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ASSESSMENT OF TECHNOLOGICAL INNOVATION IN FIRMS: CASE STUDY OF PACKAGEDWATER PRODUCTION FIRMSIN OSUN NIGERIA.

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ABSTRACT
This paper assessed the current technological innovation activities of packaged water producing firms in Osun, Nigeria. A qualitative study was conducted comprising of interviews in a semi-structured format of telephone and face-to-face interviews with observations. Four main themes were identified from the data collected, specifying the technologies use for the treatment of water and the production of the bottles and packaging processes. Participants described the relative issues of the chosen types of technologies, their technological learning capability as a firm and the environmental and safety measures put in place that has contributed to their competitive strategy and technological innovation, invariably leading to their perceived performance improvement. Despite this, respondents however identified some challenges the firm is facing with the adoption of their choices of technology, environment, safety and the market. Based on these, a technology assessment framework was developed to assess packaged water producing firms with three thematic themes such as Technological Learning, Technological Choice and technological type. This implies that the potentials of these three factors are the key drivers to assessing technological innovations and overall environmental impact on society.

Keywords: innovation, competitive advantage, technology assessment, firms

1. INTRODUCTION

Globally, the small and medium scale enterprises (SMEs) is strategic for economic growth and development. SMEs quest for accurate, timely and relevant information is indispensable for businessgrowth and competition. Analysis of firms' technology is an assessment study that provides information for firm's competitiveness, hence Technology Assessment (TA) is an assessment study to provide technological information required to assist business actors develop strategies and make decision about technological innovation with the aim of aligning technological and societal developments. (Ende, et al 1998).
Technological innovation is the introduction of newly adopted or technically modified technologies for the enhancement of business performance either for production, service rendering, marketing or administration (Mahmutaj, 2014). The adoption of technologies in Small and Medium-Sized Enterprises (SMEs) has increased the rate of diffusion and in turn the need to innovate. The SME sector is constantly innovating as it relates to the development of new products, branding and re-branding through the use of advanced technologies. Primarily, SMEs

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are saddled with the aim to create and distribute goods and services (Okafor, Onifade&Ogbechi; 2018) within a given market space. Good and service are essential commodities required in every community of which water is mostly needed.

Meanwhile, in Nigeria, water packaging business is one of the most lucrative small and medium scale (SME) business that is highly required due to the high demand for quality, clean and hygienically tested water with pre-defined national standards of cleanliness and a license for production (Handayani, Dewi, Purnomo, &Phitaloka, 2018). As identified by WHO, drinking quality water in the required quantity per day is a preventive measure against deadly diseases ((WHO, 2008). In same vein, Chenoweth, (2015) opined that to maintain the state of health of living things especially mankind, is dependent on the readily accessibility of good quality water and although water is a natural resource abundantly found in the earth not all water bodies are good sources for consumption (Hossain, 2015).

Conversely, Nigerians had issues providing safe drinking water for her citizens, until after the establishment of the National Agency for Food and Drugs Administration and Control (NAFDAC) in 1993 where strict compliances were enforced for the production of sachet and bottle water across the nation and in 2007 the Standard Organization of Nigeria (SON) complimented NAFDAC activities to further strengthen the adherence for producing quality clean drinking water (Enyidi, 2017). This gave rise to the adoption of new technologies and the development of new skills in Nigeria. A strategies firms adopted to give them a competitive advantage, and enable them produce safe drinking water in large quantity and in well-designed and recyclable packs and distributed widely.

Emerging technologies has become vital assets in firms and the option to decide on the appropriate technology to adopt has become a critical factor to consider. Business owners, as a necessity, should be equipped with the right information to decide the type of technologies they want, and to reject technologies that are neither environmentally sound nor socially equitable (ETC group, 2011). Hence, technological assessment is required to inform business owners on technology investment decisions, an information needed for decision-making (Marcial&Reinhard, 2005); and this entails the acquisition of knowledge, an innovation strategyto solve technological challenges by the acquisition of skills, utilization and diffused (share or spread) among 'actors of innovation' within the firm. For the purpose of being tech-savvy to choose or manufacture the appropriate technology that are environmentally and societally acceptable. Technological innovation is however not in terms of how firms conduct their businesses instead on how firms adopt newer technological changes to produce goods and services.

Therefore, this study is seekingto assess how water producing firms in Nigeria learn the technologies use for production, by considering where and how they got the information of the type of technologies they use and rational behind their choices. This will help firms to decide on the types of technologies they should choose from that would enable them to carry out innovative activities that would make positive impact on the environment and ensure safety of operations.

Thus, the findings of the study will provide useful information forwater producing firms in Nigeria in order to facilitate technology learning by assessing technological types to spur productivity.It will also facilitate accessibility of information on relevant indigenous technologies, provision of access to indigenous manufacturing companies, and assist in training

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for the acquisition of technological skills. Thereby enhancing quality products and market opportunities. Information from this study will be of great benefit for Water producing firms as the information would assist them make better decision in their businesses and use technologies that have better quality, capacity and less expensive, using local available technologies that are environmental friendly.

Study of the Location

The modern Osun State is located in the south-west geopolitical zone of Nigeria an inland state with its capital as Osogbo, 30 local government areasdivided into three senatorial districts. It is bounded in the north by Kwara State, in the east partly by Ekiti State and partly be Ondo State, in the south Ogun State and in the west by Oyo State. The state was created in 1991 from old Oyo State and its name was derived from the River Osun. The 2006 census estimated the population of the state at 3,423,535 with over 200 towns, villages and other settlements. The statehas considerable number of highly urbanized settlements some of which are Osogbo, Ile – Ife, Ilesa, Ede, Ikire, etc. The people of the state are warm, hospitable and highly enterprising and engages in trading artisans and farmers, very rich in arts and crafts. Yoruba and English are the official languages. Federal Government has its presence in the state with some Agencies such Nigeria Machine Tools, Osogbo Steel Rolling Company and the industrial Development Centre. Others are the Federal Department of Solid Minerals, the Liaison Office of the Raw Materials Research and Development Council, National Directorate of Employment, National Examinations Council and the West African Examination Council, among many others. The state capital also houses a National grid of the Power Holding Company of Nigeria. Activities of the Local Government areas complement the efforts of the State Government in making the State truly investment-friendly.

