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The Role of Local Content Foundry Finished Products, the Community, and the Effect of Fragile Economy in Nigeria.

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Abstract- ***Foundry technology is a branch of engineering that deals with melting and casting metals and non-metals alike to produce useful products required in a community, such as farm implements, household utensils, light weapons, and other engineering components. The demand and supply of these products now play an important role in the life of our people residing in various communities and localities across all geopolitical zones in Nigeria, where most of them are poor peoples only rely on farming, fishing, knitting, and other small-scale businesses that can run locally among themselves. According to the result of this research show that the products coming out from this industry help in giving affordable prices without compromising quality or durability compared to the imported products from the Western world that have higher forex manipulation and currency variation with multiple taxes, which translate to exorbitant prices beyond the reach of the Nigerian common man and woman. This higher inflationary mode forced the common people in Nigeria to search for the best alternative to avoid the unbearable system of our present fragile economy in the country, where insecurity, unemployment, and massive corruption have taken center stage, fueled by the removal of fuel subsidy/energy subsidy, high cost of food items plus multiple taxes and low wage remuneration that nowadays people complain very bitterly. The working method, raw materials, equipment, staff, and working capital are sourced with zero interest rate seamlessly, as the prices in various components are relatively affordable.***

Keywords: Metal casting, forex manipulation, fragile economy, local community, foundry finished products.

I. INTRODUCTION

Foundry work is the process of producing metal castings by melting the metal into a liquid state, then pouring the metal into a mould which contains a hollow cavity of desired shape. A pattern is used to make the mould of the required article. Sometimes, the core inside the mould determines the internal cavity's dimension. Foundries are of two types. Ferrous foundries produce steel and iron castings. Non-ferrous foundries produce copper-based alloy castings, aluminum-based alloy castings, and other alloys. The foundry industry is considered to be a high-risk area since it contains hazardous operations. Assessing the risk and controlling the risk according to the aspects of occupational health and safety is very hard in a foundry. The motive of this project is to identify the hazards and risks associated with the various steps involved in each process and take all possible measures to control the risk. S. 2015

Major casting processing advancements have been made in experimental and simulation areas. Newly developed advanced casting technologies allow foundry researchers to explore detailed phenomena associated with new casting process parameters, helping to produce defect-free castings with good quality. Moreover, increased computational power allows foundry technologists to simulate advanced casting processes to reduce casting defects. In view of the rapid expansion of knowledge and capability in the exciting field of casting technology, it is possible to develop new casting techniques. This book is intended to discuss many casting processing technologies. It is devoted to advanced casting processing technologies like ductile casting production and thermal analysis, casting of metal matrix composites by vortex stir

casting technique, aluminum casting, evaporative casting process. Vijayaram, T. R. (2018).

Metal casting is employed as the first step in making most products. It is the commonly used method of manufacturing the desired shape of component. Sand casting is the mostly used casting process. In sand casting the pattern which is a replica of the end product is generated first, as like in any other casting methods, with the help of machining process. Then the sand mixture is prepared with different materials like silica sand, clay, olivine oil, moisture, lime etc. Sand mixture plays a major role in defining the quality of the sand casted products. Prepared sand mixture is rammed in the mould box with the pattern is placed inside the mold box. There are several types of pattern used like solid pattern, follow-board pattern, split pattern, loose piece pattern, gated pattern, sweep pattern, match-plate pattern cope and drag pattern, skeleton pattern etc., The molten metal is poured in the cavity made by the pattern inside the mold and wait until the metal solidifies. The product is obtained by breaking the mold after solidification is completed. Fettling operation is performed to clean and cut off the unwanted projections in the sand cast component. Sand casting also has its own limitation, which is specifically termed as casting defect. Sand casting has many types of casting defect and elimination of these defects is impossible due to the reason that it depends on many parameters of sand casting process. The only option is to minimize these casting defects as low as possible. Casting defects analysis, widely used for reducing the casting defects involves the process of analyzing the root cause for occurrence of defects in the rejection of casting. Its helps industries to take necessary steps to reduce the defects and to improve the casting yield. Various analysis techniques like cause-effect diagrams, design of experiments, casting simulation, if then rules (expert systems) and artificial neural networks can be used for casting defects analysis. This work uses the numerical simulation technique, parameters of gating and riser for casting with multiple analysis characteristics in casting to analyze the effect of various gating system designs on cavity filling and casting quality using casting simulation software; satisfactory results were obtained with high hand wheel of component which is sand casted, The work also is to analyze and eliminate the shrinkage porosity and the air entrainment. Natarajan et al. (2021).

