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**TEAR DOWN ANALYSIS TECHNIQUE IN SMALL AND
MEDIUM SCALE ENTERPRISES (SMES) IN LAGOS
INDUSTRIAL METROPOLIS**

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ABSTRACT

The paper assessed the relationship that existed between tear down analysis technique and product quality and product cost of small and medium scale enterprises in Lagos Industrial Metropolis. Questionnaires were administered on this survey and data analyzed using the Analysis of Variance and Regression. Results showed that there was a positive and moderate relationship between tear down analysis technique and product quality. However, there was an inverse (negative) relationship between tear down analysis and product cost. The study concluded that the tear down analysis technique was an efficient tool for enhancing product quality and also for effective product cost reduction of the product

Keywords: *product quality, product cost; tear down technique; product functionality.*

INTRODUCTION

Tear down analysis technique has been perceived as a significant tool for increasing competitiveness since the early 1990 (Ellram, 2006). The awareness of the forth coming market changes have made manufacturers able to take advantage of tear down analysis techniques as a proactive cost and product management strategy to maintain and become market leaders. It is, therefore, an important tool to sustain manufacturers' overall efforts to remain cost competitive while meeting standards and specifications demanded by customers (Ellram, 2000).

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Tear down analysis technique in small and medium scale enterprises...

Olabisi Jayeola ; John A. Enahoro & Akinyomi Oladele John

Unlike the traditional costing method, tear down analysis obtains information from the market to determine product quality and price desired by the consumers. In addition to price information, it uses secret information gathered from competitors and consumers to produce goods and services for the market. Akao (1991) asserts that companies acquire competitors' products and disassemble them to investigate their design, material, manufacturing processes, product quality and attributes, and product costs. Through this process, these companies get to understand their competitors' products, how they differ from theirs, and what it costs to produce them.

Cost management techniques seek to anticipate costs before they are incurred, continue to improve product and process designs, and externally focus on customer requirements and competitive threats (IMA, 1998). As a proactive cost management tool, it requires continuous market research where price considerations and trend changes are closely monitored in order to understand the perceived quality and functionality of target customers as well as the price consumers are willing to pay for demand features. Tear down analysis maintains market share and profitability through its continuous and dynamic nature collecting information from competitors in the market.

In order to achieve the objective of this study, following the introduction section is Section 2 that deals with the review of related literature, while Section 3 is concerned with methodological issues. Section 4 presented the data and results of analysis using regression analysis while Section 5 draws the study's conclusions and recommendations.

STATEMENT OF THE PROBLEM

Zengin and Ada (2010) affirmed that customers of today benefit from higher quality products in the market at lower prices. Hibbets, Albright and Funk (2003) posit that most visible consequence of market driven production and operations in developed economies is the appropriate application and implementation of techniques such as the tear down analysis technique. Zengin and Ada (2010) added that the adoption of this technique in such economies has brought about incremental and monumental alterations in the global market. The traditional cost-plus-pricing strategy has hindered creativity and profitability for a

Tear down analysis technique in small and medium scale enterprises...

Olabisi Jayeola ; John A. Enahoro & Akinyomi Oladele John

considerable period (Gagre and Discenza, 1995). Modarress, Ansari and Lockwood (2005) argued that standard costing techniques do not sufficiently consider the importance of quality and functionality of product, which are the desires of today's customers. Zengin and Ada (2010) opined that cost minimization or cost reduction is not a sufficient strategy to obtain competitive advantage without the support of other market considerations like obtaining market information about the competitors' product. Ibusuki and Kamiriski (2007) pointed out that there is a need for companies to create higher value in their products while lowering costs. Since price is market driven while quantity and functionality are customer driven, the most suitable operation strategy for manufacturers should be designed around balancing cost, quality and functionality which is defined as the survival tripod (Cooper and Slagmulder 2000). Thus, the inconclusive and inconsistent results of the previous studies on the tear down analysis technique by SMEs in Nigeria call for further investigation. This would assist in enhancing customers' satisfaction with product quality and functionality while minimizing costs of operations.

