

AN ASSESSMENT OF QUALITY CONTROL TECHNIQUES ON PROCESS DESIGNING IN SELECTED MANUFACTURING FIRMS IN SOUTH EAST, NIGERIA

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Abstract

The study interrogated the link between an assessment of quality control techniques on process designing in selected manufacturing firms in South East, Nigeria. In all, 554 structured questionnaire were administered to staff of different ranks in the selected firms. The data collected with the questionnaire were analysed using Statistical Package for Social Scientist (SPSS) version 20. Two hypotheses were postulated and tested using Pearson Product Moment Correlation statistic. The result of the study revealed that follow-up techniques has a significant positive effect on production control. The study also found that there is a significant positive relationship between product ordering technique and needed resource output. It was therefore recommended that follow-up technique should be highly observed for best practice in global manufacturing and product ordering technique along with needed resource output should be strictly observed in practice.

Keywords: Follow-up technique, production control, product ordering technique, needed resource output.

Introduction

Quality Control (QC) is a systematic approach used by companies to monitor and maintain product quality at every stage of production. Quality Control (QC) is also the process businesses use to ensure products or services meet pre-defined standard and customer expectations. It involves inspecting, testing and monitoring outputs throughout production to identify defects and prevent subpar goods from reaching the market and it is the step in quality management that focuses on testing products and services to ensure that quality is maintained. Quality control consists of inspection measurement and testing to verify that the project outputs meet acceptance criteria defined during quality planning. It is focused on preventing problems being passed on to the internal and external customer.

Every business firm justifies its existence by producing something of value. Quality is the fitness for purpose or the degree of conformance of the outputs of a process or the process

itself to requirements. Hayes (2026) noted that quality control is a process through which a business seeks to ensure that product quality is maintained or improved.

Quality has been an important part of human activities since the emergence of human history. Before now, manufacturing was essentially conducted by the cottage industry and heavily relied on craftsman. The manufacturers were merely in seller's market. However, the trend has changed from seller's market to the buyer's market. The consumers have become more aware of the variety of products in the market. Thus, customers are the focus of manufacturing such that every organisation has to study what customers' needs are and satisfy them in order to remain in business by offering products of desired quality.

Although several reasons have been accountable for substandard products in manufacturing sector, Arora (2009) noted that quality of good is determined by customers. Customers become a key factor that can create competition among organisations and this makes firms to focus more on quality. This is due to effective quality which determines the rate of productivity and thus becomes an important factor in organization and also contributes to the growth of the economy. The usage of poor basic materials for production process has given way to the existence of sub-standard products in Nigerian industry, making the product not to measure up to the standard of specification as expected. This has resulted in productivity of organizations dropping because of customers' inability to buy such bad products. Where the company fails to measure up and the product identified, such product are usually confiscated or destroyed and such company may be closed down by the regulatory agencies pending when issues are resolved. So, instead of the companies making profit, huge amount of loss is incurred as a result. Some producers produce sub-standard varieties of products, different from the ones they presented for certification to regulatory agencies.

Demirbag (2006) notes that quality control and improvement is one of the most important factors in every organization. Successful enterprise understand the dominant influence customer defined quality can have on business. Hence, many competitive companies constantly enhance their quality standard by introducing total quality control departments in their organizations whose policies are aimed at satisfying customer by giving them standard quality products, excellent services and timely delivery. They go further to explain the need for organizational development by training staff for such responsibilities. Taking a historical perspective, organizations who are highly committed to the implementation of quality control usually maintain quality standard in production which in turn provides a direction to the business.

Heizer and Render (1990) noted that all firms employ the concept of quality control. Quality Control (QC) is important not just in the production or transformation process, but earlier at the design stage and later at the service stage as well. One of the major roles of the operations manager is to make sure his or her firm can deliver a quality product to the right place at the right time, at the right price.

