QUANTITATIVE TECHNIQUES AS A PREDICTOR OF MANUFACTURING SECTOR PERFORMANCE IN NIGERIA

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ABSTRACT

This study examined quantitative techniques as a predictor for manufacturing sector performance in Nigeria. Primary method of data collection was used. The population of the study covered staff of Nigeria Breweries (formally Consolidated Breweries, Imagbon, and Better Crown Product Plc, Ijebu-Ode, Ogun State, Nigeria). Only one hundred participants (both contract and permanent staff) of these aforementioned companies were purposively selected for the study. The study used researcher's developed instruments; tagged: 'Impact of Quantitative Techniques on Manufacturing Sector Planning Questionnaire (IQTMSPQ)', 'Impact of Quantitative Techniques on Manufacturing Sector Control of Inputs Factors Questionnaire (IQTMSCIFQ)' and 'Impact of Quantitative Techniques on General Manufacturing Sector Performance Questionnaire (IQTGMSPQ)'. The questionnaire requested responses on a four (4) – point Scale format which is a modification of 5-point Likert Scale. The responses rating scales are as follows: Strongly Agreed (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). Mean was used for presenting the data obtained from the questionnaire administered on each items. Regression analysis was used in testing all the three hypotheses stated for the study. The study showed that quantitative techniques (QTs) and manufacturing sector planning (MSP) are positively related, it also revealed that quantitative techniques (QTs) and manufacturing sector control of inputs factors (MSCIF) are positively related. Finally, the study found that QTs and general manufacturing sector performance in terms of productivity (GMSPP) *are positively related. The study recommended that companies particularly manufacturing company should endeavour to upgrade their knowledge on application of quantitative techniques in their daily operation*.

Keywords: Quantitative Techniques, Manufacturing Sector Performance, Input Factors.

6. Introduction

The success of manufacturing sector depends on several factors in which how to quantify available data for future planning is among and this is what prompt many researchers or companies to seeks the application of quantitative techniques in solving this issue and forecast for the future company output with the view to remain and survive in the competitive environment. Therefore, quantitative techniques may be defined as those techniques which provide systematic and powerful means of analysis, based on quantitative data. It is a scientific method employed for problem solving and decision making by the management. With the help of quantitative techniques, the decision maker is able to explore policies for attaining the predetermined objectives. In short, quantitative techniques are inevitable in decision-making process. In the production of goods and services, manufacturing firms, are faced with the decision problems of how to determine the least cost combination of inputs needed for actual production and, how best to produce, in the right quantity and quality for customers' satisfaction. These in turn, necessitate allocation problems concerning the utilization of limited resources. It is noted that in most industries generally, the thinking or philosophy of the production manager (or any other person acting in that capacity) determines what efforts he puts in the process of production (Anene & Oyelere, 2014).

The issue of quantitative techniques (QTs) applications by firms in their respective industries is related to decision-making. As such, QTs' applications assist managers generally in decision-making. The need for improved general performance (and especially productivity), could rightly be seen as a function of the awareness created for, and the actual, applications of relevant QTs to production planning and control. This specific function is the one out of all others in the entire production management system that is solely saddled with the responsibility of turning out goods or services, in the required quantity and quality and, in the least-cost combination of inputs so as to satisfy customers; this, consequently, brings about increased productivity and profitability as well (Ogbo, Orga & Adibe, 2012). These efforts are made in such a manner to actually handle the raised issues of: how to determine the least cost combination of inputs needed for production; how best to produce in the right quantity and quality for customers'.

Problem Statement

The performance of manufacturing sector in Nigeria has not been impressive to stakeholders in the sector and consequently the contribution of the sector to economic growth of Nigeria has been minimum and this has created worry for decision maker on how best to improve on manufacturing sector performance. Management problems are complex in nature and are essentially resource allocation decisions. The solutions to these problems could be obtained through qualitative approach, quantitative approach as they relate to production planning and control activities in industries. But application of suitable quantitative techniques is more realistic and deterministic. Therefore, based on these aforementioned worries, this study seeks to examine quantitative techniques as a predictor for manufacturing sector performance in Nigeria. Based on this, the following research questions were raised:

i. What is the impact of quantitative techniques on manufacturing sector planning;
ii. Of what impact is a quantitative technique on manufacturing sector control of inputs factors?

iii. Does a quantitative technique impact on general manufacturing sector performance in terms of productivity?

Objectives of the Study

The broad objective of this study is to examine quantitative techniques as a predictor for manufacturing sector performance in Nigeria.

