos and other major cities constituted a challenge to reformers (Lionel, 2013). One of the challenges was how to stabilize corporate revenues and power supply in those major markets. The relationship between those two factors necessitated bold attempts on the part of energy and government authorities (Transmission Company of Nigeria [TCN], 2013; Udah, 2012). A critical assessment revealed no connection between the fiscal exposure of the companies and the end-of-year financial balances (Makwe et al., 2012). Ehinomen and Adeleke's (2012) investigation of Nigeria's energy business growth noted positive signs that might arise from multiple-source energy.

Over a half of countries in Europe have embraced reform in the industry since 1980 (Erdogdu, 2014; Kessides, 2012). Chile, for instance, pioneered the reform trend in 1982 with advanced and developing countries following their lead to tinker with their own electricity supply industries. However, Pollitt (2012) reviewed reform in the electricity sector and concluded that it did not depend on movement from one type of energy to another but on the ability of the societies to bear the expected higher cost, no matter the extent of the reform. Brophy Haney and Pollitt (2013a) further pointed out that

after over 20 years of reform in the electricity sector, governments remained relevant and active in energy development, as the reforms remained works-in-progress.

Background of the Study

Preuninger (2014) underscored the importance of electricity in all facets of life and specifically in deciding locations for manufacturing industries. This industry decision process identified electricity cost as a primary factor, next in importance to that of personnel for many companies. Consequently, according to Frederick and Asamoah (2014), a shortage of electricity, as in interruption frequencies, interruption duration, and load-shedding caused damages to industries. Erdogdu (2013) asserted that above factors resulted from government-restricted participation, limited funding, and poor management, which led to reform of the sector. Reform started in Chile in 1982 and later in the United Kingdom in 1989 (Galetoric & Munoz, 2011; Kanellakis, Martinopoulos, & Zachariadis, 2013). In Nigeria, the long process of reform started with the enactment of the Electricity Power Sector Reform Act of 2005.

The key objective of this study was to explore how steel business leaders could take advantage of electricity sector reform in managing sources and cost of electricity in Nigeria. The possible direct result of this study could be higher business profit by incorporating advantages from electricity supply reform in electricity source options, which could lead to expansion or growth. The social impact of this reform would be general economic growth and more jobs for Nigerian citizens.

Problem Statement

Business production and efficiency in Nigeria suffered due to unreliable electricity infrastructure and the high cost of alternative energy, (Alby, Dethier, & Straub, 2013). Fifty-nine percent of small business owners suffered heavy financial losses of over five hours of electricity per day (Alby et al., 2013; Ehinomen & Adeleke, 2012). The general business problem was that a deficient prereform electricity supply structure was hindering manufacturing business leaders from attaining bottom lines of production and profit. The specific business problem was that some steel manufacturing business leaders in Nigeria lacked electricity-sourcing strategies to attain an optimal mix of public and alternative sources of electricity for the survival, growth, and profitability of their companies.

Purpose Statement

The purpose of this qualitative multiple case study was to explore electricity sourcing strategies that steel manufacturing business leaders in Nigeria used to attain an optimal mix in of public and alternative sources of electricity for survival, growth, and profitability. The target population for the study consisted of business leaders in companies in the steel manufacturing sector that used multiple sources of electricity supply for five consecutive years. The geographic location was the western region of Nigeria. Contributions of this study would include discussion of gains or losses from energy reform. Alleviation of supply stresses and profitability for steel business executives and others might result from uninterruptible electricity. The results from the study might also lead to improvements in cost management and the prices of steel goods

might also drop. The implications for positive social change include (a) the potential to improve economic wealth and strengthen the industrial base of the Nigerian society; (b) the growth of direct and indirect business start-ups; (c) job creation; and (d) improved efficiency, productivity, and profitability of the industry businesses. Also, there might be a positive effect on Nigerian society in the form of good health arising from the availability of affordable manufactured goods and services, and increased job opportunities.

Nature of the Study

The research methodology for this study was qualitative. The qualitative methodology involved seeking perceptions of appropriate individuals. Such perceptions enable researchers to understand specific descriptions of participant experience on the subject of a study (Richards & Morse, 2012). With a qualitative methodology, exploration of specifics was possible on the optimal mix of electricity sources on steel manufacturing businesses. The search for business leader perception on the interface of source mix and profitability was especially critical following reform in the electricity sector. Qualitative method was, therefore, the choice methodology.

The design for this research study was a multiple case study involving three steel manufacturing concerns. Case studies involve the approach of digging deep in the process of investigation (Houghton, Casey, Shaw, & Murphy, 2013). Interviews are also common features of case studies, though a researcher could combine interviews with other techniques. This design engenders comparison scenarios of multiple study loci. Under the circumstances of this study, the interviews consisted of open-ended questions

in semistructured atmospheres. Participants consisted of business leaders from the steel manufacturing industry.

Research Question

The research question of this qualitative multi-case study was:

RQ: How might the sources of electricity supply lead to the survival, growth, and profitability of steel manufacturing businesses in Nigeria?

Interview Questions

The following interview questions elicited responses towards answering the research question:

1. How did electricity supply source interface with the survival of your steel manufacturing business?
2. What did you do, as a business leader, when the volume of steel business operations shrank because of electricity supply?
3. How appropriate was the public to private electricity supply for your manufacturing business?
4. What strategy did you implement to ensure a profitable mix of electricity supply for business survival and growth?
5. How did your business strategy specifically affect each of the variables, survival, growth, or profitability?

Conceptual Framework

The conceptual framework of this qualitative case study was decision theory (DT) or option or optimization theory in which a combination of inputs can give the desired

outcome. North (1968) defined DT as a tool for deciding between options without full knowledge of the outcome but using available information to reach the best decision, which reduces the risk of failure of the outcome. North based his work on utility and probability theories in which value and chance of success interplay. DT originated earlier from decision making (DM) studies that date back to mid-20th century, which Chester Barnard championed to replace "policy making and resource allocation" (Buchanan & O'Connel, 2006). It had the clear attribute of ending a process and starting another in the form of action. DT consequently emanated from DM, using other tools as *decision trees*. Ordering or weighing of options occurs in analytic hierarchy process (AHP) and multiple criteria decision analysis (MCDA). Analytic Network Process (ANP) is a tool for measuring how the options affect each other (Alexander, Walker, & Naim, 2014; Lester, 2012). Halpern, Pass, and Seeman (2013) focused on maximizing the output by optimizing the probable inputs. Conversely, Mohaghar, Shahriari, and Hasani (2015) related this probable input maximization to independent systems for managing constraint. Optimizing the use of available resources in alignment with Friedman's (1971) emphasis on weighted consumption over a period by customers, ensures desired output.

Regarding electricity systems, constraints subsisted in generator type, market price uncertainties, losses mitigation, and profit maximization (Nojavan, Zare, & Feyzi, 2013). The concept of this study involved using options management to control cost and maximize profit by steel business leaders. The associated problem of this low population multiple case study was that generalization might not be accurate to represent a larger population. The concept of theoretical generalization, in which outcome of investigation

applied to its population and other populations, might be a solution (Bradley & Terry, 1952; Tsang, 2013). Thus, the study of how steel business leaders managed electricity supply sources could follow a case study design. In such a circumstance, few cases applicable to other populations would suffice. Furthermore, a conceptual framework would hinge on a theory rather than as empirical or statistical generalizations.

Operational Definitions

The words below have ordinary dictionary meanings. However, in this study, the terms are defined as applicable to steel manufacturing and marketing rather than everyday usage. Definitions are, therefore, in context.

Distribution: The measurement and amount of units of electricity from each of the varied sources (Goffin, Raja, Claes, Szwejczewski, & Martinez, 2012).

Input cost risk: The level of uncertainty involved when a manufacturing concern spends on cost centers with which the organization's functionaries are not conversant (Viljainen, MakKonen, Goje, & Spodniak, (2012).

Policy: The decisions executives in the different manufacturing companies make regarding what percentage of electricity each source would contribute towards manufacturing (Eyre, 2013; Wisuttisak, 2012).

Price risk: The uncertainty of how to assign prices to the goods coming off of the production lines (Viljainen et al., 2012).

Project risk: The uncertainty surrounding the decision to embark on a new project or to add subsidiaries to existing projects (Viljainen et al., 2012).

Reform: Changes that take place internally or externally that affect the way steel manufacturing companies do business (Eyre, 2013).

Volume risk: The uncertainty about how to match the supply of electricity cost (from all combined sources) with the quantity of steel to roll out of the production line in order to achieve equilibrium and pursue profits (Viljainen et al., 2012).

Assumptions, Limitations, and Delimitations

Assumptions

Assumptions are facts considered true but lacking actual verification (Yin, 2014). Frederic, Di Bacco, and Lad (2012) clarified that researchers use assumptions that have not undergone tests. Therefore, the beliefs exist as noteworthy concepts. The assumptions here were that business leaders in the steel industry would be honest, their responses would mirror actual situations in the industry, and scholars would present the profitability scenarios in line with the real needs of the industry and their respective business organizations. Another assumption was that interviewees would have similar experiences within the same business segment.

Limitations

Limitations of a study consist of parameters a researcher cannot manipulate, thereby hindering the possibility of generalization (Hyett, Kenny, & Dickson-Swift, 2014). According to Marshall and Rossman (2014), researchers using the qualitative methodology understand and confirm areas of potential deficiency within the studies that take place. Therefore, using open-ended questions might seem to be the best approach. However, a confirmation is necessary as to the potential for insufficiency of findings.

Furthermore, a semistructured interview environment might be sufficiently appropriate. Therefore, the data collection technique would serve within the limitations of the used instrmunt. and methodology.

Delimitations

Research topics are characteristically broad, as much as researchers try to stay within the bounds of the topic. Delimitations enable a researcher to circumscribe the topic to identify the part of the subject matter that falls outside the bounds of the study (Yin, 2014). Therefore, this study did not delve into areas involving any other industry than steel. Individuals who worked in the steel industry but had not attained leadership status fell outside the perimeter of the study. Leaders of steel companies that had remained unprofitable also fell outside the scope of the study.

Significance of the Study

The survival of steel manufacturing companies was a necessity in Nigeria. Therefore, any study focusing on such organizations would draw the attention of others within the backward and forward integration of steel businesses in Nigeria. Beyond survival, the growth of the steel sector would signify a healthy construction industry, which is in the forward integration category. Profitability of steel companies would mean much to investors watching the Nigerian Stock Exchange.

Contribution to Business Practice

When steel companies report profits, buyers and sellers of manufacturing parts within that industry might witness business growth. Business practice within the steel industry might become stronger than it had hitherto been because business leaders within

the steel industry would distiguish success and failure factors for entrenching best practices that have resulted in survival, growth, and profitability. The responsibilities of business leaders within the industry begin with understanding the strategies that have led to survival, growth, and profitability, though they do not end there. An understanding of these strategies would be of primary importance to steel company leaders who have suffered losses.

Implications for Social Change

Steel is one of the pillars of Nigerian economy. Communities in which the raw materials exist spur social development across areas around them. Social change may arise from survival, growth, and profitability of steel businesses resulting from rasied awareness levels of successful electricity sourcing strategies. Communities will become more active than would otherwise be attainable. Nongovernmental organizations will have more activities geared towards families and children in the immediate and surrounding steel mining, refining, and finishing communities. These situations will lead to the effectiveness of business leaders, increase in job opportunities, support of local talents, and mobilization of community members for the greater good.

A Review of the Professional and Academic Literature

This literature review is the result of an examination of over 300 peer-reviewed academic, doctoral, professional, and government publications in the area of electricity sector reform, availability, cost, productivity, and profitability. Research into the survival, growth, and profitability of steel manufacturing businesses from the standpoint of electricity supply sources required an in-depth search of scholarly works. The interaction

of supply and demand cause changes in the price of electricity. As a cost center, electricity could come from different sources. Hydroelectric power centers, wind sources, solar panels, and refuse-conversion systems constitute potential search topics. These and other incidental search topics helped in finding sources for the study.

Electricity sector reform constitutes the lead concept for the literature search. Other elements are electricity sourcing, cost management, steel manufacturing, Nigerian steel sector, and other incidental subtopics that arose in the process of the literature search. Search locations included Business Source Premier, Walden University Library, Business Source Complete, Google Scholar, EBSCO Host, ProQuest, and ABI/INFORM. Initial literature consisted of 100 sources composed of peer-reviewed articles, a few books, Internet sources, and government publications. In line with university requirements, peer-reviewed articles accounted for 91% of the sources. Among those, 87% consisted of articles that will not be five years old by the completion of this investigation.

In the course of literature search, themes that have so far emerged from scholarly literature pertain to cost, leadership, productivity, market prices, profitability, national policy on energy, and sustainability of businesses

Sources supporting the study were of a status in the business environment related to the topic of this study. Ulrich's Periodicals Directory was a useful tool that allowed me to confirm the peer-review status of articles. Articles that did not contribute critical knowledge are absent from this study. This strategy was to make the research as current as possible.

Six articles pertained to the conceptual framework. Three articles were seminal and old while another three were works of modern scholars whose research studies hinged on aspects of the seminal works. With this structure, the ancient and modern nuances of the conceptual framework become applicable to the study and understandable to inquiring minds.

Theoretical Ramifications

Scholars have considered organizational perspectives in the choices business leaders make in piloting the affairs of their organizations (Bradley & Terry, 1952; Halpern et al., 2013). Decision theory provides a platform for comprehending the complexity of different sources of electricity supply in a geographic region such as Nigeria. The economic principles of supply and demand could address a steel company's need to manage sourcing of electricity from just one place.

Multiple sources exist for procuring electricity in modern Nigeria. Such multiple sources imply complex inputs and outputs that require strategic optimization (Mohaghar et al., 2015). Therefore, the principles of supply and demand would only partially address the subject of this study. As much as this investigation related to the demand and supply of electricity, the crux of the matter was why and how business leaders in the steel industry select the sources of electricity for manufacturing steel. Electricity sector reform constitutes the lead concept for the literature search. Other elements are electricity sourcing, cost management, steel manufacturing, and the Nigerian steel sector.

Conceptualizing the intricacies of multiple inputs and outputs along with cost structures associated with such multiplicities should be of interest to steel manufacturers

(Bradley & Terry, 1952). Attendant ramifications would include the pursuit of profitability, which would be abnormal under social service circumstances. Considering the different sources of electricity would mean dealing with independent elements that the different electricity sources represent. Managing those different sources would require theoretical grounding, such as dependence on the decision theory. Finally, cost considerations circumscribe the decision to select whichever sources would translate to organizational productivity at the lowest possible costs (Banks, 2012).

The Supply and Demand of Electricity

Electricity, as a type of energy needed for domestic, commercial, and industrial processes, became a subject of policy changes all over the world (Erdogdu, 2013; Brophy et al., 2013a). Due to the essential and expensive nature of energy, most countries bore the cost of energy for many years from the mid-19th century. However, changes occurred in economic fortunes, leading governments to source alternatives to the public domination of the energy sector (Brophy Haney & Pollitt, 2013b). Those changes pertained to increasing demands on resources of states by numerous needs such as healthcare, roads, education, and security. The high cost of electricity became unsustainable and probably contributed to the global financial crisis (Brophy et al., 2013a). Brophy et al. (2013a) further stated that this led to reform in the sector in the form of commercialization, liberalization, or outright privatization. Electricity sector reform varied since the early 1980s in Chile, and early 1990s in Europe. Throughout the developing countries, the reform varied in degree from the standard of total (privatization) to partial (liberalization/commercialization) reform. The variance

depended on the circumstance and capacity of the society to bear associated higher cost irrespective of the degree of the reform (Pollitt, 2012).

Original Structure and Performance

Electricity infrastructure provision is a capital-intensive endeavor. This capital intensity explains why from inception governments alone invested in electricity generation, transmission, distribution, and sales (Kessides, 2012). Meyer (2012) noted that the electricity industry was conventionally a monopolistic entity but for high funds needs for its operations, which necessitated the reform in its ownership structure. The question of efficiency of service starts with generation and delivery of service to the public. In the case of China, Gao and Van Biesebroeck (2014) observed 6% and 4% reductions in material and labor inputs respectively, which is a reflection of attainment of an objective of the reform. In the 1990s, according to Nepal and Jamasb (2012), the end of cold war and several institutional reforms joined with the prevailing electricity sector reform. However, Nepal and Jamasb concluded that the reform in the so-called transition countries (TEC) led to mixed outcomes such as incomplete reform with poor future prospects.

Electricity sector components—generation (electricity production), transmission (bulk transportation), distribution (retail transportation), and retailing (sales)—were separate in the reform. In Chile, the Electricity Law of 1982 separated the hitherto government-owned, vertically integrated utility into generation, transmission, and distribution (Kessides, 2012; Pollitt, 2012). In the case of transmission, it linked up both generation and distribution companies, implying that transmission remained under the

ownership of the government with the National Energy Commission regulating its use and charges. In Australia, according to Wu (2013), reform entailed the separation of the vertically integrated company into functional units, market restructuring, instituting regulatory framework, and privatization. For instance, Victoria State privatized all four parts, while others, such as Queensland, Western Australia, Tasmania, and Northern Territory, maintained the old ownership arrangement.

In some regions, the operating structure of the electricity sector reform could not occur in a vertical integration of companies (generation, transmission, distribution, and retail). In such a situation, the system would involve separate processes such as generation (opened up for the private investors participation), transmission and distribution (with expansion and use control), and retailing liberalized (Kessides, 2012). Whatever steel business operators would do must align with corporate and government policy. Furthermore, administrative ramifications must follow regulations. Other critical elements would include internal management of steel companies. Legal and ownership fundamentals must be in line with the reform objectives of the government. Unbundling would imply decentralization of the respective units with a high degree of autonomy (Filomena, Campos-Náñez, & Duffey, 2014). Based on the postulations of scholars such as Böckers and Heimeshoff (2014), Cervigni (2013), Eyre (2013), and Hoeller and Giorno (2012), the EU Electricity Market Directive of 1996 allowed legal unbundling of transmission and distribution. The European model effectively limited liberalization to generation and retailing. Another dimension to European reform was the introduction of green energy mechanism in the electricity market (Finon & Roques, 2013). Thus,

relatively early the incorporation of environmental factors deepened the European market.

The preceding review of operating conditions and structures of electricity utilities exposed the practices and variation in the electricity sector reforms worldwide. There is an assumption of complete unbundling of all electricity utilities worldwide as an accepted model of reform (Nillesen, Pollitt, & Witteler, 2014). Furthermore, an assumption exists that the reforms and prices are determinable by the market forces of demand and supply. Electricity is an energy resource needed for numerous purposes. Electricity is indispensable in domestic, commercial, and industrial endeavors. This high impotance was the reason for involvement of the government of countries in its production, pricing and distribution from its discovery (Kessides, 2012; Pollitt, 2012). The issues about ownership structure, efficiency, pricing, and capacity arose over the years. This part of the literature review consequently traces the original concepts of generation (or manufacturing) of electricity and pricing on one hand, and reform as introduced now and pricing/competitiveness on the other.

Origin, Reasons, and Trends of Reform

Eberhard and Shkaratan (2012), Kessides (2012), and Pollitt (2012) reviewed the issues relating to poor electricity or inadequacy of electricity supply in developing countries (DCs) and articulated its economic impact of the societies. The researchers consequently dealt with the implications and recommended resource applications for efficiency improvements and combination of public and private suppliers to rescue the

situation, with implications for economic growth and developments because it reflects on the pricing of manufactured goods, which dependent on electricity cost as in the study.

Nepal and Jamasb (2012) reviewed progress and issues in electricity sector reforms worldwide. Variegated degrees of the issues and styles of the reforms were visible. Such variations included organizational structure changes, private investments, regulatory governance, and outright sale of the hitherto state-owned companies. These authors then noted differences that led to a challenge to get what optimal reform entailed. Rentizelas, Tolis, and Tatsiopoulos (2012) paid similar attention to investment ramifications. Nepal and Jamasb (2012) concluded that reform to a large degree is complex and gloomy, many years after its commencement in many countries. The investigators specifically noted the lack of clarity and progress in the market structure, workability, and predictability leading to interventions by governments.

Talosaga and Howell (2012) traced the history of reforms in New Zealand from the 1980s culminating in pricing crisis for sustainable generation of electricity. According to Talosaga and Howell, this led to the reversal of decentralization to achieve recentralization (trust ownership) with attendant instability in the sector. The conclusions contained revelations that creation of central regulator and self-governance structures in the electricity industry led to higher private investments that in turn led to the adoption of deregulated market mechanisms.