Therefore, this study seeks to evaluate the relationship that exists among tear-down analysis techniques and product cost and quality of small and medium scale enterprises in Lagos Industrial Metropolis, Nigeria.

LITERATURE REVIEW

Tear down analysis (Collecting secret information about competitors' product)

Tear down analysis as defined in IMA's report (1998) is an integrative approach to product design, development and continuous improvement that involves active and continuing participation of individuals from different departments of the organization. Zengin and Ada (2010) concluded that tear down analysis is not only a cost management technique, but also a strategic management tool involving other valuable managerial tools and techniques such as Kaizen costing, target costing technique and value engineering. They are treated as multi-functional team work bringing customers, engineers, designers, accountants and sales people together. To effectively implement cost management techniques such as tear down analysis, the Quality Function Deployment (QFD) requires active team work and support from each

Tear down analysis technique in small and medium scale enterprises...

Olabisi Jayeola ; John A. Enahoro & Akinyomi Oladele John

member of the organization. It is best implemented by a team that aims to develop the right level of quality and functionality with proper pricing (Cooper and Chew, 1996). Fuld (1985) confirmed that out of the tools that companies such as Xerox, Caterpillar, and the U.S. automobile companies now extensively use, is reverse engineering or teardown analysis. Akao (1991) asserts that these companies acquire competitors' products and disassemble them to investigate their design, material, likely manufacturing processes, product quality and attributes, and product costs. In this way, these companies understand their competitors' products, how they differ from theirs and at what cost to produce them. Some organisations have engaged in reverse engineering however, there are differences in degree to which it is being adopted and the resources that are committed to the process (Brimson 1991). Leading edge companies such as Chrysler have built significant teardown facilities, committed sizable resources, and use the results of the analysis across the full spectrum of concept, design, procurement, process engineering, manufacturing, and post-sales activity. Rather than be a tangential exercise, which may or may not be used, in leading-edge companies reverse engineering has become central to a full understanding of the competitors' product and service offerings (Brimson, 1991). Small and medium scale enterprises can adopt tear down analysis or reverse engineering to examine competitors' product so as to identify opportunities for product improvement. Cooper and Slamulder (2004) opined that the competitor's product is dismantled to identify its functionality and design and to provide insights into the processes that are used and the cost to make the product. The aim is to benchmark provisional product designs with the design of competitors and to incorporate any observed relative advantages of the competitor's approach to product design (Chase, Aquilano and Jacobs, 2004).

PRODUCT COST AND QUALITY

Product quality is an important issue (Howard, 2007). According to transcend view, quality is synonymous with innate excellence and it is both an absolute and universally recognizable mark of uncompromising standard and high achievement of product (Baum, 2001). Penrose (1995) argued that product quality is a precise and measurable variable. The product based approach believes that quality reflects differences in the quality of ingredients or attributes possessed by a product. Howard (2007) argued that higher quality can only be obtained at

Tear down analysis technique in small and medium scale enterprises...

Olabisi Jayeola ; John A. Enahoro & Akinyomi Oladele John

higher cost because quality reflects the quality of attributes that a product contains; consequently attributes are considered to have a higher production cost, therefore higher quality goods or service will be more expensive. Quality is also viewed as an inherent characteristic of goods rather than as something ascribed to them because quality reflects the presences or absence of measurable product attributes. It can therefore, be assessed objectively, and is based on more than preference alone. On the other hand, the user based approach starts from the premise that quality ‘lies in the eyes of the beholder’; individual consumers are assumed to have different wants and needs and those goods that best satisfy their preferences are those that they regard as having the highest quality (Bertocchi, 1986). This is idiosyncratic and the personal view of quality is highly subjective. In the marketing literature, the idiosyncratic view has led to the notion of ‘idea point’, the precise combinations of product attributes that provide the greatest satisfaction to a specified group of consumer. The economics literature believes that quality differences are captured by shifts in product’s demand curve. According to Burns (2005) each of these concepts faces two problems. The first is practically how to aggregate widely varying individual preferences so that they lead to meaningful definitions of quality at the market level. The second is more fundamental: how to distinguish those products attributes that connote quality from those that simply maximize consumers’ satisfaction (Baum, 2001). The aggregate problem is usually resolved by assuming that high quality products and services are those that best meet the needs of the majority of consumers.