According to Cole (2004:36), in a market-oriented organization, production begins with the customer in the market-place. An idea for a new product is generated or assessed in marketing terms, by the market research section. If the idea seems viable, it will be turned over to the research and development section where any necessary research design and development work can be carried out. The next stage forward is for early prototype to be produced. If the prototype is satisfactory, then the pre-production stage can commence. This stage according to Cole, aims to simulate as far as possible, the actual conditions on the production line. Thus, at this stage, the customer's needs as being set against the cost of materials and labour, the manufacturing capacity of the production department, and issue such as quality level. In the case of firm manufacturing industrial goods; it is likely that at this stage if not earlier, sample of the new product will be sent to the customer for testing and approval.

Quality Control (QC) is a system that ensure that manufactured products are produced and maintained to a high standard and requires companies to create an environment where management and employees strive for perfection. Quality control is a reactive process that focuses on identifying and resolving issues that arise in the final product after it has reached consumers. Quality Assurance (QA) is a set of activity and procedures also known as a quality standards that take place during and after product development. Quality assurance (QA) helps ensure quality requirements are met.

Quality Control (QC) focuses on monitoring results after a product is developed and produced. That means checking product development tor project outcomes to meet the previously defined quality standard. Quality control activities are geared towards responding to problems and detecting errors or product quality issues such as software defect glitches or imperfections. The quality control process is a systematic approach that helps ensure service or product quality is maintained after it reaches the market (Nnadi, 2018).

Statement of the Problem

Nigerian manufacturing firms are expected to produce high quality product that can compete globally. Focusing on manufacturing firms in South East Nigeria precisely, in respect of the above, the manufacturing firms are required to pursue maximization of opportunity. There

should also have a global outlook in their special field of product quality to enable the embracing of international best practice and also engage in outsourcing. Most Nigerian manufacturers are dependent entrepreneurs who rely heavily on government support. They are not creative. They have no global skill in practice, unfortunately this negative trend has resulted in domestic scale of business and loss of customers arising from global competition. Most of our manufacturers are not entrepreneur as they lack basic managerial skill. They really apply international best practice and lack the capacity for outsourcing or even follow-up opportunities open to them. They hardly engage in collective risk or pursue maximization of opportunities.

Harsh operating environment of business in South East Nigeria arising from perennial electricity shortage, political instability, insecurity, dearth of infrastructure, high foreign exchange rate and increase in the cost of production and standard of living.

Quality Control (QC) techniques and effective process designing require manufacturers to improve on their performance in the realisation of goals and objectives. There is no indication that they are sufficiently and properly applied in manufacturing organization in South East, Nigeria.

Objectives of the Study

The objectives of the research are as follows;

- 1 To assess the effect of follow-up technique on production control.
- 2 To ascertain relationship between product ordering technique and needed resource output.

Research Questions

- 1 Does the application of follow-up technique have effect on production control?
- 2 What is the extent of the product ordering technique and needed resource output?

Research Hypotheses

1. Follow-up technique has a significant positive effect on production control.
2. There is a significant positive relationship between product ordering technique and needed resource output.

Literature Review

In the physical world of production, numerous control systems are in operation. The main example is that of quality control. The control of quality rests on the assumption that in mass-production no two units are exactly identical, but that it is possible to mass produce vast

quantities of almost identical units. These last mentioned can be produced within certain tolerances, and a customer will accept variations between these tolerances, but not outside them. The role of quality control is to ensure that appropriate standards of quality are set and that variances beyond the tolerances are rejected. Thus, quality control is basically a system for setting quality standard, measuring performance against those standards and taking appropriate action to deal with deviation outside permitted tolerances. Quality control activities can be very costly, and since they represent an overhead cost in the production area. The degree of time and resources spent on them must be related to factors such as price, consistency, safety and legal requirements. For example, products such as highly priced porcelain will be subject to far higher quality control than run of the mill household earthenware. Pharmaceutical products are subject to health controls, backed by legislation and thus requires the highest standards of quality (Nnadi, 2018).

Quality Control as a Production Management Technique in Manufacturing Organization

Ricardo and Wade (2001) argue that the role of quality control is primarily concerned with eliminating from production line those products that do not conform to specification and to inspect and test finished goods to get rid of defective ones. To achieve this, every phase of product lifecycle has to be thoroughly examined. They noted that product quality control could be improved by undertaking the following activities:

- i. Product planning
 - ii. Product designing
 - iii. Process designing
 - iv. Production
 - v. After sales services
- i. **Product planning** entails deciding in advance organisations objectives regarding its product and what members ought to do to attain these objectives.
 - ii. **Product design** is a framework of the product in place.
 - iii. **Process design** is spelling out the stages at which production would take place.
 - iv. **During production**, outputs are checked against standard to ensure conformity.
 - v. **After product has been sold to vendors**, firms in a bid to preserve the quality of such products also provide after sales services like delivery.