Doostizadeh and Ghasemi (2012) and Vilar, Cao, and Aneiros (2012) focused on the use of day-ahead pricing method to determine auction price in the electricity market in Spain based on nonparametric regression techniques. The researchers found that this

method permitted the use of a day's data to predict price in contrast to the dependence of 7 days' data by another method called ARIMA model. The ARIMA model reflected all available historical data discounted in the historical prices, using behavioral differences between large and small consumers instead of the cost estimate. Thus, day-ahead pricing helped in overcoming price capping at competitive (auction) ceiling prices by large operators using their market powers. Differences in pricing behavior between large and small generators became visible. Larger establishments were able to raise prices above competitive prices during peak hours subject to (and under the control of) the limitation of vertical integration. This occurrence is because large energy generators are also buyers in the market (Doostizadeh & Ghasemi, 2012; Vilar, Cao, & Aneiros, 2012).

Hoeller and Giorno (2012) dwelt on reforms in European Union's Stability and Growth Pact, which was all about structural reforms on budgetary and monetary policies. Using a simulation method, Hoeller and Giorno ascertained the impact of the reforms on employment and productivity. This finding necessitated questions about the size and cost of structural reforms; the long-term gain of the structural reforms; and the historical relationship between structural reforms and public finances. Holler and Giorno (2012) concluded that positive budgetary effect followed systematic structural reforms in the EU zone, depending on the type of reform, and its impact on employment and productivity. Without direct reference to electricity reform, their work's relevance is to the extent of discussing the effect of all kinds of reforms, including in the electricity sector. I shall focus the current study on reform about electricity sector.

Tasdoven, Fiedler, and Garayev (2012) focusing on two key reasons for the reform in the electricity sector (higher efficiency and lower prices) revealed the effect of energy theft in Turkey. According to them, out of 4.8 million subscribers of electricity, 196,000 were illegal (non-paying) customers in 2008. Tasdoven et al. identified government agencies as the highest defaulters. The researchers recommended economic regulation (control of entry and exit), privatization (involvement of private profit-making organizations), information dissemination and enlightenment, and use of grants to third parties to perform a function without government interference. Tasdoven et al. concluded that governance tools as listed above were necessary as part of the market structure of a reformed electricity market in Turkey. The above research applies to the forthcoming study in the area of pricing because the lower the number of paying customers, the more the unit price of electricity for the same volume of dispatched energy.

Outcomes and Results of Electricity Sector Reform

The electricity sector reform in over 70 countries of the world started 1982 in Chile with UK leading as Kessides (2012) earlier indicated. Several authors gave an account of the situation with the reform in different countries. Gao and Van Biesebroeck (2014) also traced the commencement of reform in the electricity sector in Australia and Victoria region in particular since the 1980s. Gao and Van Biesebroeck observed that reasons for the reform were that of engendering competitiveness and improving efficiency that implied transfer of risk to investing companies and freeing of resources for other government services. Gao & Van Biesebroeck concluded that there was a rise in efficiency and cost of operations fell compared to state-owned entities. Levels of debts

and interest payments reduced in addition to expenditures that dropped leading to budget surpluses and higher GDP.

Joskow and Wolfram (2012) dwelt on pricing in reformed electricity sector with U.S. in focus. The researchers believed that prices should follow the demand and supply pattern in the sense of time-varying marginal costs of generating electricity. The reason for such a recommendation is that consumers could not store electricity economically. The researchers observed that this had been long in coming in spite of technological trends. The researchers concluded that electricity pricing should be dependent on the demand and supply dynamics although this was still low in availability.

Gentzoglanis (2013) ventured into the topic of regulation and pricing of electricity in the context of reform. The author acknowledged that a lot had happened in the industry in the last 20 years such that earlier regulation model (1-G) worked well in USA, Canada, and Brazil. The I-G model, according to Gentzoglanis advanced to 2-G regulatory model when markets were functional in generation, transmission and distribution, and finally into the 3-G model when smart grids became available including independent and embedded networks.

Becken and Lennox (2012) and Joe-Wong, Sen, Ha, and Chiang (2012) related increase of oil price, anchoring it on growth and welfare of developing countries, assuming endogenous growth based on production and exogenous growth based on international trading. The scholars focused on production structure and access to international financial market and found that long-run growth rate depended on the production structure while the welfare of citizens depended on the elasticity of

substitution of or flexibility in the production structure. The study relied on oil as a source of energy but considered it analogous to electricity in its production hence its relevance to understanding reform in the electricity sector. Ruderer and Zöttl (2012) studied the issues associated with transmission investments in the electricity industry, considering the wholesale pricing and need for capacity expansion to ensure easy evacuation of power. Rentizelas (2012) studied production elements pertinent to the forthcoming study. Thus, Becken and Lennox (2012) added the dimension of transmission requirements in the discourse of electricity market development.

Oyedepo (2012) addressed the crisis of electricity supply in Nigeria and raised the alarm of a worse situation, especially when sources of supply and volumes remained the same, and energy saving measures were not attractive to manufacturers. Ubi, Effiom, Okon, & Oduneka (2012) affirmed the imminent crisis, which the investigators blamed for the low industrial base of the country, Nigeria, and made a strong case for the reversal of the trend using an analysis of factors of electricity supply in Nigeria. Makwe et al. (2012) appraised the reform starting with the case for the reform and recommended that transmission loss must shrink and tariff expanded for the reform to succeed.

The respective sizes of Nigerian government and private investment drew the attention of Udah (2012). On the location of Nigeria, the relationship between the above two factors was of scholarly significance to Udah (2012). The scholar used cointegration and error correction method in analyzing the banking sector reforms in Nigeria since the 1980s. Udah (2012) concluded that banking reforms yielded gains because of easy credit it brought about that stimulated the private sector and ultimately the economy. By

analogy, the study will undergo review in the light of electricity reforms to determine its outcome in a sector comparative sense.

Still on the post-reform appraisal of the electricity sector in countries, Pollitt (2012) in his appraisal of electricity reform in many countries and its efficiency improvements posited that efficiency had been modest especially in light of the reduction of carbon emissions. Pollitt further noted improvements in the governance of the sector with the involvement of private sector but added that societies faced the challenge of paying an extra cost associated with the improvements.

Electricity Sector Structure and Reform Evaluation

Erdogdu (2013) delving into the background of the electricity reform brought out the political and economic issues that precipitated the reform of the electricity sector in the early 1980s. Erdogdu acknowledged that electricity sector reform was different from reforms in other state-owned enterprises due to its unique product type and particularly in the developing countries. Erdogdu further noted that the main reasons were (a) to improve on supply and cost efficiency, (b) to transfer risk to the private sector, and (c) to offer choice to customers. The manifestation of reform was the breaking up of the vertically integrated firms into component units - generation, transmission, and distribution. Further manifestations, according to Erdogdu, were the introduction of markets (wholesale or spot type) and the setting up of regulators in the markets. However, Erdogdu noted that the comparison of status and gains of reforms was difficult and cited World Bank (2004) that stated that reforms were not enough to achieve the goals with the status report of reforms in 93 countries. Erdogdu specifically tested the

impact of the background of the officers in charge of the reform. Elements of the background included democracy, the level of corruption in the society, price-cost margin, price ratios, and politico-economic implication of the reforms. The scholar concluded that (a) reforms were not transferable, (b) prices depended on countries, (c) background of officers driving the reforms were important, and (d) reform did better in corruption- free settings.

Chikowero (2012) dwelled on financing the electricity sector after reform in the developing countries, with a focus on Tanzania, and laid out the catalogue of reasons like inefficiency and reliance on taxpayers' money, and inadequate financing prospects. The last reason attracted private sector offer to boost financing with the attendant fallout of introduction of reforms to allow market competition and private investment. Thus, financing the electricity sector posed a challenge of which Chikowero took up the financing concern that stunted the growth of the sector in Tanzania. Chikowero concluded there was a shortfall between financing and needs, and added that with good regulation, money in financial institutions could provide long-term funds for the sector. The reform in Tanzania took place in the form of decentralization or verticalization preceding sale to investors.

Policymakers who are setting out to review the reform process for the electricity sector must consider challenges that could impede the policies (Nepal & Jamasb, 2012). In particular, the policymakers should identify the applicability of discipline as a key factor in the success or otherwise of the reform. Otherwise, their actions could lead to a transition from inefficient public monopolies to profit-gouging monopolies or oligarchies.

Concisely, signs that showed the processes and the mechanisms of the reforms were not strong to deliver expectations. Such discrepancies would present an issue whether or not electricity sector would be better off under private ownership hence the debates that were still ongoing (Bordignon, Bunn, Lisi, & Nan, 2013; Nepal & Jamasb, 2012).

An evaluation of what works or does not work in any electricity supply and demand reform must not end in identifying energy problems. The cost and reliability of electricity supply mean much to businesses and consumers. Consequently, reviewing the structural failures in any nation or region's energy reforms would make the reforms effort successful (Olugbenga, Jumah, & Phillips, 2013). Greater reliance on free market tenets without regulatory interference could constitute a solution. Effective coordination between entities of the energy sector would also be to the advantage of sector functionaries. Other elements would include complete reforms, if started. Alternatively, the reform process should not commence, and long-term power purchase contracts should become policymakers' preference for the success of electricity sector reform in Nigeria (Olugbenga et al., 2013).

From the perspective of evaluating competition in liberalized electricity market, the effects of environmental issues on the price of electricity drew the attention of both scholars and practitioners within the overall energy section, and particularly within the steel manufacturing sector (Idris, Kura, Ahmed, & Abba, 2013). A focus on carbon-energy taxation should include considering the price of electricity, price determination process, and a comparison of multi-faceted variables that matter in the price of electricity. In fact, the effect of environmental policies on electricity price and commercial

competitiveness would be of interest to practitioners. Depending on the intensity of use of electricity, profit levels could drop due to a higher tariff (Fiorio & Florio, 2011; Idris et al., 2013). This profit level drop and high tariff are some of the effects of the reform effort in which all factors in this case, including environmental issues, influence profitability and productivity.

The issue of price determination mechanism in electricity sector reforms may sometimes conform to the objectives of higher efficiencies and lower prices. At other times, the contrary occurs (Olanrewaju & Jimoh, 2014). Lack of political backing could lead to the contrary occurrences. Interference by policymakers would be an unacceptable excuse for failure to achieve the above objectives. Incidentally, socio-political and cultural factors often influence price determination (Idris et al., 2013). Another factor could be human ideology on the pricing mechanism, which reveals two types of market - competitive and transition markets (Nepal & Jamasb, 2012; Pollitt, 2012). Competitive markets are those in which demand balance, planning, and investments rely on market mechanisms. Governments regulate such markets using policies such as wholesale, transmission, distribution and retail pricing policies to prevent anti-competitive behaviors. On the other hand, transition markets consist of vertically integrated power system setup where public and private investments built and operated power plants (Nepal & Jamasb, 2012; Pollitt, 2012; Rentizelas, 2012). In the transition markets, pricing mechanisms undergo only partial development before becoming operational. Conversely, a single buyer (bulk trader) model to ensure production could not yield to market imperfection. Olanrewaju and Jimoh (2014) believed the attention of electricity

pricing experts must include an approach to time-of-use pricing. In essence, when the price of an electricity source depends on time-of-use factors, the price would probably favor buyers. Incidentally, diverse risks and uncertainties besiege electricity users. Lack of attainment of reform objectives in the transitioning market could also be attributable to a low-reform depth just as political will could limit the reform for a competitive market. Policymakers within governments characteristically seek to control private operators for achieving goals (Fiorio & Florio, 2011; Olanrewaju & Jimoh, 2014).

Another evaluation of the reform was in India. Rao (2013) acknowledging the place of electricity in economic development noted that availability, quality, and affordability were in contention. The author, therefore, studied the impact of power cuts on enterprises in developing countries. Using a national data on households with electricity supply availability and home-based enterprises, and econometric and multivariate regression analysis, the researchers found that electricity availability or access increased household income of enterprises. Rao's study provided important information for economic management in the developing countries on electricity supply, especially in the context of reform in the sector. Allcott, Collard-Wexler, and O'Connell (2014) conducted similar investigations.

Arnold, Jayorcik, Lipscomb, and Mattoo (2015) and Chan, Cropper, and Malik (2014) studied various aspects of the effect of reforms on generation efficiency of thermal plants using Indian data from 1988-2009, considering the differences in reform timing. Chan et al. anchored the study on separating generation, transmission, and distribution with the assumption that efficiency after unbundling improved. The authors

used measures like coal input consumption and operating heat rate compared to plant heat rate, availability, and operating time of availability. The authors contrasted the above variables with downtime of plants from data Central Electricity Agency of India published, covering 17 states (60 state-owned) and 23 central government-owned plants. The researchers used the least square estimates with the results showing some improvement in availability. In comparison, states that did not *unbundle* reduced losses regarding electricity generation time. No statistically significant improvements in thermal efficiency occurred due to unbundling. This study is in the proximity of Allcott et al.'s (2014) and Arnold et al.'s (2015) scholarly inquiry.

Electricity Reform Depth and Ramifications

Electricity reform took place in the developing countries with a focus on Latin America sub-continent covering Panama, Colombia, Ecuador, and Peru, from system dynamic (SD) perspective or model (Ochoa, Dyner, & Franco, 2013). Different options of operation of the networks under different political systems hence the SD model to accommodate the increasing need to open up power markets following deregulation in the sector worldwide. The researchers discussed the SD using a dispatch algorithm called *market coupling* for the first time in reform literature. The first step the authors took in the article was to compare and relate the type of technology used in the countries and their environmental or weather patterns, including the transmission capacities of each country, to form the *dispatch algorithm* that led to *market coupling* in the system dynamic model. Other factors considered in the model included development state of the economy, generation expansion, pricing, and subsidy levels. All the above were integral

in the process, according to Ochoa et al. (2013), in a Dynamic Data Exchange (DDE) protocol. The researchers concluded that the model was workable with some surmountable technical hitches that might arise.

Following the above study was an investigation by de Araújo, Cullen, and Tsamenyi (2014) focusing on Brazilian electricity sector from a regulatory accounting perspective. The researchers used archival/document analysis of data from regulators and operators. The authors concluded that tariff review procedures and regulatory accounting received little attention initially but rectified later to correct distortions. This conclusion constitutes a key area of consideration in electricity sector reforms, as the cost impact was visible on electricity usage and businesses survival. De Araújo (2014) harped on drivers of change in Brazilian electricity distribution. Tariff, accounting, and other factors were part of the drivers.

Electricity reform in New Zealand and pertained to the effect of forced unbundling (reform) of the electricity sector in New Zealand about prices service delivery and cost of goods (Aghdam, Sharma, Al-Hajji, & Ulussever, 2013). Accordingly, New Zealand's original state-owned structure was electricity generation, transmission, distribution, and retail. The structure underwent segmentation through the Electricity Industry Act (EIA) of 1998 that separated the sector components and barred ownership of any two companies traversing two sub-sectors of the industry. Operational data on generation, transmission, distribution, and retail parts of the industry included cost and service information (Aghdam et al., 2013). Therefore, interconnection existed between competition effect and national electricity price being virtually the same before and after

the reform. The authors also found that quality of service improved statistically by lowering the pre-reform levels. This scholarly finding is an example of the comparative study focusing on profitability and productivity of businesses. Another perspective on New Zealand reform related to the hiccups that followed. A crisis of sustainable generation of electricity led to a reversal of the reform by recentralization. Invariably, the creation of central regulator and self-governance structures in the electricity industry led to higher private investments, which in turn led to the adoption of deregulated market mechanisms.

Electricity reform in European Union manifests in pricing (Bushnell, Chong, & Mansur, 2013). Fluctuations in the unit prices of electricity during reform depended on the same level of technological advancement in economies that were dependent on information and communication technology. Therein, economic advancement depended on the advancement of technology instead of hitherto raw materials, labor, and capital, as cost determinants. extending to competitiveness (Križanič & Oplotnik, 2013). Prices of raw materials progressively fell as product prices rose in line with the comparative advantage theory setting in, although concluded that the thesis was not universal in the application (Bushnell et al., 2013; Križanič & Oplotnik, 2013). In the Germany and Slovenia economies under study, the researchers concluded that electricity followed the pattern of the economic cycle but was deeper. Furthermore, during the economic boom, prices increased by 59% and 56% in Germany and Slovenia respectively. The conclusion was that the liberalization affected electricity prices by lowering it initially. However, the investment was necessary for prices to rise (Tsitsiklis & Xu, 2015). The dynamics of

price changes in liberalized electricity environment was palpable. Its effects on the general economy need attention from business operators, as I propose to explore in this study.

Filomena, Campos-Náñez, and Duffey (2014) addressed the issue of investments in the reforming electricity sector. Considering the interest in the level of investment pre and post reform in the electricity sector, the researchers wrote about Markovian equilibria where the firms depended on available capacity and maintained small margins of capacity, high price, and high profit. The authors investigated the cost of investment to recover the cost as an incentive and noted a price limit of $1000/Mwhr, but recommended $4000/Mwhr for recovery of investment. However, firms limited investment in capacity to maximize profit, which was proportional to a firm's generation capacity. Furthermore, a clear gain in investment depended on the behavior of firms evading excess capacity investment.

Reviewing the reform from an employee point of view, Kundu and Mishra (2012) used Orissa India as a case study. This review mirrored Indian electricity sector reform by focusing on its effect on employment in Orissa State. Allcott et al. (2014) seemed to extend Kindu and Mishra's (2012) study by highlighting the connection between shortages and productivity. Kundu and Mishra used multiple regression methods incorporating all variables of interest to the sector workers. Data on the variables emerged from the use of a survey instrument. The instrument had base values: level of significance (0.05); t = 1.96; and standard deviation (26.7). The conclusion generally indicated that the reform benefitted all employees other than distribution companies. The

introduction of technologies led to the improvement of the general performance of the whole sector. This outcome appeared to contitute a discrimination against workers at distribution and retail levels because of the difficulty in introducing technology at those levels of operation – a peculiarity of developing markets (Arnold et al., 2015).

Environmental protection issues were the trust of work of Eyre (2013). Environmental protection and sustainability came with energy saving programs and green energy supply sources for higher efficiency and cost consideration. The author measured demand changes as a basis to measure energy saving, ignoring normal behavioral changes. In addition to measuring the changes in energy use, robust monitoring and evaluation measures were necessary according to Eyre (2013) especially as it concerned industrial users before determining feed-in tariffs. The author concluded that a combination of energy efficiency feed-in tariff and demand reduction tariffs were necessary. Temporary tariffs on renewable energy should drop after aggregation of the data on them. Eyre (2013) further concluded that energy saving feed-in tariff was a way of encouraging energy saving in the market reform setting. This tariff system, therefore, is a price determinant, as it relates to business profitability and productivity in the new study.

European Union leaders adopted electricity sector reform as part of the policy of organizational change through Electricity Directive 2003/54/EC. Finon and Roques (2013) investigated the role of public coordination that constitutes a visible hand in the reform ramifications of the European electricity market. The state of the reform in the member countries attracted varied responses. Efforts in adopting a modular approach to

assessing the impact of the reforms on the quality of supply and protection of customers led to legislation in 2007. Competition constituted the context of effort. The functionaries recognized application rules, guaranteed protection of customers, and security of supply in the process. In studying the effect of supply quality and customer protection, the author used a modular model in which each unit of distribution and supply had a separate treatment. The authors reviewed the quality of supply and protection of customers and concluded varied local measures were necessary in the member countries, even in a competitive environment. The scholars also concluded that modular method confirmed that the objective of the quality of supply and protection of customers were achievable in different ways (Finon & Roques, 2013). The conclusion points to the variegated nature of the reform in the electricity sector and questions the existence of a standard template.

Comparing the above scenario to other continents of the world would reveal the varied regime of reforms in the electricity sector and contribute to articulating the various manifestations of the reforms in different countries. The comparisons and reviews confirm similar reform developments on all continents of the world (Böckers & Heimeshoff, 2014). Thus, factors influencing reforms included variations exist in local market conditions, diversity in the general mix, demand/supply ratio and transmission capacity.

Further work on the state of the reform was by Dan, Jilke, Pollitt, Ch, van Delft, Van de Walle, and van Thiel (2012). These authors under the aegis of Coordinating for Cohesion in Public Sector of the Future (COCOPS) did a quantitative analysis of reforms in 10 European Countries' new public reforms about needs of citizens. The study was a

contribution to a parliamentary inquiry on effects of privatization on citizens. Drawing from the database of 520 studies of reforms, the investigators concluded that privatization or *agencification* was complex and recorded improvement in some areas or insignificant changes in some and none in others. Dagogo-Jack (2014) warned of a bleak future in the power sector if authorities and other stakeholders remained inactive in the finding solutions. The work on all sectors, and reforms including the electricity sector led the conclusion that reforms were intricate with pros and cons; hence the numerous studies in specific areas.