Specifically, the study seeks to examine:

i. the impact of quantitative techniques on manufacturing sector planning;
ii. the impact of quantitative techniques on manufacturing sector control of inputs factors;
iii. the impact of quantitative techniques on general manufacturing sector performance in terms of productivity.

Hypotheses

The following hypotheses are stated in line with the study objectives:

H_{01}: There is no significant impact of quantitative techniques on manufacturing sector planning.

H_{02}: There is no significant impact of quantitative techniques on manufacturing sector control of inputs factors.

H_{03}: There is no significant impact of quantitative techniques on general manufacturing sector performance in terms of productivity.

This study is divided into five sections. Following this section is section two which discusses the concept of quantitative techniques and review of related empirical literature, section three focused on methodology, section four deals with empirical analysis while section five presents the conclusion and recommendations.

7. The Concept of Quantitative Techniques

Quantitative Techniques are about the analysis of quantities (measured in physical, so-called objective data). These techniques are scientific in nature, their objective is to provide procedure and process that will aid or assist problem solving. These techniques being scientific in nature are model (mathematically) - based and therefore, follow very good logical (step by step) order. Consequently, the areas of applications include: Accounting – cash flow planning, credit policies, planning of delinquent accounting system; Construction – allocation of resources to projects, determination of proper crew size, maintenance crew scheduling and project scheduling; Facilities planning – factory size and location, hospital panning, international logistics system; Marketing – advertising allocation, product introduction timing, selection of product mix; distribution channels; Military – general logistics and supply; simulation; trajectory etc; Forecasting – profit, sales volume, market shares, brand switching, production output, etc; among various others too numerous to list here. Furthermore, they are devoid of personal opinions or judgment. Their advantages in applications, therefore, surpass a few disadvantages, especially, when compared with Qualitative techniques. Largely, QTs offer: Systems approach to organizations; recognition of risk and uncertainty (while offering tremendous solution methods to all associated problems no matter how complex); assistance to management decision making and control (Anene & Oyelere, 2014).

Higher degrees of accuracy are attainable with the applications of QTs, as well. Quantitative Technique (QT) is otherwise called Operations Research (OR), Decision Science (DS), Analytical Technique (AT), Quantitative Analysis (QA), among others. The first formal activities of this were initiated in England during the Second World War when a

team of British scientists set out to make decision regarding the best utilization of war materials. At the end of the war, however, the ideas advanced in military operations were adapted to improve efficiency and productivity in the civilian sector (Taha, 2006 and Lucey, 2007).

Since its evolution, QTs have also been developed within the field of management science or adapted from other disciplines such as Natural Sciences, Business Administration, Mathematics, Statistics and, Engineering. Further development is evident in the increasing popularity of management science (quantitative technique) as reflected in the number of Colleges, Polytechnics, and Universities offering undergraduate courses and degree programmes in quantitative techniques (Taha, 2006). From the foregoing, the following are an attempt to define quantitative techniques and further explain what it means, especially, in the management of all organizations, (whether big, medium or small).

Quantitative technique (QT) is the attack of modern science on complex problems arising from, or in the direction and management of large systems of men, machines, materials and money, in industry, business, government and defence, going by the British Standard (Taha, 2006). Lucey (2007) went on to remark that its distinctive approach is to develop a scientific model of the system incorporating measurements of factors like change and risk, with which to predict and compare the outcome of alternative decisions, strategies or controls. Quite convincingly, quantitative technique is concerned with the efficient allocation of scarce resources, being both an art and a science. The art lies in its ability to express, clearly, the ideas in a well defined mathematical model of a given situation, while the science consists of the derivation of computational methods for solving such models (Bronson, 1997). It is important to note that optimal allocation of resources (which quantitative techniques help to achieve) is of utmost importance to decision making in many traditional disciplines including all production concerns.

Quantitative technique is seen as a scientific method of providing executive departments with a quantitative basis for decisions under their control; likewise, it is a scientific approach to problem solving for executive management (Anderson, Sweeney & Williams, 2003). Also, it provides a basis for decision making. As such, if business no matter its nature is to be controlled effectively and efficiently, there is need for established businessmen and those pursuing a career in business, (including their counterparts in manufacturing world), to appreciate quantitative technique as basic, important and necessary tool for decision-making. Further, it was noted that now is the era when managers, necessarily, should be numerate, no matter their background.