Study background

Basically, water producing firms produces quality, clean and portable drinking water that is essential for consumption. The desire is to make good, safe and hygienic water acceptable for consumption. The water produced are well package for easy transportation and presentation and preserved for longevity as well. The firms under review are both registered under the Nigeria Company Cooperation (NCC) and the National Agency for Food and Drugs Administration and Control (NAFDAC) and strategically located in the industrial layout in Oshogbo, and in Ile-Ife, Osun State. The firms are adequately and functionally prepared to enter an existing market with renown companies as reveries. With an effective administrative structure, the firms are sub-divided into department otherwise called sections. The Candid Water is privately owned by the BO Williams Enterprise, a private enterprise started in January, 2019 with a staff strength of 23 staff while Mokuro Water is owned byIle-Ife indigenes and started in 2010 with a staff strength of 64 staff.In Candid Water, engages in the production of pre-forms and caps whereas Mokuro Water outsource it from other companies. Using fully automated machines for the Sachet Packaged Water production, yet to have their own water testing laboratories are similar activities of both firms, but are yet to commence the production of dispensable bottles whereas company2 is involve in distilling the dispensable bottles and refilling services.

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Mokuro Water has been in operation for about ten (10) years, and are assumed as early adopters of the semi-automatic machines, while Candid Water are considered late adopters of the technology, this may be due to the organization's size and financial strength. Meanwhile, this is different from bigger firms that all technologies are fully digitalized automatic machines: a state-of-the art technology for productions.

The machines in both firms are operated and maintained by trained in-house personnel and for the fact that they are semi-automatic, operators are required to perform some manual activities for a smooth and quality production. They engage in daily and weekly maintenance schedules of the machines while certified engineers, runs monthly services and repairs and replacesdamaged or worn-out parts when the need arises. It is however interesting to note that most of the spare parts for these machines are available in Nigeria (Local Content) however, both firms purchased foreign machines and insist on foreign spare parts as they observed that the local ones don't fit into the foreign machines

2. TECHNOLOGY FEATURES

Technically, both firms have similar technological features of in their production sections, namely: the bottle production and water treatment and packaging sections. The table below shows the names and the functions of the technologies used.

BOTTLE PRODUCTION		**WATER TREATMENT &PACKAGING**	
Machines	Functions	Machines	Functions
Pre-Form Heater	Heats the preforms to make them softer	Raw Water Tank	Water from the borehole is collected into this tank
Pet Blowing	Blows the pre-heated preform into bottles based on the pre-designed mold	Rex Tank	the water is passed here to removes taste from raw water, keeping it tasteless and fresh
PRE-FORM & CAP PRODUCTION		Sand Filter Tank	Removes sand and other particles from water to keep it clean and pure
The Drier	The Resinchemical is inputted to dry before commencement of production	Carbon Tank	Removes odour from the water to keep it odourless and preserves it for a longer time.
Injection Machine	Used to inject the dried chemical is into the molding machine	Reverse-Osmosis Machine	This machine is an alternative and most commonly used water treatment with an in-built membrane that removes taste, odour and particles from the water.
Molding Machine	Used to mold the preform and cap into the desired size and shape.	Automatic 3-in-one Machine	This machine rinses the bottles, fills the bottles according to the programmed quantity 50cl, 75cl or 100cl and then capes.
Air	Used to pump hot air for	Steamer	Use to stick firmly the labels on the

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compressor	production	machine	bottles. The Labels bears the name of product, date of production, batch numbers and expiration dates.

Table 1: Showing the machines used and their functions

The pre-forms the bottling caps are producedusing a single chemical called "Resin". The pre-forms and caps are produced in similarshapesand colors but in different sizes to meet customer's demands and requirements. Meanwhile, in the bottle production section, the pre-forms are used as the raw materials for the bottles production. And the two companies due to location and quality of water had dug their boreholes at 160 meters of two boreholes for company1 and four (4) boreholes at 160, 200, 270 and 300meters for company2.

Conceptual framework

This paper seeks to assess the technological innovativeness of firms using themes for technological assessment framework. The framework themes considered are the technological learning, the technological choice and technological type. It also considered the environment impact and safety measures.

Technological learning

Technological learning (TL) is a process whereby technology-driven companies acquire and sustain the knowledge that shapes their ongoing competitive advantage. Innovation is created within the organization when new knowledge (Moens, et al. 2009)required to solve technological challenges are learned, used and diffused: share or spread among 'actors of innovation' within the firm. TL is the means of developing the capacities of personnel in an organization that underpins long term sustainable innovation (Simpson et al, 2011). Technological use and frequent interactions with the technology promotes TL. Thus, the ability for organizations and individuals to learn newer technological skills that would enable them adopt, use, maintain, repair, replace, or reproduce their most interacted technology is known as technological learning. (Wallace, 2013). In other words, familiarity with the technology, continuous use of the technology and interaction with the technology leads to growth/increase in TL. However, TL can as well occur through the process of learning from other industries or firms of the same line of production or otherwise. Working overtime with similar technologies enables workers to learn and sometime develop similar technologies indigenous to their environment.

According to Nguyen & Nguyen (2013) as cited in Tasi, (2001), TL creates opportunities to stimulate new knowledge creation and contributes to organizational ability to innovate. Newer learning opportunity is created as the organization interacts with other companies (Enkel et al, 2009; Martinez, 2013; Nguyen & Nguyen, 2013).Therefore, TL is the ability for a firm to acquire, share and utilize technological knowledge as it is applicable to its functional activities with the primary aim of attaining success (Gilaninia et al, 2013). 'Leaning by Experience' is a type of learning by observation. This kind of learning involves monitoring, and reviewing operational functions of a machinery, functional and breakdown time as a way of interaction with the technology (Kontogiannis et al., 2016). Subsequently, 'Reflexive learning Approach'is another type of TL where the interest and perception of interest of individual staff contributes to the TL (Moens, et. al, 2009).

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Consequently, Mokhtarzadeh, &Faghei, (2019) studied a six model of technological learning. The models they studied were transfer of knowledge, acquisition of knowledge, reciprocal learning, collaborative creation of knowledge, absorption of knowledge and collaborative knowledge creation; all of which are different sources and structures of learning that creates new knowledge and increase innovativeness of firms However, the importance of TL cannot be overemphasized as innovative firm require both internal and external knowledgeand capabilities to strengthen technological innovation and achieve maximum performance (Hao-Chen Huang, 2013). The OECD(2006) as cited in Hernandez, et al (2017), opined about the accumulation oftechnological capabilities that is, developing the technical skills of staff of the firm to acquire, assimilate, use, adapt, changeor create technology (Oruwari, et al. 2002). They further addressed the fact that the responsibility lies on the onion of top managers to embark on indigenous effort, allocate resources, commitment, in-house tailor-made training in minor and important research and development innovations.