The advent of reform in the electricity sector brought with it price determination by market forces or competition. Considering that electricity is a non-storable product, the price bidding method in a spot or forward agreements for future delivery creates consumer-related questions (Joskow & Wolfram, 2012; Vilar, Cao, & Aneiros, 2012; Zhang, 2012). A spot is a contract for an hour implying 24 contracts in the day, usually done for a day before usage because the System Operator requires time to plan the generation and delivery. Spot market, according to them could be seasonal, volatile, and jumpy. Consequently, researchers would need systematic procedures to monitor market trends to forewarn manufacturing concerns on price highs and lows (Vilar et al., 2012).

United Kingdom is one of the pioneer countries that embraced electricity reform, and undertook a review of reform status over a 25-year period. The international sample of electricity generation plants featured privately owned plants were 2 – 5% more productive than publicly owned plants. Based on that profile, the effect of productivity levels might be difficult to address (Akinwale, Jesuleye, & Siyanbola, 2013; Bordignon

et al., 2013). This gap constitutes part of the purpose, which is to explore the mix of electricity sources that could lead a steel manufacturing company to profitability.

Electricity supply issues were the thrust of Lionel's (2013) study in which he addressed electricity supply in the light of growth and profitability in Lagos, Nigeria. Historical data from Nigerian Stock Exchange and an electricity distribution company were useful for a comprehension of the interaction of prices, supply, and manufacturing antecedents. A strong correlation seemed to exist between average gross company income and electricity supply efficiency. The same applied to the balance sheet and average profit after tax. The reverse was the case when related to return on investment.

No apparent direct links existed among the above parameters, price of electricity, and manufacturing costs. Furthermore, the study highlighted the electricity sector in Nigeria being under sole government ownership and control. The challenge of the present study is to see if the conditions scholars examined would vary for businesses after the transfer of ownership and control of the sector in Nigeria as will be the focus of the present study.

Extending scholarly works to the rest of West Africa within which Nigeria geographically falls, the scarcity of electricity is prevalent in West Africa in the face of the desire of consumers to have cheap electricity in the region (Ehinomen & Adeleke, 2012). A financial review of the region's electricity utilities regarding capital requirements, operating requirements, debts, and interests, the level of investments, and return on investments. The content revealed a high potential for each utility that depended on *Earnings Before Interest Taxes Debts and Amortization* (EBITDA) margins

(Ehinomen & Adeleke, 2012; Lionel, 2013). This high potential, in turn,, depended on the tariff reviews, loss reduction/technical efficiency improvement, and diversification of electricity production types. Fritch focused on the business parameters like earnings before interest, efficiency improvement, and loss reduction that relate to the topic of the study in the context of electricity sector reform.

From the perspective of another continent, the expected benefits of privatization - higher efficiency and lower prices - were not achievable in India because of diverse factors. One of the major problems was the absence of competition in generation and distribution/retailing of the product (Abeberese, 2013; Du & Wang, 2013; Gao & Van Biesebroeck, 2014; Karanfil, & Li, 2015; Allcott et al., 2014; Zhang, 2012). A historical analysis of U.S. market, confirmed better market operations and recommended open competitive bidding to determine wholesale prices and that the regulator should guide retail prices (Joskow & Wolfram, 2012). Consequently, a concern in the reform of electricity competition had serious implication for businesses as a major input to determine productivity and profitability, as under focus in the study under reform condition.

Still on comparative analysis, Baker (2016) focused on British electricity reform and its impact on consumer income. The scholar found that the reform measures had extended into areas of the regulatory measures. This study will form part of other assessments of the effect of reforms in the electricity sector in the context of mixed electricity portfolio for companies within Nigeria's steel manufacturing sector. The Australian situation on the reform in all sectors, for instance, is traceable to the tortuous

journey and obstacles encountered (Aghdam et al., 2013). Business communities in Australia supported the reforms while the labor unions did not actively do so. The reforms brought about lower cost, higher productivity, and cost reflective pricing. The import of the general reform of electricity reform should be of interest to other researchers.

Barros et al. (2014) added diversification of electricity to the discourse of electricity reform. Through economic processes, by-products using electricity plants scattered at different places and coordinated through purchase agreements. Harnessing electricity generation and delivering it to public supply system benefited the electricity sector and members of the public (Eberhard & Shkaratan, 2012; Makwe et al., 2012; Nepal & Jamasb, 2012). Power purchase agreements are common under deregulated/reformed electricity sectors. However, the need exists to study such agreements about numerous sources of power as anticipated in an open electricity market. The impending study will probably capture explanations in the process of data collection. Scholars had investigated the issue of investment and pricing in the electricity sector that are key features of the reform. The main issue pertained to electricity market mechanism and investment risks observing that pricing was dynamic totally (only at wholesale and not at the retail level) (Akkemik & Goksal, 2012). In addition to the above situation, contributions of renewable sources complicated it. Therefore, an economic model incorporating all the variables and sources was necessary to conclude on two pricing types - *ex-ante* pricing that is the price set ahead based on consumption in real-time, and *dynamic* pricing which is the price when supply equals demand. Ex-ante price further

represented a weighted average of marginal operating cost and marginal outage cost (Eberhard & Shkaratan, 2012; Makwe et al., 2012; Nepal & Jamasb, 2012). Pricing as a major factor in electricity reforms needs to be totally determined using a realistic and representative model to impact positively on businesses.

Again, Aghdam et al. (2013) measured the state of Australian electricity sector reforms since the 1990s from the assumption that it would improve productivity and social wellbeing. The article adopted several hypotheses - testing methods to determine whether there was an improvement in productivity and efficiency using ANOVA (Analysis of Variance) method. The outcome included revelations that productivity improvement was due to technological improvements and not the reforms. Efficiency improvement occurred because of breaking up of the structure of the monolithic organization and not due essentially to reforms or privatization (Aghdam et al., 2013). Thus, the author revealed that the same effects - improvement in productivity and efficiency – were achievable without privatization of the electricity sector.

The relationship between reform and consumption of electricity depended on the unit cost of electricity (Müller & Watson, 2013). The essential factors for executing any reform could include cointegration equation, impulse response function, causality and variance decomposition for energy prices, energy consumption, and economic output (Akinwale et al., 2013; Karanfil & Li, 2015; Nnaji, C., Chukwu, & Nnaji, M., 2013). Consequently, higher energy prices could decrease consumption in the industrial sectors such as steel manufacturing, especially in the short run. In the same token, consumption

could increase for domestic users in the short run while a long term decrease could occur term (Akinwale et al., 2013; Akkemik & Goksal, 2012).

Kohler (2014) explored the extent to which differentials in electricity pricing and energy affected efficiency in South Africa. The relationship between electricity pricing and energy appeared to have connections with new power stations and other power infrastructure. Kohler (2014) implied that energy output would follow the principles of supply and demand. This association with the economic principle would explain the pricing of electricity. The differential might not completely result from visible factors. Therefore, the workings of the sector might find an explanation in extraneous and emergent circumstances. This phenomenon is another reason for seeking the knowledge of steel manufacturing executives whose corporations are using a mixed portfolio of electricity to pursue profitability.

Electricity consumption and the economic implication were the thrust of Tang and Tan (2012) using Portugal as their location. The researchers explored the effects of energy conservation on the economy of Portugal using multivariate causal study format. Tang & Tan found out that electricity consumption and economic growth in Portugal had bidirectional cointegration. A unidirectional relationship between electricity consumption and real income could lead policymakers to order a conservation of energy. Furthermore, such policymakers could suggest corporations should make investments in renewable energy to boost the economy (Bordignon et al., 2013). Specifically, the evidence is not available that consumers are better off with restructured U.S. electric power sector in line with original objectives of higher efficiency and benefit to consumers. Conversely,

Akinwale (2013) associated such policymaker decisions with the outcomes of the pre- and post-reform periods in Nigeria.

Focusing on the fluctuation in electricity generation under deregulated market, and conditions with consequences on the profitability and retail prices of the commodity, Streimikiene, Bruneckiene, and Cibinskiene (2013) used the two oldest electricity markets (Chile and U.K) to study the effect using autocorrelation simulation analysis. The phenomenon called *the cycle hypothesis* by the authors reflected the possibilities of continuous fluctuations in under and over a generation of electricity. Thus, under- and over-generation of electricity underwent investigation with data from Chile and U.K. Arango and Larsen discussed the auto-correction method (feedback loop) to stabilize both capacity (investment) and prices. Similar to Böckers and Heimeshoff's (2014) observation, the investigators observed that response to daily demand would lead to serious instability due to under- and over-generation. The scholars recommended accurate forecasting (which reform shortcomings caused) and regulator coordination of generation investments. However, using empirical data from the countries, the investigators arrived at 18-20% capacity reserve margin. The authors concluded that determination and sustenance of reserve margin was a threat to the electricity market. The investigators consequently recommended *forward reliability marketer* to reduce risks, control market power and coordinate new investments. The article by Arango and Larsen has implication for electricity pricing, especially under low-capacity condition.

Nepal and Jamasb (2012) focused on problems of executing the reforms in both developed and developing countries in the area of investment shortfall, sustainability,

economic efficiency, and social care. From the regional analysis of reforms, Nepal and Jamasb concluded that privatization was successful in Nordic countries, U.K., Chile, and Latin American Countries (Argentina, Brazil, Columbian, etc.). However, the imposition of cost-reflective tariffs was critical to sustaining the sector in Eastern Europe, Asia, and Africa.

Efficiency and Pricing

The efficiency of plants operation has a direct relationship to the price of electricity. According to Nepal and Jamasb (2012) and Pollitt (2012), the main objective of the reforms would not be far from pursuing efficiency and cheap costs. The scholars concluded that expenditure decline and compromise of technological elements in reforms could reduce long-term productivity improvements in the sector and offset the benefits of the reform (Brophy et al., 2013b; Fiorio & Florio, 2011).

Electricity pricing and cost issues are of high importance hence numerous models are in use, and more may arise in the future. Pricing and prices are different issues in the post-reform operations of electricity utilities. According to Dootizadeh and Ghasemi (2012), the model is also called real-time pricing (RTP) or Day-ahead real-time pricing (DA-RTP) that requires an electricity distributor to maximize profit by managing customers demand and operational constraints. Dootizadeh and Ghasemi concluded that DA-RTP was beneficial to the regulators, distributors, and consumers. It is noteworthy that no mention of the effect on availability, productivity, and cost occurred, hence the forthcoming study. Oladokun and Asemota (2015) revealed that 2014 Lazard Levelized Cost of Energy Analysis Model priced diesel-powered system at $0.225 -

$0.404/KWh and a range of $0.165 - $0.242/KWh for gas powered system. The model gave a range of $0.28 - $0.33/kWh for diesel and range of $0.14/kWh to $0.16/kW for gas fired. Oladokun and Asemota expressed the regret that Nigeria has abundance of gas reserve, but heavy gas flaring by oil companies perpetuates power failure across Nigeria (Oladokun & Asemota, 2015).

Market structure and market operations of reformed electricity sectors are critical to their operations. Fang, Wu, and Tang (2012) waded into the area of need by developing an auction model to decide electricity transaction cost and power transmission cost in the wholesale electricity market. The researchers concluded that auction rules increased the chance of generating companies' winning of supply contracts, particularly to large consumers. MacAfee's second-price sealed auction was the dispatch model used for generating companies supply allocations from time to time in a competitive environment and using multi-unit electric power transactions between generating companies and large customers (Fang et al., 2012). Related to this, Braithwaite and Hansen (2012) examined how large commercial and industrial customers responded to dynamic pricing in California by enrolling such customers into critical peak pricing tariffs (CPP) and demand responses (DR). The researchers concluded that CPP customers responded significantly, but load drops occurred only among few of the large customers.

Athanasios and Athanasios (2011) studied the pricing of electricity at the level of environmental impact of the process of generating a product. Specifically, Athanasios and Athanasios related it to carbon dioxide (CO_2) emissions allowance pricing, and concluded that management of electricity price subsidies and higher CO_2 emission prices

may serve as an incentive to investors. This incentivisation means that rewards of higher unit prices of electricity and emission allowances are beneficial to investors by way of profits. This CO_2 emission consideration is of interest to the current study since it affects the price of electricity through subsidization of 'clean' generation.

Another model on pricing in the electricity sector was by Steel-Santos, Leme, and Galvao (2012). Their article was on non-linear approach for a mix of generation types (gas, hydro, nuclear, coal, etc.) to optimize the electricity network. Thus, the authors used cost allocation through studying of the cost of each generation and load factor of consumers to get the price function. Steel-Santos et al. found that function was a non-linear one but linearized using load factors to categorize them according to peak and off-peak periods. The researchers concluded that even on one network type, the two-part tariff could be useful to optimize the network for maximum technology generation efficiency.

Partial reform and pricing in China were the focus of work by Zhang (2012). This reform situation is unique because, in the electricity sector of China, only the generation portion underwent privatization. Product and pricing portions remained under state control in the design to balance the interest of the two sides - producers and consumers. The author concluded that the price plan of electricity depended on negotiation among the parties. According to Zhang, that was due to the dependence of Chinese economy on electricity supply and, therefore, had social stability implication. This outcome is at variance with the free market basis of the reform in the electricity sector and confirms the flexibility of reform in different climes that political setup in a place determined (Joe-

Wong, Sen, Ha, & Chiang, 2012). The subject of electricity production and Power Purchase Agreements engaged the attention of Nelson and Simshauser (2013) and Joe-Wong, Sen, Ha, and Chiang (2012).

The scholars investigated the role of electricity producers under reform condition and their role in the market especially on long-term financing and Power Purchase Agreements (PPAs). Merchant producers were firms that generated electricity and sold it directly in the spot market with PPAs. Nelson and Simshauser did a dynamic, multiyear integrated production and project finance (PF) model with 40 years tenure. The authors examined two scenarios – perfect world model in which all costs were irrecoverable and real world case that full cost recovery was not possible. Findings during the 2005-2011 period included revelations that cash yield to equity was 13.2% for perfect world scenario and 1.1% for real world case. According to them, use of CCGT (Combined Cycle Gas Turbine) was not a good economic investment because of low yield to equity. For a new study of electricity reform and pricing, this study produced a basis for investigation of sustainability and attainment of the objective of higher efficiency and lower prices following electricity sector reforms.

Hogan (2012) dwelt on step tariffs or multiple prices in a deregulated or reformed electricity market. Hogan studied market clearing prices and price manipulation including transmission rights. The author found that electricity market design relied on bidding and security-constrained economic dispatch with prices depending on locations. Thus, the author targeted a design that could use the transmission system to meet transactions and provide right prices under forward contracts. The author then concluded that multiple

prices arose from economic dispatch in which small changes in agreements led to high prices in a semblance of manipulation of prices.

Price and cost constituted the main thrust of an evaluative study on the effect of electricity sector reform on electricity availability, cost, productivity, and profitability in Lagos, Nigeria. Related to availability and cost of electricity is the issue of security of supply in the reform era (TCN, 2013). Rodilla and Batlle (2012) addressed sustainability or security of electricity supply as an issue since the commencement of reforms. Specifically in Chile 1982, according to the authors, distrust in the mechanism of the market led to more regulation. The investigators established method of plot of demand and supply that gave the equilibrium price or marginal price point. The authors concluded that incentives for investment capacity were necessary for long-term security of supply through the regulator's intervention.

The impact of cost on productivity and profitability dovetails into inflation in the society. The effects of human elements in the determination of reform policies were the focus of Frankel, Ostrowski, and Pinner (2014). The need for policies to address disruptive potentials of solar power led to serious considerations of multiple sources of energy. The authors addressed potential implications of macroeconomic policies that could occur in any country. Macroeconomic and monetary policies would consequently have a direct connection with human elements regarding the human mentality informing policymaker actions (Frankel et al., 2014). Wide differences, therefore, existed among discussants because price differences depended on product categories, differences in

consumption pattern, which attracted different interpretations among those discussants (Frankel et al., 2014).

Balvers, Gu, and Huang (2013) delved into electricity assets' pricing, consumption, and productivity. According to these authors, electricity is synonymous with economic developments and cannot be stored. Consequently, the authors studied electricity as representative of real-time business activities because consumption of other products including food depended on it. Thus, electricity consumption according to the authors was also a measure of the productive ability of the economy especially as consumers cannot store supplies. The electricity members of the public consume directly measures production. The authors sampled data from 1961 to 2008 and showed a good correlation between electricity consumption and stock returns in the US, in addition to representing economic cycles. The source further illuminated the importance of electricity as an economic and business success factor.

Sahodash (2010) in his work on electricity restructuring in the U.S and prices, found that although out of 23 (of 51) states that reformed, retail price was lower or higher depending on fuel type for the generation of electricity. The author also concluded that the pricing structure in reformed and non-reformed states differed in the non-reformed states unit costs depended on the total cost of fuel. For the reformed state, the structure depended on the amount and cost of fuel used to produce the electricity in the last energy dispatch. Again, this conclusion points to the circumstantial successes recorded in some countries in the reform. The study corroborated the conclusions of), Aghdam et al.

(2013), Joskow & Wolfram (2012), Krinzanic and Oplotnik (2013), and Newell, Pizer, and Raimi (2013).

In their work on electricity market operations, Nowotarski, Tomczyk, and Weron (2013) proposed two types of prices in the electricity market - pools & futures markets. Pools market according to them operated on hourly or a day-ahead basis while futures market had duration of one week for many years. The authors highlighted the importance of the prices and their characteristics. For instance, the researchers observed that pools market prices were unstable as against futures market prices. Therefore, participants in the electricity market availed themselves of futures and pools markets mix to optimize returns. The authors provided a method for accumulating data on pool prices and futures market with the objective of using the pool prices for short-term and futures prices for long-term risk management. The researchers concluded by recommending that year-ahead prices were preferable for long-term decisions in the electricity market. This recommendation is fundamental to the operation of the electricity market distinct from the ex-ante and dynamic pricing (Nowotarski et al., 2013) or *spot* or *forward* agreement prices (Simshauser & Whish-Wilson, 2015).

Kwoka (2012) tackled the reform problem relating to price bidding within the electricity sector. Day-ahead strategy entailed that energy prices and reserve prices were in the forecast. Two-pricing levels determined the reserve amount based on maximization of profit of generating companies for optimized energy in the market and the amount of energy devoted to each company, and Game theory that assumes that companies have

conflicting objectives - survive at the expense of the other. The authors proposed bidding model function based on the Game theory using the two pricing mechanisms.

Due to the uniqueness of electricity as a product and its bidding or pricing method, storage of the product became a factor of its management. Budischak, Sewell, Thomson, Mach, Veron, and Kempton, (2013) factored this into the changing ownership structure of the electricity sector. Budischak et al. (2013) examined the gains of storage of electricity at low prices and its potential to stabilize prices called this welfare effect because it lowered prices to consumers by executing large-scale storage of electricity. The author concluded that storage balancing by generators and users was necessary to optimize welfare benefits since losses due to over-generation must synchronize with storage gains.

Market structure, Power Purchase Agreements, and pricing in the reformed sector elicited the interest of Decarolis (2014). The investigators used EEX1, Europe's biggest energy market, with ARIMAX model to simulate long-term contracts. Using the model revealed a significant positive correlation between electricity futures contract prices and that of long-term futures contract prices of fuels (coal, gas, crude oil). According to the authors, futures and pool prices had the potential to meet the non-arbitrage condition. In other words, the system must be fair and without risk-free arbitrage. This mechanism is a case of coordination of prices, which the authors concluded was prone to instability in the relationship between futures market of electricity and other fuels. The authors made an exception for coal.

The structure of reformed oligopolistic electricity market also attracted the attention of Wogrin, Hobbs, Ralph, Centeno, and Barquin (2013). Worgin et al. used data from Ontario Canada to observe that by interchanging peak and base load use of electricity, the technology of electricity production could impact on overall system efficiency, and pricing (such as non-linear pricing, time-of-use pricing, and real-time pricing). The researchers aimed at finding a balance between demands, on the one hand, and peak and base loads on the other. The researchers also found that with the change in elasticities of demands, prices fell in the peak segment of the demand.