Metal casting or foundry have several characteristic that clearly define their role in various ways of human endeavor like in agriculture, transportation, textile, construction and general household utensils. Virtually any metal that can be melted can and is being cast. Many parts and components are made by casting, including automotive components such as carburettors, engine blocks, crankshafts, agricultural and rail road equipments, pipe and pumping fixtures, power tools, gun barrels and large components of hydraulic turbines Mahto 2015. These products or casted metals are required in various shapes and sizes in large quantities for making machine spare parts, tools, pipes and other important component required in our daily consumption. These products demand and supply generated higher economic competition between local content product and imported foundry goods that our local people can afford to buy because of the forex manipulation and multiple taxes, in the current economic realities in Nigeria. The quality or workability of these foundry products are tested and found suitable according to design specification, as some time the sales goes with warranty to customer from foundry managers. The objects or components have certain structural and functional shape that can withstand stresses and strain that can fulfil other service conditions, possesses a desirable finishing and have an acceptable cost. The local content foundries in Nigeria, make other many metal casting products by utilizing indigenous raw-material source from locally available solid minerals or metal scraps obtainable from building site, dead cars, railway abundant scrap wagons, burn transformers, metal scraps coming out from industries and local blacksmiths. That other locally obtainable material however include local fuel like coals/coke, natural sand, silica sand, facing sand, synthetic sand and sand binders/additives. . the local foundries operate on locally fabricated melting furnaces like rotary furnace for melting ferrous metals, which has heating capacity up 1300°C, for non-ferrous material like aluminum is melted by using open hearth furnace at temperature of 660°C. The technique employed by these local foundries for their production comprises the following skill personnel, casting

designers, pattern-makers, the mould and core-makers, the melters (furnace men) and metallurgical personnel. failures of machine components are described, systematized, and analyzed. An attempt is made to trace the causes of each failure, describe the mechanism, list the influencing factors, and suggest the remedies. A meaningful analysis of a failed part is one of the most useful sources of information available to the engineer. From the study of failure he can frequently learn whether the failure was caused by a defective design, inadequate material properties, poor production practice, or service abuse, and can thereby devise necessary improvements to eliminate failure. Lipson, (2022).

II. METHOD

The metal scrap recycle has a growing challenge, predicted to soar to the end of the twenty-first century. Coupled with the recent ambitions to retrofit old and already manufactured internal combustion engine vehicles to new energy vehicles, if mismanaged, metallic wastes generated as by-products can exacerbate the challenge Xavier, et al (2025).

The local content products are made and source by recycling from the waste scrap metals generated from discarded vehicles, metal scraps from construction sites, rail deformed steel, foulded beam of bridges, copper cables, brass and aluminum removed from renovation of houses and remanence of building and civil engineering companies in and outside Nigeria. The material or scraps are handled and recycled according to the following stages collecting and parking of scraps, sorting of scraps, processing the scraps, for free heating, purifying and arrangement for melting, and finally melting and casting.

Local sourcing of raw materials for the production of machine parts and kitchen utensils is important for developing indigenous manufacturing capacity, reducing dependence on imported materials, creating employment, and encouraging the recycling of industrial and household waste. Industrial waste as a raw material potential can replace primary sources of natural resources, significantly reduce resource consumption and help ensure the raw material independence of territories and individual countries. In Nigeria, traditional and small-scale foundries have demonstrated that locally available materials can be used to produce aluminium pots, frying pans, spoons, bowls and other metal products. Research on indigenous Nigerian foundries shows that sand casting is particularly suitable for small-scale production because the process can produce components of different shapes and sizes at relatively low cost.