> "Learning and building technological capability at the company level means a dynamic process of obtaining and building internal capabilities and using the knowledge available from other companies and institutions. The processes of building technological capabilities depend, therefore, on a set of factors related to a flow of knowledge within the company and between the company and the context in which it competes. "(Hernandez, et al, 2017).

Technological learning can occur in two distinct groups; ‘internally and externally’ and ‘formally and informally’. According to Hao-Chen Huang (2013) technological innovation is achieved when firm learn internally within the firm and also externally from other firms. Meanwhile, this form of technological learning has created more problems especially for developing countries that seek to learn more from existing technologies and are not opportune to generate new technological ideas, concepts, and designs of their indigenous technologies, thereby importing technologies from developed countries (Çemberci, 2013).

Technological choice

Making a choice of the type of technology to use depends on many factors. Considerations of weather to choose an indigenous (locally made) technologies or adopt a foreign one becomes a critical issue for organizations. Technological choice plays an important role in the growth and productiveness of the firm (Ngahu, 1992;Muthoni, Omato&Kithinji (2013), having technological knowledge of the appropriate and most recently developed technology to adoption. Thus, as marketing trends changes, the firms are able to adapt and protect their technologies from becoming obsolete, that is using outdated technologies which could affect the quality of products and source of income (Muthoni et al. 2013)

Adrian et al (2016) highlighted some factors that could guide an organization’s choice of a technology. They itemized them as the selection of the right technology, technologies that would deliver on time, technology that would bring an increase in the return on investment, technology that hired and trained staff can operate, an automated technology, produces in large capacity and high volumes, that makes cost of manufacturing low with rapid manufacturing speed, etc.

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Technological choice (TC) is considered as a choice that is not based on sophistication of the technology or the age of the technology but rather on the functional based on the peculiarity of their environment, with the capability to operate it and the possibility to produce the desired output based on quality and quantity.

As far back in the 19th century, Parr & Rod (1999) opined that before a technology is chosen, firms should consider theirObjectives, analyze the opportunities and limitations; the final output and quality of the technology.

TC is a proactive decision-making process top managers of firm engage in, knowing which technology to adopt and making the right decision to adopt the technology is sometimes difficult and overwhelming (Watson, 2011) except they are technocrats or employ the services of one. According to Digital Promise, Accelerating Innovation in Education (2015), top managers can thoughtfully choose the right technology from the vast arrays of technological choices using the following nine (9) strategic approaches: the purpose of the technology, alternative technologies, compare with other firms technologies, acquire adequate information about the technology, take note of the functionalities of the technology, determine the cost analysis, examine the features of the technology, pre-determine the level of production and ensure the relative advantage of the technology is shared.

Technological type

The technological type entails the type of technological choice the firm made to carry out its production activities. The type of technology could however be a foreign imported technology or an indigenously manufactured technology. Advances in new technologies have made it very difficult for organizations to make decisions regarding the type of technology they have to adopt (Dasgupta, et al., 1999). This also entails the choice of new or fairly used (second-hand) machines. As a choice of this magnitude depends on the techno-savvy of the firm to ascertain the most appropriate type of technology to adopt.

According to Siyanbola et al., (2012) indigenous technologies are developed when indigenous knowledge is applied to produce tools, techniques, processes andmethods that help in solving problems. Meanwhile, different scholars defined indigenous knowledge as “local knowledge that is unique to a given culture or society. The unique, traditional, local knowledge existing within and developed around specific conditions of women and men indigenous to a particular geographic area” (Warren et al., 1995; Grenier, 1998; Siyanbola et al., 2012).

Subsequently, Manabete&Umar, (2014) opined that Indigenous Technologies are technologies that are designed and fabricated based on the culture, tradition and needs of a people and usedbasically in the environment of those people. Hence, the need to develop indigenous technologies for socioeconomic development and capacity building is highly being advocated. Recently, the Chinese science and technology policy made emphasis on the development of “indigenous innovation” and“indigenous capacity building” instead of dependency on foreign and importation of technologies; this emphasis has improved the technology-intensive base of the Chinese nation (Oholm& Lundin, 2013) making their choice of technology to be indigenous rather than foreign.

In an attempt to bridge the gap of importing new machines, firm owners resort to the acquisition of second-hand or local machines (Schluep, 2012). Some attested that a large percentage of theseimported equipment are completely unserviceable in Nigeria and when a breakdown occurs,

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getting the manufacturers to fix them is usually a challenge in terms of delay in coming, loss of production time, cost of bring in the expatriates, etc.thus contributing to abandonment of machines(Omole et al, 2015).

In Nigeria, however, indigenous companies like "Machine Tools", Emmytex Machine Construction Nigeria, and a host of similar indigenous machine manufacturing companies are available on https://utibeetim.com. These companies design, construction and deliver high quality machines and machine tools similar in shape and function as the foreign ones, an examples. Similarly, certified engineers and technical skilled workers (mostly Iron welders) also engage in construction of machines as well. For instance, a manager of a bread production firm is a welder who had engaged in constructing all the machines for bread production decided to construct similar machines for himself and went into bread production business, another engineer constructed a Chin-Chin cutting machine for his spouse who is currently a chin-chin major distributor in Nigeria

Environmental impact

The production processes of a firm directly or indirectly has negative or positive impact in the environment. Firms choice on the type of technology weather foreign or indigenous, boils down to the impact the technology has in the environment and to the user of the technology. The concern to improve on our immediate environment based on our daily activities ensures the full assessment of technologies. According to Ogola (2007), environmental impact assessment is defined as a study that looks at the effects of a project, a plan or a program or activity on the environment. However, Petra & Ute, (2019) environmental innovation study considered that firm's introduced of product, process, organizational, or marketing innovation that had resulted in environmental benefits considering the production activities on the environment, reduction of energy usage, lower CO2 emission from machines, substitution of machineries or materials by less polluting or less dangerous alternatives, decreased soil, water, air, or noise pollution and recycling of used materials, products and waste water.

