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Emerging Vocations in Metal Working Industry for the Development of Small and Medium- Sized Enterprises in Nigeria

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Abstract
The metal working industry is a vital sector in the Nigeria's economy, considering its significant potential for growth and development. However, the industry is bedeviled with various challenges, which include; limited access to finance, inadequate infrastructure, shortage of skilled personnel among other things. Therefore, this paper identified emerging vocations in the metal working industry that can contribute to the development of small and medium-sized enterprises (SMEs) in Nigeria. Specifically, the paper highlights historical development of metal working industry in Nigeria, emerging vocations in the metal working industry and their benefits, rationale for the SMEs and strategies that can promote the development of SMEs in Nigeria's metal working industry. Finally, the paper concludes that, emerging vocations in the metal working industry have the potential to drive growth and development in the SMEs sector of the Nigeria's economy.

Keywords: Emerging, Enterprises, Industry, Metalworking, Vocations

Introduction

The metalworking industry, otherwise known as metal fabrication industry, is a vital sector of Nigeria's economy that involves the processing and transformation of metals into various products, such as tools, equipment and other metal products (National Institute for Metal Working Skills [NIMS], 2020). The industry contributes to the industrial development and employment generation of any nation. Specifically, the industry encompasses various activities, such as, metal fabrication, machining, welding and casting. In Nigeria, the metalworking industry is characterized by the following factors, small scale operations; metalworking industry is limited in capacity and are small scale in nature; informal sector dominance; a significant portion of the industry operates on the informal sector with limited or no regulation, limited access to finance; the business faces problem of accessing finance and that hinders growth and development, skill gap; there is an acute shortage of skilled metal workers in Nigeria and that affects the quality of metal products produced (Ogundipe & Olurafemi, 2017).

Apart from the above-mentioned factors; Adeyemi and Ojo (2018) rightly observed, there are other challenges facing the metalworking industry, such as; infrastructure deficits which include inadequate supply of electricity, transportation network, and lack of water

supply; competition from imports, the Nigerian metalworking industry faces stiff competitions from imported metal products, which are most often cheaper and of higher quality; regulatory challenges, the industry is subject to various regulations and policies which are often difficult to navigate; environmental concerns, most often, metalworking industry in Nigeria is faced with challenges of poor environmental practice that can harm the environment or contribute nuisance to public health. Inspite of the above challenges, metalworking industry has great opportunities and that could help boost the economy of Nigeria. Therefore, the paper painstakingly discusses on historical development of metalworking industry in Nigeria, emerging vocations in metalworking industry, the SMEs, rationale for SMEs, considerations for setting up SMEs and at the end, a conclusion was drawn.

Brief Historical Development of Metalworking Industry in Nigeria

The development of metalworking industry in Nigeria can be categorized into five phases, namely, pre-colonial, colonial, post-colonial, structural adjustment and modern eras and they are briefly explained below.

Pre-colonial Era (Before 1800)

This is a metalworking period marked before the coming of white colonial masters. During that period, the metalworking industry was characterized by indigenous metal working techniques developed by and refined by the local communities, such as the Hausas, Igbos and Yorubas. Adebayo (2017) revealed that, the technology then was used to:

1. Make farm tools like, hoes, cutlasses, axes, and other domestic utensils,
2. Make weapons such as sword, spears, and arrows for hunting purposes.
3. Produce ornamental pieces of materials for decorative purposes, such as jewelry, anklets and wristlets. In addition to the above, local metals like iron, copper and bronze were used. Also, techniques like casting, forging, were employed, (Nigerian Institute of Mining, Metallurgy and Materials (NIMMM, 2019).

Colonial Era (1800 – 1960)

This is a period between 1800 to 1960, and it is marked by the introduction of European metal working technologies which transformed the industry. The technologies were used to construct railways and railway facilities such as rails, locomotives and wagons. The colonial government also invested in infrastructure, such as, roads, and bridges which required metal products. The era also witnessed the establishment of metal working companies like, John-Holt and UAC in Nigeria (Federal Ministry of Industry, Trade and Investment (FMITI, 2019)

Post-Colonial Era (1960 – 1980)

This is an independence era which was marked by a significant growth in the metal working industry. During the period, Nigerian government greatly invested in infrastructural development, which included roads, bridges, and building works. The era saw an establishment

of some metal working companies including machine tools manufacturing companies (FMITI, 2017). The era also witnessed the establishment of Ajaokuta Steel Company, and Delta Steel Company in order to produce the needed iron and steel in Nigeria (FMITI, 2017). However, the industry was faced with so many challenges, such as inadequate fund and dependence of on imported raw materials.