In Finland, electricity pricing was an issue of importance to engage Florio (2013) who specifically related scientifically, ownership structure on pricing. The author further examined the cost of fuel and wholesale pricing on retail prices in Finnish competitive market bearing in mind the study hypothesis that price level in investor-owned companies was higher than state-owned ones. It concluded that ownership structure had a strong impact on retail prices, that efficiencies of the two are the same and that low prices by state-owned companies were due to heavy investments in the generation and low-cost fuel sources.

In Rusia, Kuleshov, Viljainen, Annala, and Gore (2012) viewed pricing in the reform in the light of competition. Using market shares of retailers, the investigators found that two segments existed - active and sub-active retailers. Kuleshov et al. concluded that unequal access to customers, price asymmetry and over regulation on investment impeded competition and investment inflow. This determination meant that pricing was not efficient, and affected the economy through inflation in Russia following

the reform. Boussena and Locatelli (2013) also reviewed power sector reform in Russia as it contrasted the reforms in the sector and that in the petroleum sector, showing clear disparity. Boussena and Locatelli (2013) also observed that the changing economic landscape manifesting as weak financial institutions and high level of inflation affected the power companies being privatized causing stagnation in the reforms. The author recommended amendment in the petroleum (fuel) supply market to keep reforms viable and on track.

Pricing of electricity has inflation dimension from a psychological perspective. Paradiso, Kumar, and Margani (2014) used the experimental method in which information on increases in purchase prices and inflation perception or overall expenditure increases to do a study. Paradiso et al. (2014) defined inflation as general price development using Consumer Price Index (CPI). This definition anchored on Friedman's (1971) postulation explaining changes in expenditure for weighted consumption of goods by an average customer over a specific period. The author targeted to relate perceived (or psychological) and economic inflation on the behavior of consumers. Paradiso et al. consequently defined Index of Perceived Inflation (IPI) as price changes evaluated inline with status quo as collated from past purchases. Using ANOVA (Analysis of Variance) and t-test statistical tools, the author confirmed that higher frequency of prices coincided with perceived inflation. The conclusion's applicability to electricity price changes is of interest to the study.

Roozbehani, Dahleh, and Mitter (2012) saw pricing of electricity as major fallout of reform in the electricity sector, the way Fiorio and Florio (2011) also saw electricity

pricing. The authors looked at the price structure wholesale and retail and concluded that when wholesale prices were volatile and retail prices were stable; distortions showed in the market, which was exploitable by participants without redressing the distortion. The investigators implied that perfect market condition for optimal pricing was still a problem in the electricity industry. The current study will look into how the effects price of goods (e.g. steel products) in the economy from production to sustainability of businesses.

Kleit and Michaels (2013) examined the oligopoly effect on electricity pricing, especially on bid-based markets. It was comparable to oligopoly in other industries to knowing the limits of the electricity markets. The author concluded that the bid-based market had benefited U.S. customers with more to come because of rich data and regulatory control using market rules.

Newell et al. (2013) approached pricing from an environmental perspective. The authors focused on carbon-energy taxation in the price of electricity price determination in Europe and compared it to increase in the price of electricity. In fact, the effect of environmental policies on electricity price, and, therefore, competitiveness in the European market was attractive to the scholars for a study. The researchers found that, depending on the intensity of use of electricity, profit levels dropped due to a higher tariff.

The effect of price increases on the demand side of electricity price increases was the thrust of the work by Carter, Craigwell, and Moore (2012) about manufacturing in 18 companies of 15 European Union countries. The authors followed the impact of electricity price increases on cost and price of manufactured products to identifying the

sectors not suffering from electricity price increases. Efficiency improvements reduced the need for investment in the generation of electricity and increased investment in the demand side of the industry.

Siano (2014) dealt with electricity pricing concerns in Canada. The author observed that prices were not reflective of economic and environmental costs of production of power, causing waste and strain in generating plants. Siano (2014) subsequently advocated real-time and time-of-use pricing to cover the cost and moderate the peak demand of electricity through conservation. This structuring underscores the place of pricing in the sustainability of electricity supply as a crucial factor in predicting economic ramifications of electricity use.

Electricity Reform, Manufacturing, and Productivity

Riker (2012) investigated the impact of improvements in efficiency in electricity of 85 "four-digit" manufacturing industries. He used industry-specific model that predicted the change in industry's export in response to an increase in the efficiency of electricity as an input into industrial production. The conclusion was that cost of production was lower, translating into higher efficiency and lower prices. This conclusion, the author noted, had implications for international business competitiveness.

Mian, Rao, and Sufi (2013) linked to two scenarios on a continuum such as (a) the drop in power and (b) the downturn in economic fortunes. Mian et al. specifically focused on the relationship between the economic downturn and fall in demand for electricity. Other factors such as strong pound and high --interest rates led some companies into receiverships, according to them. Apart from manufacturing, the investigators also

reviewed construction sector and concluded that the private sector contribution to construction growth over the next three years would be weaker than previously anticipated due to the flat housing market and a deepening recession in manufacturing.

Mian et al. (2013) did not address as its title suggests, the effect of the drop in power sales due to limited availability. Rather the researchers discussed the consequence of the downturn in the economy that manifested in a low demand for electricity, may be reflecting the fact that inadequacy was not a problem in the developed economies such as U.K. I shall relate this study to the developing countries with Nigerian steel industry as a case in view.

Cicala (2014) examined the overwhelming and disproportionate impact of high-energy cost on production. The scholarly work included contrasts that bigger companies would absorb the effect and balance the two variables- electricity cost and production. The inadequacy of electricity did not constitute a factor. Rather the higher price impact was noticeable. This price factor has a direct relationship with inadequacy of electricity, which most of the time leads to higher unit cost it and consequently higher production cost of goods (Minan et al., 2013).

Gugler, Rammerstorfer, and Schmitt (2013 examined the reforms in the context of the efficiency of the electricity sector. The scholars assumed that profit incentives also encouraged and improved R and D (Research and Development) and innovation in the sector. Gugler et al. concluded that R and D expenditure declined and compromised the technological basis for reforms in the sector and thereby reduced the long-term productivity improvements in the sector and offset the benefits of the reforms. The extent

of the finding of Gugler et al. would be explicable in the light of Nigeria to extending it or otherwise.

Sanghvi (2003), in contrast to Mian et al. (2013) and Gugler et al. (2013), dwelt on the inadequacy of electricity supply in developing countries (DCs) and developed a methodology for measuring the economic impact of the strategies. The article finally dealt with the implications and recommended resource applications for efficiency improvements and combination of public and private suppliers to rescue the situation. The state of affairs in the DCs has implication for economic growth and developments. It, therefore, reflects on the pricing of manufactured goods, the extent of which face analysis in this study by the degree of productivity and profitability.

Electricity shortage impact on manufacturing was also the subject of a United Nations Industrial Development Organization's (UNIDO) report. One of such reports was by Chan et al. (2014) who noticed the gap in productivity between developed and developing countries. The researchers used UNIDO document called Operationalizing UNIDO Corporate Strategy that set out plans towards understanding the issues that relate to productivity. The conclusion was that the concern about the ineffective provision of power was the highest ranked in their survey. Thus, the factor of the inadequacy of supply of electricity was identifiable as hampering productivity and deeper understanding and solution to it. The contribution of reforms towards reversing the situation is under focus in the study.

Productivity after reform in Brazilian electricity industry was the subject of study like the proposed one in Nigeria. Schmelzer-Roldán (2014) focused on the distribution

sector and used Data Envelopment Analysis (DEA) in 18-distribution companies in the years 1998-2005. The researchers measured how the productivity had evolved along with the reforms since 1990. According to the scholars, the productivity growth rate was 1.3% because of technical changes. The rate grew by 2.1% per year. The researchers, however, also found that technical efficiency, on the other hand, had negative growth of -0.8%. Their conclusion was that firms in the sector did not reflect the efficiency compared to given incentives to investments in the demand side of the industry. De Araújo's (2014) descriptors matched those in Schmelzer-Roldán's (2014) study on distribution.

In Iran, electricity was a factor in manufacturing, hence the government's policy on electricity subsidy. Simshauser and Whish-Wilson (2015) studied the effect of the policy and concluded that without it, production cost and price of products would rise. According to them, such policies had a negative effect on the welfare of citizens following the social class line of the poor, middle-class, and rich groupings. The authors drew a direct conclusion on the effect of the high cost of electricity on citizens, an area I shall use the current study to effect positive social change by influencing business leaders and policy makers with it.

In Turkey, the impact of electricity price changes extended beyond manufacturing to show an overall impact on the economy. Tariffs that cover the cost of production and allow reasonable profit became a topical issue in Turkey post-electricity reforms since 2001 (Akkemik, 2012; Akyıldırım, Altarovici, & Göncü, 2014). The author directed attention on the impact of price deregulation on national price formation and concluded that the mining, steel sectors were the most affected with consumer prices being slightly

better than the producer prices. This price variance implies that manufacturers were worse off in production cost than consumers who had better prices that did not reflect the full cost of production, just as Florio (2013) highlighted the effects on consumer prices.

China was the subject of energy demand and use in a situation of oversupply. Barnhart and Benson (2013) traced the case from undersupply to oversupply. In fact, Barnhart and Benson stated that China's case was ironic and disobeyed known economic theories and predictions. He further stated that electricity supply grew by about half of GDP growth rate, but fell by September 1998 when electricity growth was just 2% and GDP by 7.2%. According to him, the degeneration was worse because of dwindling demand such that investment zeal dropped in China power generation. This downward trend implied over capacity following rapid development within the sector by about 10GW per year over a 10-year period (1988-1998), Barnhart and Benson concluded.

The impact of electricity sector reform on manufacturing also underwent a review within Czech Republic (Abotsi, 2015). Using empirical evidence especially with foreign entry and participation in the European Union context, at the firm level, performance improvement or productivity improvement took place in manufacturing firms at company level in Czechoslovakia, for instance (Böckers & Heimeshoff, 2014; Cervigni, 2013). These data comprised annual balance sheets and income/expenditure statements for companies of turnover CZK 20m – CZK 40m, and spanning 21 manufacturing firms (Böckers & Heimeshoff, 2014; Bushnell et al., 2013; Cervigni, 2013).

Specific focus on Nigeria as on the Czech Republic had earlier taken place in which Makwe et al. (2012) premised their article on the inefficiency and inadequacy of

electricity in Nigeria. The observable inefficiency reflected in high-transmission losses, low generation, and low tariffs. The investigator used linear programming method called General Algebraic Modelling System (GAMS) to compare the effect of pre and post-reform time. Makwe et al. (2012) concluded that $0.03 unit price of electricity was inadequate and could explain the losses in revenue in the pre-reform time. The conclusion was that the farther away from the source of electricity, the more expensive it is to supply customers. Thus, clarity exists on price impact of reforms and viability. However, the impact of the price changes on business productivity and profitability needs investigation (Fiorio & Florio, 2011).

Bölük and Koç (2010) laid out the situation on electricity cost function in manufacturing in Turkey and found out that electricity demand was appreciable after the reform. This demand level implied that electricity price changes impacted on labor and investment demand in businesses. Again, pricing issues in manufacturing were prominent in the article as in my proposed study where the impact of availability and price on productivity in the steel sector in Lagos, Nigeria shall be in focus.

Carter et al. (2012) investigated the influence of manufacturing on electricity demand. The authors concentrated on the demand side of the electricity sector in 18 manufacturing companies, in 15 European countries. The researchers concluded that efficiency improvements reduced the need for investment in the generation of electricity and increased investment in the demand side of the industry.

Kirkpatrick (2014) conducted an investigation of two factors affecting the performance of industries in developing countries- electricity source and quality, and

management practices. Kirkpatrick found out that due to the unreliable public source of electricity, firms engaged in self-generation of electricity leading to smaller companies losing the advantage of economies of scale. This sourcing quagmire made small companies suffer a loss in competition with larger ones and ultimately led to lower productivity and growth. The author further found that increased public electricity generation translated to increase in manufacturing. Thus, the author concluded that cost of electricity depended on its source and generation capacity, and ultimately affected competition and productivity. Arnold et al. (2015), Bushnell et al. (2013), and Simshauser and Whish-Wilson (2015) investigated similar phenomena and confirmed the effect of public electricity on manufacturing boom.

Electricity, Economy, and Competition

Extending the discussion on productivity to the larger economy, Chen and Santos-Paulino (2012) examined the effect of energy in China's industrial strides by using total factor productivity approach. The researchers noticed heavy energy consumption with heavy environmental pollution. The impact of energy and capital in the growth of "high-tech light industry" gave overall productivity improvement (TCN, 2013). It also found that distorted energy prices mechanism particularly led to the inadequate supply of energy for a considerable time.

Lionel (2013) also examined electricity supply in the light of growth and profitability in Lagos, Nigeria. Historical data from markets and electricity distribution entity in Lagos served in the study. A strong connection exists between average gross company income and electricity supply efficiency. The same applied to the balance sheet

and average profit after tax. The reverse was the case when related to return on investment. There is no direct link of the above parameters to the price of electricity and manufacturing cost. Ehinomen and Adeleke (2012) also studied electricity and economic growth in Nigeria during a period covering over two decades. Cointegration between electricity and economic growth appeared to prove to invest more in electricity and improving efficiency could translate into higher economic growth anywhere in times of electricity reforms (Müller & Watson, 2013), as well as in Nigeria.

Salvagno (2012), in a dissertation on electricity, dwelt on the oligopolistic competition and day-head trading. The author observed the use of technology to manipulate entry into the market- high cost, but the low-risk technology for risk-shy incumbent companies to limit entry of others. Salvagno studied the phenomenon for different categories of companies adopting different technologies and concluded that entry can be discouraged by the use of risky technology if the entrant is more risk- shy that the incumbent. This study has implications for the pricing of electricity because of the use of unfair market power. This inequality is an example of market distortion factor in an oligopolistic setup like electricity industry. The implication of this is higher and uncompetitive prices that affect the cost of production, productivity, and profitability of businesses.

Schubert and Turnovsky (2011) digressed into energy prices (considered as an analogy to electricity prices in the study) to assess its impact on the economy. In line with the simulation method, energy price increases affected growth and development of economies especially ones that open to other countries, according to the authors. The

researchers also found that higher prices affected the balance of trade and the production capacities of countries affected.

Electricity Reform Consequences and Outlook

There are some clear fallouts of reform in the electricity sector. Viljainen et al. (2012) noted that reforms in the electricity marketer over 20 years ago led to the entrenchment of competition. The authors discussed the phenomenon in Finland, as Florio (2013) did, in which electricity generation had undergone liberalization while transmission and distribution remained natural monopolies. The author identified three conditions for good competition - equal access, multiple ownerships of generation firms, equal finance access, and no government intervention/interference except against manipulation. The authors concluded that Nordic electricity market consists of Notary, Finland, and Sweden. A decoupling of Finland occurred from the price zone, thus portraying a type of manipulation of the price that could only occur in small networks.

Finoni (2011) focused on the role of regulators in the structure of electricity markets to limit domination – a consequence of the reform. The author addressed steps aimed at limiting domination of the sector- the so-called antitrust regulations – including the limiting of long - term contracts and maintenance of vertical integration that tended to limit entries into the sector. The author had observed that while the above theoretical approach made producers bear all risks (project risk, price risk, input cost risk, and volume risk), no guarantees existed for good generation mix and inadequate generation. This uncertainty led to crises and consequent incentives to invest in low variable cost technologies – hydro, nuclear, renewable generation types to guarantee base load

generation and market stability. Finoni consequently focused on incentives to producers to avert market failures through an optimal mix of technologies. One of the incentives the author advocated was the use of debt financing at a *government bond market rate*. The consequences included (a) the transfer of risk to consumers; (b) consumer bidding for electricity supply forward contracts with producers' management of numerous supply contracts; (c) risk hedging for producers and consumers, and (d) financial market borrowing by producers. The author concluded that market failure related to risks but should not discourage investment in generation in a reform environment. Instead, the difficulty of transferring risks to suppliers and consultants would lead to market failures due to consequent low investment in different technologies of generation. Wisuttisak (2012) addressed regulation and competition issues in Thai electricity sector by examining the challenges of regulation in the electricity sector under deregulation/liberalization in the context of competition. The author pointed out that there were problems in the law governing the reforms and the body driving it. Thus, the place of the instrument and institution driving a reformed electricity sector became noticeable as a factor in efficient market and pricing by Wisuttisak.

Erdogdu (2013) introduced terms like "disaggregation and marketization" in electricity sector reform in the context of Western Australia transition. The investigator examined market mechanism like wholesale electricity market (WEM), natural contracts, Short-Term Electricity Market (STEM), and the balancing market (BM). Testing of these mechanisms related to reliability and sustainability of the electricity system to the benefit of customers against market domination. The authors further revealed that one of the

reasons was to free the taxpayers' funds from state-owned electrical companies and instituted level playing grounds to ensure fair competition, higher efficiency, and lower prices. Erdogdu (2013) stressed the importance of the role of regulation through rules and tender processes. In the case of Western Australian utility, Economic Regulation Authority (ERA) conducted surveillance in the market to enforce compliance. The authors further observed tariff that could cover cost was a necessity. Such tariff could attract and keep entrants and save government funds. The scholar concluded that it was difficult to predict how the market would evolve by theory.

Ma (2011) explored instantaneous pricing of electricity issues in China called on-grid tariffs, especially in power generating subsector, to encourage competition. However, rising awareness of environmental protection played an important role in the process. The article was therefore to articulate response to the challenge. It studied all available options and concluded that tariff setting should rely on competition allowing for marginal cost recovery at the balance point between supply and demand to determine prices including incorporating carbon emissions incentives in the pricing model. This article, therefore, adds the outlook of determining electricity taking into account environmental factors.

Roozbehani et al. (2012) addressed pricing as fallout of deregulation or reform in the electricity sector. The investigators looked at the price structure- wholesale and retail- and concluded that when wholesale prices were volatile and retail prices were stable, distortions showed in the exploited markets without redressing the distortion. Thus, a perfect market condition for optimal pricing is still a problem in the electricity industry.

How the effects productivity and profitability of businesses in the economy is under investigation in a new study.

One of the consequences of electricity reform is the inflation rate changes in the economy. Leeper and Walker (2012) addressed the human factors in the determination of inflation because of its implication on the macroeconomic policies of the country. This result arose because national surveys shape the level of official inflation level and impact on macroeconomic and monetary policies (Leeper & Walker, 2012). In fact, the authors contended that the median of perceived inflation determined official estimates better than professional forecasters do. The scholars noted the wide differences in perceived inflation among respondents because price differences depended on product categories, differences in consumption pattern and different interpretations, which quoting Hobijn et al. (2009), was relatively low (2-4%) between 1995-2005. One way the above variation in perceptions of inflation was controllable was through replacing the inflation about changes in *prices in general* that generated fewer differences among respondents. To study the above phenomenon, the authors used three surveys to ask respondents about noticed price changes in 12 months. The longest price changes occurred within 12 months, and average price changes took place within 12 months. Operators hypothesized the occurrence of bias towards largest changes. Another study by the authors contained predictions of price changes with hypotheses proving the largest price changes were respondent choices. On the platform of statistical analysis, the authors concluded that focusing on specific prices (rise or drop) affected the inflation perception or prediction, since practitioners noted those prices due to the extreme values. Finally, the authors

concluded that despite disparities in individual perception of the past or prediction of inflation, their median was better than that by professional forecasters. The prediction is instructive to understanding the determination of inflation as rooted in controlled subjectivity.

Cervigni (2013) studied the competition consequences in Europe using a survey method. Bottlenecks affected market integration. Cervigni confirmed that the above problem would limit capacity and competition in the market. Böckers and Heimeshoff (2014) took this further by reviewing the reform in 15 European countries. The researchers reviewed the performance of the reform after 20 years and measured it with customers' satisfaction over prices. The researchers used Euro-barometer surveys (on perceptions of consumers) in the 15 European countries anchored on two conditions – public ownership and liberalization. Böckers and Heimeshoff (2014) found that customers' behavior directly correlated with average prices in each of the countries. Privatization directly correlated with dissatisfaction with prices. Liberalization directly correlated with higher satisfaction.

Political interference in reformed sector market played out as a fallout in Nepal. Gugler et al. (2013) contrasted electricity sector reforms in small power systems and large power systems, from a political stability standpoint. According to the authors quoting Bacon (1999), small systems refer to one of peak load up to 1000MW. The investigators observed that while regulation was important in a large system, it was of paramount importance in a small system due to instability and to prevent bundling and collusion, and noted that the problem of information asymmetry in setting up of

necessary regulation. Pitcher (2012) observed that Nepal maintained vertically integrated structure in the power system while allowing private generators to contribute to capacity expansion.