A scrap is one of the most important locally sourced materials for producing kitchen utensils and some machine components. Sources include discarded cooking pots, beverage cans, vehicle components, electrical materials, cables and wires, construction materials, and other aluminium products.

aluminium is particularly suitable because it has a relatively low melting temperature of about **660°C**, is lightweight, corrosion-resistant and can be recycled repeatedly. Studies of Nigerian foundries have documented the use of scrap aluminium as the principal charge material for producing cooking pots, frying pans and spoons.

For machine parts, recycled aluminium alloys can be used for components such as pulleys, housings, brackets, covers, handles and certain casings, provided that the alloy composition and mechanical properties are properly controlled. Research conducted in Nigeria has also demonstrated the use of automobile piston scrap as charge material for sand-cast. Tikhlivets et al (2024).

Iron and steel scrap

Ferrous scrap, including discarded automobile parts, machine components, steel plates, rods, pipes and other metal waste, can serve as a local source of material for machine-part production. Depending on its composition and quality, scrap steel or cast iron can be remelted and cast into components such as machine frames, brackets, pulleys, gears, housings, bases and agricultural-machine components.

The use of local metal scrap is particularly relevant because Nigerian foundries already obtain much of their metallic charge from local scrap suppliers. However, proper sorting and quality control are

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essential because contamination or an unknown alloy composition can produce defective castings.

Natural moulding sand is another important locally available material. It is used to make the mould into which molten metal is poured. Nigeria has deposits of natural sands that have been investigated for their suitability in aluminium casting.

The effectiveness of moulding sand depends on properties such as permeability, refractoriness, strength, grain size and collapsibility. Understanding the attributes of moulding sands is essential for foundry efficiency and high-quality cast production, which can be achieved through adequate information on their properties Nigerian research has demonstrated the suitability of locally available moulding sands for producing aluminium castings. Shuaib-Babata, et al 2025.

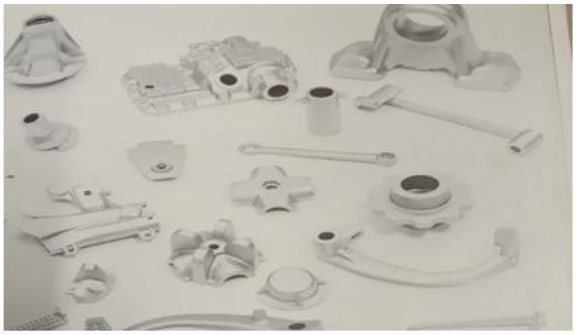
Foundry sand can therefore be used for producing both machine parts and kitchen utensils, particularly where sand casting is appropriate.Clay is locally available in many parts of Nigeria and has several applications in foundry operations. It can act as a binder in moulding sand and can also be used as a refractory material for furnaces.

Casting With Heat Treatment (Annealing)

Finished Cast Products

Special Finishing of Casting

Rotary Furnace for melting metals



Complicated Component Parts

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Mould and Moulding Boxes

Sample Size and Sampling Technique A purposive and stratified sampling technique will be used. sampling was used to select operating foundries and key stakeholders who have direct knowledge of local-content manufacturing. Stratified sampling will then be used to divide respondents into appropriate groups, such as foundry operators, workers, consumers and community stakeholders.

Where the population is sufficiently large, the sample size may be determined using an appropriate statistical formula such as the:

$$n = N1 + N(e^2)$$

Where:
n = required sample size; N = total population; e = acceptable margin of error.

Sources of Data
Both primary and secondary data were used.
Primary data was collected directly from respondents through:

Structured questionnaires, Interviews, Direct observation. Physical inspection of foundry facilities. Discussions with foundry operators and community stake holders, Examination of selected finished products. The primary data will provide information on the actual contribution of local foundries to employment, income generation, local sourcing, skills development and community welfare.

Secondary Data, Secondary information was obtained from: Academic journals, Textbooks, Government publications. Sand casting is one of the oldest metal forming techniques known to humans, yet it remains the most prevalent casting method worldwide due to its cost-effectiveness, flexibility, and capacity to accommodate a wide range of alloys, sizes, and complexities. Anwar, et al. (2021).