These activities embrace all the technical and management aspects of product quality and safety during the specification development/ manufacturing and usage of the product (Ricardo and Wade, 2001).

Types of Quality Control

Nnadi (2018) notes that quality control be carried out in process or on finished goods;

- i. **In-Process Quality Control:** This control measure is undertaken while producing the product. It ensures timely identification of defective product and prevents further production of defective. In-process quality control (IPQC) is the monitoring and testing of products and manufacturing parameters while production is actively taking place. (IPQC) a rather waiting for a finished product. It catches defects in real-time to prevent waste, correct process drift and ensure safety. IPQC is widely utilized across various manufacturing sectors, example, pharmaceuticals, electronics and food to maintain compliance and uniform output.
- ii. **Finished Good Inventory:** Here, quality check is performed after all operations have been performed. The aim is to prevent defective products from getting to the users of such products. It is also a critical part of managing any manufacturing business. Finished goods are products that have completed the manufacturing process, are fully assembled and packaged, and are ready to be sold to customers, but have not yet left the manufacturing inventory.

The Benefits of Quality Control (Cole, 2002) pointed out the following;

- i. Reduction in costs of scrap or re-working
- ii. Reduction in complaints from customers
- iii. Enhanced reputation for company's products
- iv. Feedback to designers and engineering staff about performance of products and the machines required to produce them.

Importance of Quality Control

- i. Quality Control is important because it identifies and corrects problems and defects as they occur to make sure that the final product is the highest quality possible.
- ii. Quality Control can involve software testing and beta or canary testing, which provide lessons applicable to future projects and products.
- iii. A proper quality control process leads to happier customer who have more incentive to be loyal to the company.
- iv. Without quality control, the organization cannot be sure that the product works as intended and suits the customer needs.

Empirical studies show that superior business results are usually associated with sound quality control techniques as a business strategy to implement product quality.

Deming (1982) pointed out that improved quality can reduce overall costs, dispelling the popular belief that high quality means higher total cost for the organization. He balances his view by stating that with fewer parts reworked, fewer materials will be wasted and leading to actual cost decline.

Employee involvement: In general, involvement of line and shop floor workers is fundamental to TQM and quality at the source (Gimenez, 2000). For this reason, companies should:

- i. Give ownership of quality to the workers, elicit and listen to workers ideas about improvement and empower them to make more decision and perform tasks that are quality related.
- ii. Organize workers for greater gross functionality and greater customer consciousness.
- iii. Train and educate workers in quality related skills and about importance of TQM to company competitiveness to their own advancement, prospects and to job security.

Employee Ownership of Quality: Quality is not something that management can mandate or dictate (Arere, 1995). To gain employee commitment to the quality process, companies must modify their systems of management control and rewards to give employee greater responsibility and opportunity to become customer and quality oriented and motivate them to strive for continuous improvement. Many companies tell employees that quality comes first then send a mixed message by paying them on a quota basis and pressing them to get the product out the door. Furthermore, adversarial relationship between management and labour will prevent workers from taking a quality oriented programme seriously and will eventually kill the programme (Daft, 2000). In many cases, managers' attitudes about labour and about the way they supervise workers will have to change, too. Specifically, middle and low level managers and supervisors must relinquish control, give workers more responsibility for running their own jobs and provide them with opportunity to use their own judgment to solve problems. One sure sign that workers on the shop floor are being afforded greater ownership of quality initiatives is an abundance of charts on the shop floor created and updated by workers to reflect their own plans and control activities.

Organisation for Quality: Workers in TQM organizations must be process oriented and customer conscious (Daft, 2000). To that end, companies restructure jobs to put workers in contact with whoever their customers and suppliers are whether internal or external to the company. As a result, probably, the most pervasive organizational feature about TQM organization is the prevalence of teams (Nicholas 1998: 120-121).

