THROUGHPUT ACCOUNTING AND ECONOMIC VALUE ADDED OF FIRMS IN THE NIGERIAN MANUFACTURING SECTOR

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Abstract

This study examined the concept of throughput accounting as an operational accounting method which has a nexus with the theory of constraints in manufacturing concerns. Theory of constraints as a management strategy describes methods to maximise operating profit, but both must deal with bottleneck resource which can hamper the profit. The proxies which are common to throughput accounting and theory of constraints have effect on Economic Value Added in firms used in the study. The expost facto research design was used as the data were extracted from the Nigerian Exchange Group fact books for the period 2015 to 2021. The population of the study was the average of 83 companies in the manufacturing sector which were listed in the stock exchange during this period. The sample size used was 69. Four research questions were answered, and four hypotheses were tested at 0.05 level of significance. Multiple and simple regression analysis were used to test the data collected. Findings indicate that a significant relationship exists between the joint measurement of throughput accounting with theory of constraints and Economic Value Added of listed manufacturing firms in Nigeria. It was recommended among others that management should consider the profitable use of the scarcest resources when operating expenses are treated. More so, management should see profit as a function of material cost, total factory cost, and throughput. Manufacturing companies should not recognize inventory as an asset but take it as the product of uncompleted manufacturing which stands between the company and profit.

Keywords: Throughput accounting, theory of constraints, economic value added.

1. Introduction

Throughput accounting is a management accounting approach that helps management to make decision for the improvement of profitability in the enterprise. It is a simplified approach to operational accounting. It uses more of analytical and systemic approach to make decisions clearer by using the precepts of the theory of constraints.

The throughput concept was introduced to divert attention of manufacturing firms from so much emphasis on cost and inventory to establishing a relationship between throughputs and operating expenses to have productivity and net profit. Theory of constraints as a management strategy describes methods to maximise operating profit. It starts from the principle which identifies the flow of money generated by an

enterprise and identifying the limitation of this flow, caused by a single factor, the main constraint (bottleneck). Both principles must deal with bottleneck resource which can hamper the profit (Oanh, 2022).

Burch (1994) posited that the traditional role of management accountants has been to control and reduce cost over time. With the advent of just in time (JIT) philosophy, inventory is seen as a liability rather than an asset, and manufacturing companies have scrambled to eliminate as much inventory as possible, to reduce the company's liability. The throughput concept was introduced to divert attention of manufacturing firms from so much emphasis on cost and inventory to establishing a relationship between throughputs and operating expenses to have productivity and net profit. The variables used in the construction of equations in throughput accounting are: Net Profit, which equals Throughput, less operating expenses; Return on inventory, which equals Net profit, divided by inventory; Productivity, which is derived as Throughput, divided by operating expenses; and Inventory turnover, which equals Throughput, divided by inventory.

By having relationships such as the above in place, Burch (1994) opines that companies can establish a base line for determination of continuous improvement on their performance by making decisions using throughput analysis. As this analysis helps management to reduce cost, investment decisions can be made on areas of cost minimization. Throughput therefore can be defined as the rate at which the system generates profit through sales which is equal to sales less material cost.

From the perspective of the theory of constraints, it could be referred to as contribution, or contribution margin. Simply put, throughput is the money that is available for settling all expenses, after the raw materials costs have been paid for. From the relationship shown above, the other variables seen are inventory and operating expenses. While inventory represents the money invested by the company in products it intends to sell, valued at only raw materials costs, operating expenses is the money spent to convert inventory to throughput (Baye & Prince, 2013). The aim of management is to reduce inventory and operating expenses, while throughput is increased. According to the Chartered Institute of Management Accountants (CIMA), the theory of constraint and throughput accounting have something in common, the maximization of throughput and reduction of inventory and operation costs.

The theory of constraints, according to Goldratt (1984) assumes the position that a chain is not strong when it has a weak link. Therefore, the constraints - those weak links - need to be identified and removed to ensure that the weakness can no longer damage or hinder the manufacturing progress and success of the company. Using the theory of constraints, a company can focus its efforts and attention on the

business obstacles and optimize processes so that it sees improved performance or output (Uwah & Asuquo, 2016).