The indigenous foundries mainly produce their local content goods and services through sand casting technology under the following series of operations, preparation of sand, pattern-making, mould and core-making, melting of scraps metals in furnace, pouring liquid metal into the mould, solidification of casting, breaking the mould, fetdling and cleaning of casting. Other requirement in this casting processes is to ensure the mould cavity must be clean and free from any debris and setting-up the gating and rising system correctly for the smooth running of liquid metal in the mould. These materials includes: Broze,magnesium,iron, brass, Aluminium,zinc,steel, and some specialized alloyed materials. Alloy is most often used to strengthen the material to be casted. . Patwari et al.(2024)

The actual elements to be considered while casting are:
The list of methods to produce metal parts is long, and includes machining, forging, fabrication, and more. In this journal we will just discuss various casting processes you might select to make an important component.

Sand casting has been around for ages and is used to make about 2/3 of cast products. It is a versatile method to produce a wide range of cast geometries including those with internal structures and passage ways – from less than a pound to huge parts weighing several tons.

The process is versatile and cost effective, even in low volume because tooling cost can be minimized, through direct machining of the mold. It is the best way for shaped designs where some subsequent machining is employed for areas with tight surface finish or dimensional tolerance requirements. It is viable for just about any alloy except reactive metals and those requiring vacuum pouring. Investment casting produces a finished metal part by creating a ceramic shell around a detailed consumable pattern,

usually of wax , which is ultimately melted or burned away. This method is selected because it produces an excellent "as-cast" surface finish. It can achieve thin walls, tighter tolerance, and shaped or non-symmetrical parts with fine details including internal structures.

There are less expensive solutions when tolerance demands are less strict – heavier sections or parts that will be machined anyway – and upper size limits are much lower for investment castings than, say, sand castings. Tooling costs have historically limited investment casting to higher volumes, but processes like pattern printing have made it viable for prototype or even single piece

Continuous casting is a process where molten metal is drawn through a forming die as it solidifies into a desired shape. Internal shaping, however, is limited by material cast as the high melting point of iron (as opposed to copper based alloys) makes shaping difficult due to die life considerations.

A continuous cast bar would typically be cut to the desired length and machined further. Continuous casting generates metal with sound structure and can be cost effective when used to reduce expensive machining processes like milling, and the material may be acquired in small quantities. It is not a good fit for more complex components with irregular shapes or intricate internal passageways.

Centrifugal casting is the technology of choice for severe service applications in configurations that can be developed with an axis of rotation. Molten metal poured into a spinning die solidifies directionally, centrifuging low density impurities to the ID where they are subsequently machined away. The result is material cleanliness that is typically superior to other casting or forging processes.

Casting was used in this manufacturing process which involves melting of metal ores, scrap metals, carbonaceous material, alloying elements, fluxes and other additives in hot furnaces from where the liquid metal is collected by the ladle to be poured over the pouring basin, delivering the molten metal into the mould cavity. After pouring, the metal solidifies slowly inside the mould cavity. Casting is the most widely used manufacturing process which involves melting of metal ores, scrap metals, carbonaceous material, alloying elements, fluxes and other additives in hot furnaces from where the liquid metal is collected by the ladle to be poured over the pouring basin, delivering the molten metal into the mould cavity. After pouring, the metal solidifies slowly inside the mould cavity. The solidification starts with the material phenomenon called nucleation which triggers growth of solid particles (transformation of liquid metal into solid crystals with release of energy) into fine/coarse grains possessing individual boundaries. During this solidification phase, all metals tend to shrink in their volume but which vary with different metals and alloys. This solidification phenomenon governs the design of various components of casting such as riser and gating system and also influences the dimensions of the mould cavity required for a particular metal cast. Allowances are provided on the patterns itself which are copies of the final cast. Moulding sand is prepared, the properties of which affects the quality of the final casting and that is dependent on different proportion of combinations of ingredients such as clay content, moisture content, carbon additives, etc. In this chapter, the basic understanding of the casting process, operations and design involved in the sand mould casting process, various metal mould casting processes and few other commonly used casting processes are described in detail. Kumar, (2019).