Bennett and Robson (1999) positioned that theoretical discussion of the relationship between quality and cost falls into three categories; one group follows the product-based approach which argue that quality and direct costs are positively related. The implicit assumption here is that quality differences reflect variations in performance features, durability or other product or service attributes that require more expensive components or materials, additional labour hour, or other commitments of tangible resources (Bertocchi, 1986). This view dominates much of American thinking on the subject. A second view which draws on the operations management literature, sees quality and cost as inversely related because the costs of improving quality are thought to be less than the resulting savings in re-work, scrap, and warranty expenses (Burns, 2007). According to this view, which is widely held among

Tear down analysis technique in small and medium scale enterprises...

Olabisi Jayeola ; John A. Enahoro & Akinyomi Oladele John

Japanese manufacturers and explains much of the dedication to the goal of ‘continuous improvement’ quality, it is synonymous with absence of defect and the cost in question is quality (Howard, 2007). Quality costs are defined as any expenditure on manufacturing or service in excess of that which would have been incurred if the product had been built right the very first time (Penrose, 1995). In a comprehensive firm, these costs would include such hidden elements such as the expenses of carrying excess raw materials and work-in-progress inventory to ensure that defective items do not shut down the production process, as well as the cost of owning and operating excess capacity in order to compensate for machine clogging and downtime (Burns, 2007).

Implementations of tear down analysis technique

Although, the quality of a product is critical, the development of the best product on the market will not necessarily translate to increased sales (Bygrave, 1994). Many companies fail to understand the nature of the problem before trying to solve those related to product quality and increased market share. Adopting the tear down analysis technique to business processes, a competitor’s analysis should focus on and revolve around where competitors are most vulnerable; in other words, where natural marketing opportunities exist (Robert, 2010). The better way to adopt tear down analysis is to study and understand the history of your company and to note it down with that of your competitors. This will give an understanding of competitor’s goals, strategies, beliefs and capabilities and these challenge your assumptions. According to Robert (2010), a competitor’s analysis begins with an understanding of competitor’s behaviour in the industry. And the first step is to get a handle on the situation by noting the history of the industry. Secondly, is to determine where your competitors are vulnerable while noting the history and to develop a comprehensive analysis by formulating a framework of your competitor’s history, goals, strategies, beliefs and capabilities (Bygrave, 1994).

The competitor’s history includes the operating industry, which is a major component of understanding the current situation, and the trend and possibilities of forging ahead. Goal is basically a summary of how competitors are currently operating in the industry. From the industry, you will begin to observe obvious competitors trends, therefore assumptions about

Tear down analysis technique in small and medium scale enterprises...

Olabisi Jayeola ; John A. Enahoro & Akinyomi Oladele John

future goals should take on additional significance. Tear down analysis is a philosophy that attempts to understand the competitors' assumptions of risk, corporate values and long term commitments (McCarthy and Perreault, 1990). Robert (2010) listed stages involved in tear down analysis to include finding out what your competitors believe about issues in the industry; the differences in beliefs among the competitors and the common beliefs. The purpose of this is to have a grasp of the gap or dogmatic misconceptions. The next stage is to devise and understudy competitors' strategies. This is the synopsis of what competitors attempt to accomplish in their industries in the future period and how they are carried out. Test your assumptions, check your literature and attend conferences, trade shows, and workshops, have discussions with employees and others who may have useful and relevant information. The last stage is to determine your capabilities to implement competitors' strategies observed and to find out how they have changed over time. Also find out if these have translated to additional financial expenses and resources and if the business will be able to sufficiently respond to any changes in paradigm that may be established and implemented