Ijeoma (2015) subsequently, researched about the operational activities of manufacturing firms and opined that there are extensive hazards to the environment caused by these firms. This which could possibly cause health andeconomic problems to the inhabitants. Conversely, (Petra & Ute; 2019), studied the environmental innovations and pointed that a vital way to improve the environment is through [Choi, & Han, 2018; Carrión-Flores, & Innes, 2005), the introduction of new or improved technologies, products, processes, or organizational forms that are beneficial to the environment as they reduce or avoid negative environmental impacts (Wu, 2009;Petra & Ute; 2019)

Safety measures

According to Kontogiannis et al. (2016), employers are bound by law and the society to provide a safe working environment for their employees to avoid the occurrence of accidents within the workspace and during working hour. A resultant of an unsafe environment leading to accident is most likely going to affect the production on that day (or for a period). Hence, to implement a successful competitive strategy and innovate effectivelyto develop and promote the right safety culture by improving the safety, health and welfare of staff as authorized by the International Labor Organization (ILO) and World Health Organization (WHO) (Ateekh-Ur-Rehman, 2012).

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Packaged water producing firms would have to produce good quality, clean, portable water, the measures to ensure safe production against contamination requires the enhancement of innovative strategies. Zubar, (2014). studied the immediate need to implement and maintain good health safety and management practices that would promote the safety and health of staff in a manufacturing firm. The author considered the following safety and health factors: cleanliness of the environment, lighting of work space, ventilation & temperature measures, fire emergency procedure, exit points, devices, and physical appearance of staff.

Safety of the work space to avoid accidents like slipping over due to wet floor, skin burns due to excess heat within the working space, contamination of water from small particles like hairs, nose or mouth discharges, and handling with unclean, unhygienic hands are measures to be considered.

According to Hanks (2020), occupational Safety and Health Administration (OSHA) is primarily to ensure that employees perform their responsibilities in a safe working environment. The author states that the OSHA safety regulations concentration on the safety of factory workers and the regulations includes the use of personal protective equipment (PPE) for each employee including eye shields, hard hats/hair nets, breathing devices/nose mask, hand gloves, heat extractors, safety shoes, coverall, where applicable; also to protect workers from falling objects, harmful chemicals and noise levels louder than 85 decibels.

3. RESEARCH METHODOLOGY

This study was carried out in purposively selected local Government Areas in Osun State. Precisely metropolitan areas in Osogbo and Ile-Ife all in the state; these places were chosen because it'sconsidered more densely populated. The study adopted qualitative approach using content analysis. The interpretive method aims at drawing a substantive inference from responses of respondents. It offers an understanding on the intricacies surrounding technological innovations in water producing firms. Case study design is suitable for this study because it provides in-depth investigation of a problem in one or more real life settings. The strength of this research method is its ability to discover a wide variety of environmental and safety measures as its related to the firms of interest.Purposive sampling technique was used to select two firms; one management staff from each firm was interviewed. Coding themes were developed as patterns and themes emerged. The essence is that, as new construct emerged, it will guide in theory formation before thematic saturation was reached; this means no new concept was emerging from the available data.Qualitative method was employed for this study, it involved the collection of data through in-depth interview and telephone interview with observations. In-depth interview was conducted for one of the firm's management, while telephone interview and observations was conducted for the other firm. This is because the later firm was visited and observations made but for some contingencies visitation could not be repeated, hence a telephone interview, with the consent of the participants. This is to elicit more information as to the types and choices of technologies in water producing firms and their technological learning. Data was collected with the help of recorded audio recorders and call records on mobile phone.

The data from this study were analyzed using content analysis. Three basic steps were adhered to. These are, coding the bunch of text obtained from the field and creating themes as coding progressed; at this stage while reading the texts line by line, concepts were formed, and were repeated in the course of interacting with the texts. This is called open coding. The process

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fragments data into conceptual components. The next step involves more thematic classification, each concept was compared to see how they might relate to more inclusive and larger concepts called categories. This process is called theoretical coding. Second, memoing and theorizing, memos are ideas that cross the minds of the data collectors on the field which formed the field notes. They are also the writings of the analysts as they became familiar with the data they are coding. Third, integrating, refining and writing-up theories. Atlas ti version 8 was used to code and develop themes from these data. The essence of coding is to move methodologically to a higher conceptual level. Furthermore, the coded data were retrieved through query tools. This assisted in organizing the data in a systematic way. This further helped in generating themes for the study and formulating the concluding part of the study.

Hence, the responses were therefore classified into a thematic framework comprising four major themes which focus on the following:

1) The process through which firms learn technologies as introduced water producing firms in Osun state Nigeria
2) The facts about how technologies are chosen in practice
3) An overview of types of technologies practically in use in Nigeria
4) Perceptions of the environmental and safety measures (preferably including how it affects the staff and immediate environment

Themes 1-3, are presented in the analysis below with their individual sub-themes. While the fourth theme on environmental and safety measures will be presented using a matrix table. Confidentiality and anonymity were observed. Respondents were informed about the purpose of the research. Their consent was sought and obtained before interview sessions were carried out. No interviewee was put under duress to provide information. The rights and integrity of the interviewees were respected.

4. RESULTS OFANALYSIS

After entering and transcribing the data, the following thematic themes were arrived at to discuss the key findings. Participants of the interviews are well experienced managers who had worked in several similar companies for over ten (10) years, and thus they shared their experiences and opinions in their firm's technological innovativeness.