Pitcher (2012) finally observed a distortion of the pricing structure because of subsidy for residential users politicians use for selfish gains. The researcher concluded that reforms in a small system became complicated because of political instability and growth in demand but recommended strong regulatory institution as the first step towards reforms. Kessides (2012) extended the discussion to all developing countries. Kessides observed that reforms in the electricity sector in the developing and intermediate countries were incomplete and uncertain due to peculiar circumstances. The author identified the emergence of a hybrid model of standard reforms and regulation of vertically integrated companies without competition and other reform requirements giving rise to debate as to the applicability of standard reform format in the developing countries. The problem of cost arising from price control outside market competition framework and cross-subsidies arising from the hybrid reforms had a negative effect on the realization of high efficiency and welfare of citizens of developing countries.

Residential electricity prices were one of the outcomes of the reform. Simshauser and Nelson (2013) took a study of the outlook in the years ahead from the background that electricity price increased by 10 % per annum from 2009-2013 as against 3% inflation. These authors addressed the demand side issues using data on customer price index (CPI) and Electricity Price Index (EPI) from 1989-2012 and found that a wide gap between the two (10 & 3%) unlike in the preceding 18 years when electricity prices

decreased considerably. According to the authors, between 1985 and 2008, there was price leap representing a period of investment. To the question of whether prices will continue to increase, the authors posited that it would be in the short term due to current investments. The conclusion was that competition was necessary to improve efficiency and reduce cost.

Electricity export issues and implications for reform were other issues in the mix. Gebhardt and Höffler (2013) examined the competitiveness of the exports in the light of border integration in Europe as a test using electricity trade. European Union 2007 sector inquiry decision empowered stakeholders to open up Europe's electricity and gas market, to achieve one. Gebhardt and Hoffler authors observed that there were price differences in border capacities that cannot explain it all. The authors noted that the expectation was that price differential should be predictable in the direction of profitable trading and zero in the opposite direction. However, Gebhardt and Hoffler noted that this was not the case due to the incomplete integration.

The need for price prediction is a necessity of the electricity market. The importance of the spatial structure of the transmission grid in electricity price prediction was of utmost importance to researchers and electricity functionaries (Schmelzer-Roldán, 2014). The use of econometrics models would serve in determining the effect of system constraints on electricity market integration is an integral part in the estimation, forecasting and interpolating of prices. The quality of price predictions depended on the quality of data on changing network components and configuration. A price

determination model, for instance, would reveal the factors in the price of electricity as relevant in economic growth and competitiveness.

The potential for abuse of market power Pham (2012) as earlier cited on in the study addressed the dynamics of the wholesale electricity market and competition about market power of participants. Pham (2012) observed the abuse of market power potentially eliminated the gains of the market to customers and used conjectural variations equilibrium model that required the use of a measure to represent market power in the market. This equilibrium model was at variance to use of traditional methods such as "market concentration, calibration of marginal cost and price cost margin" which could not apply to electricity. Pham concluded that conjectural variation equilibrium model was a better method because it took into account the existence of market power in electricity industry irrespective of the size of supply firm (Oladokun & Asemota, 2015).

Pollitt (2012) followed the electricity market reform in developed and developing countries in the last 20 years in the light of expectation of improvement in efficiency of electricity supply at low cost. Using data from 92 countries, from 1982 to 2002, to test the above hypothesis, the author disproved the phenomenon in all countries where reforms had happened. The author separated each country features in the reform and utilized panel data and regression. Finally, the author concluded that higher level of losses in supply had a connection with the reforms.

Electricity Pricing and Inflation

I have dealt with prices and pricing in the literature review. At this moment, I will examine the inflation fallout of the reforms. Gospodinov and Ng (2013) set out to study the relationship between inflation and price changes. Specifically, Choi (2010) investigated the assumption that inflation and relative price variability (RPV) relationship was linear and stable. According to the author, this linearity relied on an empirical study using linear regression, which contradicted studies by Hartman (1991), Park (1978), Reinsdort (1994), and lately Jha and Dang (2012). Jha and Dang (2012) used Personal Consumer Expenditure (PCE) data (disaggregated) of 1967-2003 in the U.S. and found the relationship to be of U-shape just as the earlier claim of quadratic shape. The finding, according to Gospodinov and Ng (2013), had implication for macroeconomic management of which if it were linear, would enable economic managers to vary one to control the other. However, the U-shaped relationship showed that RPV dropped with a higher level of inflation initially but reversed the dip after a threshold value of inflation. Gospodinov and Ng (2013) meant that inflation had a marginal effect on RPV - below the threshold value, higher inflation value increased R.P.V., while above the inflation threshold value, higher inflation value increased RPV. Gospodinov and Ng (2013) concluded that the same outcome applied to both U.S and Japan without stability but varied over different periods.

Leeper and Walker (2012) looked into the process determining the inflation rate. The author focused on the economic policy of excluding the price of food in determining inflation level by policy makers due to volatility and low durability. Leeper and Walker

(2012), therefore, set out to distinguishing food inflation and non-food inflation. The scholars explored convergence considering increasing global volatility in food prices (2003-2007). Volatility made non-food inflation non-representative of real inflation there requiring core value of inflation especially in developing economies where the signal to noise ratio was low. Signal to noise was high in the developed economies with even significant differences among them in food price changes. The author used CPI (headline) from 11 countries and concluded that food inflation being higher that non-food inflation, excluding the former in core inflation calculation especially in developing countries where food was more as consumption goods constituted a major distortion in the calculation. More so, the author argued that transmission of stock from food to non-food inflation was strong in poorer countries and, therefore, should constitute a factor.

Bravo-Biosca, Criscuolo, and Menon (2013) considered the dynamics that affected general business growth. The examples combined human elements, technology, and regulatory factors. The implications of those dynamics touched on the macroeconomic policies of regulating governments. This combination of factors underscores the influence of human elements in the policy reform process. Steel manufacturing sector business leaders may rely on those elements among policymakers to achieve macroeconomic and monetary policies for the sector.

Weight of Electricity

Schubert and Turnovsky (2011) used oil price (as an analogy of electricity) to measure its impact on growth and development of economies especially ones that opened to other countries. The researchers stated that higher prices affected the balance of trade

and the production capacities of countries affected. The authors used price simulation to assess the effect of such increases and found that effect on long-term growth rate depended on elasticity of substitution in production.

United Nations Development Organization (UNIDO); Africa Institute of Applied Economics, Enugu, Nigeria; and International Institute for Applied System Analysis, Laxenburg, Vienna, Austria issued a collaborative report. Onyeji, Bazilian, and Nussbaumer (2012) reviewed the report and explored why the present poor state of electricity supplies in developing countries with a focus on Sub- Saharan Africa (SSA) despite reforms. According to the authors, quoting IEA (2011) and World Bank (2011), Latin America, Middle East, and developing Asia had 7%, 11%, and 19% of their population lacking electricity while SSA had 69% (IEA, 2011). In addition to the lack of access in SSA, The researchers found that low capacity, poor reliability and high cost was a problem in SSA impeding economic growth. Onyeji et al. (2012) concluded there was a strong correlation between lack of electricity and poverty despite reform that over 90% differences in electricity access in developing countries existed. Thus, a connection existed between electricity availability and the reason for reforms in the sector. Erdogdu (2013) reviewed reforms in the 20 years (1982-2002), moreover, found a higher level of reform-related losses in supply within 92 countries. This interconnectedness is a reflection of the vital use of electricity and, therefore, its weight in the economy.

Reform and Regulation

The consensus in the electricity sector reform is that there must be a regulator in each country. Regulation or governance of the sector is in the areas of price

determination, customer services, intercompany relations, and administration of contracts. Burtraw, Palmer, Paul, and Woerman (2012) ventured into the market regulation of electricity supply price and redefined regulation in the context of social goals as democratic control of prices, sales, and production to achieve a social goal. Burtraw et al. gave the history of regulation and cited the example of California power crisis in 2000 – 2001.

Generation price increased drastically, but the retail price remained where government regulations stipulated. Burtraw, Palmer, Paul, and Woerman (2012) shared the same views with Fiorio and Florio (2011) that the issue of price swing caused market distortion and heavy losses to the power companies. The companies collapsed because demand was high for the low retail price. According to the authors, the government intervened by directly purchasing electricity from producers and permitting long-term Power Purchase Agreements (PPAs), which was not allowable, to protect prices.

California State built power plants to boost supply and lower prices ultimately. Thus, privatization took the place of liberalization in California with state involvement in the generation, showing the evolution of the reforms there. Similarly, Simshauser and Laochumnanvanit (2012) studied the dynamics of electricity price regulation. The government also used the instance of such phenomenon in California where in 2000/2001 retail price of electricity stagnated, and consumption rose, causing a rise in wholesale price by 100%. This price inconsistency encountered government (further regulation) action that brought it down to $135 from $230 per MWh. The same happened with higher

intensity in Queensland Australia. The authors concluded that government regulation is always a necessity if the power supply is to remain stable.

Wisuttisak (2012) also examined the challenges of regulation in the electricity sector under deregulation/liberalization in the context of competition. The author focused on the Thai's electricity sector and pointed out that there were problems in the law governing the reforms and the body driving it. Thus, the place of the instrument and institution driving a reformed electricity sector was noticeable as a factor in efficient market and pricing.

Horbach, Rammer, and Rennings (2012) researched into environmental regulatory changes that affect the future. The researchers chose their thrust theme as next practices, new grounds and why, and leadership, to direct resources to tackle challenges. Thus, the authors approached the article from the angle of the future direction. The scholars observed in the regulation policy that experts in the industry did not constitute a force to allow for unfettered exploration of new ideas without sticking to status quo. The investigators eventually disagreed with the trend and recommended the use of relevant experts with allowance for "adaptive learning". Horbach et al. (2012)recommended that operators should focus on next practices instead of best practices. The scholars further recommended establishing why the need for next practices and focus on leadership. The purpose would be to maximize the use of resources through service providers, staff, customers, and the regulatory body.

Transition

The above literature review considered issues relating to state-owned enterprises with a focus on the electricity industry and the mode of operations leading to the era of the divestiture of ownership by governments. Governments unbundled prior vertically integrated firms into functional, but related units. This unbundling preceded setting up of the framework to govern the operations of the resultant companies in the form of regulators before their sale. The reforms have been in existence for about 30 years and have been implemented and assessed differently, depending on the countries concerned or their level of development (Bhattacharyya, 2013; Galetoric & Munoz, 2011). The developments in the electricity sector worldwide were traceable to some conclusions like format or standard, the degree of implementation and successes being that the standards are varied (Aghdam et al., 2013; Erdogdu, 2013). The effect of the reform on the price of electricity, service improvement, investment incentive, manufacturing, and productivity, was positive for sustainability of service although not universal (Krinzanic & Oplotnik, 2013; Hoeller & Giorno, 2012). Despite the stated gains of the reform, challenges included supply inadequacy that affected economic development. Consequently, (a) the social wellbeing of the citizens, (b) the effect of the failure of service on the cost of production (through energy input cost), (c) price of goods, (d) productivity and profitability of business concerns aroused the interest of Ehinomen and Adeleke (2012), Arango and Larsen (2011), Wogrin et al. (2013), Schmelzer-Roldan (2014), and Makwe et al. (2012). The assessment of the electricity sector reform in Lagos, Nigeria is in focus from the standpoint of availability, cost, productivity, profitability, and sustainability of

businesses in Sections 2 and 3 of the study. In Section 2, I shall provide information about my role in the study, the participants, the proposed research method and design, data collection/organization technique and analysis, steps to comply with ethical requirements of the study, and steps to ensure validity and reliability of my sources of data. In Section 3, I shall present my findings, analyze and relate them to the literature as reviewed, and demonstrate their need for practice in business and their implication for social change.

Section 2: The Project

Completion of this project involved focusing on energy manufacturing business leaders who implemented the matrix of multiple electricity sources, cost associations per source, leadership capacity, and extraneous elements that might emerge. In this section, I address the research activity in regard to the above elements through explaining my role as the researcher, the participant interface, the research method and design, as well as the population for the study. I also explain sampling techniques, data collection instrument and techniques, data analysis and organization, as well as factors necessary for validating the study, which constituted other parts of this investigation project plan.

Purpose Statement

The purpose of this qualitative multiple case study was to explore electricity sourcing strategy that steel manufacturing business leaders in Nigeria used to attain an optimal mix in of public and alternative sources of electricity for the survival, growth, and profitability of their companies. The target population for the study consisted of business leaders in the steel manufacturing sector that used multiple sources of electricity supply for five consecutive years. The geographic location was the western region of Nigeria. Contributions of this study included discussions of gains or losses from the reform. Alleviation of supply stresses and profitability for steel and other businesses may emanate from the uninterrupted availability of electricity. The results from the study might lead to improvements in cost management. The prices of steel goods might drop. The implications for positive social change would include (a) the potential to improve economic wealth and industrial base of the Nigerian society; (b) the growth of direct and

indirect business start-ups; (c) job creation; and (d) improved efficiency, productivity, and profitability of the industry businesses. Also, there might be a positive effect on Nigerian society in the form of good health arising from the availability of affordable manufactured goods and services and job opportunities.

Role of the Researcher

As the researcher, I served as the primary data collection instrument. In such a circumstance, I used open-ended questions (Appendix A) to interview the research participants. The interviews were semistructured. In this regard, each participant had an opportunity to answer questions in a conversational fashion. Participants were able to express full understanding and reveal their perceptions of the subject of the research from the questions. I focused and paid attention to the details each participant provided. A participant's nonverbal cues constituted part of the overall data I captured.

The topic of this study was of interest to me because of my job experience in the electricity and steel manufacturing sector of Nigeria's economy. Other players in the steel manufacturing field had been in contact with me over the years. Therefore, participants in this study included individuals I met in the regular course of my management career within Nigeria's steel manufacturing sector. The western region, where the steel manufacturing business has its base, had been familiar to me because of job location over several years. Consequently, I had a good understanding of the workings of the industry, and the topic of this study was, therefore, of interest to me.

According to Rubin and Rubin (2011), accuracy is of utmost importance in data collection. Inaccurate data will impinge on the overall quality of the study. Furthermore,

the Belmont Report contains instructions that required strict adherence (United States Department of Health & Human Services, 1979). I followed such instructions and heeded ethical guidelines in the all participant-related activities. The Belmont Report stipulations included respect for participants and beneficence. Therefore, in implementing the interview process, I incorporated respect for research participants, respect for their privacy, elimination of risks, and all other ethical protocol from the Belmont Report.

In following ethical rules for the execution of the study, I provided prospective participants with a consent letter from which they learned about the study and their rights. Before commencement of the interview, I established rapport with the participant. Each party understood the voluntary nature of the interview activity. Participants understood that participation was at will, and no remuneration would inure to any participant. Withdrawal from the study would not result in any penalty. Each participant's information underwent shrouding through nominal coding. Therefore, I alone was in a position to determine who represented the codes.

Bias is usually a major problem, and every step in a research process should include efforts to eliminate bias (Yin, 2014). My experience in the management of electricity and steel manufacturing process did not override the participant contributions to the body of knowledge this research study contains. My personal lens was of no significance in interpreting data. An interview protocol is an essential tool for guiding an interviewer's steps (Marshall & Rossman, 2014. Using interview protocol, I ensured that I followed the appropriate steps from the moment of meeting a participant until I asked

the first interview question (Appendix A) and throughout the interviews. Those interview protocol steps helped to build a rapport with the participants before an interview.

Participants

Participants consisted of 10 business leaders residing in the midwest region of Nigeria. Such individuals met diverse criteria to be eligible to participate. The participants had attained the rank of general manager before participating. The participants were at least 30 years of age. The operational region was within the midwestern region of Nigeria. The participants showed proof of five years of consecutive implementation of multiple mixes of electricity supply sources.

Strategies for gaining access to participants included sourcing potential participants from local publications and approaching them to see if they might be interested in participating in the study. This initial access effort took the form of face-to-face meetings for solicitation, solicitation phone calls to prospective participants, and referrals from steel manufacturing executives who had personal connections with other business leaders in the steel manufacturing sector.

Research Method and Design

Research Method

The different methods for conducting academic research are quantitative, qualitative, and mixed methods. The nature of a study determines the methodology appropriate for the investigation. A researcher evaluates the circumstances of the research and decides which method would be appropriate (Kramer-Kile, 2012; Rubin & Rubin, 2012; Yin, 2014). The other methods were inappropriate for this study because the

quantitative method would require the use of numerical elements to identify multiple factors and variables. The methodology would involve focusing on broad spectra of the subject matter; deploying and testing hypotheses to reject or fail to reject; finding correlations, causes, or effects; and making broad statement in the findings (Kleinbaum, Kupper, Nizam, & Rosenberg, 2013; Logie-MacIver, Piacentini, & Eadie, 2012). This substantive research did not need such broad perspectives. The mixed methods would involve following qualitative steps and quantitative steps in no special order (Marshall & Rossman, 2014). that the mixed methods process was inappropriate for this study because the quantitative aspect was inapplicable.

Quantitative research method involves numerical representation of research elements for computation to find correlations or causes and effects via statistical analysis (Logie-MacIver et al., 2012). The quantitative method involves hypotheses testing, accepting, or failing to accept hypotheses, and statistical analyses using diverse models to reach decisions. According to Rubin and Rubin (2012), using the quantitative method would mean using numbers to quantify all human and material elements that constitute factors in the study. In contrast, qualitative researchers probe humans to learn what those humans have not yet revealed in writing. These two ways have constituted contributions to existing bodies of knowledge in diverse fields (Rubin & Rubin, 2012; Wisdom, Cavaleri, Onwuegbuzie, & Green, 2012). Researchers have a responsibility to extend the borders of learning (Boblin, Ireland, Kirkpatrick, & Robertson, 2013). The quantitative method was inappropriate for a study investigating how steel manufacturing business

leaders determine what mix of electricity sources would lead their corporations to growth and profitability.

A researcher may use the qualitative method when a subject matter is narrow and requires deep investigation. In some circumstances, human subjects who possess knowledge and experience become the center of focus in research (Miles, Huberman, & Saldaña, 2013). Such situations warrant the use of the qualitative method (Kramer-Kile, 2012). The nature of this substantive study warranted the use of a qualitative method.

Mixed-methods in research involve combining quantitative and qualitative methods (Marshall & Rossman, 2016). Using this method in research would involve completing the quantitative method before commencing the qualitative method or vice versa (Kahlke, 2014) The topic of the study must warrant the use of mixed methods before a researcher decides to implement the combination. In the case of a study exploring leadership decision paths to a deploying a mix of electricity sources, the experience of the business and the specific steps leaders took would be critical to understanding the phenomenon. Because the quantitative method was less applicable to this substantive study than was the qualitative method, I did not use the mixed method; the mixed method would have involved a method inappropriate for the study.

The purpose of this qualitative multiple case study was to explore electricity sourcing strategies that steel manufacturing business leaders in Nigeria used to attain an optimal mix in of public and alternative sources of electricity for survival, growth, and profitability. The need to explore expert solutions warranted talking to the experts. Diverse research designs exist such as phenomenology, descriptive, case study, grounded

theory, and ethnography (Boblin et al., 2013). Out of these designs, case study approach aligned with the problem and purpose of the study.

The phenomenological design is a researcher's way of capturing the lived experiences of research participants (Moustakas, 1994). Descriptive design involves focusing on a sample that aptly represents the standard that a researcher is interested in studying (Radley & Chamberlain, 2012; Street & Ward, 2012). The case study involves viewing participating entities as distinct groups for the purpose of the investigation (Yin, 2014). An organization that makes a specific contributions to business in the area of the study would represent appropriate characteristics for participation. In this instance, two organizations that have demonstrated these tendencies would qualify for participation solicitation.

Data saturation arose from an effort to pursue data through depth and breadth in the investigation. Ten participants from two organizations were sufficient for data collection. Saturation occurred through follow-up interviews and using methodological triangulation to capture pertinent data from all angles. Under this circumstance, I used member-checking to verify the accuracy of interpretations of participant responses. Follow-up interviews, re-interviews, observation, and document reviews along with above strategy led to data saturation.

Research Design

Qualitative research designs are descriptive, phenomenological, ethnographic, narrative, and case study approaches (Richards & Morse, 2012). A descriptive design involves the direct presentation of the phenomenon without the researcher's bias.