MATERIAL AND METHODS

The study employed a cross-sectional survey where primary data were gathered at one point in time from a sample selected to represent the population of the study. The study covered small and medium scale enterprises in Lagos Industrial Metropolis while selecting 218 SMEs from the three senatorial districts. The SMEs included manufacturing, confectionery, general trading and agro-allied. The categories of enterprises were registered by the Corporate Affairs Commission (CAC) in Lagos State of Nigeria, 2013 and were within the definitions of National Council on Industries (2001). The predictor variable was tear-down analysis while the criterion variables were product quality and product cost which were measured through customers' patronage, customers' satisfaction and market share. The study had a scale which comprised 15 items developed by the researchers and tested for reliability which yielded a coefficient determination of 0.79 and also tested for face and content validity. The response format was the 6-point Likert scales rating. To make the instrument adequately measure what it was supposed to measure, advice and assistance of experts in measurement and evaluation was sought. The instrument was checked and validated by experts in psychometrics and the study reported crobach's alpha of 0.82.

3.1 MODEL SPECIFICATIONS

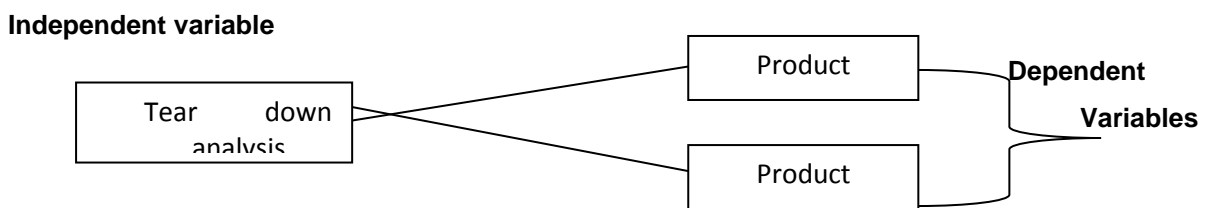
Simple linear regression model was employed as a model to determine the relationship between response variables, y_1 & y_2 , and a single explanatory variable, x_1 at a time. The structure of the study was prepared based on the identified variables shown below.

Given that the equation $y = f(x)$ where y is a dependent variable and x is an independent variable of the study.

The model is $y_1 \text{ \& } y_2 = \beta_0 + \beta_1 x_1 + \varepsilon_1 \dots \dots \dots (i)$

Where;

- i) Y_1 is the first criterion variable product quality;
- ii) Y_2 is the second criterion variable product cost;
- iii) X and Y , are the sample values of the response and exploratory variables and ε are random disturbance terms assumed to be normally distributed with mean zero and variance σ^2 ;
- iv) The intercept parameter, β_0 , is the value predicted for the response variable when the explanatory variable takes the value zero; and
- v) The slope parameter, β_1 , is the change in the response variables predicted when the explanatory variable is increased by one unit.



RE-STATEMENT AND TEST OF HYPOTHESES

Hypothesis 1: there is no significantly relationship between tear down analysis technique and product quality of small and medium scale enterprises in Lagos industrial metropolis.

Hypothesis 2: there is no significantly relationship between tear down analysis technique and product cost of small and medium scale enterprises in Lagos industrial metropolis.

Hence,

Tear down analysis technique in small and medium scale enterprises...

Olabisi Jayeola ; John A. Enahoro & Akinyomi Oladele John

Model 1 for H_{01} is stated as $PQ = f(TDA)$ and $y_1 = \beta_0 + \beta_1x_1 + \varepsilon_1$

Model 2 for H_{02} is stated as $PC = f(TDA)$ and $y_2 = \beta_0 + \beta_1x_1 + \varepsilon_1$

RESULTS AND DISCUSSION

Table 1 below showed that there is a statistically significant relationship between the tear down analysis technique and quality product of small and medium scale enterprises in Lagos Industrial Metropolis, as the probability (or significance) of the t-calculated is equal to 0.000 which is less than 0.05 or 5%.