Presentation, Discussion of findings and Summary

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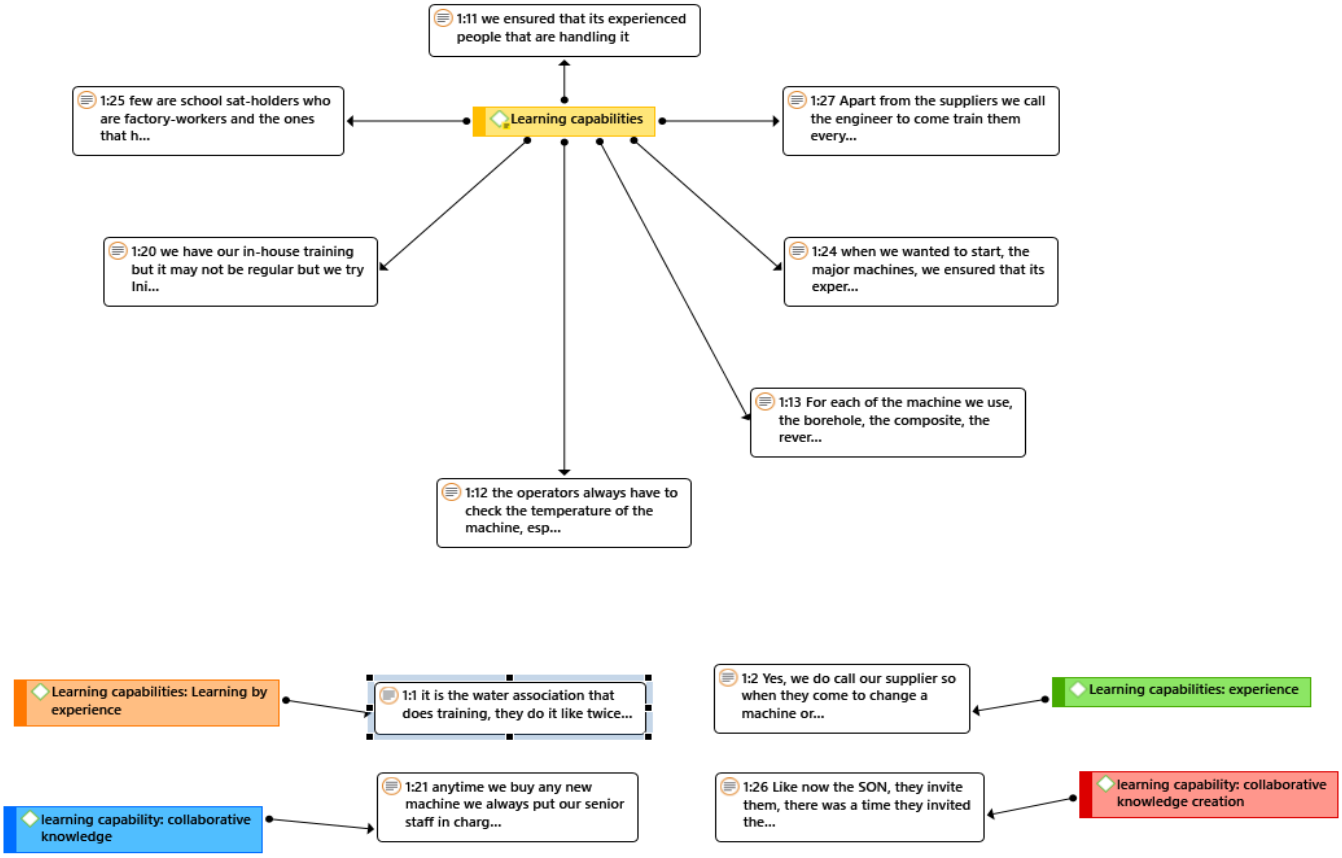

Figure 1: Semantic Network Showing Learning Capabilities

Figure 1 shows the learning capabilities available for the firms and the various forms they took. Each company has been able to offer periodic training that left the beneficiaries to gain hands skills by experience, observation, doing and acquisition. Through varying forms of challenges occurring on the job and peculiar ways of containing them, the firms have been able to garner technical know-how on these problems.

Learning by Experience

Participants: Em! Initially we had a problem with one of our machine that is the 'Reverse Osmosis Machine', so the engineer came over when we were seeking for correction for the problem, so we invited a consultant who invited that engineer. So it was during the process that we were able to know that those components can even be gotten in Nigeria and he can fix it he shown us some samples that he had done. It's an engineer from another company that coupled it together for us. That is what he does as a profession. he is almost good with all the machines even he was the one that re-coupled the one that had issues and both are working very well.

Candid Water

Participant: Nigerians are trying, they are trying, like that mold I didn't expect to get it and they did it, at least kudos to the company, it's just for them to improve

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themselves on the little…little challenges they had.For example, now, for this bakery that I told you that we would start very soon, I was opportune to do my IT (Industrial Training) in a bakery company (confectionary company) so they are majorly producing bread, a section I worked in they are producing bread, so there is…they had the local type oven, and the kneading machine, was locally made in fact that was what the man-the manager was doing, he fabricates machines. He was doing that fabricating the oven and everything they are using to make bread for others., So it was later he thought to himself that he can go into bread making and he was still doing that, I think the man is a welder he was still doing that (still producing the machines)

Mokuro Water

Learning by observation

Participant: we have our in-house training but it may not be regular but we tryInitially, we do it once in a week, but when production is high now, at times it may or might be difficult and at times we train like once a month. Most of them were trained somewhere else and when they came we trained them also. Our engineers that installed the machines trained them before they now started operation

Candid Water

Participant: We have in-house technicians, so part of our staff are being trained for that so anytime we buy any new machine we always put our senior staff in charge, they would train them together with it so if there is any fault, they would handle it themselves. **Mokuro Water**

Leaning by doing

Participant: They must first of all oil the machine, the machines that are moving, they oil it, check the bolts, tightens the bolts and check for the oil at the compressor that one must be done before production starts every day. when we wanted to start, the major machines, we ensured that its experienced people that are handling it.

Candid Water

Participant: the operators always have to check the temperature of the machine, especially the bottling-line, if bottles are not coming out well, they would stop the machine and check the problem.

Mokuro Water

Learning by acquisition

Participants: Em… since they started here, it hasn't happened but where I came from we used. Actually, it is the water association that doestraining, they do it like twice in a year, they call those organizations that they should come over and its compulsory for all the certified companies with them. They must send their representative and they train them but they have not done it for a while now.

Candid Water

Participant: Yes, we do call our supplier so when they come to change a machine or a part, they normally train our staff too. We give them training every three (3) months' interval to remind them.We do the training within the factory and apart from the suppliers, we do callour engineer to come train them.

Mokuro Water

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The semantic below shows the two major sources through which the technologies adopted were sourced. Typically, these were classified into indigenous technologies also known as locally made technology and the foreign made technology. Overall, locally made machines were employed in the daily operations. Aside being readily available, both the spare and the maintenance protocol can be easily accessed compare to the foreign sourced machines. Sometimes, in case of breakdown of any machine, sourcing the spare part could take 2weeks or more sometimes because of rigor of shipment and other modalities. This and some other challenges have made the firms to resort to indigenous technology (See the various challenges mentioned in the semantic network below). It turns out that despite initial worry about the capacity of the local machines, they performed more than expected at a very relatively minimal cost. In some other instance, capacity for maintenance is also lacking.

