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Comparative Analysis of Green Manufacturing practice among Manufacturing Firms in South-East Nigeria

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ABSTRACT*:* *Green manufacturing is paramount to the future of Nigerian Manufacturing. This study evaluated the level of awareness of manufacturing firm managers in South-South, Nigeria using RECE model. The study used a qualitative research design to ascertain green manufacturing practice viz: recycling, energy efficiency initiative, choosing green materials and eco-innovation among manufacturing managers in South-East, Nigeria. It was found that Anambra State is more conscious of green manufacturing as against Abia, Ebonyi, Enugu and Imo State. The study concluded that green manufacturing is a benchmark for the future of Nigerian manufacturing firms and recommended that the RECE model developed here can be used by manufacturing firms in Nigeria to assess and implement green manufacturing practice.*

KEYWORDS: Sustainable manufacturing, RECE model, Recycling, Energy efficiency initiative, choosing green materials and eco-innovation.

INTRODUCTION

Incessant regularities affect the manufacturing sector and affects their tendencies of achieving their set objective. The global world recognizes the challenges that manufacturing activities pose on the ecosystem and is determined to address these challenges to ensure that environmental concerns are properly incorporated into social-economic development efforts. It is critical that necessary conditions be established at the global and national levels to make it possible for developing countries to move towards green manufacturing.

Green manufacturing is defined as an economically driven, system-wide and integrated approach towards the reduction and elimination of all waste streams associated with the design, manufacture, use and or disposal of products and materials. Gina (2008) believes that it is the renewal of production processes and the establishment of environmentally friendly operations within the manufacturing field. Essentially, it is the greening of manufacturing, in which workers use fewer natural resources, reduce

pollution and waste, recycle and reuse materials, and moderate emissions in their processes. It involves not just the use of environmental design of products, use of environmentally friendly raw materials, but also eco-friendly packing, distribution, and destruction or reuse after the lifetime of the product (Ogbo, Eneh, Agbaeze, Chukwu, & Isijola, 2017).Green manufacturing efforts range from the promotion of community engagement to the reduction of Greenhouse Gas (GHG) emissions, among other efforts. Although the balance among the three dimensions of economics, the environment and social issues varies greatly across firms, many seek to pursue equally balanced initiatives. Some firms claim that the achievement of this balance in the corporate world is incredibly difficult, going so far as to say that, in some cases, green solutions will never be profitable, no matter how intelligent or innovative the business model (Guide, Harrison, and Van Wassenhove,2003).

In line with global best practice, green manufacturing adopts the production technology program and process route with fewer resources and energy consumption, little environmental pollution as far as possible. The standard to reach green manufacturing include zero potential safety problems, zero health threat on the operators and product users, and zero environmental pollution, wastere cycling, and waste disposal during the production process as much as possible(Gao, and Song, 2009). For Nigeria manufacturing firms to practice green manufacturing, they must pay attention to those factors that promote sustainable development viz recycling, energy efficiency initiative choosing green materials and eco-innovation, manufacturing.

Green manufacturing has achieved special attention from many researchers and several research papers have been published in this new realm of science. It is a manufacturing paradigm that has come to stay and should be seen as a new normal that will facilitate the future of Nigerian manufacturing firm hence the need to assess the level of green manufacturing practices among members of management staff of South-South, Nigerian. Manufacturing firms on the basis of Recycling (R), Energy efficiency initiative (E), Choosing green materials (C) and Eco-innovation (E): RECE, as a model for addressing green manufacturing practices.

Specifically, this research intends to apply RECE model to determine the level of green manufacturing practices among manufacturing firms in South-South, Nigerian using recycling, energy efficiency initiative, choosing green materials and eco-innovation parameters.

Conceptual Framework: RECE Model

The RECE model has its foundation on green manufacturing as a driver for sustainable manufacturing. Its purpose was to provide a platform for green manufacturing practices across manufacturing firms. RECE provides a basis for a growing body of research that relates to green manufacturing in manufacturing firm.