Table 1: Result of regression analysis between tear down analysis and product quality

	Coefficient	Standard Error	t-statistics	P-Value
Constant	10.895	1.224	8.899	0.000
TDA	0.549	0.047	11.569	0.000

Dependent variable: product quality

Source: Author's computations

Hence, the null hypothesis that says there no is significant relationship between the tear down analysis technique and quality product of small and medium scale enterprises in Lagos Industrial Metropolis is rejected and the alternative hypothesis that says there is a statistical significant relationship between the tear down analysis technique and quality product of small and medium scale enterprises in Lagos Industrial Metropolis is accepted.

In addition, Table 2 contained the constant (alpha 10.895) which predicted the value of the dependent variable which measured the quality of the product when the predictor was set at 0, and the coefficient on the independent variables (beta 0.522).

Table 2: Result of ANOVA of regression analysis between tear down analysis and product quality analysis

	Sum of Squares	Df	Mean Square	F-Statistics	P-Value
Regression	721.621	1	721.621	133.832	0.000
Residual	1930.33	358	5.392		
Total	2651.95	359			

Source: Author's computations

Tear down analysis technique in small and medium scale enterprises...

Olabisi Jayeola ; John A. Enahoro & Akinyomi Oladele John

The size of the coefficient for the independent inference gave the size of the effect that inference has on the dependent variable measure of the quality of the product which in this case was .000. The coefficient explained how much the dependent variable measured the quality of the product and the size was expected to increase since it was positive, when the independent inference TDA was increased by 1. The prediction components of Table 2 were the t-value and the significance. The t-statistics was the coefficient divided by its standard error. If 95% of the t-distribution is closer to the mean than the t-value, the coefficient will have a p-value of 5%. The p-value indicated how confident it was that the independent inference TDA had some correlation with the dependent variable measuring product quality. Note that the size of the p-value for a coefficient revealed nothing about the size of the effect that variable had on the dependent variable measure as it was possible to have a highly significant result for a minuscule effect. The result showed a p-value of .000 which indicated that there was a statistically significant relationship between TDA and quality of the product. Thus, this also confirmed the alternative hypothesis and rejected the null hypothesis.

Table 3 showed that the F-value which was the Mean Square Model (721.621) divided by the Mean Square Residual (1930.335), yielded $F = 133.832$. The p-value associated with this F-value was very small (at 0.000) as shown in the table.

Table 3: Diagnostic statistics of the ANOVA of regression analysis between tear down analysis and product quality

R	R Square	Adjusted Square	R	Std. Error of the Estimate	Durbin-Watson
0.522	0.272	0.270		2.32207	1.843

Source: Author's computations

These values were used to answer the fourth research question: 'what relationship exists between the tear down analysis technique and the quality of the product/service of small and medium scale enterprises in Lagos, Nigeria?' The p-value when compared to the alpha level (typically 0.05) was lesser at 0.000, thus we rejected the null hypothesis that there is no significantly relationship between the tear down analysis technique and the quality of the product/service of small and medium scale enterprises in Lagos Industrial Metropolis and

Tear down analysis technique in small and medium scale enterprises...

Olabisi Jayeola ; John A. Enahoro & Akinyomi Oladele John

accepted the alternative hypothesis that there was a significant relationship between the tear down analysis technique and the quality of the product/service of small and medium scale enterprises.

Table 4 below showed that there was a statistically significant relationship between the tear down analysis technique and the product cost of small and medium scale enterprises in Lagos, as the probability (or significance) of the t-calculated was equal to 0.000 which was less than 0.05 or 5%.

Table 4: Result of the regression analysis between tear down analysis and product cost

	Coefficient	Standard Error	t-statistics	P-Value
Constant	-1.381	0.280	-4.935	0.000
TDA	0.690	0.064	10.757	0.000

Dependent variable: product cost

Source: Author's computations

Hence, the null hypothesis that says there no is significant relationship between the tear down analysis technique and the product cost of small and medium scale enterprises in Lagos Industrial Metropolis was rejected and the alternative hypothesis that says there is a statistical significant relationship between the tear down analysis technique and the quality of the product of small and medium scale enterprises in Lagos State, Nigeria was accepted.