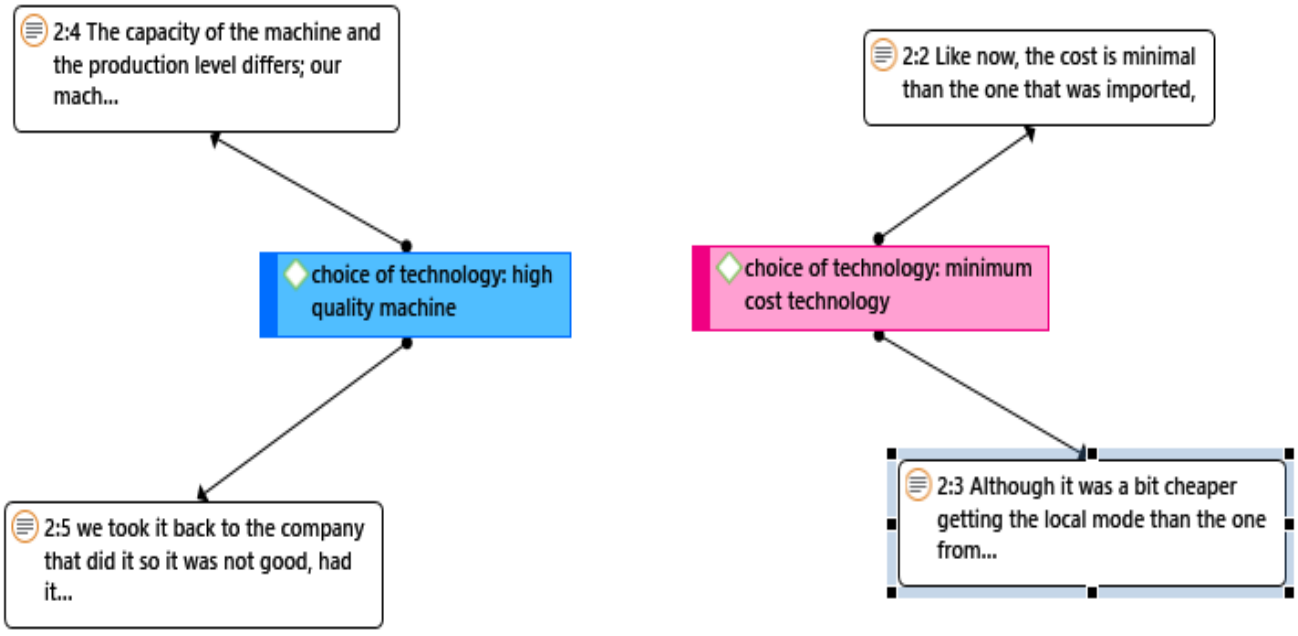

Figure 2: Semantic Network Showing the Technology Choice

Figure 2 shows the semantic network explaining the technological type adopted by the firms. Generally, these can be categorized into minimum cost technology and high quality product machines. The technological type adopted are majorly informed by these two characteristics. The indigenous technologies seemed to satisfy these two conditions the most, at least, relative to their foreign counter-parts. Aside access, cost minimization constitute a crucial factor in achieving firm's corporate goals and this what these firms are showing here.

Technological choices

Higher capacity

Participant: Yes, according to the director, he said he had some partners in china and secondly when he was there he got to know that the capacity that their machine can give him is more than what we can get from our locally made ones

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and he needs a higher production as he feels he wouldn't cope with the locally made ones. But looking at the capacity that is giving us, the turn-over is more than what the imported one is giving. It is the local water treatment machine that treats the water very well **Candid Water**

Participant: It shows that for us to have more production and not to have any delay the local one won't give you more quality than the new oneso am not discouraging those ones oh, they are okay but for you to get quality, enough efficiency and high level of production without time consuming. But the local ovens in fact that one had more space because he fabricated it himselfthan the new one and the shape comes out very well.

Mokuro Water

Minimal cost

Participant: Like now, the cost is minimal than the one that was imported, what we spent in getting the local water treatment machine was far smaller than the amount we got the first one that was imported.

Candid Water

Participant: Although it was a bit cheaper getting the local mode than the one from China. We didn't spend so much.

Mokuro Water

Quality of machine

Participant: like where I worked before, all their machines are local made, our own is more sophisticated than theirs. The capacity of the machine and the production level differs; our machines give more production.

Candid Water

Participant: If it is not original it cannot be like original, because they didn't get the size of the local mode and they didn't really give us the shape we needed. Then as time goes on, the setting of the mold with the machine, you know the machine was imported, so now we want to use locally made something with the imported one, so it didn't really go well, so the setting didn't work, we have been having issues, in fact, we have to remove it, we took it back to the company that did it so it was not good, had it being the machine was made locally, it will go well.

Mokuro Water

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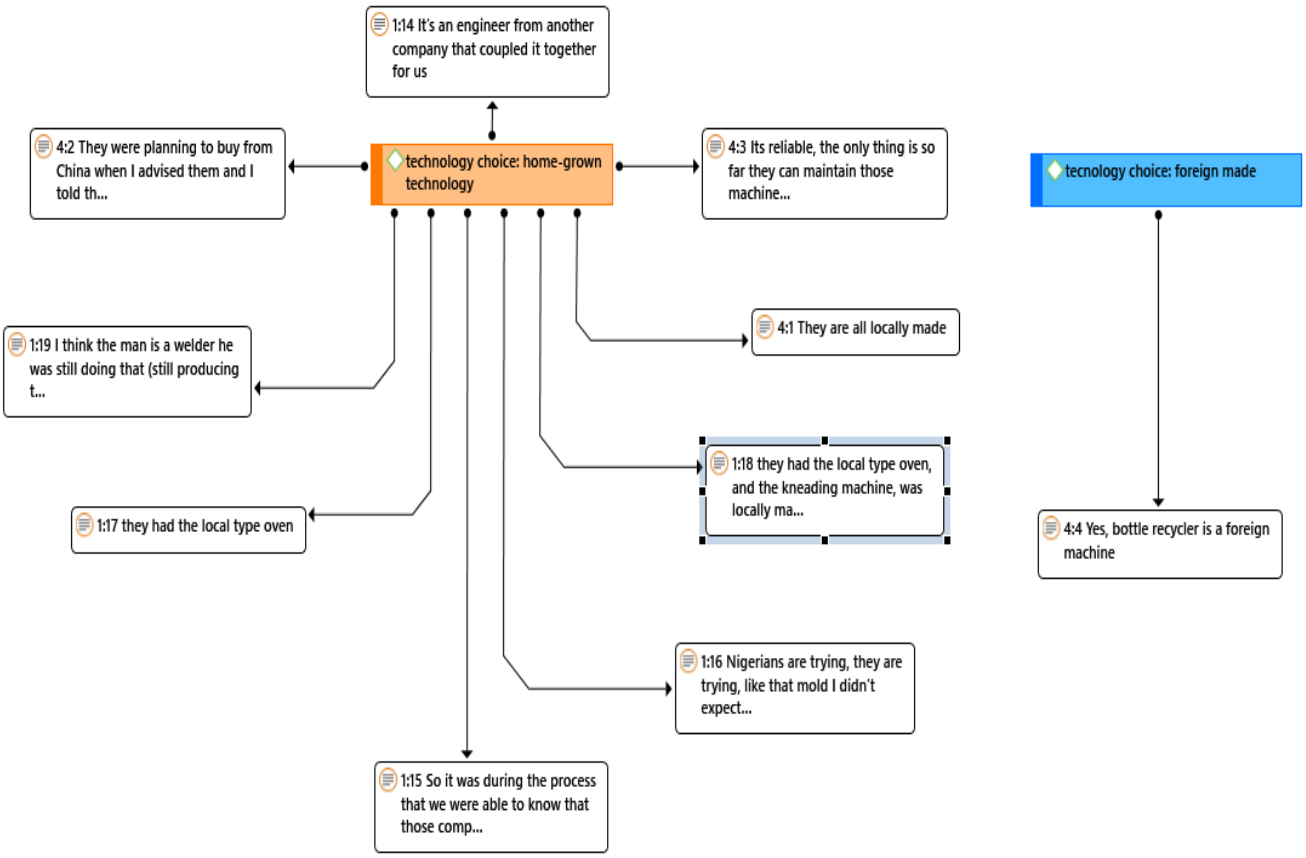