Factors that Affect Quality

Nnadi (2020) note that quality depends on a number of factors and an integrate quality control system must focus on these factors. The factors outlined as follows:

- i. **Policy:** Management establishes policies concerning product quality. These policies specify the standard or levels of quality to be achieved in a product or services. They can be an important pre-control and concurrent control means for ensuring quality. Dubiety et al (1998:487) note that management considers three factors in determining its policy for quality: the product or services market, its competition and image. An evaluation of the market product, an indication that customers are willing to pay for the product or services. Quality expatiations and price for example widely differ in the luxurycar (Mercedes) and economy car (Golf) markets within the auto industry. Quality levels provided by the competitors also affect policy because the competitive company product or service must be competitive to succeed in the market place. Also, one must consider the market and competitive management and the organization image. Long-term interest may be damaged by making a product of quality inconsistent with the firm's image.
- ii. **Information:** Information plays a vital role in setting policy and ensuring that quality standards are achieved. Concerning policy, accurate information must be obtained about customer preference and expectation and about competitor quality standard and costs. Competitive be heading is one effective approach to obtaining valuable information about a competitors quality standard and costs. Also, new computer technology is enabling organization to obtain quality information and evaluate information about the quality of products while they are being produced.
- iii. **Engineering and Design:** Once management has formulated a policy concerning quality, it is taken to the designer who must translate the policy into the desired product, or the designer must create a product that will appeal to customers and that can be produced at a reasonable cost and provide competitive quality.
- iv. **Materials:** A growing number of organizations have realized that a finished product is only as good as the materials used to produce it. In this regard, many manufacturing companies are implementing a new pre-control strategy with material suppliers. They are reducing their number of suppliers, weeding out the lower quality vendors and focusing on developing effective long-term relationship with the better ones. Ford general motors and Chrysler use this approach.
- v. **Equipment:** The ability of equipment tools and machinery to accurately and reliably produce desired output is important especially in manufacturing industries. If the equipment can meet acceptable tolerances at competitive costs and quality an organization will have opportunity to compete in the market place.

- vi. **People:** Materials design and equipment are important ingredient in quality products but people are the vital contributors. Working individually or in teams, employees take the ingredients and process them into the final product or service. Managers must therefore not only provide the proper training to produce quality but also enable people to develop attitude that value quality.
- vii. **Field Support:** Often the field support provided by the supplier determines a products quality image “perceived quality.” This is not to say that the products of these firms are necessarily the best in their industries, an excellent field support reputation, however, can have a positive impact on a product quality image.

Methodology

The method used in the study is the quantitative research design because it aims at using both qualitative data by the results to understand a research problem. The data for this study were obtained majorly from primary source of data. The primary data used for analysis in this study were collected through the use of structured questionnaire.

Population of the Study

The population targeted for this study comprised all registered manufacturing organization in the South Eastern Nigeria. Record from Gold Star Directories (2008) for the major 5000 companies in Nigeria shows that manufacturing companies in South Eastern Nigeria with complete data of employees, location, and year of incorporation are thirty nine (39) while their numerical strength is nine thousand, two hundred and eight five (9,285) personnel. The distribution of these companies according to state, total manufacturing firms per state, and numerical staff strength per state respectively.

Sample Size Determination

The total firm’s population size of 39; hence, it becomes the firm’s sample size as well. However, the overall staff population of 9,285 employees is much and will be difficult to manage considering the fact that each of the employees must be accessed individually. Hence, a total sample size of five hundred and sixty four (564) staff used for the research, using the Z-test statistics (2004) formular which was deemed appropriate for the study. They constitute the actual number of staff that were issued questionnaire.