Table 5: Result of ANOVA of the regression analysis between tear down analysis and product cost

	Sum of Squares	df	Mean Square	F Statistics	P-Value
Regression	70.698	1	70.698	115.714	0.000
Residual	72.094	118	0.611		
Total	142.792	119			

Source: Author's computations

Table 5 showed that the F statistics which is the Mean Square Model (70.698) divided by the Mean Square Residual (72.094), yielded F= 115.714. The p-value associated with this F-value was very small (at 0.000) as shown in the table. These values were used to answer the

Tear down analysis technique in small and medium scale enterprises...

Olabisi Jayeola ; John A. Enahoro & Akinyomi Oladele John

second research question: ‘what relationship exists between the tear down analysis technique and the product cost of small and medium scale enterprises in Lagos Industrial Metropolis?’ The p-value when compared to the alpha level (typically 0.05) was lesser at .000, thus we rejected the null hypothesis that there is no significantly relationship between the tear down analysis technique and the product cost of small and medium scale enterprises in Lagos and accepted the alternative hypothesis that there was significantly relationship between the tear down analysis technique and the product cost of small and medium scale enterprises in Lagos.

Furthermore, the results of the test to establish the relationship between tear down analysis and product cost presented in Table 6. The table showed an R-value of -0.704 between TDA and product cost implying negative correlation between the two variables. At -0.704 the result showed a strong negative relationship between TDA and product cost. This implied that increased use of tear down analysis brings about a reduction in the product cost. The table also showed the R^2 of the regression as 0.492, which was the fraction of the variation in the dependent variable, measure product cost that was predicted by the independent inference tear down analysis.

Table 6: Diagnostic statistics of the ANOVA of regression analysis between tear down analysis and product cost

R	R Square	Adjusted Square	R	Std. Error of the Estimate	Durbin-Watson
-0.704	0.495	0.491		0.782	1.843

Source: Author’s computations

In other words, 49.2% of decreased product cost was associated with adoption of the tear down analysis technique. The table also showed the standard deviation error which was an estimate of the standard deviation of the coefficient. It could be thought of as a measure of the precision with which the regression coefficient was measured. Should a coefficient be larger when compared with its standard error, then it probably would have been different from 0.

Relationship between tear-down analysis technique and product quality and cost of SMEs in Lagos industrial metropolis.

Findings from the field were:

- i) The majority of the respondents representing 83.6% of the total respondents agreed that their enterprises produced quality products at affordable prices for their customers' without compromising quality. Further investigation revealed that this was achieved through the adoption of tear down analysis to business activities.
- ii) Also, 70.5% of respondents jointly agreed that their enterprises used price and customers' requirements and information gathered from the market and competitors to design products. Almost 90.3% of the total respondents agreed that their enterprises examined competitors' product so as to identify opportunities for cost reduction and product improvement.
- iii) In addition, 77.5% of the total respondents agreed that they always engaged in continuous market research where price considerations and trend changes were closely monitored in order to understand the perceived quality and functionality of products at affordable prices.

The above findings confirmed the test statistics carried out to analyse the data collected. There was a positive and statistically significant relationship between the tear down analysis technique and product quality and cost of small and medium scale enterprises in Lagos Industrial Metropolis. The t-test at 5% level of significance was used for testing the hypothesis. The correlation coefficient (R) result of 0.522 showed a positive and moderate correlation between the tear down analysis technique and product quality. The p-value associated with F-value when compared with the alpha level (typically 0.05) was less at .000. The alternative hypothesis which says there is a significant relationship between the tear down analysis technique and product quality of small and medium scale enterprises in Lagos was accepted. Also, the p-value associated with F-value when compared with the alpha level (typically 0.05) was less at 0.000 for tear down analysis and product cost. However, there was a negative relationship between tear down analysis and product cost as the result of the correlation coefficient (R) was -0.704. Zengin and Ada (2010) opined that the adoption of

Tear down analysis technique in small and medium scale enterprises...