This model is proposed by the researcher for developing countries. Extant literature shows that most developed countries where green manufacturing practices exist have among other factors used the RECE scale viz: (i) **Recycling**: recycling is the process of recovering material from waste and turning it into new products, (ii) **Energy efficiency**

initiative: Energy efficiency initiative is the process of minimizing the volume of energy used during manufacturing process, (iii)**Choosing green material**s: Choosing green materials require choosing for production materials that conserve natural resources, save water and energy, minimize toxic emission and contribute to safe healthy indoor environment and (iv) **Eco-innovation**: entails adoption of technologies, design and innovative ideas that are eco-efficient (Hua, 2009, Jamie, Katerina, Ernst and Eric 2011, Javier, Pablo and Totti2016).

METHODOLOGY

This is a descriptive study based on literature review and a semi-structured interview with management and staff of Manufacturing Firms in South-South, Nigeria. The hypothesis of this study was that green manufacturing practices varies among the manufacturing firms in South-South, Nigeria.

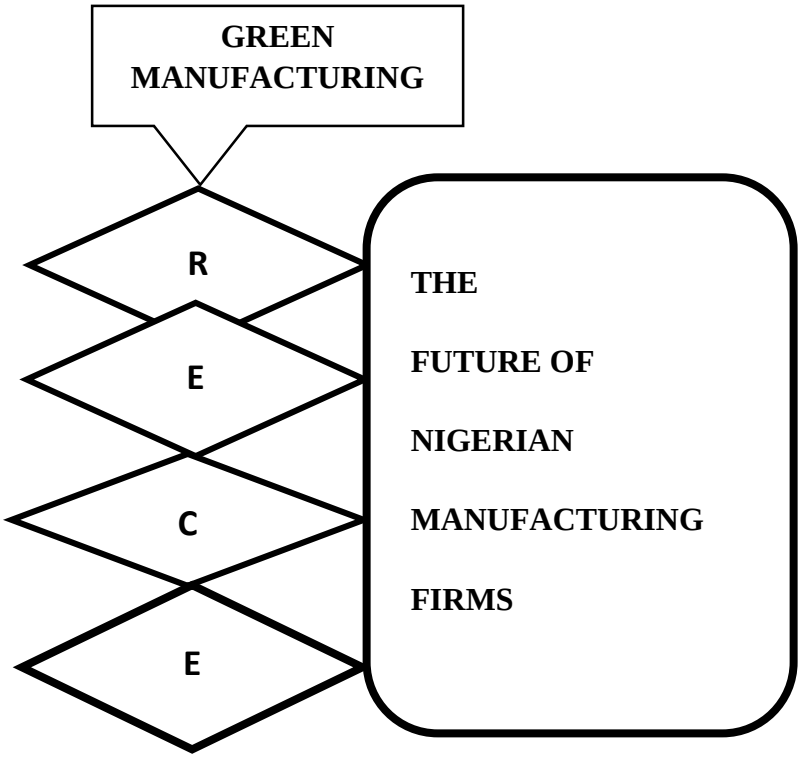

Figure 1: Researcher's Model

Figure 1 shows the application of the RECE model on green manufacturing practices and how it is pivotal to the future of Nigerian Manufacturing firms. The application of this model was considered suitable for this study because it highlights the various parameter that should be considered by Nigerian manufacturing firms to practice green manufacturing towards a sustainable future.

The population of the study was composed of all manufacturing firms located in South-East, Nigeria. The choice of the manufacturing sector was predicated on the fact that it is the major sector in Nigeria that generates vast volume of waste and environmental

pollution. The target population for this research work consists of one thousand two hundred and fifty four (1254) staff. The sources are from the employees of the top, middle and lower level management staff from the manufacturing firms in South-East, Nigeria. The sample size of two hundred and fifty seven (257) was drawn from the population. Out of two hundred and fifty seven (257) questionnaires administered were administered, two hundred and forty (240) were returned to the respondent. Literature was reviewed based on their relevance to the study. Secondary data collected from reports, articles, research studies and reviews were used for this research.