The application of quantitative techniques in planning and control activities of production management is therefore vast, especially as they enable managers to understand and predict organization production system. It is pertinent here, to note that these techniques only assist managers in understanding the production system and in taking decisions. These techniques do not take decisions on their own for the production planners; rather they only provide a systematic approach to helping a decision-maker choose a course of action by investigating the problem, searching out objectives and alternatives, and comparing them in the light of their consequences using appropriate framework to bring expert judgment and intuition to bear on the problem (Okoko, 2009).

Therefore, there are different types or categories of quantitative techniques used by manufacturing sector for improved performance in planning and control inputs programme of the company which include:

- Graphical and Charting Techniques,
- Control Charts,
- Linear Programming,
- Forecasting Techniques (like Regression and Time Series Analysis, Markov Chain, Sensitivity Analysis, etc),
- Critical Path Scheduling (CPS) Analysis,
- Programme Evaluation and Review Technique (PERT),
- Inventory Models,
- Dispersion Measures (like Variance and Standard Deviation),
- Capacity Utilization Model,
- Vendor Rating and lastly
- Acceptance Sampling.

However, it is noteworthy that a few of these techniques can actually be applied to both production planning and production control activities. From the foregoing it could be seen that a wide range of quantitative technique (some of which are quite simple in nature) are available for use. Whereas they are actually being used by industries in countries outside Nigeria, their application in particularly to manufacturing sector performance in Nigeria is of concern and main justification for this study.

Review of Related Empirical Literature

Anene & Oyelere (2014) examined the factors that affect applications of Quantitative Techniques (QTs) to production planning and control in selected Nigerian manufacturing industries. Data were collected using questionnaire administered on 160 staff of 20 companies randomly chosen from each of the 8 purposively selected Nigerian Small-Scale Industries. Analysis of data was done descriptively and quantitatively using cross tabulations, percentages and inferential statistical tools respectively. Specifically, student t test was used to test the significance of the number of companies that apply QTs, The results showed that the types of QTs commonly in use include: Graphical and Charting Techniques, Control Charts, Forecasting Techniques (Simple Regression and Time Series Analyses), Inventory Model, Range, Variance and Standard Deviation, Capacity Utilization Model, and Acceptance Sampling. The study concluded that certain QTs are being applied to production planning and control by a significant number of companies from the selected Nigerian small-scale industries.

Anene (2014) examined whether, Qualitative Techniques are applied by the studied companies and the actual number of these companies that apply Qualitative Techniques, as well as factors inhibiting the use of Qualitative Techniques. A wide range of 11 Qualitative Techniques (QTs) tools were found to be applicable to Production Planning and Control with 35(23.2%) of the companies actually applying QTs. factors were also found as inhibiting factors.

Eze & Okpala (2015) examined the quantitative impact of Small and medium scale enterprises (SMEs) on Nigeria's economic growth performance for the sample period 1993 to 2011. The econometric technique adopted for the study was multiple regression method based on ordinary least squares technique. However, in order to avoid the incidence of spurious estimates, evidence from the ADF test conducted revealed that the variables are integrated of order two,1(2). The Johansen test conducted showed evidence of long run equilibrium relationship between small and medium scale enterprises and economic growth. However, in the mean time, output of SMEs (SMEO) does not make any significant contribution to Nigeria's economic growth performance. The study concludes that poor government policies, on tariffs and incentives, bribery and corruption, non-existent entrepreneurial development centers and poor state of infrastructure act as impediments to the growth and development of SMEs in Nigeria.

Anene & Orji (2014) examined the implication of application or non-application of quantitative technique (QTs) in production planning and control (PPC) by these industries. Only 35 companies (23.2%) of the 160 companies surveyed from the selected SSIs actually applied QTs in their PPC activities. Thus, an overwhelming 116 (76.8%) did not apply QTs. Descriptively; result indicates a drop of about 10 points, showing that fewer companies within the industries have experimented with the techniques. Further result from t-statistic test on the data, gave t = 7.948 in absolute terms. This shows that the number of companies from the selected Nigerian small-scale industries that do not apply QTs in their PPC is statistically significant.

8. Methodology

Research Design

Descriptive survey design was adopted. The choice of the survey as the research design for the study was necessitated by the nature of the study, because, the study gathered data from members of the selected population with the aid of the questionnaire.

Population, Sample and Sampling Techniques

The population of the study covered staff of Nigeria Breweries (Formally Consolidated Breweries, Imagbon) and Better Crown Product Plc, Ijebu-Ode, Ogun State, Nigeria. Sample is the subset of the population, for the purpose of the study, one hundred participants (both contract and permanent staff) of these aforementioned companies were purposively selected for the study.

