EFFECT OF ADVANCED MANUFACTURING TECHNOLOGIES ON SUSTAINABILITY REPORTING OF QUOTED CONSUMER GOODS MANUFACTURING FIRMS IN NIGERIA

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Abstract

In recent times, advanced manufacturing technologies and sustainability reporting have been the focus of academic and business discuss. To this end, this study seeks to examine the effect of advanced manufacturing technologies on sustainability reporting of quoted consumer goods companies on the floor of the Nigerian Exchange Group. The study was anchored on the legitimacy theory and the ex-post facto research design was employed. The population of the study includes all consumer goods companies as at 31st December, 2019. Data of sustainability reporting (measured by scoring index on the basis of the performance indicators in the global reporting initiative guidelines G4, global reporting initiative and sustainability guidelines on economic, environmental and social performance) and advanced manufacturing technologies (measured by costs of plant and equipment plus information technology costs) were obtained from the annual reports and accounts of the selected consumer goods companies in Nigeria. Data obtained were analyzed using regression estimation technique and the study found a significant relationship between usage of advanced manufacturing technologies and the provision of sustainability disclosures. More so, advanced manufacturing technologies were found to have a significant effect on economic and environmental disclosures but not on social disclosures. Based on the findings, it was recommended among others that the government and the society at large should pay attention to advanced manufacturing technologies used by consumer goods firms to ensure that they promote sustainable development.

Keywords: Advanced manufacturing technology; Social disclosure; Environmental disclosure; Economic disclosure; Sustainability reporting.

Introduction

Sustainability reporting and advanced manufacturing technologies (AMT) have been ongoing discussions in the business world for some time now. Manufacturing is an important activity in any economy not just because it results in the creation of goods and services that satisfy human wants but also because of the role it plays in the growth and development of any economy in the world (Nath & Sarkar, 2017; and National Agency for Science and Engineering Infrastructure (NASENI), 2019). Over the years, the increase in population has resulted to increase in demand for

manufactured products. The need to supply better quality products at lowest cost to beat competition resulted in the development of AMT.

AMT is the use of computer and machines in the manufacturing process; this new set of technologies ensured precision at a faster rate than ever before, (Dean & Snell, 1996 in Ismail & Isa, 2011; and Isa & Foong, 2015). However, manufacturing activities have been widely believed to be the major cause of the adverse climatic conditions that are experienced in the world today like the depletion of the ozone layer, pollution of the air and water, deforestation and even more worrisome, is the fact that it imposes some health conditions experienced in the world today (Joseph, Tarbo & Ikya, 2017; Ejoh, Orok & Sackey, 2014; and Mastrandrea & Schneider, 2008 in Onyali, Okafor & Egolum, 2014). In order to show commitment towards creating a safer environment, organizations produce sustainability reports to show the impact of their activities on the economy, society and environment, and how such impacts are managed by them.

One question that lingers is that since AMT facilitate production, does it improve sustainable operations? Impliedly, does it improve sustainability report of manufacturing firms? Remarkably, current researches on the subject like those of Bag, Gupta and Kumar (2021), and Machado et al. (2020) suggested that the adoption of AMT can contributes to sustainability in manufacturing. Notwithstanding the viewpoints of prior studies in developed nations, to the researchers' knowledge, there are scanty empirical evidences in this area in Nigeria. Thus, there is the need to ascertain if this assertion is true in sub-Saharan African and Nigerian in particular.

In light of the above, this study was carried out to examine the effect of AMT on sustainability reporting of quoted consumer goods companies on the floor of the Nigerian Exchange Group. Given that sustainability reporting is made up of three (3) dimensions of disclosures - economic, environmental and social disclosures, the specific objectives of the study are:

1. To determine the effect of advanced manufacturing technologies on economic disclosures of consumer goods companies in Nigeria;
2. To ascertain the effect of advanced manufacturing technologies on environmental disclosures of consumer goods companies in Nigeria; and
3. To evaluate the effect of advanced manufacturing technologies on social disclosures of consumer goods companies in Nigeria

Predicated on the above specific objectives, the researchers made the following hypotheses to guide the investigation:

H_{o1} AMT does not have any effect on economic disclosure practices of consumer goods companies in Nigeria

H_{o2}: AMT does not have any impact on environmental disclosure practices of consumer goods companies in Nigeria.