Although this design is straightforward, an exploration of the mix of electricity supply sources would need a more systematic investigation than the descriptive design offers. On the other hand, a case study design involves associating organizational or human cases with specific results (Bartel, Wrzesniewski, & Wiesenfeld, 2012; Yin, 2014).

The case study approach applied to the nature and purpose of this study. Furthermore, every datum underwent capture and processing with a predetermination as to what the datum would be worth. The case of leadership identification of the best mix of electricity supply contained the necessary elements that every steel manufacturing concern would desire to investigate.

In recognition of the above characteristics of qualitative research designs, with particular attention to the case study design, interviews, follow-up interviews, incidental probing questions and member-checking would be necessary for attaining data saturation. Additional techniques include observation and document reviews. Strengthening the data through member confirmation of the accuracy of interpretations would also contribute to data saturation.

A researcher uses the phenomenological design to inquire into the lived experiences of research subjects (Moustakas, 1994). This substantive study did not require a focus on a person's lived experience. Therefore, this design was inappropriate for the study.

The narrative design would apply to a study in which a researcher would collect a sequential course of events (Richards & Morse, 2012). Storytelling was outside the nature

of this study on the appropriate mix of power supply sources for the steel industry. Using the case study design was more appropriate than the narrative design in this study.

A researcher could use the descriptive design to explore the circumstances surrounding how research subjects act in the context of the research topic, which could often be graphic (Koltz & Feit, 2012; Yin, 2014). Descriptions would have been inadequate in conveying findings about the optimum mix of electricity supply for a steel industry operation. Therefore, this study would not benefit from the descriptive design.

Ethnographic design involves learning about cultural groups in their habitats (Richards & Morse, 2012). Steel industry executives did not constitute a cultural group. Members of the steel industry population did not live in an enclave, and consequently did not have an identifiable way of life. Therefore, an ethnographic design was inappropriate for the study.

Population and Sampling

The target population for the study consisted of business leaders that have used multiple sources of electricity supply in the steel manufacturing sector for five consecutive years. The research question for this study was as follows:

RQ: How might the sources of electricity supply lead to the survival, growth, and profitability of steel manufacturing businesses in Nigeria?

The alignment of this population with the research question manifested in the position members of this population have occupied in companies operating within the steel manufacturing industry.

I used purposive sampling to access participants. The geographic location of steel industry operators was already identifiable. Accessing the appropriate sample was consequently hitch-free. Solicitation efforts led to accessing a sample of 10 steel industry executives. The participants came from three steel manufacturing companies. Because the size of a sample does not necessarily determine data saturation, this sample is probably sufficient for in-depth investigation, even if the need arises for follow-up interviews (Marshall, Cardon, Poddar, & Fontenot, 2013). I used member checking to pursue data saturation. This method lead to facilitating confirmation of the meanings participants intended during interview responses. Semi-structured interviews characteristically focused on quality and depth of the information (Prendergast, Chan, & Hak, 2013). Therefore, the interview atmosphere for this study would be semi-structured.

Criteria for selecting participants included the following: (a) minimum age of 30, (b) minimum corporate status of general manager, (c) minimum of 5 years as an executive in a company manufacturing steel, and (d) working for a steel company that has been in operation for 5 years. A research participant must be representative of knowledge of the segment under investigation (Lester, 2012; Prendergast et al., 2013).

Interview setting for this study was a function of the participants' convenience. The nature of the steel industry warranted executive trips outside the steel manufacturing zones because some research participants were not readily accessible within the geographic zones. Participants faced research interviews in environments without any privacy issues (Yin, 2014). Furthermore, the individuals participating in this study faced interviews at times and places they found convenient at the time of the interviews.

Ethical Research

Informed consent process for this study involved securing the permission of interested individuals to interview them. The individuals received consent form (Appendix B) outlining the ramifications of the study before they committed to participating. The informed consent process is a full-disclosure action equipping a prospective participant with enough knowledge ahead of participating.

A participant had the right to withdraw from the study without any repercussion. To consider a participant no longer in the study, I should receive an email, text message, telephone call, or any other form of communication the participants deems convenient. I would note the mode and time of the communication for reference purposes.

Participants in this study did not receive any remuneration. Paid research could sometimes elicit only commercial value data, and a researcher must ensure the elimination of bias from both the participant and researcher's sides (Marshall & Rossman, 2016). Prospective interviewees must know ahead of participating that remunerations would not come to them because the research was an academic exercise for contributing to the body of knowledge on the subject of the research.

I ensured the adequate ethical protection of participants by showing prospects due respect, scheduling their interviews according to their convenience in terms of time, place, and atmosphere. Keeping open communication with the prospects throughout the recruiting process was critical to the success of the data collection activity. Participants understood every step in the data collection activity (Marshall & Rossman, 2016). I secured participant permission every step of the way before, during, and after the

interviews, especially in times of verifying the accuracy and meanings of their responses. If a participant deemed necessary sighting official permission to conduct the study, I showed IRB approval number to the participant, as an item in the consent form.

Participants' names undewent shrouding with codes. For instance, if Johnny Walker were Participant 1, his code name would be P1JW. All other participant information followed that scheme. A Microsoft Excel spreadsheet served in listing names and codes representing such names. The spreadsheet resided in a secure filing location available to me researcher. By this action, the confidentiality of all participants was certain, and in line with the postulations of Miles et al. (2013). In the same manner, I stores all data in a secure receptacle such as external hard drive, password protected flash drives, and compact discs, stored in a fireproof safe. Confidentiality assurance involved a plan to destroy all data 5 years after the end of the study through incineration, smashing, and deleting, according to the nature of the data receptacle.

Data Collection Instruments

Instruments

I served as the main data collection instrument. In that regard, I conducted participant interviews and asked the questions to elicit answers from research participants. I used a prompt containing interview questions (Appendix A) to chart the course of sequential data. The interview questions was open-ended to allow me to ask follow-up questions when a participant's response appeared to be incomplete. The interview activity was semistructured to allow me the horizon to move back and forth on the questions, especially when an answer for, say, Question 3, touches on something the

participant might have left out while answering Question 1. Furthermore, the use of semistructured interview atmosphere removes formality and creates ease for participants (Yin, 2014).

An interview protocol was necessary for guiding the activity steps while in the company of the participant. The interview protocol (Appendix C) contained the steps to follow from the time of meeting the participant to the end of the interview activity. An interview protocol might be inconclusive in design because certain issues occur between interviewer and interviewee that a protocol designer might not predetermine (Miles et al., 2013). Such contingencies require a researcher's immediate attention outside the scope of the interview protocol. I deployed such processes.

The reliability and validity of the data collection instrument and the process underwent enhancement through member checking. In such a circumstance, I went back to participants to verify the interpretations I had of their responses. Meanings are important in conveying results of scholarly research (Yin, 2014). Therefore, member checking would be an avenue for ensuring the research was valid through conveying a participant's exact intention.

Data Collection Technique

Technique for collecting data involved interviews. The interview questions constituted a document with open-ended questions serving as prompts. For a study focusing on extracting specific process by which steel manufacturing company executives operate profitability after mixing sources of energy, the in-depth interview would be necessary. A researcher has the responsibility of ensuring the process of

collecting data is devoid of process clogs and unnecessary personal conflicts (Marshall & Rossman, 2016; Rubin & Rubin, 2012; Yin, 2014).

The data collection interview technique involved the following steps:

1. Asking a question
2. Probing further
3. Identifying dots that need connection
4. Confirming understanding
5. Ensuring a participant understands the questions
6. Repeating questions that appear to capture incomplete or inconclusive data
7. Finding out if participant has other information that is not in the list

Review of archival records is an important step in ensuring the quality of a study (Kelemen & Rumens, 2012). Archival records enable a researcher to understand what a research participant did prior to the launching of the study. I looked at diverse documents showing different energy sources that were of interest to the steel manufacturing companies. Combining archival records with observation and interviews meets the requirements Erickson (2012) and Petty, Thomson, and Stew (2012) recommended. Furthermore, Eide and Showalter (2012) harped on the need to achieve credibility to a study. The combination of these multiple strategies added quality to the study.

Observation is the process of watching a process. In this investigative activity, data collection included observing steel manufacturing industry officials following their steps to procure electricity from multiple sources. According to Marshall and Rossman (2016), researchers must follow steps in virtually all aspects of the investigation. In this

instance, the steps I followed involved sitting with a steel manufacturing company officer, looking over the process of placing an order, and particularly understanding the criticality of the ordering activity. Considering that a manufacturing plant avoids downtime during production, I understood that the company's energy loading needs determined the tempo, quality, and quantity to order (Wogrin et al., 2013).

Data collection techniques have advantages and disadvantages (Chaney, B., Barry, Chaney, J., Stellefson, & Webb, 2013). The advantages of this data collection technique are that (a) interviewer and interviewee are in a face-to-face meeting, (b) both parties are able to make instant corrections when the needs arise, (c) the open-ended nature of the questions warrant adjustments that are necessary for capturing otherwise difficult data, and (d) each person can ask extraneous questions that have bearing on the success of the data collection activity.

The disadvantages of this data collection technique might include the following: (a) the process might be mechanical sometimes, (b) an important step or action might escape the human minds of interviewer and interviewee, (c) the process could consume more time than the parties imagine, and (d) using only interview questions may be insufficient for capturing all necessary data to contribute to existing body of knowledge.

Advantages of reviewing archival records include revealing to a researcher data that would strengthen the research (Chaney, 2013). Through this means, a researcher is able to see what happened in the past as a catalyst to the present (Bansal & Corley, 2012). The advantage relating to this study on steel manufacturing business was that publications from newsstands and professional magazines and newsletters contain

extensive information regarding what and how the steel industry operatives run their manufacturing operation. Furthermore, several public domains contain extensive information that served as archival data. Some of such public domain data would not require owner's permission (Yin, 2014). In this study, such public domain data effectively served as archival data that brought quality to this study because participant responses confirmed some of those data and debunked others.

Disadvantages often exist in archival records in that researchers would take steps to verify the data under several circumstances (Yin, 2014). That extra verification requirement was responsible for sorting out diverse data sets with individual participants. Archives often consist of filing cabinets, vaults, and safes. In the digital age, organizations have found massive storage spaces online to serve as archives. Incidentally, organizations are able to release non-confidential documents to the public. Disadvantages of analog archives are that a researcher might have to look through several unrelated documents before getting to applicable documents. Disadvantages of digital or virtual archives are that confidential documents saved virtually stand the chance of leakage because the activities of hackers. In terms of usefulness to research, the virtual archive documents are even more voluminous, and could cause a researcher stress. The need to sort through documents applies also to virtual archive documents (Bansal & Corley, 2012). Keeping these advantages and disadvantages in view, I spent several months ensuring alignment among interview data, observation data, and archival data.

The use of member checking will aid in interpreting data (Condie, 2012). Lee, Liebenaue, and DeGross (2013) recommended compiling extensive notes on each phase

of the study. The three scholars used that method to note specific stages they encountered challenges in the data collection process. The method Lee et al. (2013) used serves as a good example of achieving data interpretation. I followed those steps to ensure data interpretation would fall in line with meanings the participants intended.

Data Organization Technique

Data tracking is important in the process of research; diverse methods are in use for organizing data (Al-Huan, 2012). Keeping track of data through notes and journal entries contribute to efficiency in research, and the use of software facilitates such tracking (James, 2012). I consequently used two computer programs to organize data. Those programs were Microsoft Excel and 'R' package for Qualitative Data Analysis (QRDA). These two resources served in lining up journal notations of emerging themes, challenges, new ideas, and extraneous developments capable of affecting the research activity. These two programs are effective in sorting and labeling factors or research variables (in the case of quantitative studies).

Raw data remained in a container within a safe with access limitations. At the end of the study, all the data would remain in storage for five years before destruction. By keeping all data in such storage, participant confidentiality is safe, research credibility would remain intact, and references would be possible within the five years following completion of the study (James, 2012).

Data Analysis

In analyzing qualitative research data, a researcher may follow diverse methods (Yin, 2014). The foundational use of open-ended questions set the stage for an analysis

procedure a researcher might use. In the instance of this qualitative case study, I used data triangulation. The analysis activity involved processing data from participant interviews along with data from another source. The triangulating data came from the review of company archival documents. I conducted an evaluation to ascertain a match between interview data and archival data.

Analysis sequence was as follows:

- Upload data to RQDA software one question after another
- Conduct sorting and coding
- File and save emerging themes from the first round
- Repeat process for each question and combined answers from participants to the specific respective questions
- File and save emerging themes from second round
- Use the above sequence to process all questions and responses
- Compile all themes and combine with themes that emerged during interviews
- Run queries to find the intervals among participant responses per question
- Conclude data analysis and run the report to determine overall findings.

'R' package for Qualitative Data Analysis (RQDA) is a program for analyzing qualitative and quantitative data. The quantitative interface of RQDA makes possible running of queries that permeate data and retrieve nuances that are otherwise unreachable (Hug, 2013). With the features of RQDA, I streamlined data to achieve format and uniformity without unnecessary repetition of procedures. Furthermore, RQDA possesses a capacity from design to find clusters and organize them in a determinable order.

In analyzing data with RQDA, the themes that emerged during interviews and those the RQDA detected during sorting and labeling formed the basis for the initial compilation of preliminary results. I focused on key themes after using the preliminary results to conclude on which themes had higher frequencies than the others did. The confirmation of these frequencies enabled me to associate the preliminary results with scholarly postulations in the literature review. Association of data similarities was critical to the validity of any study (Miles et al., 2013), especially as scholarly research constituting an existing body of knowledge might already contain themes that could prove similarities to themes emerging in new studies (Marshall & Rossman, 2016).

In the context of the conceptual framework, the decision to source electricity from multiple avenues for manufacturing would ordinarily be unattainable. However, companies using such a method to drive down energy cost in manufacturing made a firm decision. Therefore, analyzing data that pertained to a combination of electricity sources might be incomplete without due consideration of the theory supporting the manufacturers' insistence on combining electricity sources. North's (1968) decision theory, also doubling as option or optimization theory elucidated the apparent risk of mixing power sources. An analysis of participant responses in this study helped to reveal the issue of a chance of success in executing such a policy decision. Measuring the contribution of each source to operational profit would probably reveal the effect of one source on the other (Alexander et al., 2014).

In line with scholarly postulations, organizations seek to maximize profit as the mainstay of organization. Incidentally, manufacturing companies often focused on

maximizing output, leaving the marketing and sales departments to worry about profits (Halpern et al., 2013). Relating this phenomenon back to the conceptual framework, Mohaghar et al. (2015) viewed all the elements as different but interconnected systems forming a matrix that could lead to profits or losses. The respite would only come from the organization's overall objectives. An analysis of participant responses would probably lead to a confirmation or debunking of these articulations. While the scholarly postulations appeared to be valid, the workings of Nigerian economy, especially in the steel manufacturing region, might form the basis for the confirmation or debunking.

Reliability and Validity

Research must undergo diverse evaluations to determine how reliable and valid the study is (Marshall & Rossman, 2016; Yin, 2014). Research users desire scientific confirmation of the extent to which a study would relate to other fields, geographies, populations, or conceptual frameworks. Therefore, qualitative studies must possess attributes that convey credibility, transferability, dependability, and confirmability.

Dependability, Creditability, Transferability, and Confirmability

To ensure the impending study would be trustworthy, I tried to achieve dependability through remaining consistent with the context of this study. This consistency conveyed the reliability of the study. Some steel manufacturing concerns in the western region of Nigeria embarked on a policy decision to mix their electric power sources in a bid to pursue profitability. Context is critical to an understanding of dependability of a study, especially at the end of the investigation (Johnston & Dijkers, 2012). Consequently, the conceptual framework for this study was the decision theory.

Other names for this theory are option theory and optimization theory. Against this backdrop, pursuing dependability must recognize the uniqueness of steel manufacturing in Nigeria so that other scholars and research users must know the extent to which to apply the nuances of this study to other situations. Finally, the antecedents of a study may include the period the study took place, the topic, geographic location, and extraneous and emergent factors. Such phenomena would require the use of bracketing to shield both researcher and the research study from external influences (Tufford, 2012). Furthermore, bracketing would help a researcher in stowing away elements of bias to place scientific considerations in the forefront of the study (Mörtl & Gelo, 2015). I followed the above precepts to ensure dependability of this study.

Creditability is a form of measurement that conveys how much internally valid a study might be. Such measurement must pertain to the quality and interestedness of potential participants (Sirriyeh, Lawton, Gardner, & Armitage, 2012). I planned to achieve credibility by ensuring that prospective interviewees had dealt with the problem of mixed source of electric power within the steel industry. Such participants must also show interest in, and commitment to knowledge dissemination, so that other business leaders within Nigerian steel manufacturing sector may learn. Members who have a genuine interest in the topic of a research study possess the capacity to contribute to the creditability of such study (Landu, 2014; Podsakoff, P., MacKenzie, & Podsakoff, N., 2012).

In pursuing transferability, a piece of research must possess qualities to render the study valid externally (Johnston & Dijkers, 2012; Landu, 2014). An individual who

determines the results of this study transferable must have reasons to do so, and limitations do not exist on such unilateral and third-party determinations. Of critical importance is the fact that research readers, users, applicable business practitioners, and other scholars are to determine the transferability of a study (Ketokivi & Choi, 2014). The assumptions underscoring this impending study contained bases for any readers and research users to generalize unilaterally or apply the tenets of this study to the situation they choose.

To achieve confirmability, a researcher takes a stand to make every effort in implementing all possible strategies that enhance the study. Further than that, the researchers explore potential shortfalls and deploy procedures to eliminate such negatives (Landu, 2014). I planned to audit every step of this investigative process, using reflective journal entries and other notations to capture any possible negatives that might occur in the process. By so doing, such negatives became important factors during data analysis to demolishing the negatives. Double-checking data, taking a stand to fault the study and its process, countering different postulations, and faultfinding are some of the ways in which to pursue confirmability (Mok & Clarke, 2015). Quality audit of a study contributes to confirmability, and a researcher who intends to eliminate bias must implement such audits multiple times during a study (Gutiérrez & Penuel, 2014; Lester, 2012).

Data saturation is a critical need for assuring that a study would be usable in professional and academic fields. I followed scholarly directives to pursue data saturation in this study. A researcher must think quality assurance ahead of investigative activities (Pezalla, Pettigrew, & Miller-Day, 2012). Following protocol in every respect would help

a researcher assure reaching saturation, especially during data collection. This process is because a good protocol would remove guesswork in a researcher's efforts, especially when going back and forth to capture points that pertain to questions other than the sequential question in hand (Robinson, 2014). Foundation for reaching saturation often takes place when a researcher identified ahead of time the changes that begin to occur within incoming data, especially when successive participants repeat themes the researcher has already captured from prior participant responses (Walker, 2012). The role of sample sizes in attaining saturation is recognizable in that a researcher can dig deeper multiple times within small samples or investigate by covering the breadth of large samples (Halverson, Graham, Spring, Drysdale, & Henrie, 2014). The above considerations circumscribed my efforts in this study to ensure data saturation.

Transition and Summary

Section 2 contained elements of research methodology that were critical to prosecuting this study. The purpose of this qualitative multiple case study was to explore electricity sourcing strategy steel manufacturing business leaders in Nigeria used to attain an optimal mix in of public and alternative sources of electricity for the survival, growth, and profitability of their companies. I served as the primary research instrument. I used interview protocol to guide my investigative steps, and interview questions as prompts to initiate the conversation with participants. Participant confidentiality was central to the success of this study in that a participant who did not have adequate protection might not participate. The Belmont Report set forth the principles for protecting human subjects, and this document contains a documentary commitment to those principles. Quality was

also important in assuring research readers and users of the dependability, creditability, confirmability, and transferability of the study.

Section 3 contains results of the findings along with the primary themes that emerged. Social change antecedents from the study also form part of the contents. I seized the opportunity to make recommendations for action and further research. Readers of this study have the opportunity of knowing about my reflections on the study.

Section 3: Application to Professional Practice and Implications for Change

Introduction

The purpose of this qualitative multiple case study was to explore electricity sourcing strategies that steel manufacturing business leaders in Nigeria used to attain an optimal mix in of public and alternative sources of electricity for the survival, growth, and profitability of their companies. The participants turned out to belong to three distinct professional categories: engineering, power, and steel. I was consequently able to determine the extent to which each industry may have uniquely influenced the respective participants' contributions to the study. All participants came from entities with private generation capacity at their businesses, either for full or partial production. The participants summarily shared their regret that alternate sources of energy were exorbitantly expensive compared to the public source.