Instrumentation

The study used researcher's developed instrument; tagged: 'Impact of Quantitative Techniques on Manufacturing Sector Planning Questionnaire (IQTMSPQ)', 'Impact of Quantitative Techniques on Manufacturing Sector Control of Inputs Factors Questionnaire (IQTMSCIFQ)' and 'Impact of Quantitative Techniques on General Manufacturing Sector Performance Questionnaire (IQTGMSPQ)'. The questionnaire requested responses on a four (4) – point Scale format which is a modification of 5-point Likert Scale. The responses rating scales are as follows: Strongly Agreed (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). The initial drafts of the instrument were subjected to face validity. In order to ensure the reliability of the instrument, a test-retest study was carried out.. Thus, the test re-test reliability method was used to determine the reliability index. The data that were generated was correlated using Pearson Product Moment Correlation. The outcomes for reliability index for IQTMSPQ, IQTMSCIFQ and

IQTGMSPQ are 0.89, 0.82 and 0.86 respectively. This showed that these instruments are reliable for testing the study hypotheses.

Methods of Data Analysis

Mean was used for presenting the data obtained from the questionnaire administered on each items. The items was scored on a scale of 4, 3, 2, and 1, for SA, A, D, and SD respectively. A mean cut off of 2.50 = (4 + 3 + 2 + 1)/4 was adopted. Thus, an item with mean rated scores of over 2.50 indicates agreement with the statement while less than 2.50 indicates disagreement. Regression analysis was used in testing all the three hypotheses; thus, the null hypotheses developed for the study was tested at .05 level of significance.

9. Empirical Analysis

Data Analysis and Hypotheses Testing

H_{01}: There is no significant impact of quantitative techniques on manufacturing sector planning.

Items	*Mean*
Quantitative techniques enhanced planning of inputs for production.	*3.4*
It provides best combination for scientific way of planning.	*3.3*
Quantitative techniques forecast company future outcomes.	*3.7*
Application of quantitative techniques in your company provides planning policies options.	*3.8*
It helps to compare to past planning outcomes with future outcomes.	*3.6*

The respondents agreed (rated mean responses of 3.4, 3.3, 3.7, 3.8 and 3.6) with all the five items relating to the impact of quantitative techniques on manufacturing sector planning. Thus, this implies that there is significant impact of quantitative techniques on manufacturing sector planning. Regression was carried out to examine the separate impact of quantitative techniques (QTs) on manufacturing sector planning (MSP). That is,

Model 1:

$MSP = a_0 + a_1QTs + U$……..…….....*(i)*

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.518	.083		6.234	.000
	QTs	.649	.041	.846	15.682	.000

a. Dependent Variable: MSP

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	43.647	1	43.647	245.921	.000[a]
	Residual	17.393	99	.177		
	Total	61.040	100			

a. Predictors: (Constant), QTs

b. Dependent Variable: MSP

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.846[a]	.715	.712	.42129

a. Predictors: (Constant), QTs

From the above regression results of separate impact of quantitative techniques (QTs) on manufacturing sector planning (MSP), the result showed that quantitative techniques (QTs) and manufacturing sector planning (MSP) are positively related. Hence, this direct relationship is statistically significant at 5% level of significance using t-test and standard error for decision making. R-squared measures the goodness of fit of model. In the analysis, the R-squared is 72% which is a good measure of fit which shows that quantitative techniques (QTs) account for about 72% systematic variation in the dependent variable (manufacturing sector planning (MSP) whereas the remaining 28% (U = stochastic terms) are other factors which affects manufacturing sector planning (MSP), but not captured in the above model.

H_{02}: There is no significant impact of quantitative techniques on manufacturing sector control of inputs factors.