H_{o3} AMT does not have any impact on social disclosure practice of consumer goods companies in Nigeria.

Review of Related Literature and Theoretical Framework

Advanced Manufacturing Technologies (AMT)

AMT is an umbrella term that covers all manufacturing technologies that involve high automation and computerization in product design, planning and processes. According to Lewis and Boyer (2002) in Haruna, Gakure and Orwa(2015), AMT is the technique that uses computer, machines and electronics in the operation and regulation of the manufacturing process. This includes a variety of machines that facilitate the management of the production process. It involves the use of applications such as Computer Integrated Manufacturing (CIM), Computer-Aided Design (CAD),Computer-Aided Engineering (CAE), Flexible Manufacturing Systems (FMS), Material Requirements Planning (MRP 1), Manufacturing Resource Planning (MRP II), Enterprise Resource Planning (ERP) Robotics and the like in manufacturing of goods and services, (Isa & Foong, 2005; and Ugwuanyi & Ojeh, 2013).

AMT has resulted to improvement in design of products and has also facilitated dissemination of relevant information to improve the manufacturing process and the products (Okay, 2010 in Haruna et al 2015). It has reduced production costs by reducing material wastes. This is achieved by improving the ability to foresee problems and defects of products at the design stage before actual manufacturing takes place. It has also reduced the number of prototypes required, and the time from product conception to sale (Khan et al., 2011 in Haruna et al, 2015). Furthermore, AMT enables manufacturing organization to produce customized products for its customers by facilitating the production of different variations of a product at a very short period of time.

The improvements in production processes brought about by AMT can lead to increased profit and business growth (Koc & Bozdag, 2009); and fast-track the economic development of firms (Haruna et al, 2015). Machado et al. (2020) asserted that AMT facilitates the new industry system also known as Industry 4.0. Empirical researches have shown that AMT improves sustainability among manufacturing concerns. Sustainability in manufacturing referred to sustainable manufacturing practices aimed at enhancing production of goods and services that are economically viable in a socially and environmentally responsible manner (Machado et al., 2020) see sustainable manufacturing as the combination of production processes and systems in such a way as to achieve efficiency in production via the use of sustainable resources to produce high quality products and services that ensure the safety of the stakeholders and preservation of the society and environment throughout its lifecycle.

The advantages of AMT include reduction of material waste, its ability to save energy and reduce emission and the substitution of humans with robots in some risky manufacturing processes. AMT may also have an indirect improvement on workers' health and safety by decrease of exposure to harmful production steps. It offers a lot of opportunities for sustainable manufacturing in business due to its ability to produce goods and services digitally (Machado et al., 2019). In the views of Machado et al. (2019), AMT needs to be supported by strategy that considers the sustainability impacts of the product throughout its lifecycle.

Sustainability Reporting

Sustainability reporting involves disclosure on company's sustainability performance viewed from three (3) dimensions, namely economic, environmental, and social. According to the Global Reporting Initiative (2013), the economic dimension of sustainability has to do with the effect of the organization on the local, national, and global economy. The environmental dimension looks at the effect of an organization on living and non-living natural systems, including land, air, water and ecosystems and the social dimension of sustainability is concerned with the impact the organization has on the society within which it operates. Sustainability reporting is an instrument of collecting and presenting, in a systematic manner, sustainability information for management process; and to stakeholders (Saji, 2014 in Eneh & Amakor, 2019). In this study, the three (3) dimensions of sustainability reporting (economic, environmental and social) were employed.

In sustainability reporting, information is presented in a methodical way so as to enable comparison and measurement of impact over time and it entails both financial and non-financial information. Financial information is linked to the financial accounting system and is expressed in monetary terms while the non-financial information can be qualitative, such as the reputation of an organization and organizational policies or quantitative, such as number of accidents and tons (units) of greenhouse gas (NIVRA, 2009 as cited in INTOSAI WGEA, 2013). Sustainability reporting is a recognized way of engaging and involving stakeholders in corporate practice to improve long term success of the organization (Corporate Citizenship, 2012).

Sustainability reporting can also improve organizations' ability to understand and manage sustainability related risks and help them better anticipate changing societal expectations (Saridewi & Koesrindartot, 2014; and Uwuigbe, 2011). This can be used to inform and stimulate future practice (Corporate Citizenship, 2012) and as an effective tool to manage organization's reputation. Thus, it is no surprise that the majority of the reporters are large companies and firms having severe environmental impacts. (INTOSAI WGEA, 2013). Sustainability reporting can be used as a medium

to show compliance, demonstrate corporate point of view and promote corporate image (Corporate Citizenship, 2012).