MATERIALS AND METHODS

(i) Matrixon recycling practice among the five States (Abia, Anambra, Ebonyi, Enugu and Imo) in South-East, Nigeria.

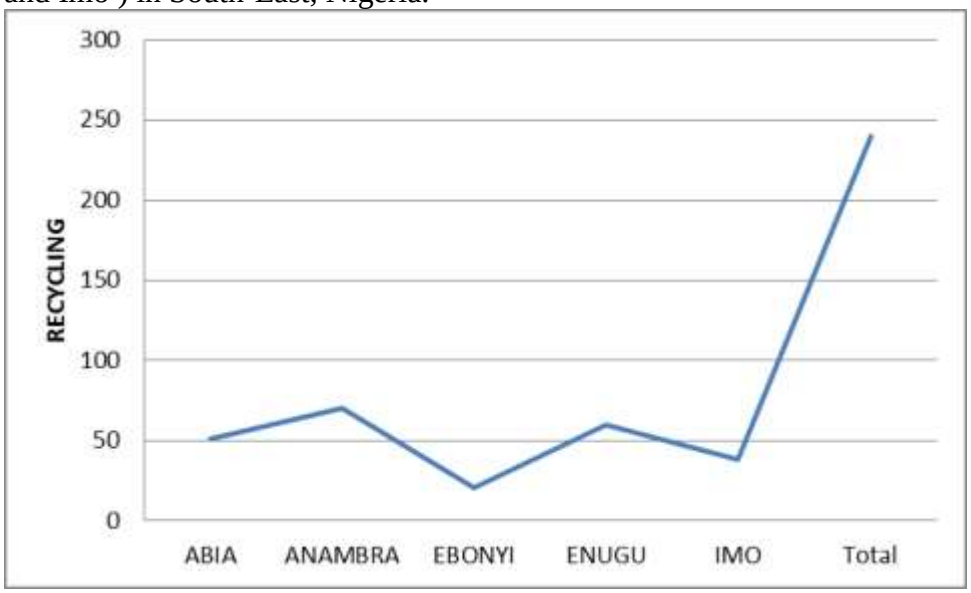

Figure 2: Field Survey 2020

From fig 2, recycling practice trend varies from state to state, where 51 respondents from Abia State confirm that their manufacturing firms practice recycling. 70 respondents from Anambra State confirm recycling practice, 21 from Ebonyi State, 60 from Enugu State and 38 from Imo State. Thus Anambra State is the State with the highest recycling practice.

(ii) The extent of energy efficiency initiatives adopted by the five States (Abia, Anambra, Ebonyi, Enugu and Imo) in South-East, Nigeria.