Items	Mean
Quantitative techniques predict best combination of company inputs.	2.9
Application of quantitative techniques allows company to effectively control inputs factors.	2.8
It reduces inputs costs implication from its predictive nature.	2.5
Application of quantitative techniques helps to mar objectives with available inputs materials.	3.3
Application of quantitative techniques provides inputs efficiency for productivity.	3.2

The respondents agreed (rated mean responses of 2.9, 2.8, 2.5, 3.3 and 3.2) with all the five items relating to the impact of quantitative techniques on manufacturing sector control of inputs factors. This revealed that there is significant impact of quantitative

techniques on manufacturing sector control of inputs factors. Furthermore, regression was carried out to examine the separate impact of quantitative techniques (QTs) on manufacturing sector control of inputs factors (MSCIF). For instance,

Model 2:

$MSCIF = a_0 + a_1QTs + U$……..……..(ii)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.218	.071		5.576	.000
	QTs	.427	.022	.534	13.921	.000

a. Dependent Variable: MSCIF

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	35.276	1	38.332	210.382	.000[a]
	Residual	15.721	99	.164		
	Total	50.997	100			

a. Predictors: (Constant), QTs

b. Dependent Variable: MSCIF

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.885[a]	.772	.763	.40328

a. Predictors: (Constant), QTs

Furthermore, the above regression results of impact of quantitative techniques (QTs) on manufacturing sector control of inputs factors (MSCIF), the result revealed that quantitative techniques (QTs) and manufacturing sector control of inputs factors (MSCIF) are positively related. Therefore, this direct relationship is statistically significant at 5% level of significance using t-test and standard error for decision making. In the analysis, the R-squared is 77% which is a good measure of fit which depicted that quantitative techniques (QTs) account for about 77% systematic variation in the dependent variable manufacturing sector control of inputs factors (MSCIF), whereas the remaining 23% (U = stochastic terms) are other factors which affects manufacturing sector control of inputs factors, but not captured in the above model.

H_{03}: There is no significant impact of quantitative techniques on general manufacturing sector performance in terms of productivity.

Items	Mean
Application of quantitative techniques improved your company productivity.	3.1
Quantitative techniques provide procedure that assist problem solving.	3.2
Quantitative techniques promote effectiveness in cash flow planning for productivity.	3.2
It enhanced effectiveness in allocation of resources to projects.	3.3
It determines project scheduling for improves company productivity.	3.1

Thus, the respondents agreed (rated mean responses of 3.1, 3.2, 3.2, 3.3 and 3.1 respectively) with all the five statements relating to the impact of quantitative techniques on general manufacturing sector performance in terms of productivity. This implies that there is significant impact of quantitative techniques on general manufacturing sector performance in terms of productivity. Regression was carried out to examine the separate effect of impact of quantitative techniques (QTs) on general manufacturing sector performance in terms of productivity (GMSPP). That is,

Model 3:

$GMSPP = a_0 + a_1QTs + U$……..*(iii)*

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.321	.051		5.314	.000
	QTs	.634	.039	.774	13.357	.000

a. Dependent Variable: GMSPP

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	36.437	1	38.583	189.288	.001[a]
	Residual	14.215	99	.139		
	Total	50.652	100			

a. Predictors: (Constant), QTs

b. Dependent Variable: GMSPP

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.775[a]	.702	.693	.28658

a. Predictors: (Constant), QTs

Finally, the above regression result of impact of quantitative techniques on general manufacturing sector performance in terms of productivity, a_1 is 0.634 and is the parameter estimate for QTs. The result further revealed that QTs and GMSPP are positively related. Hence, this direct relationship is statistically significant at 5% level of significance using t-test and standard error for decision making. R-squared measures the goodness of fit of model. In the analysis, the R-squared is 70% which is a good measure of fit which shows that QTs accounts for about 70% systematic variation in the dependent variable (GMSPP) whereas the remaining 30% (U = stochastic terms) are other factors which affects GMSPP, but not captured in the above model.

10. Conclusion and Recommendation

This study have examined quantitative techniques as a predictor for manufacturing sector performance in Nigeria using staff of Nigeria Breweries (Formally Consolidated Breweries, Imagbon) and Better Crown Product Plc, Ijebu-Ode, Ogun State, Nigeria. The study used researcher's developed instrument; tagged: 'Impact of Quantitative Techniques on Manufacturing Sector Planning Questionnaire (IQTMSPQ)', 'Impact of Quantitative Techniques on Manufacturing Sector Control of Inputs Factors Questionnaire (IQTMSCIFQ)' and 'Impact of Quantitative Techniques on General Manufacturing Sector Performance Questionnaire (IQTGMSPQ)'. Mean was used for presenting the data obtained from the questionnaire administered on each items. Regression analysis was used in testing all the three hypotheses; thus, the null hypotheses developed for the study was tested at .05 level of significance. Thus, based on the study findings, it was concluded that there is significant impact of quantitative techniques on manufacturing sector planning, control of inputs factors and general performance in terms of productivity. The study recommended that companies particularly manufacturing company should endeavour to upgrade their knowledge on application of quantitative techniques in their daily operation.

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