Sustainability reporting creates information resource by helping to gather and organize information to improve management systems and the quality of management information. This enables organizations to find out weaknesses, opportunities and set new goals. Paying attention to sustainability can help to drive innovation, develop new market offerings and safeguard sustainable growth in the long run (INTOSAI WGEA, 2013; Corporate Citizenship, 2012; and Uwuigbe, 2011). Furthermore, sustainability reporting can act as a tool for leadership, increase employee satisfaction and make organizations attractive to new employees (Aggarwal, 2013). Sustainability reporting can also be a tool to attain cost savings; this is because, it facilitates efficiency in the use of resources by providing a framework for measurement and target setting of organizational goals (Saridewi & Koesrindartot, 2014; Corporate Citizenship, 2012; and Uwuigbe, 2011). Thus, sustainability reporting help companies to find out the weaknesses in their systems and opportunities in their environment (Buniamin et al., 2011).

Theoretical Framework

This study is anchored on the theory of legitimacy. The theory states that the organization tries to make sure that they are seen as operating within the boundaries of normal activities of their respective societies, that is, they want stakeholders to see their activities as being "legitimate". The societal perception is not static but changes over time, which requires organizations to be receptive to the environment in which they operate (Deegan & Unerman, 2011 as cited in Ismail & Haddaw, 2014). Long-term survival of an organization is dependent on how well the organization meets the expectations of stakeholders in its environment; as such, companies that are socially and environmentally responsible have lesser risk of sanctions and product boycotts and have increased license to operate in their environment (Aggarwal, 2013).

With the current challenges facing the world today coupled with the changing consumer tastes, business organizations strive to present their companies as providers of smart products and services to their customers and as solution providers to the economic, environmental and social issues in our world. Companies that are perceived as smart and sustainable enjoy a certain level of goodwill from stakeholders like customers, employees, investors, government and society. This goodwill ultimately translates to better workforce, increased market value, increased access to finance, government support, improved returns and so on.

Methodology

The study employed the *ex-post facto* research design. The researchers also made use of content analysis for data collection. The decision to use content analysis was to enable the researchers to extract both qualitative and quantitative information from the annual reports and accounts of the selected companies. The population of study

includes all consumer goods companies listed on the floor of the Nigerian Exchange Group as at 31st December, 2019; this is made up of twenty (20) consumer goods companies. The sample size, however, includes companies that were not delisted in the process of restructuring or had compliance issues with the Nigerian Exchange Group as contained in the exchange's website between 31st December 2015 and 31st December 2019.

These criteria were used to ensure that the selected companies were relatively stable and also to ensure the availability of their annual reports and accounts. Using the judgmental sampling technique, a total of ten (10) quoted firms were selected for this study; based on their market capitalization status and availability of 2015-2019 annual reports and accounts. This means that the companies that made up the sample were listed in the Nigerian Exchange Group as at 2015 and were still listed as at 31st December 2019. Judgmental sampling technique was chosen to enable the researchers derive the desired data for the study.

Secondary data were collected from the annual reports and accounts of the selected sampled companies. Annual reports and accounts were chosen because it is the most important document a company uses to communicate with its shareholders and other stakeholders. Data obtained were analyzed using both descriptive (mean, standard deviation, minimum and maximum values) and inferential (regression) statistical tools. The empirical model of the study is estimated as follows:

$$SREP = f(AMT) \qquad \text{eq. 1}$$

Equation 1 is the implicit form of the regression model; however, equations 2-4 were expressed in their explicit forms to enable the researchers decompose the three dimensions of sustainability reporting and to validate the research hypotheses of the study:

$$ECDISC_{it} = ß_0 + ß_1AMT_{it} + €_{it} \qquad \text{eq. 2}$$
$$ENDISC_{it} = ß_0 + ß_1AMT_{it} + €_{it} \qquad \text{eq. 3}$$
$$SODISC_{it} = ß_0 + ß_1AMT_{it} + €_{it} \qquad \text{eq. 4}$$