Structural Adjustment Era (SAE 1980 – 1999)

This era saw turbulent changes in the metalworking industry. The economic reform initiated by Babangida's government which included trade liberalization and privatization negatively affected the metal working industry. The industry also witnessed a stiff competition from imported metal products and that affected the local production (Adebayo, 2017).

Apart from the above changes, there was a decline of state-owned metal working industries, and this is apart from the decline of Ajoakuta Steel Company due to corruption, mismanagement, and inadequate funding. As a result, the challenges, many metal working companies in Nigeria closed-drown (FMITI, 2017).

Modern Era (2000 – Present Day)

The modern era started from the year 2000 to the present day. The era has witnessed tremendous efforts to revive the metal working industry. For instance, Nigerian government has launched the Nigeria Industrial Revolution Plan (NIPR) to promote industrial development and growth (FMITI, 2017). Also, government has encouraged private sectors to invest in metal working industry and in that vein, private investors, have established metal working companies, including fabrication and tool manufacturing. Despite the above challenges, metal working industry continuous to evolve and grow with ample opportunities for development and investment. (FMITI, 2017).

Emerging Vocations in the Metal Working Industry

Emerging vocations stemmed up from the term vocations. While vocations refer to the occupations or careers that require specialized skills, emerging vocations are the occupations or careers that are newly created or rapidly evolving due to technological advancements, social changes, or innovative business models. (ILO 2021). Emerging vocations in the metal work industry are particularly driven by the advancements in technology, sustainability and innovative manufacturing processes. These vocations include but not limited to the following ;3D printing, automation technology, Computer Aided Design (CAD), metal waste recycling, metal waste management, non-destructive testing (NDT), metal working Research and Development (R and D), metal casting, machining operation and metal fabrication.

(a) 3D Printing

This is otherwise known as additive manufacturing; it is the process of creating a three-dimensional object (3D) layer by layer at a time. It is the opposite of subtractive manufacturing in which 3D objects are created by cutting a solid block of materials until the final shape of

object is produced. 3D printing is used to create engine parts for various application in the automotive aerospace and power generation facilities. 3D printing lowers manufacturing startup costs, very easy to learn, reduces material wastages, integrates digital design, and lower energy and environmental costs, among other things. Additive manufacturing specialists are increasingly becoming important nowadays. They design and produce metal parts and products using the 3D printing technology (Gibson, *et al.*, 2021); Markus, 2021)

(b) Robotic and Automation Technology

This is a technology that enables one to design, build, deploy and manage software robots that emulate human actions by interacting with digital system. Robotics and automotive technology are group together, for the fact that robotic is a sub-set of automotive which focuses on the development and manufacture of robots. (*IEEE RAS*, 2022; *Tech Target*, 2021).

Just like human being, software robots can perform tasks or a wide range of defined actions. Robots have the advantage of performing task or actions with precision faster than human beings. The technology has further advantages of making organizations more profitable, flexible, and responsive. Also, it increases employee satisfaction, engagement, and productivity by removing mundane tasks from the actual working days (The Sun, 2024).

One can be a robotic technician or engineer depending on the entry point of the career, and the person can earn between $120,000 – 160,000 per annum in the USA (International Federation of Robotics (IFR, 2020). Robotics and Automotive specialists are highly needed in Nigeria.

(c) Computer Aided Design (CAD)

This is the use of computer software to develop, analyze modify and optimize designs. CAD, helps designers to create technical drawing and models, through the use of computer instead of the real technical drawing boards (**Richard, 2023)** CAD helps technicians and engineers to create two-dimensional (2D) drawing or 3D model. Also, it helps them to visualize, concepts, simulate real world conditions, translate drawings or designs quickly, and improve the quality of designs as required (Daniel, 2020). The average take home of CA Designer in the US, is $64,891 per annum (Pay scale**,** 2023). Specialists in this area are greatly emerging.

(d) **Welding Technology**

International Organization for Standardization. (2019) described Welding Technology as an area that deals with the application of heat to join two or more metals, permanently. Welding engineers develop and implement welding processes and procedures for metal fabrication and manufacturing and, average salary of welding engineer in the Plymouth is £37,404 per annum (American Welding Society, 2016).

(e) Metal Waste Recycling

This is the process in which waste metals are collected, processed and manufactured into new products after they have been used. In recycling process, waste metals are collected and sent to the facility (Shredder) for sorting out, cleaned and then processed into metal products that can be used in manufacturing. Metal recycling is an emerging profitable business most especially in Germany and India (World Steel Association, 2019).