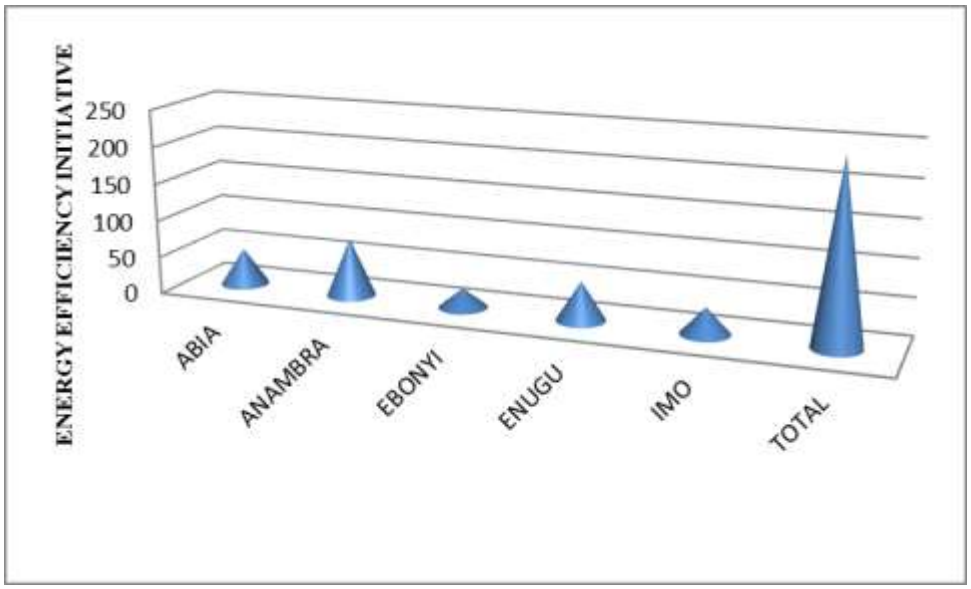

Figure 3: Field Survey 2020

From fig 3, responses on energy efficiency initiative varies form state to state with Abia 49, Anambra 78, Ebonyi 26, Enugu 52, and Imo 35. Thus showing that Anambra State has the highest manyufacturing firms with energy efficiency initiative.

(iii) The extent to which the five States (Abia, Anambra, Ebonyi, Enugu and Imo) in South-East, Nigeria choose green materials for manufacturing.

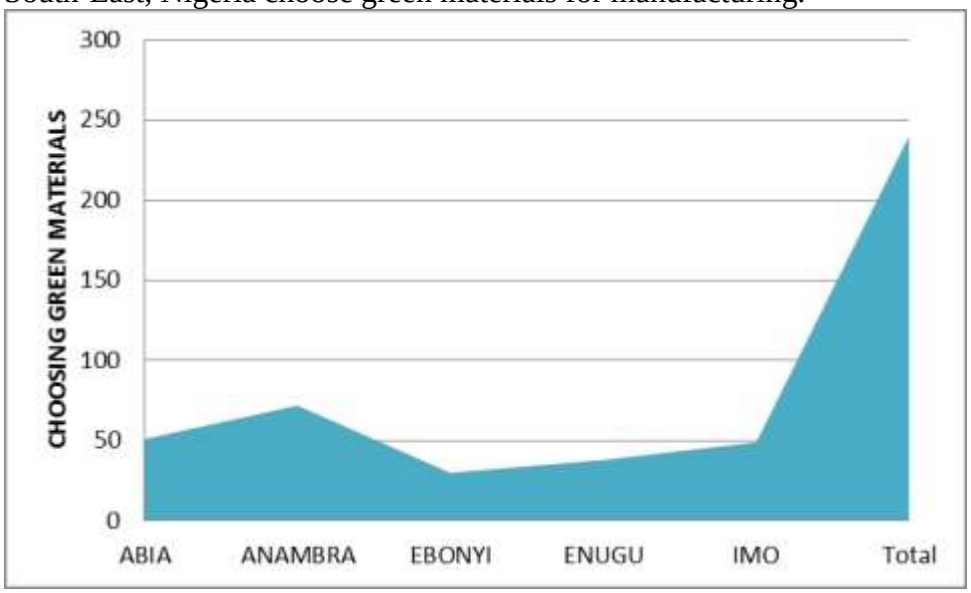

Figure 4: Field Survey, 2020.

From fig 4, Abia State manufacturing firms choose green materials for manufacturing at the rate of 51, Amanbra 72, Ebonyi 30, Enugu 38 and Imo State 49 with Anambra still the highest state that practices green manufacturing.

(iv) The trend of eco-innovation adopted by the six States (Akwa Ibom, Bayelsa, Cross River, Edo, Delta and Rivers State) in South-South, Nigeria.