Where: SREP = Sustainability reporting; ECDISC = Environmental disclosure; ENDISC = Economic disclosure; SODISC = Social disclosure; AMT =Advanced manufacturing technology; $ß_0$-$ß_1$ = Regression coefficients; € = Error term; i = individual consumer goods companies; t = time period

Definition of Operational Variables

The dependent variable is sustainability reporting and it was measured by scoring index based on performance indicators provided in Global Reporting Initiative Guidelines G4 (GRIG4) Specific Standard Disclosures. Global Reporting Initiative (GRI) Sustainability Guidelines on Economic, Environmental and Social

Performance is currently the most prominent reporting guidelines used by companies and researchers (Molla et al., 2019 in Paula- Carmen & Dorin-Paul, 2019; and Morhardt et al, 2002 as cited in Burhan & Rahmanti, 2012). The index scores for economic, environmental and social disclosures based on GRI4 guidelines were used as proxies for economic, environmental and social disclosures. A score of one(1) was awarded if an item was reported and if otherwise, zero (0). The formula used to calculate the index score is:

$$Index = \frac{n}{k}.$$

Where n = number of items reported by the entity; k is the total score possible. The independent variable is the advanced manufacturing technologies (AMT). Data for AMT was obtained from annual reports and accounts of selected companies; this is supported by the works of Machado et al. (2019); Ford and Despeisse (2016) and Egbunike et al. (2015) who obtained AMT data from company reports. Since AMT has to do with the use of smart machines and computer systems, this study used the cost of plant and equipment plus IT cost as stated in the annual reports of selected companies as proxy for AMT.

Results and Discussions

Table 2a shows a coefficient of correlation (R) of 0.559. This means that the value of coefficient correlation between the independent variables and the dependent variable is 0.559. It implies that the relationship between advanced manufacturing technology and sustainability reporting is 55.9%. The coefficient of determination (R-square) is .313. This implies that 31.3% of the variation in sustainability reporting is explained by variation in advanced manufacturing technology, the rest is explained by other factors.

Table 2a: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.559[a]	.313	.298	.41501

a. Predictors: (Constant), AMT

Source: SPSS 20 Output

Table 2b: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.680	1	3.680	21.368	.000[b]
	Residual	8.095	47	.172		
	Total	11.775	48			

a. Dependent Variable: sustainability
b. Predictors: (Constant), AMT
Source: SPSS 20 Output

Table 2c: Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.089	.093		11.679	.000
	AMT	1.128E-008	.000	.559	4.623	.000

a. Dependent Variable: sustainability
Source: SPSS 20 Output

Test of Hypothesis I

H_{o1} AMT does not have any impact on economic disclosure practices of consumer goods companies in Nigeria.

Table 3a: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.402[a]	.162	.144	.21288	1.936

a. Predictors: (Constant), AMT
b. Dependent Variable: economic
Source: SPSS Output

Table 3b: ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	.420	1	.420	9.263	.004[b]
	Residual	2.175	48	.045		
	Total	2.595	49			

a. Dependent Variable: economic
b. Predictors: (Constant), AMT
Source: SPSS Output

Table 3c: Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.730	.047		15.554	.000
	AMT	3.778E-009	.000	.402	3.043	.004

a. Dependent Variable: economic

Source: SPSS Output

From Table 3a-3c, the coefficient of correlation (R) is 0.402. It implies that the relationship between advanced manufacturing technology and economic disclosures is 40.2%. The coefficient of determination (R-square) is 0.162. This implies that 16.2% of the variation in economic disclosures is explained by variation in advanced manufacturing technology, the rest is explained by other factors.

From table 3c, it can be seen that the coefficient of variable social is 3.778E-009. The probability is .004. Since the tabulated t-value which is 2.011 is less than the calculated t value 3.043 at 5% significance level. The null hypothesis which states that AMT does not have a significant impact on economic disclosures among consumer goods companies in Nigeria is rejected while the alternative hypothesis is accepted.

Test of Hypothesis II

H_{o2} AMT does not have any impact on environmental disclosure practices of consumer goods companies in Nigeria.