(f) Metal Waste Management

This is the process of managing waste metals or trash from the cradle up to the point of sale (Markus, 2021). In Nigeria, scavenges, collect the waste metals from garbage, then to the point of sale where a measuring scale is used to weigh the materials for payment. In Nigeria, metal waste management is becoming a lucrative business that can fetch money to individuals.

(g) Non-Destructive Testing (NDT)

This is used to evaluate or ascertain the properties and or integrity of materials or systems without causing damage or altering the structure of the materials. Several NDT tests are carried out on metals, such as; visual inspection (VT), radiography (RT), ultrasonic testing (UT), magnetic particles Testing (MT), liquid penetrant testing (PT), eddy current testing (EC), acoustic emission testing (AET), leak testing (LT) and thermal imaging (TI). The benefit applications of NDT is very diverse and include among other things; cost saving, improved safety, increased efficiency, and enhanced quality. Career or occupation in this area can fetch money for any individual. An average salary of NDT shop technician is $47.00 per hour (American Society for Non-Destructive Testing, 2020).

(h) Metal Working Research and Development

This is an area that deals with the process of improving metals through the development of new materials, production process and applications. Research and Development (R and D) in metal working industry include; developing new materials, improving production processes, and developing customer appliances **(**Kalpakjian, & Schmid, 2014). The most common metalworking processes are; casting, forging, machining, welding, stamping and extrusion. In India, the average salary for R&D professionals ranges between £5,000 to £53,000 per year **(**Pay scale, 2023).

(i) Metal Casting

Metal casting is one of the ancient occupations that involves the shaping of molten metals into any desired forms or shapes. The major types of metal casting are; sand casting, investment casting, die casting and centrifugal casting. Sand casting involves using sand mold to cast metal parts; investment casting involves the use of wax or plastic pattern to create intricate metal parts; die casting utilizes metal molds to create high volume of metal parts, whereas, centrifugal casting uses centrifugal forces to cast symmetrical metal parts (John, 2011).

Metal casters, otherwise known as foundry workers, create metal parts and product by pouring molten metal into molds. They work with different types of metals such as iron, steel, aluminum and copper. They work in foundries and machine shops. In the USA, the average salary of metal casters is from $50,000 to $80,000 per year, and this depends on the location and experience. **(**U.S. Bureau of Labor Statistics BLS, 2023)

(j) Machining Operation

Machining operation is an important occupation in the manufacturing industry, involving the use of machine tools to shape and fabricate metal parts and products. Machining operations include; turning, drilling, milling, grinding, and CNC machining. Turning involves the use of lathe machine to cut and form cylindrical shapes; drilling operation utilizes drill presses or lathe machines to create holes in metals; milling operation involves the use of milling machines to cut and create flat or irregular shaped parts; grinding is carried out using grinders to produce and polish metal surfaces; whereas, CNC machining involves the use of computer numerical control machines to perform various machining operations (ASME, 2020). Machinists, also known as machine tool operators or CNC machinists, use machine tools like lathes, milling machines, drilling machines, grinders to cut, shape and finish metal parts and products. They work with various metals such as, aluminum, steel, bronze and copper and also follow the blueprint of computer-aided design (CAD) to ensure accuracy and precision. An average salary of machinists in the USA ranges from $50,000 to $75,000 per annum. with variations based on experience, location, and industry. **(**U.S. Bureau of Labor Statistics, BLS, 2023**)**

(k) Metal Fabrication

Metal Fabrication is an occupation that involves creating, assembling and repairing of metal products and structures. The major metal fabrications are; sheet metal fabrication, structural and precision fabrication. Sheet metal fabrication is all about working with sheet metal to create products like ducts, gutters, body and roofing; structural fabrication involves forming large –scale metal structures like bridges, building and heavy machinery; whereas, precision fabrication involves crafting intricate metal parts for industrial used like aerospace, automotive and medical facilities. The occupation is normally carried out in the construction sites, fabrication shops, and manufacturing plants (David, 2018). An average salary of metal fabricator in the USA starts from $50,000 to $80,000 per annum. with variations based on experience, location, and industry. (U.S. Bureau of Labor Statistics [BLS], 2023)

Small and Medium-Sized Enterprises

In Nigeria, small and medium-sized enterprises (SMEs) are companies or business enterprise with less than 500 employees and a turnover of less than N500,000.000. In specific, they are classified as follows; micro scale, small and medium scale enterprises with the following number of employees, 1-10, 11-49, and 50-469 respectively. The turnovers for micro small and medium enterprises in Nigeria are; N10,000,000 and N500,000,000 respectively.