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More reliable and durable parts with high structural integrity are required to meet the increasing advancements in science and technology. However, these different casting techniques involve a similar fundamental procedure: melting metal, pouring it into a mold, and allowing it to solidify. However, they vary in their physical and mechanical properties, durability, and surface finishing, making one technique more desirable than the other in their application areas. Some techniques were found to be more advantageous and effective than the other, which will aid foundrymen in making the best decision in choosing a technique, considering parameters such as environmental friendliness and cost implications. The appropriate implementation of these will help restructure and refine foundries, improve the quality of cast products, and set the casting technology world on course for the new age. Adeleke et al. (2022).

III. RESULT

Table 1. indicates the interview results at panteka Kaduna, Kaduna State

	Acceptability of products	90%
	Quality of products	85%
	Affordability	100%

The interview was made by direct interaction with the customers and the researcherFig 1 shows a bar –chat of result in Kadund

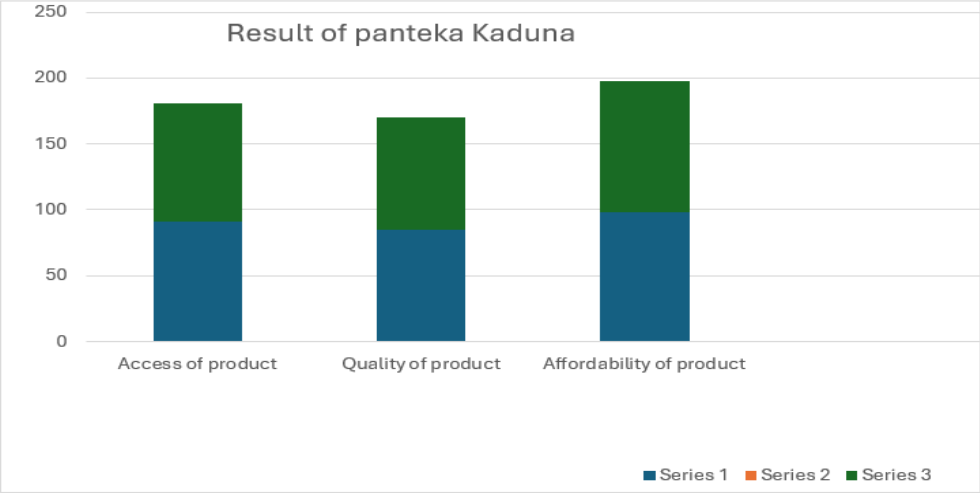

Table 2 Shows the interviewed results in percentage at Challawa Kano, Kano State.

	Acceptability of products	65%
	Quality of products	86%
	Affordability	95%

Kano state has a large number of lower income people that heavily patronize local content products hence the high percentage in the acceptance of the products.

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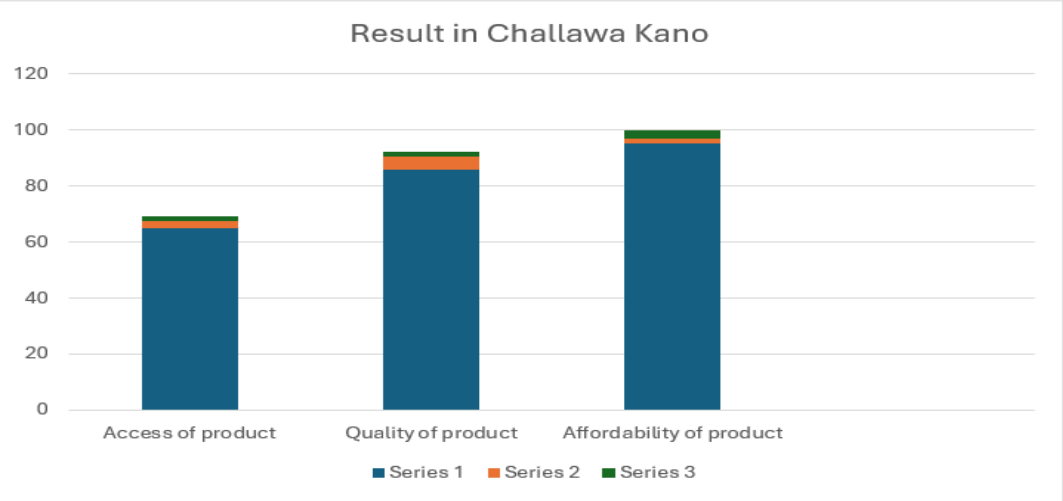