(v)

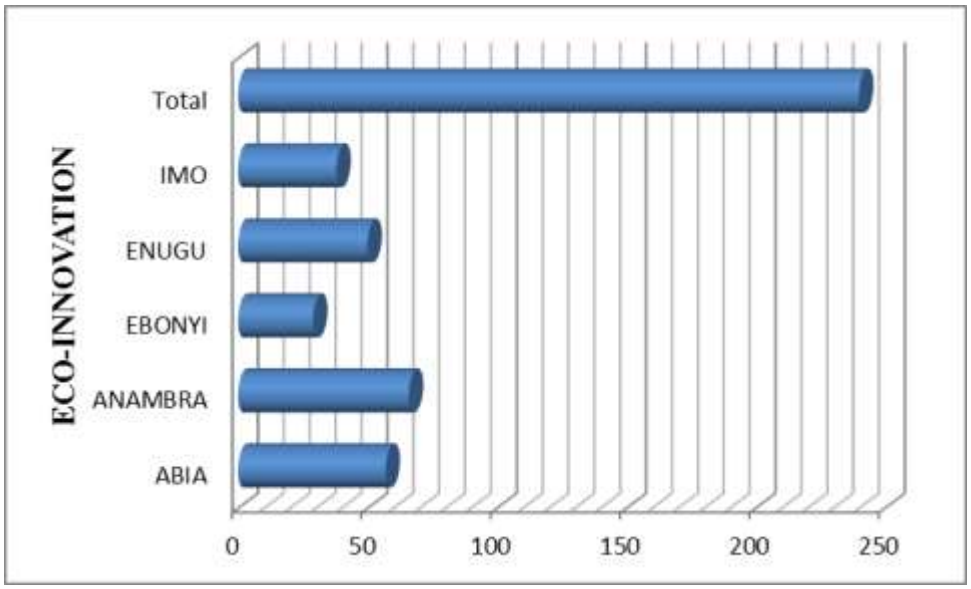

Figure 5: Field Survey 2020

From fig 5, based on the responses from the respondent, 57 respondents confirm that eco-innovation is practiced in Abia State, Amanbra 66, Ebonyi 29, Enugu 50 and Imo State 38. Anambra State manufacturing firms practice eo-innovation.

SUMMARY OF FINDINGS

Green manufacturing practice based on the RECE model is particularly practice in Anambra state ageing the other four States in South-East, Nigeria.

DISCUSSION

Green manufacturing is manufacturing paradigmn that employs green strategies to viz: recycling, energy efficiency initiative, choosing green materials and eco-innovation. It is a global believe that green manufacturing drives sustainable manufacturing. Manufacturing firms are the major sector of the economy that emits vast volume of waste and pollution that adversely affects the eco-system. The study applied the RECE model developed by the researcher because it encapsulates the various parameters that manufacturing firms should consider to practice green manufacturing.

Results from the findings show that Anambra state, Nigeria Practice recycling, energy efficiency initiative, choose green material and practice eco-innovation as a drive towards practice green manufacturing. This therefore, shows that Anambra State manufacturing firms are working towards a sustainable future.

CONCLUSION

Green manufacturing is an economically driven system-wide and integrated approach towards the reduction of waste and pollution associated with manufacturing activates. The essence of green manufacturing is to secure the future of manufacturing firms. The

role of green manufacturing in the 21st century is critical as it minimizes landfill waste and enhances pollution control. With the application of the RECE model it is concluded that amongst the South-East Nigerian manufacturing firms, Anambra State is more conscious of green manufacturing practice. Therefore, if the practice is consistent, they are most likely to secure sustainable manufacturing. Service delivery by the hospital phenomenally.

Recommendation

Based on the findings, the following recommendations are made:

RECE model can be adopted by manufacturing firms in Nigeria to assess and implement Green Manufacturing Practice.

Manufacturing firms in Anambra State, Nigeria should be used as a yardstick to develop strategies that are applicable in Nigeria towards green manufacturing practice.

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