Figure 3: Semantic Network Showing the Technology Type

Foreign and Indigenous Technologies

Participant: Yes, we have eh…like the reserves osmosis, one was locally produced and the other was imported, all others are imported, except the sachet machines were bought in Nigeria, locally made- the automated filling machine or automated packaging machines for sachets, yes it is also local

Candid Water

Participant: We imported them, part of it is from china, we also have Germany products. They are new, we didn't buy old products, because you will always have problem when you buy fairly used, so it is not advisable we imported the mold too, so we needed another one because it had issues so we had to change it. They now told us that eh…we have to wait for 3 months before it would get here and customers were waiting, we now have to get Nigerian locally made (laughed) one. That one didn't take us more than 2-3weeks we got it in Nigeria at Ibadan.

Mokuro Water

Environmental Impact of Firms Activities

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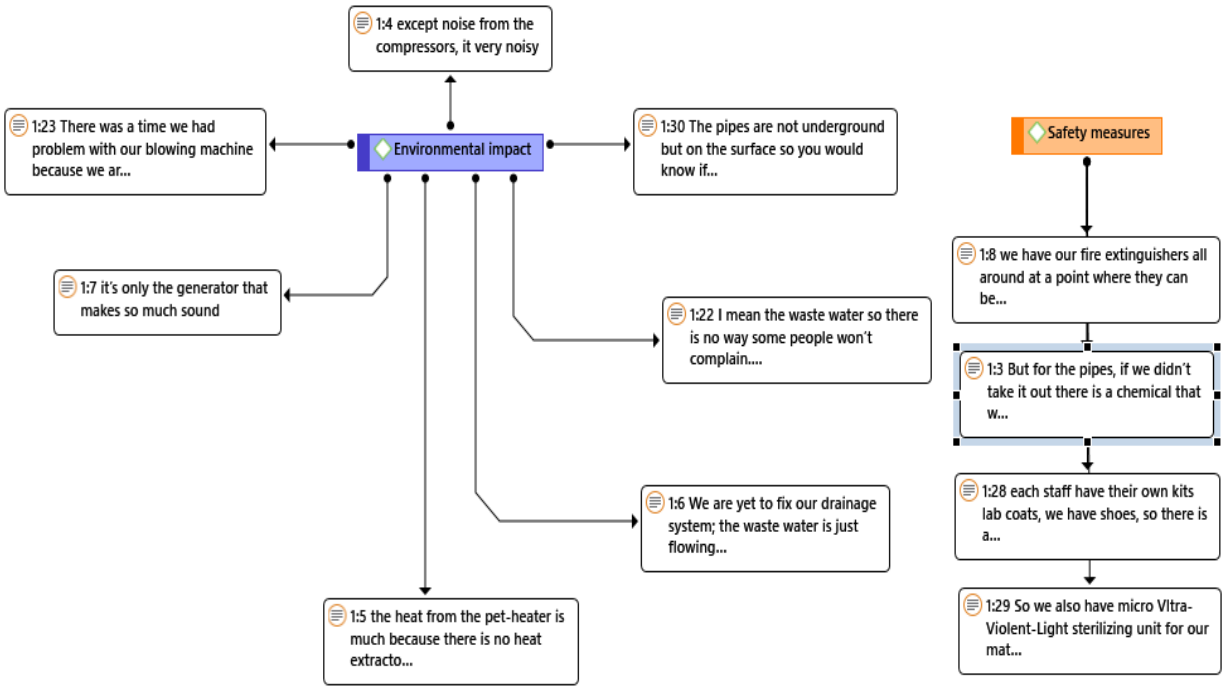

Figure 4: Semantic Network Showing the Environmental Impact and Safety Measure

Figure 4 shows the semantic network explaining the various environmental impact of the activities in the firms on the immediate environment and the safety measure put in place to prevent work hazards on the employees. Specifically, major sources of threat to the environment from their operations came in terms of noise from the generator, but no chemical released into the neighboring water bodies.

Air pollution

Respondent: But no emission of CO2 from any of our machines and we don't even use generator because this is the industrial area of Oshogbo where the light is 24hours everyday

Candid Water

Respondent:no emission of gas from any of the machine, except from the generator**.**

Mokuro Water

Heat pollution

Respondent: Actually, the heat is much because there is no heat extractor, there was supposed to get heat extractors in that room, so as that one is producing heat the extractor is blowing it out. So it not a problem but it something we are supposed to fix but we have not, but we are planning to do so soon.

Candid Water

Participant: Ha! For the blowing machine, there is heat and there is heat even in the production room. we use hot steam labelling machine so it generates heat. We have heat extractors

Mokuro Water

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Soil pollution

Respondent: That is our, you know, our 'Reverse Osmosis machine', it treats the water, it will take in the good one and it will take away the bad one, which we call waste and now we are yet to fix our drainage system, the water is just flowing out to the environment... but we are already planning for a drainage system. But where am coming from there is a drainage system directed to a farm and there were no negative effects on the people living in that area.