Fig 2. Shows the bar –chat result at challawa Kano

Table 3 Interaction between the researcher and the customers at Mile Twelve Lagos, Lagos State

	Acceptability of products	55%
	Quality of products	95%
	Affordability	100%

Fig 3. A bar-chat result at Mile twelve Lagos.

The state has a reasonable number of higher wage earners, as a result of that the acceptance of the product is a little bit low compare with table one and two.

Table 4 Indicates how people respond to the questions in percentage at Port-Harcourt City, Rivers State.

	Acceptability of products	91%
	Quality of products	85%
	Affordability	98%

The state is an oil producing region in Nigeria with many international companies and also have diverse people in the region there fore the acceptance is very high.

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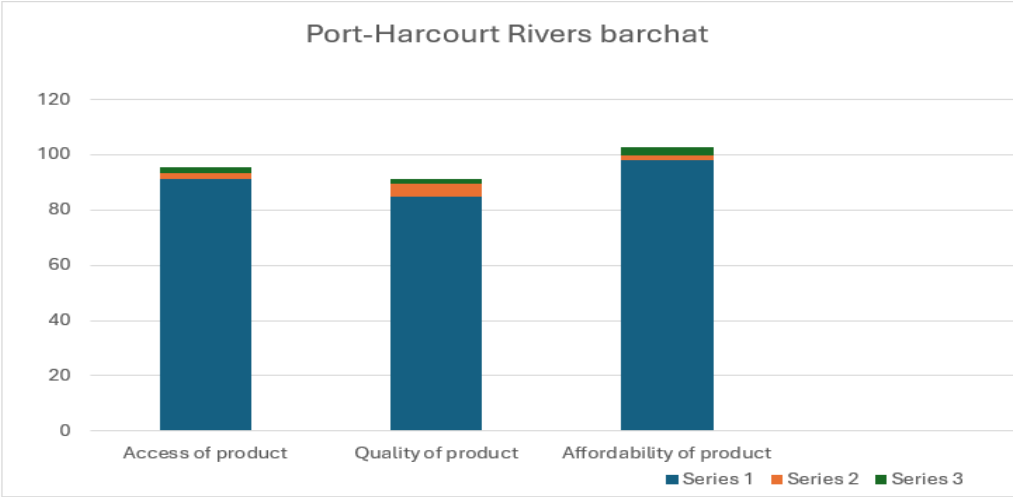

Fig 4. . A bar-chat result at Port-Harcourt Rivers.

Table 5 shows the interview in Nekede Town, Imo State.

