

# Power Distribution Network and Production Chain Analysis in an Industrial Company

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**Abstract:** *This project report examines the power distribution network in production companies in Nigeria, with emphasis on electrical parts and its production chain. The study aims to identify the challenges associated with the power distribution system and the effects on the company's operations. Research methodology included a combination of secondary research with a literature review and analysis of primary data collected through surveys. The findings of the study revealed that power distribution is essential to the company operations, and the current power infrastructure requires attention. This project offers a comprehensive analysis of the power distribution network, unearths the problems that this company faces, and provides recommendations that can enhance the reliability of electricity distribution and, in turn, the production chain. The research recommends investments in modern power infrastructure and the adoption of energy-efficient practices to enhance production chains and ultimately reduce energy costs.*

**Keywords:** Power, Distribution Network, Production Chain, Analysis, Industrial Company

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## INTRODUCTION

The electricity distribution network and manufacturing chain are essential elements of every industrial enterprise. A stable power supply guarantees the seamless execution of operational procedures and minimises the likelihood of operational delays and recurrent damage to machinery or completed goods. The power distribution network supplies the electrical energy required for the manufacturing chain, which transforms raw materials into completed goods. Power distribution is essential infrastructure in contemporary economies that energises many sectors, including industrial, transportation, and healthcare. In Nigeria, electricity distribution issues are significant obstacles to economic growth, characterised by frequent power outages and insufficient power supply. Research in Nigeria indicates that power outages impede corporate development, diminish productivity, and escalate operational expenses. A research by Oyelade and Oludele (2018) revealed that power interruptions reduced the workforce in Nigeria's industrial sector by as much as 60%. The reduction results in a decrease in industrial output. Furthermore, power interruptions adversely affect small and medium-sized firms that mostly depend on energy for their operations. Consequently, it is essential to tackle the

difficulties related to electricity distribution systems for effective and sustainable corporate operations.

Prior research has highlighted technical issues, including insufficient maintenance, obsolete infrastructure, and inadequate investment, as the causes of frequent power outages in the nation. Additional studies examined alternate energy sources, including solar and wind energy, and their capacity to mitigate Nigeria's electrical issue. Subsequent studies advised that the Nigerian government prioritise investments in power infrastructure and other energy sources to improve the nation's electricity distribution. This research seeks to examine the power distribution network of Superflux International Limited, a printing and manufacturing firm, and its effects on the company's production chain. The study will analyse the essential components of the power distribution network, the company's infrastructure, and suggestions for improvement.

Superflux International Limited is a prominent printing and manufacturing firm situated in Ojodu, Lagos State, Nigeria. The firm operates a printing facility that produces sensitive goods such as degree certificates, bank cheques, and tickets, using advanced printing machinery under stringent security protocols. The firm also engages in commercial printing, changeable data printing, envelope manufacturing, thermal/POS roll manufacture, and further services. The sensitivity of the company's production necessitates a reliable power supply for optimal machine functioning and effective human management, which are critical for daily operations.

The firm began operations in 1998, specialising in security print goods, and has expanded from a two-person trade entity to around 300 people in a state-of-the-art production facility. Superflux International Limited has established itself as the premier cheque supplier in Nigeria, recognised by the Central Bank of Nigeria, the Central Bank of Zambia, and the West Africa Monetary Zone. They manufacture a diverse array of cheques that include advanced security measures, providing optimal protection against fraud. The cheques are available in various sizes and may be completed as cut sheet, flow line or multi-part formats.

Leveraging knowledge and experience acquired over the years in security printing, they are capable of producing bright patterns that fulfil unique security and creative needs of customers. The cheque printing and finishing operations adhere to specified quality standards to ensure process and procedural integrity. Superflux International Limited has evolved into a conglomerate with investments in courier and transportation services in Nigeria and Kenya, alongside a company engaged in agro-allied operations. The sensitive nature of its activities restricts factory visits to authorised persons, and workers undergo thorough searches while entering and exiting the facility. Comprehensive CCTV coverage of the whole corporate premises is in place to provide effective surveillance and monitoring.

### **Production Chain Analysis**

Production and printing processes occur continuously, necessitating that staff in the operations division work in shifts to optimise production and efficiency. The firm utilises more than 30 industrial-grade printing and manufacturing equipments and equipment. This list include intaglio printers, flexographic printers, offset printers, packing equipment, die cutters, check cutting and encoding machines, forklifts, pallet jacks, among others. The standard sequence of operations include the promotion and advertising of services to potential customers. Upon securing a work or contract, design samples and prototype prints are sent to the customer for

validation and approval. Following thorough conversations with the customer about revisions, the printing process begins. The sample structure and specifications have been uploaded to the systems for further manufacture. Each machine is configured according to the specific requirements of the work and anticipated outputs. Upon fulfilment of anticipated orders, the output is packed and either collected or sent to the customer.