Candid Water

Respondent: They complain, about the water flowing out, although it is useful for some people and some, it a disturbing issue for them. I mean the waste water so there is no way some people won't complain. You know it has to go through the gutters to the road, some people would go there they would use it to clean their bikes, wash their clothes, some people it would be a disturbance to them. There was a time they complained that the water was going out, some people would still pour dirties so it got blocked and we have to clear it so to move the dirties even clear the gutter so there would be free flow of the water.

Mokuro Water

Noise pollution

Respondent: except noise from the compressor, it very noisy but emits no gas, located outside the factory, in the premises oh! Outside the production room but within the premises. They are covered, there is an in-built house for each compressor **Candid Water**

Respondent: And the generator, they do complain that we disturb themthe generator that makes so much sound but every other thing no. There was a time we had problem with our blowing machine because we are using 3, one of them had fault, so the sound it makes was so loud so they come and complain, so for now we have not rectified it so we are not using it so we are just using the other 2 we still have plans to repair the other one but for now to avoid complains.

Mokuro Water

Recycling of productand waste water

Respondent:we have a recycling machine that we use to crush bad bottles and bottle caps back to the resin form and use it to do another one. We don't throw away any waste even the used bottles, we have people that we use to pay commission when they bring back the bottles after they have used them.

Candid Water

Respondent: we are still thinking of how to recycle it to use it for something else but temporally we are using it for domestic use, we use it for toilet and other things because we believe that recycling it back to the machine won't allow the membrane to live long, the shelf life is short and that membrane is the one that does the major work and it very expensive to change

Mokuro Water

Firms Safety Measures

Use of Personal Protective Equipment (PPE)

Participant: Yes, they wear their Personal and Protective (PPE) which is going to be: hand gloves, nose cover, cloth-coverall, cap to cover the hair and a type of shoe that are not slippery**Candid WaterParticipant:** Eh…each staff have their own kits lab coats,

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shoes, slippers, nose cover, gloves, some sections where they use their hands mainly, you know I told you we use semi-auto machines, so they have to place bottles on the line so it has to be with gloves to avoid contaminations. **Mokuro Water**

Challenges faced

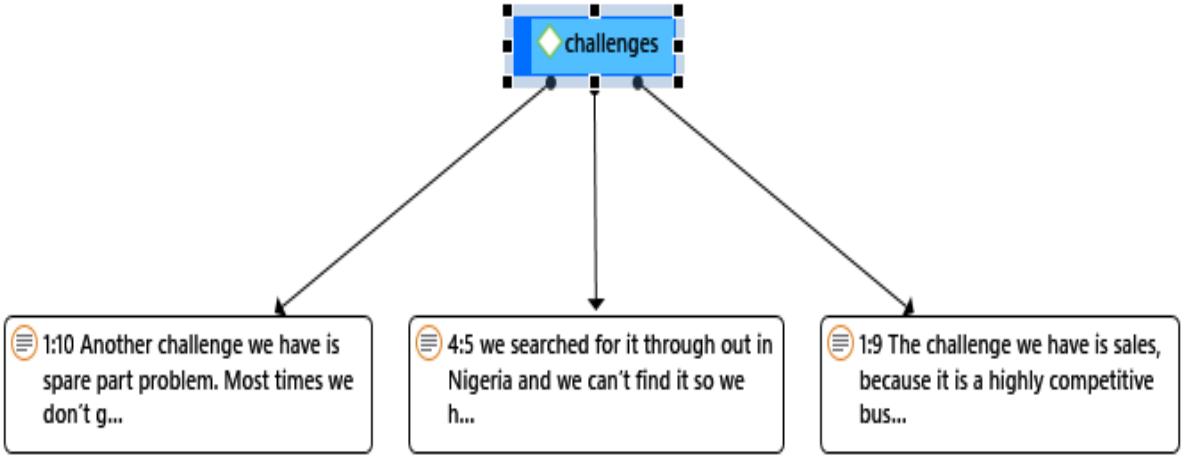

Figure 5: Challenges firms faced

Participant: The challenge we have is sales, because it is a highly competitive business and being in the midst of highly competitors, you have to be careful because at times people bring down their price to attract customers. But you have to look at the cost of production to fix your price, so it is a really giving us issues like you know big companies like Bigi, Vijiu are also into water production and we are competing with people like that, you know, we have to buckle up very well so that we can be in market with them

Another challenge we have is spare part problem. Most times we don't get spare parts around us, we have to order from Lagos, Ibadan, and import from China. And at times it affects and delays our production, so if there is no readily spare part, we have to wait. None within Oshogbo

Ah! Most times Marketing staff you know they are the most wicked, because most times all they have in mind is how they will make it and not how the company will make it. They sell, they will tell you customers didn't pay, most of them run all these contributory organizations so. Like my Oga would say they are giving themselves self-loan.

Candid Water

5. SUMMARY OF FINDINGS

Firm's interaction with the machines with close observations, and frequent maintenance practices, engineering staff could develop indigenous machines. This interaction occurred basically when the imported machines became faulty. Technological use and frequent interactions with the technology promoted the Technological Learning. Most interesting is the

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availability of spare parts in local markets to replace damaged parts of any of the machines, even the imported technologies. Thus, the ability for the organizations and her personnel to learn these newer technological skills indicates that the technology learning over a period of time.The firm's technological innovative choice depended on three basic factor such as the capacity, cost and quality of the machine. The most adopted technologies are foreign technologies, few instances led to the adoption of locally made technologies and the long work experience and skills acquired gave rise to the fabrication of similar foreign technologies. Thus firms have a mixture of both foreign and indigenous technologies used in their production line. This indicates firm's capability to learn some of the foreign technologies over time for them to be able to re-engineer them to meet required demand. The environmental impediment to reduce waste of excessiveflows of wasted-waste presented pollution in the surrounding environment. Complains and concerns were raised but an innovative strategy to use waste-water for domestic use and agriculture purpose can curb hazards. However, the production practices are clean, there were no emission of carbon monoxide ($C0_2$) but for the firms that do generate their own electricity. Moreover, used bottles are recycled within the factory and retrieval system is sub-contracted and recycled. Workers are ensured to be safely dressed with the proper PPE kits but some firms lacked some basic safety kits and safety apparatus to prevent health related issues and accidental cases. This research paper has therefore set-up a research framework from the conceptual framework to assess production firm's technological innovations and ascertain or determine the sustainability of the operations of the firm and predict future forecast of the firm and it competitive strength to survive in business

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