The steel industry, for instance, contributed more in terms of diverse opinion and the emergence of themes. This emergence was fortunate because the optimal mix strategy investigation related more to steel than to any other industry. Power and engineering were essential antecedents since manufacturing would be nonexistent without these two elements. Responses from Participants 2, 3, 5, and 7 led to the identification of themes, as those participants appeared to share experiences without being acquainted with one other. The striking similarities among those participants became clear in the discovery of themes during analysis.

Presentation of the Findings (Qualitative Only)

The overarching research question in this study was:

RQ: How might the sources of electricity supply lead to the survival, growth, and profitability of steel manufacturing businesses in Nigeria?

The five themes were (a) cost of generating electricity and the investment in alternative sources of energy, (b) erratic power supply and its impact on the steel production industry, (c) quality of power supply relative to the capacity and its impact on profits, (d) the electricity factor in the steel production process, and (e) use of multiple sources. The subthemes that emerged were as follows: (a) high cost, (b) lack of availability, (c) bad planning of water and gas resources, and (d) installing and maintaining alternate sources of power. Others included poor power infrastructure and privatization. Competitiveness, inadequacy of the steel industry, poor quality of the steel industry, taxation, and tariffs constituted additional themes and subthemes.

All transcripts were imported into R statistical software. Preprocessing was performed on each transcript using standard data cleansing and validation techniques. In particular, sections of the transcripts directly related to the interviewer were removed to leave only the participants' responses for each transcript. This was done to ensure that the interviewer's questions and statements were not counted as part of the participants' responses, thereby inadvertently misrepresenting participants' sentiments during sentiment analysis. Further cleansing and validation involved preparing and processing the transcript text by ensuring uniformity in text formatting, consistency in grammar and spelling. Once cleansing and validation had been completed, the transcripts, now containing only participant responses, were then consolidated into a single corpus.

Analysis was performed on the corpus using standard text mining, natural language processing, and other statistical techniques.

Initial exploratory analysis revealed that the participants could be categorized into three distinct groups: engineering, power, and steel. These three groups indicated the three industries represented within the sample of participants. Figures 1 through 3 visualize the associated descriptive statistics discovered during exploratory analysis.

Figure 1.

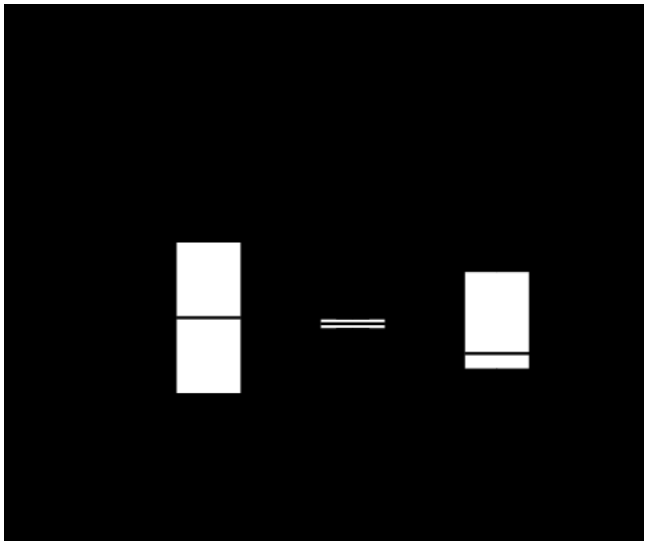
Distribution of industries.

Among the group of participants, two identified as engineers, two identified as part of the power sector, and six identified as coming from the steel industry. To visualize how each industry contributed to the overall study, I tokenized each transcript and generated token counts for the entire corpus. In lexical analysis, tokenization is the practice of breaking text into smaller units, typically as single words or unique symbols or characters. By tokenizing each transcript, I was better able to determine the extent to

which each industry may have uniquely contributed to the study. Figure 2 below presents the summary of tokens for each industry.

Figure 2.

Token summary per industry.



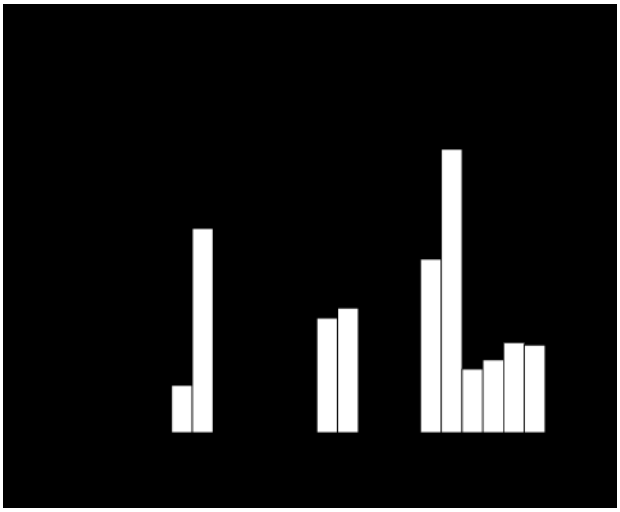
Tokenization is advantageous in that it does not take into consideration the frequency of the words in a given text. Rather, it counts a word only once in the entire document. This allowed me to visualize, in the box and whisker plot above, a summary of the unique things that were said by members of each industry. As shown in Figure 2, the steel industry presented the most variation of tokens. It is often the case that token count can be correlated with the emergence of themes and the diversification of sentiment. In other words, more tokens can be indicative of a greater diversity of opinion within the steel industry. The steel industry thereby contributed more in terms of diverse opinion and the emergence of themes. However, the skew of the box and median for the steel industry indicated the presence of clustering. I interpreted that to mean that general

sentiment within the industry would lean in a particular direction, despite the diversity of opinion.

Unlike the steel industry, the power industry represented a tight clustering, indicating much less variation of opinion. The engineering industry presented an even distribution of token count with a much wider range than power, though still less than steel. At this point, it became necessary to understand the cause of these variations within each industry. Figure 3 presents the summary of token count for each participant relative to their industry and relative to one another.

Figure 3.

Participant token summary.



As can be seen from Figure 3, the notable variation in token count for the steel industry comes from the difference between Participant 2's responses and Participant 7's responses. The variation in token summary for the engineering industry likewise comes from the difference between Participant 5's and Participant 3's responses. As will be

shown, both Participant 2 and Participant 5 contributed significantly to the emergence of themes that other participants only touched on briefly. Likewise, Participant 3 and Participant 7 both shared striking similarities concerning their own contribution in the discovery of themes during analysis. The greatest variation of opinion remained with the remaining four participants.

Preliminary coding analysis revealed a variety of themes. Natural language processing techniques were used to confirm the preliminary coding results as well as discover any relevant, hidden themes I may have missed. Further analysis revealed that all themes from both preliminary coding and natural language processing could be consolidated into five themes. To summarize the five, consolidated themes, I generated a list of the most relevant terms per theme. I generated the list by taking the frequency of each term and calculating its probability of occurrence within each theme. I then used the probability threshold of 0.015625 to query and retrieve at least seven of the most probable terms per theme. Figures 4 through 8 visualize the top most probable terms per theme, ordered by relative importance.

Figure 4.

Top nine terms for Theme 1.

Other top terms for this theme, though not above the threshold, were *alternate*, *advice*, *build*, *maintain*, *rely*, and *install*. Theme 1 can then be summarized as containing the participants' attitudes toward the cost of generating electricity and the investment in alternate sources of energy. As was noted by Participant 2 and Participant 5, steel production is a process that requires continuous flow of power, as well as requires a substantial amountof power. Participant 2 went on to further state that the need for reliability is what drives businesses toward alternate sources of electricity. As was discovered during the interview, all participants have private generation capacity at their business, either for full or partial production. These alternate sources of energy are not inexpensive. As was noted by Participant 10, gas is considered as a raw material in steel production. Participants 1, 2, 5, 6, and 10 all remarked that gas is a commonly sought after alternative source of energy. However, the cost and lack of availability have made it a difficult alternative to install and maintain. Participant 5 in particular noted that bad planning of water and gas resources in the country has led to significant problems in power generation, both in the public and private domain. Participant 4 categorically said "it is like stating the obvious. Because of the process in steel industry that does not need interruption, if the two sources are okay, cost will determine which is used. The one with the least cost is naturally chosen. "Despite these setbacks and high costs, the consensus among the participants was that they would still advise businesses to consider building, installing, or maintaining an alternate source of power.

Figure 5.

Top seven terms for Theme 2.

Other top terms for this theme, though not above the threshold, were *compete/competition*, *unreliable*, and *bad*. Theme 2 can then be summarized as containing the participants' attitudes toward the problem of power supply and its impact on the steel production industry. Sentiment analysis for this theme revealed significant disappointment with public supply of power. Participant 2 remarked that the problems associated with bad power supply are huge and expectations are high. The problematic power supply led to losses for many businesses in the steel industry. Participants 2, 5, 9, and 10 all stated that they experienced losses with respect to time, resources (i.e. wasted steel and lost production), and blackouts (lost power). All of these losses were consistently attributed to unreliable supply from public sources. As Participant 5 stated, power infrastructure is poor. There are bad poles, cross arms, and insulators everywhere that do not efficiently provide power. Participant 7 used the example of a power outage in

the middle of a critical production stage: "Supposing power goes off when casting is going, it will stop, and materials used up to that time will waste and then we will have to reprocess. Huge amount of money is involved." Participant 7 revealed and warned that "it takes time to clear the production line, which also a kind of loss. So, steel production is heavily dependent on power."

A subtheme within this theme was privatization. Both Participant 9 and Participant 10 indicated that privatization has not been helpful. The industry's expectations of improvement in power supply due to privatization were never met. As Participant 5 stated, little to no money has been invested in the development of infrastructure by the private energy companies. It has been a significant source of disappointment. Participant 4 was of the opinion that the unreliable supply has led to an inability for steel producers in Nigeria to compete with the international market. Because of this inability to remain competitive, steel imports have risen significantly. Participant 5 further shared the opinion that distribution of power should return to the government, as maintenance was much better in government hands.

Figure 6.

Top 10 terms for Theme 3.

Other top terms for this theme, though not above the threshold, were *distributor/distribution*, *plan*, *save*, *change*, and *assurance*. Theme 3 can be summarized as containing the participants' attitudes toward the quality of power supply relative to the capacity and its impact on profits. In Participant 1's exact words, "Fluctuations in supply and its quality also affect the whole system." This sentiment is shared by all 10 participants. Participant 4 echoed this sentiment all the more by stating that "they [the steel industry] were suffering from inadequacy and poor quality at the same time." Inadequacy of power supply is the capacity (voltage) that businesses receive. Quality relates to the poor distribution of power and the lack of continuity or consistency. These factors substantially affect the industry's ability to be profitable. Participant 1 reported that TCN (the Transmission Company of Nigeria) had advised them to follow certain control procedures for electricity management. In simple terms, Participant 1 stated that they were told to ration their supply. Examining the statements of the other participants reveals that rationing is a rather common practice. Participants 8, 9, and 10 all confirmed that rationing occurs at their place of business. In particular, Participant 8 and 10 both affirmed that business only runs three days in a week to allow them to manage their power supply. Rationing is only one attempt to provide a solution to the quality and capacity issues in the industry. Other solutions have involved planning for the use of alternate sources of energy. The difficulty in that has been that cheap, public supply is usually inadequate, and expensive, private supply, though it is more adequate, is not much reliable, but is much more expensive. As Participant 7 stated, it is almost never worth it to depend on private sources of power, particularly for steel production. This is a

problem that TCN has assured it will change, but consensus among participants is that such change is unlikely. The primary bottleneck to such change is the distributors and the overall distribution system, a sentiment participants shared.

Figure 7.

Top 8 terms for Theme 4.

Other top terms for this theme, though not above the threshold, were *water*, *close*, and *distribution*. Theme 4 can be summarized as containing the participants' attitudes concerning the steel production process and how electricity needs factor into it. Along with that, a sub-theme also emerged concerning the role of government in the steel production industry. It was unanimous that the steel production process requires constant electricity. As Participant 4 aptly stated, "the process in steel industry does not need interruption." However, as stated by Participant 5, power is not available everywhere, which is a big bottleneck for steel production in the country. Most locations lack adequate public supply, and must rely on other sources. Some alternate sources included

water and coal. Participant 9 mentions that their business had received an offer on developing a hydroelectric plant as a private source of energy for their steel production. Both Participant 5 and Participant 2 went further to suggest that government take an active role now in the distribution of electricity. Participant 5 remained a strong advocate for government maintenance, especially. Participant 9 suggested that government policies were also an issue for the steel industry. Taxation and tariffs are interrupting production by halting the means by which steel manufactures can develop private energy sources. Participant 9 also correlated the taxation and tariffs with the aftermath of privatization. This is a sentiment that is shared by Participant 5.

Figure 8.

Top 7 terms for Theme 5.

Other top terms for this theme, though not above the threshold, were *synchronization*, *combine*, and *ok*. Theme 4 can be summarized as containing the participants' attitudes toward the use of multiple sources of power. Participant responses

indicated strong consensus for mixing public and private sources of energy. Participant 3 stated, "It should be 90% of public and 10% of private sources for profitability." Similar sentiment can be found in other participant responses. Participant 6 stated that "costs will come down when you combine the two [sources]." Likewise, Participant 1 shared that their place of business also has plans to synchronize the use of public and private sources. While only one participant believes that profit is maximized by synchronization, it is nonetheless a consensus that synchronization alleviates costs. Participants believed that synchronization improves the load capacity. In other words, power outages and lost production due to interruption as well as wastage in steel manufacturing can be averted with an efficient mixing of both public and private sources of energy. However, public sources remain the most sought after source, as stated by the participants. The primary issue with synchronization remained the cost of private sources and the lack of availability of decent public sources.

To reiterate, the research question was: How might the sources of electricity supply lead to the survival, growth, and profitability of steel manufacturing businesses in Nigeria? Participants revealed that success in using a multiplicity of electricity supply sources still hinged on factors such as (a) public energy handling, (b) private energy handling, and (c) consumer self-protection through private means. Survival of steel manufacturing business in Nigeria is an element contingent on human and material factors. Participant 2 stated that the problems were so huge and expectations were very high. Accordingly, the basic thing is that the companies understand that their survival is on the line. There is need for competition for them to deliver on the expectations.

Growth of steel manufacturing business in Nigeria, Participant 9 stated, "As far as I have public supply, I have no problem, especially with good quality. We have 3200KVA UPS set up, to contain production losses due to power cuts."

Profitability of steel manufacturing business in Nigeria would depend on the simple demand and supply principles. Further than that, steel manufacturing profitability would also follow the finance and accounting principles, *Revenue,* less *Expenses,* equals *Net Income*. Participant 1 associated profitability with power sector privatization, and categorically stated that the privatization activity "has not shown in generation of electricity. No impact on efficiency." Overall, erratic supply of electricity creates a flow and ebb of outcomes. Based on participant responses, supply crunch and other extraneous factors create occasions of potential or apparent losses. Participant 10 took a personal stand due to frustrations arising from shortage of power. "I will prefer my own generation to avert losses. Electricity supply is 40% of cost and we consider electricity and gas as raw materials in steel production." Participant 10 explained, "This is why we have private generation and new tariff will make steel plants to close down. We cannot bear the cost of inefficiency of electricity supply system." In addressing the issue of raw material in short supply, Participant 10 still pointed out, "Gas for power generation is also an issue but we plan to utilize it for self-generation than use public supply for production." Profitability opportunities face challenges from irregular electricity and scarcity of other energy options. Participants implied that the sources of electricity would only lead to survival, growth, and profitability if all other things remain equal in the production equation.

Confirm, Deconfirm, or Extend Knowledge

The representative disciplines within this study are engineering, steel, and power. The findings from this study confirm knowledge in the three representative disciplines. Rather than extend knowledge, the findings revealed a need to apply existent knowledge in the applicable field. By way of existing knowledge, the structure, ownership, and administration of the industry companies rested in the hands of such private entities (Makwe, Akinwale, & Atoyebi, 2012). Participant 2 confirmed the issue of structure, ownership, and administration as very complex question, and stated, "I can answer in 3 segments – generation, transmission and distribution challenges. The generation and distribution companies have a sense of ownership and this can lead to changes. People now understand what the problems are."

In terms of existing knowledge, electricity distribution entity in Lagos and other major cities constituted a challenge to reformers (Lionel, 2013). Participant 5 desired that such challenges come under the government to ensure "the public electricity distributors maintained the supply network." Participant 5 expected each distribution area taking supply from transmission substation, should be manned by the transmission station for better results. In further confirming existing knowledge, Pollitt (2012) reviewed reform in the electricity sector and concluded that it did not depend on movement from one type of energy to another but on the ability of the societies to bear the expected higher cost, no matter the extent of the reform. Participant 5 explained that "some individuals tried to invest in power generation, but the real problem was that the cost of production of steel was high. The cost of gas was high, and gas was unavailable to investors." Participant 5

warned as follows: (a) steel production required a lot of power, (b) power was a raw material for production of steel, and (c) power was not a utility.

Brophy Haney and Pollitt (2013a) further pointed out, after over 20 years of reform in the electricity sector, governments remained relevant and active in the development, as the reform remained work-in-progress. Participant 10 bemoaned three factors contributing to difficulties in the reform process. Participant 10 lamented, "I have a list of 45 companies that closed down because of three reasons: electricity, government taxation problem, and unionization problems." He emphatically concluded saying, "Power supply and government policies are a big problem for us."

Comparison with other peer-reviewed study findings: Electricity, as a type of energy needed for domestic, commercial, and industrial processes, became a subject of policy changes all over the world (Erdogdu, 2013; Brophy, Haney, & Pollitt, 2013a). Participant 1 preferred public supply and estimated that private supply would cost N52/unit while the public supply cost N40/unit. The difference was substantial for the kind of profit Participant 1 envisaged. Participant 1 restated that "the public rate changed from time to time just as the cost of gas for private generation, which could go up to N100/unit."

Brophy et al. (2013b) contended that "due to the essential and expensive nature of energy, most countries bore the cost of energy for many years from the mid-19th century" (p. 13). Participant 1 related to Brophy et al.'s (2013b) perspective and questioned reformers. "If you have public supply and have the capacity to generate your own power, in terms of unit cost, will you prefer to use your generated power or public

source?" Participant 2 confirmed that "when power supply is not there, it affects steel production to the extent of negatively affecting business. There is strong correlation between electricity supply and steel production. Two factors about electricity supply are important here – availability and reliability." Participant 2 confirmed facing challenges in both aspects over an entire quarter when production was down to zero because of lack of electricity and gas. In line with participant confessions, Brophy et al. (2013b) had earlier reported that changes occurred in economic fortunes, leading governments to source alternatives to the public domination of the sector.

Meyer (2012) noted that electricity industry was conventionally a monopolistic entity but for high funds needs for its operations, which necessitated the reform in its ownership structure. Participant 1 revealed "public supply is cheaper as a known fact because aside the cost of gas, we have to maintain generator and save for their replacements" and concurred that the above factors made private generation very expensive. According to Participant 1, and in consonance with Meyer (2012) statement that: " private generation is ultimately for intervention to mitigate unreliability and shortages in public supply."

Rentizelas, Tolis, and Tatsiopoulos (2012) regarded investment as important in the process of reforming and operating systems related to energy. Participant 7 made comments of similar congruence to the effect that private supply meant having to get gas, which remained a problem because of supply unreliability. Participant 7 warned that: "investment in power supply must be at maximum even when utilization is 50%. This level of investment means high cost. Private source is, therefore, expensive." What is

unclear, therefore, is finding the basis for how and when to accept high costs with available supply or low cost with little and occasional supply lack.

Nepal and Jamasb (2012) concluded that reform to a large degree is complex and gloomy, many years after its commencement in many countries. Participant 5 dwelled on the complexity and gloom from the standpoint of cost, revealing that "steel production uses induction furnace and cost of production is so high because of power supply problems and will outweigh the cost of imported steel." In line with the postulations of Nepal and Jamasb, Participant 5 decried the above complexities as responsible for the importation of a lot of steel into Nigeria, and confirmed that "because production of steel is hampered by power supply. The manufacturing companies go down with consequent job losses in construction industry." Nepal and Jamasb (2012) reviewed progress and issues in electricity sector reforms worldwide. Variegated degrees of the issues and styles of the reforms were visible.

Interface with conceptual framework. The conceptual framework of this qualitative case study was decision theory (DT) or option or optimization theory in which combination of inputs can give the desired outcome. North (1968) defined DT as a tool for deciding between options without full knowledge of the outcome but uses available information to reach the best decision, which reduces the risk of failure of the outcome.