The company's pricing strategy is contingent upon the nature of the project, output volume, and production costs. The production chain for this printing company can be broken down into the following primary activities:

1. **Inbound logistics:** This includes activities such as purchasing raw materials, storing them, and transporting them to the production facility. All materials are safely kept in the factory storage unit and is only accessible by specified members of staff.
2. **Operations:** This includes the actual printing process, as well as any post-printing operations such as cutting, folding, and binding. Jobs are classified and scheduled to various machines based on type, specifications and expected delivery dates.
3. **Outbound logistics:** This includes activities such as storing finished products, packaging them, and shipping them to customers.
4. **Marketing and sales:** This includes activities such as generating leads, developing marketing materials, and closing sales.
5. **Service:** This includes activities such as providing customer support, reprinting damaged products, and recycling waste. In addition to these primary activities, there are also a number of secondary activities that are important to the success of this printing company. These secondary activities include:
6. **Procurement:** This includes activities such as finding and negotiating with suppliers, as well as managing the supply chain.
7. **Technology development:** This includes activities such as researching new printing technologies, developing new printing processes, and training employees on new technologies.
8. **Human resource management:** This includes activities such as recruiting and hiring employees, training and developing employees, and compensating and rewarding employees.
9. **Infrastructure management:** This includes activities such as maintaining the printing facility, managing the printing equipment, and ensuring the safety of employees.

The production chain for this printing company can be complex and challenging to manage. However, by understanding the different activities involved in the production chain, the company can further improve their efficiency and profitability.

Here are some of the key factors that can affect the efficiency of the company's production chain:

1. **The quality of the raw materials:** The quality of the raw materials used in the printing process can have a significant impact on the quality of the finished product. High quality papers can affect the appearance and resolution of prints, security tags and watermarks are highly sensitive and can be best implemented when the quality of ink and paper being used is of good standard.

2. **The efficiency of the printing equipment:** The efficiency of the printing equipment can also have a significant impact on the production time and cost. Lags and incessant jams in the rollers of the printing machines can lead to an increase in damaged outputs and delay in job completion. The company has engineers who operate round the clock in the maintenance and repair of all factory machines. This sustains smooth operation and quick troubleshooting of issues that may occur during the production process.
3. **The skill level of the employees:** The skill level of the employees who operate the printing equipment can also have a significant impact on the quality and production time of the finished product. Every employee in the operations department undergoes a supervised training process before to assess their responsiveness and ability to operate the machines without hindrance.
4. **The layout of the production facility:** The layout of the production facility can also have a significant impact on the efficiency of the production chain. Security printing jobs like bank cheques and ballot papers are done in a section separate from commercial prints and envelope productions. The factory basically has three layers; The lowest layer is for envelop and Thermal roll productions, Middle layer is for commercial prints and the top layer is for sensitive printing jobs.
5. **The use of automation:** The use of automation can help to improve the efficiency of the production chain by reducing the amount of manual labor required. All machines require minimal human interference, print schedules, design and other adjustments are made on the system therefore, the machines print, cut and produce to set specifications. Security watermarks and numberings are all automated on the machines.

### Power Distribution Network

The power distribution network in this printing company comprises various components, including transformers, switchgears, distribution panels, diesel generator and electrical cables. The network is responsible for transmitting and distributing electrical power from the main power source to different sections and equipment within the factory facility.

1. **Transformers:** Transformers step up or step down the voltage to ensure efficient power distribution. They help match the voltage requirements of different equipment and sections within the factory. A 500kVA transformer steps down the incoming 33kV line from the National Grid to 400V for use in this factory. This transformer is the primary link between the factory and the National Grid.
2. **Switchgears:** Switchgears are used to control and protect the power distribution network. They isolate faulty equipment and prevent electrical failures from affecting the entire production chain. Switchgears also facilitate maintenance and repairs. Every section in the factory has switch gears to either isolate a series of similar machines or similar equipment.
3. **Distribution Panels:** Distribution panels receive power from the switchgears and distribute it to various sections or production lines within the factory. They contain circuit breakers and fuses for overload protection and to ensure the safe operation of equipment.
4. **Electrical Cables:** Electrical cables connect the distribution panels to the equipment and machinery in the production chain. They carry the electrical power required for the operation of the different processes, ensuring a smooth and uninterrupted flow.
5. **Diesel Generator:** A diesel generator is a mechanical-electrical machine that produces electrical energy (electricity) from diesel fuel. It is a combination of a diesel engine with an electric generator to generate electrical energy. A diesel compression-ignition engine is usually designed to run on diesel fuel, but some types are adapted for other liquid fuels or

natural gas. Due to the epileptic supply of power from the National Grid, the diesel generator serves an alternate source of power for this company. More often than none, the diesel generator runs nonstop even when there is power supply from the Grid. This is to prevent disruptions in the printing of sensitive materials due to the unstable nature of electricity from the National Grid.