Olabisi Jayeola ; John A. Enahoro & Akinyomi Oladele John

the tear down analysis technique in developed economies has brought about incremental and monumental alterations in the global market at affordable prices. They added that cost minimization or cost reduction is not a sufficient strategy to obtain competitive advantage without the support of other market considerations like obtaining market information about the competitors' product. Cooper and Slagmulder (2000) argued that since price is market driven and quality and functionality is customer driven, the most suitable operation strategy for manufacturers should be designed around balancing cost, quality and functionality which is defined as survival tripod.

Discussion

When a company is about to develop a product for the market, it should be understood that it cannot produce everything needed by the operators in the market. Hence, the company should determine its primary strategic orientation about what it intends to produce for the market. It can focus on the production of what can distinguish it in the market place in terms of market share. The tear down analysis technique assists businesses to develop the lowest cost or highest value product through the collection of useful information about the competitors' products. This is typically done with commodity type products reaching a mature phase in the life cycle, or where there is consolidation for a shrinking market. This orientation typically requires additional time and cost to optimize product cost and the manufacturing process. Hibbets, Albright and Funk (2003) posit that most visible consequences of market driven production and operations in advanced economies is the appropriate application and implementation of modern techniques such as the down analysis technique. Zengin and Ada (2010) added that such economies had brought about incremental and monumental changes in the global market. Also that cost minimization or cost reduction is not a sufficient strategy to obtain competitive advantage without the support of other market considerations like obtaining market information about the competitors' product. According to Cooper and Slagmulder (2000) price is driven by market and customer is driven by quality and functionality therefore manufacturers should adopt a survival tripod as a strategy by balancing cost, quality and functionality of a product.

Penrose (1995) argued that product quality is a precise and measurable variable. Penrose stressed that product based approach believes that quality reflects differences in the

Tear down analysis technique in small and medium scale enterprises...

Olabisi Jayeola ; John A. Enahoro & Akinyomi Oladele John

ingredients or attributes possessed by a product. Howard (2007) opined that higher quality can only be obtained at higher cost because quality reflects the quality of attributes that a product contains and because attributes are considered to be more costly to produce, therefore higher quality goods or service will be more expensive. On the other hand, the user based approach starts from the premise that quality ‘lies in the eyes of the beholder’; individual consumers are assumed to have different wants or needs and those goods that best satisfy their preferences are those that they regard as having the highest quality (Bertocchi 1986). This has led to the notion of ‘idea point’, the precise combination of product attributes that provide the greatest satisfaction to a specified consumer in the economics literature, to the view that quality differences are captured by shifts in a product’s demand curve, and in the operations management literature to the concept of fitness for use.

CONCLUSION AND RECOMMENDATION

The results of the study showed that there was a statistical significant relationship between the tear down analysis technique and quality product and product cost of small and medium scale enterprises in Lagos Industrial Metropolis. It was concluded from the findings that cost minimization or cost reduction is not a sufficient strategy to obtain competitive advantage without the support of other market considerations like obtaining market information about the competitors’ products. Therefore, quality product or service can be produced or provided through the application of tear down analysis techniques. Contrary to the opinion of Howard (2007) who argued that quality can only be obtained at a higher cost; he added that quality reflects the quality of attributes that a product contains and because attributes are considered to be costly to produce, higher quality goods or services are more expensive. Hence, the study had demonstrated that the tear down analysis technique was suitable to collect secret information about the competitors’ products and then incorporate the observed operational strategies of competitors to the production or provision of quality goods or services at affordable prices to the customers.

Tear down analysis technique in small and medium scale enterprises...

Olabisi Jayeola ; John A. Enahoro & Akinyomi Oladele John

It is therefore recommended that operators in small and medium scale enterprises continuously make an effort to produce or provide quality goods or services through the efficient and effective adoption of the tear down analysis technique to business activities.

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Olabisi Jayeola ; John A. Enahoro & Akinyomi Oladele John

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