Bradley and Terry (1952) and Halpern et al. (2013) considered organizational perspectives in the choices business leaders make in piloting the affairs of the respective organizations. Participant 2 wrote off the question of choice insisting that "the answer is straight-forward. Surely, we will take our own power supply because of unreliable and

inadequate state of the public option. Steel industry is capital intensive and investment cannot be endangered by lack of good electricity." Decision theory provides a platform for comprehending the complexity of different sources of electricity supply in a geographic region such as Nigeria. Participant 1 revealed a plan the manufacturing company decided to execute, which was "to synchronize the sources using such equipment with public utility." The organizational plan could be an example in decision theory, but the platform required further authentication through ascertaining the extent of complexity involved in the dilemma Participant 1's manufacturing company planned to address. Participant 1 further explained that any excess power the company generated from the plant would become available to public utility companies at a price. The public utility firms would use installed import/export meter. Nigerian Bulk Electricity Trader (NBET) asked this question, and is eager and supportive of efforts to generate additional power into the grid.

From the conceptual framework standpoint, Mohaghar et al. (2015) postulated the economic principles of supply and demand could address a steel company's need to manage sourcing of electricity from just one place. Multiple sources exist for procuring electricity in modern Nigeria. Such multiple sources imply complex inputs and outputs that require strategic optimization. Participant 6 contended that "when there is heavy demand like using the furnaces, to avoid exceeding the capacity of private source, public supply is used." This contention aligns with Mohaghar et al.'s (2015) advised functionaries in the energy sector to manage sourcing in the light of input and output complexities.

Regarding electricity systems, constraints subsisted in generator type, market price uncertainties, losses mitigation, and profit maximization (Nojavan, Zare, & Feyzi, 2013). Participant 3 cautioned that power was very essential for steel industry because steel manufacturers consumed a lot of energy because of high inductive load. Consequently, the manufacturers located close to potential adequate supply. The alternative, which would be to run private generators, was very expensive, according to Participant 3. Participant 4 expressed the regret that steel production process was a continuous one that entailed heating and melting, and required a lot of electricity. Participant 3 revealed that the industry was "suffering from inadequacy and poor quality at the same time. If they have to go on generators, it will be capital intensive and end up in high production cost and consequently impact on their competiveness and profitability."

Bradley and Terry (1952), as well as Tsang (2013) conceptualized their respective studies on the premises of options management to control cost and maximize profit by steel business leaders. Conversely, the problem associated with the low population multiple case studies was that generalization might not be accurate to represent a larger population of which the concept of theoretical generalization, in which outcome of investigation applied to its population and other populations, might be a solution.

Accord or discord with existing literature. For effective business practice, Turkey would be an appropriate example for electricity reformation. Tasdoven, Fiedler, and Garayev (2012) focusing on two key reasons for the reform in the electricity sector (higher efficiency and lower prices) revealed the effect of energy theft in Turkey. On

effective business practice, Nigerian steel practitioners harp on the need to lower cost. This relation of cost to profitability spans all spheres of business. Participant 2 made comments that align with scholarly presentations. According to Tasdoven et al., out of 4.8 million subscribers of electricity, 196,000 were illegal (non-paying) customers in 2008.Participant 2 stated, on the transmissions part of public elelctricity supply, "it cannot be 100% private nor public. There is need for private-public partnership. Also, attitudes need to change to understand profit and loss factors and make sure people are held accountable."

Tasdoven et al. identified government agencies as the highest defaulters. According to Participant 3, stated that "I think it should be 90% of public and 10% of private sources for profitability." Tasdoven et al. recommended economic regulation (control of entry and exit), privatization (involvement of private profit-making organizations), information dissemination and enlightenment, and use of grants to third parties to perform a function without government interference. Participant 4, in the case of private sourcing, stated the desirability of profit motive; and in the case of public supply, the efficiency and regularity of supply would render the public supply desirable because it would be economically affordable.

Tasdoven et al. concluded that governance tools as listed above were necessary as part of the market structure of a reformed electricity market in Turkey. The above research applied to this study in the area of pricing because the lower the number of paying customers, the more the unit price of electricity for the same volume of dispatched energy. This conclusion is in line with Participant 4's subjective analysis. An example

from the United Kingdom would also serve in highlighting accord or discord with scholarly postulations. The electricity sector reform in over 70 countries of the world started 1982 in Chile with UK leading as Kessides (2012) earlier indicated.

Participant 1 revealed that Nigeria's process involved following control (or rationing) Transmission Company of Nigeria (TCN) instituted and commented:

> We have been waiting for increase in the line capacity in the last five years with TCN assuring that it was committed to achieving that with materials already received. Once the work is done, we believe the supply problem will be over. We can also go for private power generation.

Similar to the UK reform process, Participant 1 reported that their company applied to Nigerian Electricity Regulatory Commission (NERC) for required license, for 50MW plant. Those processes are similar to what scholars have reported. Participant 6 gave an example from India based on experience that "In India what is done by steel companies is to build a power plant of their base load capacity and run it in parallel with the public source. The purpose of this strategy, according to Participant 6 was, to allow the reactive power to be thrown to the grid. The cost will come down when you combine the two."

In terms of the Australia within existing literature, Gao and Van Biesebroeck (2014) traced the commencement of reform in the electricity sector in Australia and Victoria region in particular since the 1980s. Participant 3 self-identified as an Engineer, working for the transmission company, having 23 years of experience in the electricity sector, and familiar with the issues in the topic of this study. Participant 3 revealed

knowing of a company that went into private generation, ran aground, and returned to the public supply. This Nigerian experience probably in line with is one of the reasons Gao and Van Biesebroeck's observation. Gao and Van Biesebroeck observed that reasons for the reform were that of engendering competitiveness and improving efficiency that implied transfer of risk to investing companies and freeing of resources for other government services. Participant 4 also self-identified as working for a transmission company in Nigeria, with no less than 22 years in power sector. I am widely experienced and knowledgeable in the goings-on in the power sector, which presently is grappling with a lot of problem in generation, transmission and distribution sector.

Gao & Van Biesebroeck concluded that there was a rise in efficiency and cost of operations fell compared to state-owned entities. Levels of debts and interest payments reduced in addition to expenditures that dropped leading to budget surpluses and higher GDP. Participant 1 made comments that align with Gao and Van Biesebroeck's conclusion that "electricity supply issues and affect steel production due its electricity intensive nature. Fluctuations in supply and its quality also affect the whole system. Participant 1 concluded, to improve on the quality of supply and to support the source, we put in about $1m to install SVC (Static Voltage Compensator), as advised by TCN, to protect the source and other consumers."

Applications to Professional Practice

When steel companies report profits, buyers and sellers of manufacturing parts within that industry would witness business growth. Sustaining such growth would involve constant greasing of the mechanical parts of the business entity. Southwest

Nigeria may have benefited from the operations of steel manufacturers. However, association with scholarly findings prior to this investigation may not have been a topic. The issue of electricity for manufacturing conjured challenges, but engineers in the steel sector of Nigeria's economy constantly needed a boost of energy. An experiment in mixed sources became necessary. The extent to which mixed energy sources provided the firms with profits remained unclear. The outcomes included multiplication of energy sources, personnel movement due to entrepreneurship desires, inconsistencies in power supply and power shortage. Consumer confusion remained constant over choosing between public and private energy providers. Professional practice became a victim of the inconsistencies.

Findings from this study showed that professional practice within the steel industry could grow under circumstances of reliable power supply. Business leaders had the ideas, especially as the pool of professionals in the study consisted of university-trained engineers with several years of work experience within one or all of the three segments of industry such as Energy, Steel, and Power. Considering the level of experience within steel manufacturing in Nigeria, the Southwest portion of the country could maintain a monopoly of experienced steel professionals. Findings from the study could enable such professionals to spearhead a national awareness to propagate an energy policy reflecting the findings from this study.

The findings are relevant to improved business practice because the engineers who provided responses to the interview questions consist of individuals who have participated in organizational policymaking. The policies so far implemented within the

steel manufacturing sector, along with the combination of participant contributions in this study will effectively equip existing and future steel business practitioners to make appropriate decisions. The readiness of steel manufacturing engineers and their counterparts on the business side to pursue profitability of their entities can serve as a platform for moving the business practice in a positive direction. The ability of the stakeholders to sustain such a positive direction will lead to incremental growth and development of not only steel manufacturing, but also the business entities with attendant profitability for the benefit of shareholders.

The inconsistencies within the steel industry constituted setback for not only the industry, but also the entire nation, considering the high demand for steel. Delineating success and failure factors could only arise from joint commitment by all the industry practitioners. When policy addresses business entity interests for monopolists and oligarchs to the detriment of the manufacturing engineers and availability of raw materials for their production success, survival, growth, and profitability would be unattainable. Findings from this study revealed the innate features the manufacturing establishments as well as the composition of the personnel. The manufacturing establishments became more noticeable from the specific details participants provided on equipment capacities. The personnel capacities became clear from the self-identification of most of the participants that received university degrees in the applicable fields of engineering, and have been working in the steel sector for several years.

Findings from this study shows that the responsibility of business leaders within the industry begins, but does not end, with understanding the strategies that have led to

survival, growth, and profitability. In this instance, the business leaders who provided responses to the interview questions expressed the optimism that a dissemination of appropriate campaigns would play a critical role in moving the steel industry forward. That optimism was dependent upon the understanding by appropriate functionaries that policies must address on an equal footing the concerns of the manufacturing engineers and business plotters. An understanding of the associated strategies would not only be of primary importance to steel company leaders, but also inalienable from the wider communities comprising of dwellers, steel industry workers, ancillary business entities, and the policymakers. Findings from this study revealed that steel manufacturing companies that have suffered losses are in a good position to suggest ways out of the quagmire, and on to profitability.

Implications for Social Change

Steel manufacturing companies that embrace the findings from this study would bring about positive outcomes within their host communities. Communities in which the raw materials exist possess the capacity to influence social development across areas around them. When social change occurs, improvements will manifest in the way of life of individuals, communities, organizations, institutions, cultures, and societies. People change behaviors upon embracing new thoughts and concepts. Communities exhibit group attitudes, and demonstrate collective reaction to most phenomena. Communities in which the raw materials exist possess the capacity to influence social development across areas around them.

Organizations within a socially changed community would relate more with their immediate communities because of shared understanding. Schools, associations, and religious entities would share progressive values. Nongovernmental organizations will have more activities geared towards families and children in the immediate and surrounding steel mining, refining, and finishing communities. Cultural perspectives would witness close connection with community members who would ordinarily shun such cultural artefacts. New associations and societies would emanate from the new understanding arising from social change.

Steel is one of the pillars of Nigerian economy. Members of the communities in which the steel manufacturing plants are located contribute labor to the plants. In return, members of such communities learn lifestyles from top officers of the firms. Social change may arise from survival, growth, and profitability of steel businesses in that awareness levels will increase. Southwest region of Nigeria is home to ancient communities, cultures, and societies. Considering the significance of steel in Nigeria, the geographic areas hosting steel manufacturing plants have invariably raised individuals up to occupy high positions in government, industry, and commerce. Communities will become more active than would otherwise be attainable.

Social change benefits of this study would come in diverse forms: (a) employment opportunities will increase for community members in the localities steel manufacturing plants exist, (b) corporate social responsibility benefits will accrue to local communities, (c) parts of the steel industry communities will attract businesses to satisfy the forward and backward integration possibilities, (d) steel users throughout Nigeria will benefit

from the Southwest Nigeria growth and development arising from steel business growth, and (e) Southwest Nigeria citizens will sensitize citizens of other parts of Nigeria of the growth of steel, thereby increasing interest in the business. These situations will lead to the effectiveness of business leaders, increase in job opportunities, support of local talents, and continuous mobilization of community masses.

Recommendations for Action

Findings from this study should be of interest to the engineers working for steel manufacturing concerns. Furthermore, purchasing departments of steel manufacturing companies should also show interest in what the participants have said by absorbing the findings from this study. Based on the results, purchasing departments of steel manufacturing plants should simply purchase any available energy products whenever they are available. The production plant strategy should be to achieve zero to little downtime in production. The business side of steel manufacturing companies is ready to transact swiftly when the final products are available from the steel production lines. By so doing, cash flow would support immediate purchase of energy products promptly to eliminate downtime.

Based on the results, steel manufacturing companies should pay close attention to the need for backward and forward integration. The steel manufacturing companies could award contracts to community members who show interest in aspects of the steel business. Success strategy must include implementation of tripartite agreements to spread the associated risk in energy procurement. Steel manufacturing companies must institute or strengthen monitoring activities to know when, where, why, and how government

functionaries focus on specific policies. This monitoring activity would strengthen the steel manufacturing companies' profitability base.

Publishers of technical should show interest in the results from this study. Engineering students rely on such publications to prepare for their future in the fields of engineering, steel, and power. Franchisees in the three fields of human endeavor should also be attentive to the findings from this study because they will learn opportunities, especially when the flow and ebb engender potential business success in the steel, power, and engineering arena. Professional associations, labor unions, engineering student societies, and entrepreneurs should show interest in the findings from this study because of the awareness level their platforms offer them.

The dissemination process for the findings will include engineering journals, academic journals, contemporary newspapers, student union newsletters at diverse universities. Because of the general outcry for solutions to electricity, a dissemination strategy involving civic center public seminars would be appropriate for sharing the findings. This activity is important because individuals who attend might learn how to be proactive in a market where profitability would hinge on raw materials of unpredictable supply.

I will provide a summary of findings to participants on demand. Opportunities to present at conferences would be appropriate to share with attendees of such conferences updates on the steel manufacturing quagmire. Such attendees would, in turn, take the message to other places to raise awareness. All organized societies for power,

engineering, and steel, would receive solicitation for training workshops based on the findings from this study.

Recommendations for Further Research

Based on participants' interview responses that sourcing should be *for* "90% of public and 10% of private sources for profitability, and that costs will come down when you combine the two [sources]," several questions arose answerable on through scholarly investigation. The following prompts would be appropriate for guiding future researchers along the lines the participants were either expressing or implying:

1. Best practices in energy sourcing for steel manufacturing.
2. The relationship between steel manufacturing business survival and government policies.
3. The role of steel manufacturing siting in the survival, growth, and profitability of neighboring SMEs
4. Quantitative research study to conduct a nation-wide examination of this same subject with a view to identifying potential new geography-based success factors within Nigeria.

Limitations are important in keeping a researcher alert to prevent preconceived notions to circumscribe the study. The issues that arose during interviews were outside the scope of this study because of reliance on Hyett et al.'s (2014) admonition to respect the perimeters representing limitations. Future researchers should consider using the quantitative method to conduct a broad sweeping nationwide study aimed at discovering if the Southwest concentration of steel business might be contributing to the flow and ebb

of business status. Future researchers should also consider economies of scale and synergies to see if research participants could throw light on those nuances of steel business. Based on participant responses, one of the deductions could be that importation of a key element could drive down both the costs and power outage. The 10 participants satisfied qualitative research requirements. However, the use of quantitative methodology would serve in keeping research participants within the bounds, to elicit 'yes' or 'no' answers to appropriate algorithmic questions. Results from such an investigation could undergo comparison with this qualitative research to find missing links in either or both of the studies.

Considering the >170 million population of Nigeria, and the 356,669 mi^2 land mass, future researchers should use questions that might elicit data on other geographic parts of Nigeria appropriate for steel manufacturing. The open-ended questions in this study enabled me to probe the deepest recesses of participant knowledge and experience. Possibilities of collecting extraneous data exist that might not contribute effectively to confirming how a multiplicity of the sources of electricity supply might lead to the survival, growth, and profitability of steel manufacturing businesses in Nigeria? Participant 7 insisted:

> Quality is also an issue because induction furnace produces a lot of harmonics due to its coils. Required power is grown to match demand of the furnace. Participant 7 advised from experience that Private power generation can hardly cope with this unlike the public source, which is like an infinite bus with capacity to easily absorb the needs of the furnace. To cope with this, we synchronized our

private generation with public supply at 132kV.

This issue of synchronization was important to most the participants. Therefore, future researchers could consider investigating the possible role of synchronization in profitability of steel manufacturing business.

Finally, of critical importance is Participant 2's comment regarding locations, gas supply, and price differential. That comment raised the issue of the flaring and wasting of gas in the Southwest of Nigeria, which was outside the scope of this study. Future researchers could strongly consider Participant 2 commented: that is a question of gas supply. In some locations, there is no gas. In that instance, you can only rely on public supply. For captive or private generation, gas price is at commercial rate ($7.38/unit). Participant 2's revelation was that for public plants, the price was $2.5/unit. Participant 2 considered that "as approximately three times more cost for captive generation than for public plants This makes the unit cost of private generation very high than that of the public power supply". Participant 2 was bold to conclude: "so, public supply with availability will be the best so that steel companies can focus on core business." With this assertion, future researchers have a theory to confirm or debunk in Participant 2's bold assertion, as such an assertion does not represent the overall data analysis result.

Reflections

I used the case study design to investigate how the use of multiple sources of power supply might lead to the survival, growth, and profitability of steel manufacturing businesses in Nigeria. I found out that the professional engineers worked on different aspects of steel manufacturing. Some of them focused on energy. Others focused on

configuring of steel types, sizes, and quality. Those in quality control played their professional and occupational roles to help their respective manufacturing companies. I occasionally found one engineer countering what another engineer had already said in answer to the same question. I later realized that the different job specifications exposed the engineers to varied nuances of the same industry. Therefore, I understood the three industries better after this study than I did prior to the study. As a professional engineer and Fellow of the Nigerian Society of Engineers, I saw nuances that pertained to the aspects of engineering I belonged. This study has enabled me to understand diverse aspects of the fields and can now make the right decisions when matters pertain to the fields of Power, Steel, and Engineering.

Summary and Study Conclusions

The purpose of this study was to explore how multiple sources of electricity supply might lead to the survival, growth, and profitability of steel manufacturing businesses in Nigeria. Data collection involved (a) interviewing 10 participants, (b) reviewing archival records pertaining to procuring energy from diverse sources, and (c) observing manufacturing personnel process in scouting for alternative energy sources. The questions were semistructured, thereby allowing me to ask follow-up questions arising from comments participants made while answering the prompting interview questions.

Extra-thematic considerations dotted all stages of the investigation. Public supply was inadequate and unreliable. Private generation is a necessity for steel and other production. Public supply was preferable, if available and reliable, for cost reasons.

Private generation was preferable for reliability although more expensive to save losses. No improvement in public supply after privatization. All participants have private generation capacity for full or partial production. Private generation was better with synchronization with public supply. Profit maximization was achievable through synchronization of private with public sources of supply to avert production interruptions and wastages, while using more of the public source. The above elements were in full perspective during data collection and analysis.

The methodological triangulation helped me in analyzing the three sources of data. Although I first noticed saturation while interviewing the sixth participant, I continued the interviews to avoid misreading the similitude of saturation.

- Data sources diversified following saturation of responses – 6 core steel producers, 2 other heavy energy industries and 2 power supply utility engineers.
- Validation was through seeking immediate clarification of responses – i.e. member checking.
- All participants were all of managerial level with high responsibilities

Based on raw and refined data, the steel industry in Nigeria will continue to face challenges until the manufacturing concerns enjoy uninterruptible power supply at the plants. Participant 3 stated that sourcing should be "for 90% of public and 10% of private sources for profitability." Similar sentiment occurred in other participants' responses. Participant 6 stated that "costs will come down when you combine the two [sources]." Likewise, Participant 1 shared that their place of business also had plans to synchronize

the use of public and private sources. While only one participant believed that profit maximization was by synchronization, it was nonetheless a consensus that synchronization alleviated costs.

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Appendix: Interview Protocol

Action Items	Conversational
Introduce the interview and set the stage.	Script:
• Watch for non-verbal queues • Paraphrase as needed • Ask follow-up probing questions to get more in-depth	1. How did electricity supply source interface with survival of your steel manufacturing business?
	2. What did you do, as a business leader, when the volume of steel business operations shrank because of electricity supply?
	3. How appropriate was the public to private electricity supply for your manufacturing business?
Wrap up interview thanking participant Schedule follow-up member checking interview	4. What strategy did you implement to ensure a profitable mix of electricity supply for business survival and growth?
	5. How did your business strategy specifically affect each of the variables, survival, growth, or profitability?

Follow–up Member Checking Interview

Introduce follow-up interview and set the stage	Share a copy of the succinct synthesis for each individual question. Bring in probing questions related to the research question.
Go over each response for accuracy and meaning	