### Electrical System Analysis

A complete analysis of the electrical system in the company was carried out to assess the various components and determine its reliability and efficiency.

1. **Load Analysis:** The company is basically sectioned into two - Administrative Building and Factory Building. All electrical loads such as machinery, lighting, HVAC systems and office equipment within both buildings was identified. The usage patterns of these electrical loads were also captured. The table below shows a summary of the energy demand in the company.

	Lighting	Office Equipment	Machinery	HVAC System	Total Load
<b>Administrative Building</b>	2.2kW	5.8kW	-	12.5kW	20.5kW
<b>Factory Building</b>	1.6kW	0.5kW	250kW	20kW	272.1kW
					<b>292.6kW</b>

2. **Voltage Levels:** This varies as some machines in the factory are three-phase systems while some are single-phase power systems. A multimeter was used to ascertain this to correlate with installations setups and schematic diagrams of every equipment. Every component in the administrative block runs on a single-phase power system.
3. **Earthing/Ground System:** An analysis of the earthing system in the factory was conducted and it was discovered that overtime the earthing system of the factory has depreciated and this could result in harm to operators and damage to machinery.
4. **Power Quality:** Volage stability, harmonics and transient voltage surges analysis was carried out to establish power quality as this is crucial to equipment functioning. During the study, no voltage instability was discovered as the factory runs on diesel powered generators round the clock.
5. **Electrical Wiring:** The general condition of cables and wires in the factory was satisfactory. During analysis, some issues were identified in the company's production chain and power distribution network. These issues include:
6. **Lack of monitoring and control:** The absence of real-time monitoring and control systems makes it challenging to detect and address power distribution issues promptly. This can result in delays in identifying faults and increased downtime.
7. **Aging Infrastructure:** Aging components and infrastructure in the company's power distribution network resulted in power interruptions and posed safety risks. Some factory machines are outdated and consistently develop faults during operations which in turn affects product delivery schedules.
8. **Cost of production:** Due to the company's reliance on diesel generators for consistent power supply, there is an increase in operations and maintenance costs. This subsequently increases pricing and reduces the company's yearly revenue.



9. **Staffing:** Finding and keeping qualified staff is a challenge for this printing company. This is due to the high turnover rate in the industry and the demanding nature of the work.
10. **Technology:** The printing industry is constantly evolving, with new technologies being developed all the time. This can make it difficult for printing companies to keep up with the latest trends, which can lead to business losses.
11. **Energy Efficiency:** The energy efficiency of the company can be greatly improved due to the type of lighting systems and old machinery currently in use.

### **Recommendations**

Based on the findings of this study, the following recommendations are proposed:

1. The company should consider alternative sources of renewable energy, such as solar or biomass to supplement electricity from the National Grid and reduce dependence on diesel gensets.
2. The company should consider adopting energy-efficient practices like upgrading lighting systems to LED fixtures and optimizing or replacing older machines with new energy efficient alternatives. This will help lower electricity consumption and reduce operational costs.
3. Improve the management of employees by building their entrepreneurial capacity to shape the organization's productive chain.
4. Develop a regular maintenance plan for existing power infrastructure
5. Conduct a comprehensive assessment of the power distribution and production infrastructure thereby prioritizing upgrades or replacements for aging components and machines. This may involve replacing old machines, upgrading distribution cables, and installing modern electrical panels.
6. The company should conduct regular assessments of power demand and ensure that the power distribution network has sufficient capacity to handle current and future requirements. Consider factors such as expanding production capacity, introducing new equipment, or incorporating renewable energy sources.
7. A centralized monitoring and control system that provides real-time data on power distribution parameters should be implemented. This will enable proactive identification of faults, prompt response to outages, and better management of the overall power distribution network.
8. Training programs for staff members responsible for power distribution to enhance their understanding of the network and equip them with troubleshooting skills. Additionally, establish a robust preventive maintenance schedule to ensure regular inspections, repairs, and replacements of critical components.

### **CONCLUSION**

This report captures the important sectors and activities in Superflux International Limited. The power distribution network plays a vital role in the production chain of this company, ensuring its reliability and efficiency is crucial for uninterrupted operations. By addressing some of the issues captured and recommendations offered, the company can enhance its productivity and improve the resilience of its power distribution network.

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