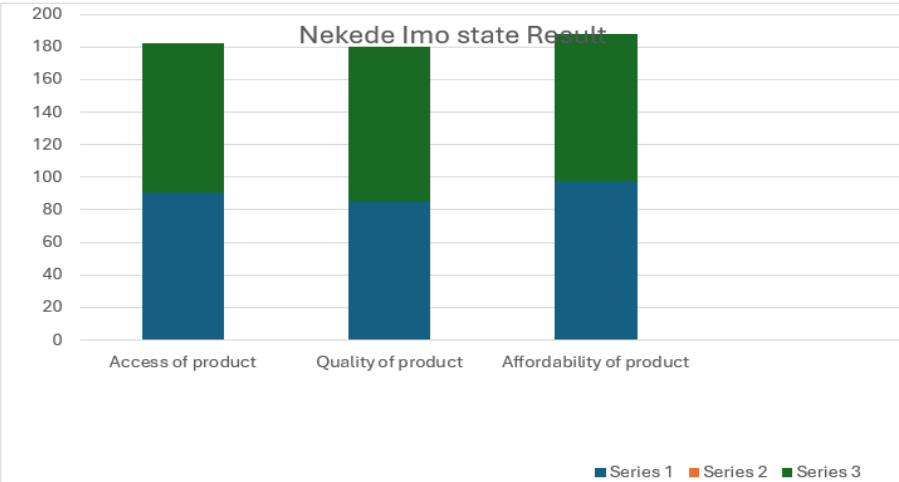

Fig 5. Shows the bar –chat result at Nekede Imo state Result. Imo State Nigeria is predominantly occupied with business men, farmers and civil servants the interview shows high acceptance of all the products.

IV. DISCUSION

The method employed for the conduct of this research is the direct contract for both product-makers and customer, across some heavily populated cities and towns in Nigeria, like, Panteka in Kaduna, Challawa in Kano, Lagos iron and steel market, Sapele in Delta State, Ibadan Oyo State, Port-Harcourt Rivers State and Nekede in Imo State. the products are kitchen utensils such as spoons, cooking pots, plates, farm implements also includes plough, harrows and cutting blades, light weapons such as knives, arrows and marchets.

This direct contact interview is aimed to access, evaluate and record the response from affected peoples in their communities on the performance, acceptability, quality and affordability as the majority of people in Nigeria are very low-income earners mostly village farmers, low income business people, women and school age children living in our local communities across almost all the geo-political zone in Nigeria. The said result of the experiment was captured and recorded appropriately in table 1

V. CONCLUSION

Considering the responses of the communities involved on this research shows that local content foundry finished products plays a greater role in Nigeria by relieving the masses from depending on foreign imported goods and services as a result of multiple taxes, foreign exchange manipulations and the cost of handling and transportation that has been causes the higher price which the common people cannot accommodate. However, theses products have been widely accepted by the community because their quality, durability and affordability are almost to the international standard. he production and utilization of local content foundry finished products have significant potential to contribute to Nigeria's industrial development, community empowerment, and economic resilience. The foundry industry provides an important link between raw materials, manufacturing, infrastructure development, and the needs of various sectors of the Nigerian economy. By promoting locally produced foundry components and finished products, Nigeria can reduce its dependence on imported goods, conserve foreign exchange, create employment opportunities, and strengthen domestic manufacturing capacity.

The involvement of local communities is equally important to the sustainability of the foundry sector. Foundry activities can generate direct and indirect employment, support skills development, stimulate small and medium-sized enterprises, and create opportunities for local entrepreneurs. Greater collaboration among foundry industries, communities, educational institutions, government agencies, and private-sector organizations can promote technical training, technology transfer, and the development of a skilled workforce. Such collaboration would enable communities to participate more effectively in the industrial value chain and benefit from the economic opportunities created by local manufacturing.

However, the fragile nature of the Nigerian economy presents considerable challenges to the growth and competitiveness of the foundry industry. Inflation, unstable energy supply, high production costs, limited access to finance, inadequate infrastructure, exchange-rate fluctuations, and dependence on imported machinery and certain raw materials can increase the cost of locally manufactured products. These challenges may make imported alternatives appear more competitive, thereby limiting the market for local content products and discouraging investment in domestic production.

To overcome these challenges, there is a need for consistent government policies that promote local manufacturing, improved infrastructure and electricity supply, accessible financing for foundry enterprises, investment in modern production technologies, and effective implementation of local content policies. Government and industry stakeholders should also encourage the procurement and use of locally manufactured foundry products where quality and technical standards are met. Strengthening standards, research and development, innovation, and technical education will further improve the quality and competitiveness of Nigerian foundry products.

Finally local content foundry finished products can serve as an important instrument for strengthening Nigeria's manufacturing sector and supporting community development, particularly during periods of economic fragility. Although the sector faces significant structural and economic constraints, strategic investment, effective policy implementation, community participation, and stronger industry–academia collaboration can improve its performance. Developing a robust local foundry industry will not only support employment and industrialization but also contribute to Nigeria's long-term economic resilience, technological self-reliance, and sustainable national development.

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