Method of Data Analysis

Data presented in tables and statistical tools for data analysis correlation, chi-square and Z-test. The contingency analysis is the test of independence and the chi-square distribution was used. The test of independence used to test the null hypothesis that there is no relationship between

the attributes in the vertical and horizontal cross tabulation as against the alternative hypothesis that is otherwise at a select level of significance. A contingency table is constructed to enable the researcher carryout easy computation of the test data using the chi-square distribution test (X^2). Test statistics are as follows: $2X^2$ test of a contingency table 2

$$X^2 (R-1) (C-1) \quad X^2 = \sum \left(\frac{F_o - F_t}{F_t} \right)^2$$

F_o = Observed frequency

F_t = Expected frequency

R_1 = Number of rows in the contingent table

C_1 = Number of columns in the contingent table

Σ = Summation

Data Analysis and Results

Table 1: Distribution of Selected Firms' Personnel by Designation

		Frequency	Percent	Valid Percent	Cumulative Percent	Bootstrap for Percent ^a			
						Bias	Std. Error	95% Confidence Interval	
								Lower	Upper
Valid	Supervisor	150	27.1	27.1	21.1	-27.1	.0	.0	.0
	Unit Head	120							
	HOD	74	21.7	21.7	48.7	-21.7	.0	.0	.0
		60							
	Clerical staff	60	13.4	13.4	62.1	-13.4	.0	.0	.0
	Deputy	45							
	Director	45	10.8	10.8	72.9	-10.8	.0	.0	.0
			10.8	10.8	83.8	-10.8	.0	.0	.0
	Director	554	8.1	8.1	91.9	-8.1	.0	.0	.0
	Executive officer		8.1	8.1	100.0	-8.1	.0	.0	.0
	Total		100.0	100.0		.0	.0	100.0	100.0

Source: Field Survey (2026); Unless otherwise noted, bootstrap results are based on 554 bootstrap samples.

Designation of selected firms' personnel is documented in table 1. The table confirms that virtually all levels of staff were sampled starting from clerical staff to directors. However, the lower level staff were few in number than the higher level employees. For instance, approximately 19% of the respondents fell within clerical and executive officers' position while the remaining 81% were supervisors, unit head, HOD, Deputy Directors, and Directors.

Table 2: Distribution of Selected Firms' Personnel by Staff Category

	Frequency	Percent	Valid Percent	Cumulative Percent	Bootstrap for Percent ^a				
					Bias	Std. Error	95% Confidence Interval		
							Lower	Upper	
Junior Staff	105	19.0	19.0	19.0	.0	1.6	15.7	22.4	
Valid Senior Staff	449	81.0	81.0	100.0	.0	1.6	77.6	84.3	
Total	554	100.0	100.0		.0	.0	100.0	100.0	

Source: Field Survey (2026); Unless otherwise noted, bootstrap results are based on 554 bootstrap samples.

The staff category is document in table 2. A look at this table shows that approximately 81% of staff studied was senior staff while the remaining 19% were junior staff. However, the researcher ensured that any junior staff must have been with the company for a minimum of five years and with a minimum qualification of first school leaving certificate.

Table 3: Descriptive Summary Statistics of the Major Questionnaire Items

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis		
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Q ₁	554	1	5	2.70	1.249	.187	.104	-1.320	.207
Q ₂	554	1	5	2.60	1.164	.299	.104	-1.302	.207
Q ₃	554	1	5	2.73	1.124	.271	.104	-1.234	.207

Q ₄	554	1	5	2.58	1.162	.314	.104	-1.283	.207
Q ₅	554	1	5	1.65	.593	1.136	.104	5.235	.207
Q ₆	554	1	5	1.65	.618	1.036	.104	3.493	.207
Q ₇	554	1	5	1.62	.634	1.374	.104	4.936	.207
Q ₈	554	1	5	1.51	.634	1.703	.104	6.119	.207

The descriptive outcomes in table 3 have major revelations. In a nutshell, they were high rate of disagreements to questions one to twelve designed to achieve the objectives of the study. The mean response rate for these set of questions were all below 3 points. But for questions thirteen to twenty designed to achieve objectives one and two, all but question seventeen were above 3 point agreement.

Hypothesis One

H₀: Follow-up technique has a significant positive effect on production control.