However, an enterprise with more than 500 employees and above N500,000,000 turnover are large scale enterprise**s. (**Small and Medium Enterprises Development Agency of Nigeria [SMEDAN], 2022**;** National Bureau of Statistics [NBS], 2021).

Rationale for Establishing Small and Medium sized Enterprises

Small and Medium sized Enterprises (SMEs) make up majority of business outlets in the world. In most developing countries, SMEs are the backbones of economic growth for the fact that they contribute significantly to their GDP, often accounting for 50% of the total economic output. They foster industrial diversification by filling market gaps that larger companies might overlook there by creating a robust and resilient economy. Also, SMEs improve the manufacturing sector through the production of goods. They encourage grassroot innovation by addressing local challenges with customized solutions. Furthermore, SMEs offer services, such as consultancy, entertainment and hospitality. In term of trade, SMEs provide whole sale and retail activities. SMEs are labour intensives, meaning, they create jobs for a significant portion of a workforce, especially, in the rural and semi urban areas, thereby providing employment opportunities for the unskilled, semiskilled and skilled workers and consequently reduce unemployment. In addition, SMEs contribute to poverty alleviation, empower communities and promote equitable wealth distribution. Women and youth, often marginalized in the formal sectors, find opportunities for engagement in SMEs thereby boosting social inclusion. **(**Small and Medium Enterprises Development Agency of Nigeria [SMEDAN], 2022).

Considerations for Setting up Small and Medium Scale Enterprises

As rightly designed by SMEDAN (2023) and the CBN (2023), when setting up SMEs, one should consider the following key factors:

1.Business plan
2.Capital
3.Operational set up
4.Regulatory compliance
5.Information and Telecommunication
6.Risk management
7. Networking and partnership
8. Evaluation

Business plan is basically needed to start up any company, and this comprises of market survey of the product to be sold; pricing of the products and financial projection or strategy of the product.

Capital: This is the livewire of any business. Without money or finance, hardly can a business thrive. Therefore, money is needed to start a business, money is needed to buy machines, tools, equipment and raw materials for production.

Operational set up: This includes locations of the company or factory. One should choose a strategic location for a business. Also, equipment supplies and staffing must be well provided and selected.

Regulatory compliance: This include registration with relevant bodies; relevant licenses and permits, and tax obligations by the company.

Information and Telecommunication: This involves setting up of necessary soft wares and communication systems and data management for the company.

Risk management: This is about insurance and insurance policy; contingency planning in case of any unexpected events or natural disasters and cyber security threats.
As part of networking and partnership; an entrepreneur should consider joining relevant industrial associations, attending conferences, meetings, and making collaboration with complimentary businesses.

Evaluation: An entrepreneur should consider monitoring of his business, listen to feedback from customers for the improvement of the company's products (SMEDAN, 2023; CBN, 2023). However, apart from the above considerations, government agencies, such as National Directorate of Employment (NDE), Industrial Training Fund (ITF). SMEDAN, Bank of Industry, and Nigerian Export Promotion Council are there to support the setting up of SMEs**.** (World Bank, 2023).

The metalworking vocations listed earlier can be developed into SMEs through the support of the abovementioned institutions. The effort will provide employment opportunities to Nigerians. In effect, this will improve the economy, reduce crime, social vices and poverty among other things.

Conclusion

The paper has briefly traced the development of metalworking industry, pinpointed numerous metal working vocations, and discussed about them. If such emerging vocations are given an enabling environment, they can translate into SMEs in Nigeria, and the impact of the development will be high employment generation. reduction in crimes, improvement in the citizenry and development of the economy.

Suggestions:

Based on the issue discussed, the following suggestions have been proffered:

1. Federal Government should support the SMEs, through increase funding and incentives in the metalworking industry.
2. The Federal Government should establish more vocational training programs to address skill gaps in the metal working sector**.**
3. Governments (both Federal and States) should foster collaborations through Public-Private Partnerships (PPP)**,** to boost the growth of the metalworking industry in the Nigeria

4. Governments (both Federal and States) should heavily invest in electricity supply, for the fact that energy is greatly needed in the metalworking sector, most especially in the welding and fabrication section.
5. Governments should simplify policies to encourage local production.

6. In an attempt to attract youth and investors, Governments should promote emerging vocations in the metal working industry, through awareness campaigns.

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