Table 4a: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.657[a]	.432	.420	.18949	2.253

a. Predictors: (Constant), AMT

b. Dependent Variable: environment

Source: SPSS Output

Table 4b: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.312	1	1.312	36.542	.000[b]
	Residual	1.724	48	.036		
	Total	3.036	49			

a. Dependent Variable: environment

b. Predictors: (Constant), AMT

Source: SPSS Output

Table 4c: Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.023	.042		.545	.588
	AMT	6.679E-009	.000	.657	6.045	.000

a. Dependent Variable: environment
Source: SPSS Output

From Table 4a, the coefficient of correlation (R) is 0.657. It implies that the relationship between advanced manufacturing technology and environmental disclosure is 65.7%. The coefficient of determination (R-square) is 0.432. This implies that 43.2% of the variation in environmental disclosure is explained by variation in advanced manufacturing technology, the rest is explained by other factors.

From table 4c, it can be seen that the coefficient of variable social is 6.679E-009. The probability is .000. Since the tabulated t value which is 2.011 is less than the calculated t value 6.045 at 5% significance level. The null hypothesis which states that AMT does not have a significant impact on environmental disclosures among consumer goods companies in Nigeria is rejected while the alternative hypothesis is accepted.

Test of Hypothesis III

H_{o3} AMT does not have any impact on social disclosure practice of consumer goods companies in Nigeria.

Table 5a: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.109[a]	.012	-.009	.14082	1.836

a. Predictors: (Constant), AMT
b. Dependent Variable: social
Source: SPSS Output

Table 5c: ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	.011	1	.011	.568	.455[b]
	Residual	.932	47	.020		
	Total	.943	48			

a. Dependent Variable: social
b. Predictors: (Constant), AMT
Source: SPSS Output

Table 5d: Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.347	.032		10.966	.000
	AMT	6.243E-010	.000	.109	.754	.455

a. Dependent Variable: social
Source: SPSS Output

From Table 5a, the coefficient of correlation (R) is 0.109. It implies that the relationship between advanced manufacturing technology and social disclosures is 10.9%. The coefficient of determination (R-square) is 0.012. This implies that 1.2% of the variation in sustainability reporting is explained by variation in advanced manufacturing technology, the rest is explained by other factors. From table 5d, it can be seen that the coefficient of variable social is 6.243E-010. The probability is 0.455. Since the tabulated t value which is 2.011 is greater than the calculated t value .754 at 5% significance level. The null hypothesis which states that AMT does not have a significant impact on social disclosures among consumer goods companies in Nigeria is accepted while the alternative hypothesis is rejected.

The findings show that AMT has significant effect on economic and environmental disclosures but not on social disclosure of consumer goods companies in Nigeria. This findings agrees with those of Machado et al. (2020), and Machado et al. (2019) who found out that AMT impact on sustainability in manufacturing which reflects in the sustainability reports issued by manufacturing organizations. The findings of Machado et al. (2019) suggests and indirect impact of AMT on social sustainability parameters like workers health and safety which also agrees with this work.

Conclusion and Recommendation

From the analysis above, it can be concluded that there is a relationship between usage of advanced manufacturing technology by organizations and the quality of sustainability reporting. Further analysis shows that of the three aspects of sustainability reporting, environmental disclosure has the highest correlation with AMT, followed by economic disclosures; social disclosures shows the least correlation with AMT. Furthermore, AMT has significant effect on economic and environmental disclosures but not on social disclosure of consumer goods companies in Nigeria.

Based on the conclusion above, it is recommended that urgent attention should be paid to the type of AMT employed by consumer goods companies in Nigeria. There is need to use technology that will ensure the sustainable development of the society. Technologist, engineers, managers and all those involved in the design and use of AMT should study the peculiarities of Nigeria economy, environment and society before adopting the use of any AMT. furthermore, government at all levels should

ensure that policies and incentives in place to provide enabling environment for manufacturing companies. This will encourage investments in AMT which will invariably lead improved manufacturing activity, improved economy and sustainable society. Again, there is an urgent need for an overhaul of the educational system in Nigeria so that graduates are equipped with the relevant skills needed in AMT environment.

Previous works on AMT by other researchers already mentioned in this work have shown that AMT affect sustainability. However, an organization's sustainability efforts are usually communicated to its various stakeholders through sustainability reports. This work contributes to existing knowledge by examining how the use of AMT affect sustainability reports available to stakeholders for decision making in emerging economies like Nigeria. The work only used data from quoted consumer goods manufacturing companies in Nigeria. Further studies could study other sectors of quoted companies to determine the impact of AMT on sustainability reporting in those sectors. Furthermore, it would be imperative to carry out a survey study to obtain more information on the relationship between AMT and sustainability reporting from decision makers.

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