Table 4: Analysis of Variance (ANOVA) Statistic for Hypothesis One

			Sum of Square	df	Mean Square	F	Sig.
Between Groups	(Combined)		715.329	4	178.832	2879.061	.000
Ord Planning Tech	Linear	Unweighted	390.899	1	390.899	6293.180	.000
(OPT)	Term	Weighted	683.543	1	683.543	11004.526	.000
Within	Deviation		31.785	3	10.595	170.573	.000
Groups			34.101	549	.062		
Total			749.101	553			
Between Groups	(Combined)		649.521	4	162.380	1827.703	.000
Ord Org. Planning	Linear	Unweighted	376.904	1	376.904	4242.317	.000
Tech (OOT)	Term	Weighted	639.484	1	639.484	7179.843	.000

Within	Deviation	10.037	3	3.346	37.656	.000	
Groups		48.775	549	.089			
Total		698.296	553				
OrdCntrlBetween	(Combined)	708.934	4	177.234	2589.294	.000	
Groups Technique	Linear	Unweighted	390.669	1	390.669	5707.478	.000
(OCT)	Term	Weighted	676.762	1	676.762	9887.153	.000
Within	Deviation	32.172	3	10.724	156.674	.000	
Groups		37.578	549	.068			
Total		746.513	553				

Source: IBM SPSS Processed (2026)**. Correlation is significant at the 0.05 level (2-tailed)

Decision Rule

Analysis of Variance (ANOVA) compares deviations between variables from statistical significance viewpoint by looking at the goodness of fit from the F-statistic. The decision rule is to reject the null hypothesis of no difference between the groups if computed F-statistic ($F_{(c-1)(n-1)} = S_B^2/S_W^2$) is greater than tabulated F-statistic ($F_{t(c-1)(n-1)}$). The tabulated F-statistic for hypothesis three at four degree of freedom and 95% confidence level is 7.81. This value is less than the computed F-values of 170.57, 37.65 and 156.67 respectively for three identified production management techniques of planning, organizing and control. Hence, H_0 was therefore rejected in the three cases. The researcher thus concludes that, follow-up technique has a significant positive effect on production control.

Hypothesis Two

H_0 : There is a significant positive relationship between product ordering technique and needed resource output.

Table 6: Pearson Product Moment Correlation Statistic for Hypothesis Two

	Management Planning Technique (MPT)	Management Organizing Technique (MOT)	Management Directing Technique (MDT)	Management Controlling Technique (MCT)
Pearson Correlation	1	.954**	.929**	.822**

Sig. (2-tailed)		.000	.000	.000
Planning Technique (PT) Sum of Squares and Cross- Products	194.363	193.419	193.083	170.964
Covariance	.351	.350	.349	.309
N	554	554	554	554
Pearson Correlation	.954**	1	.942**	.837**
Sig. (2-tailed)	.000		.000	.000
Organizing Technique (OT) Sum of Squares and Cross- Products	193.419	211.458	204.220	181.426
Covariance	.350	.382	.369	.328
N	554	554	554	554
Pearson Correlation	.929**	.942**	1	.875**
Sig. (2-tailed)	.000	.000		.000
Directing Technique (DT) Sum of Squares and Cross- Products	193.083	204.220	222.397	194.653
Covariance	.349	.369	.402	.352
N	554	554	554	554
Pearson Correlation	.822**	.837**	.875**	1
Sig. (2-tailed)	.000	.000	.000	
Control Technique (CT) Sum of Squares and Cross- Products	170.964	181.426	194.653	222.412
Covariance	.309	.328	.352	.402
N	554	554	554	554

Source: IBM SPSS Processed (2026)**. Correlation is significant at the 0.05 level (2-tailed)

Summary of Findings

The finding show that follow-up technique has a significant positive effect on product control on planning, organising and control to be positively high as follow-up on production control

and planning technique is 170.57, production control and organising technique is .37.65, production control and control technique is 156.67. The study findings also that there is a significant positive relationship between product ordering technique and needed resource output on planning, organising, controlling and directing technique 0.95.

Discussion of Results

The result of the hypotheses showed that:

- i. Follow-up technique has a significant positive effect on production control.
- ii. There is a significant positive relationship between product ordering technique and needed resource output.

Recommendations

Based on the findings of the study, the following recommendations among others were made: i. Follow-up technique should be highly observed for best practice in global manufacturing.

- iii. Product ordering technique along with needed resources output should be strictly observed in practice.

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