The theory of constraints states that any system contains a choke point that prevents it from achieving its goals. This choke point, which is also known as a bottleneck or constraint, must be carefully managed to ensure that it is operational at all the time as possible. If not, then goals may not be achieved. The reason is that no additional throughput (revenue minus all variable expenses) can be generated unless the capacity of the constraint is increased (Bragg, 2022).

According to CIMA (2005) the general hypothesis of throughput accounting and theory of constraint is that constraints are impediments to achieving a firm's goal and their impact reduces profits. This hypothesis is based on the belief that every business has constraints. A constraint can be a resource, a company policy or management mindset. This hypothesis has similarities with limiting factor analysis, which is defined as a factor or condition that impedes meeting goals.

Another major variable of this study, the Economic Value Added (EVA) is a commercialized performance measurement system that emphasizes the incremental income which an organization can make over and above the required income meant to cover costs of capital which is invested by both debt and equity holders in the organization (Hill, 2008). EVA focuses on the determination of the earnings that are above the required cost of capital for the shareholders and other providers of funds. Therefore, if the firm earns more than the required rate of return, then value has been created for the shareholders. Economic Value Added (EVA) emphasizes the accounting profit minus economic or implicit costs. Therefore, this study is to establish the relationship between throughput accounting with theory of constraints and economic value added, and how these variables can assist manufacturing companies in Nigeria to have value addition in their operations.

The major problem identified in this study is that most manufacturing concerns continue to make operational decisions, based on traditional generally accepted accounting principles (GAAP) accounting analysis, and cost-benefit analysis to try to return to profitability or sustain profitability. There exists a very strong opposition between traditional management accounting and throughput accounting because traditional accounting makes no distinction between the resources of the system. The gap to be filled however, is that manufacturing companies would now deviate from the norm. What is needed is an effective way to judge the impact of operational decisions on profitability (e.g. decisions about purchasing, inventory, pricing, staffing, production methods, promotions, sales channels, and more), using available

operations data. This leads to the search for new growth paths for increase in sales (Uwah & Asuquo, 2016).

Throughput Accounting (TA) can help companies evaluate impact of operational decisions on profitability before they are made. This type of accounting can help manufacturing companies to monitor actual impact of each decision on profitability, and adjustments can be made to attain profitability. As Holcomb (2016) puts it, throughput accounting uses three key metrics to evaluate each decision, calculated from existing data: Throughput (T), Investment (I) and Operating Expense (OE). From these, it is possible to estimate other traditional financial metrics for day-to-day decision-support.

Therefore, the link between throughput accounting (TA) as the independent variable and economic value added (EVA) of firms, as the dependent variable is that EVA, being a value-driven concept uses non-financial measurement with flexibility of adapting to the changes of internal and external environments to attract the benefits provided by TA, which uses cost reduction and efficiency techniques for decision making without relying solely on the information derived from the generally accepted accounting principles (GAAP).

2. Review of related literature

The manufacturing sector has to do with the real sector of an economy. Accounting for manufacturing is concerned with how resources are converted into work-in- progress and then finished goods that are value-adding to all other agents of the economy. Manufacturing companies will typically have a long production cycle with significant number of raw materials, unfinished and finished goods, hence a high level of inventory. This is when throughput accounting is expected to account for the details and recognize the constraints that would cause delay in production, increase production time and cost, hence a reduction in profit (Akinjare, Ojo, Adetiloye & Akinjare, 2019).

2.1 Conceptual review

Economic Value-Added based performance.

With the continuous reduction in profit, value continue to diminish, rather than add. Olusegun et al (2021) opine that firms use different methods to measure performance as this however depends on what their

objectives are. Multiple performance measures provide a more comprehensive picture of performance that considers a wide range of possibilities.

Financial elements from the Generally Accepted Accounting Principles (GAAP) are not the only indicator for measuring performance of a firm. Non-financial measurement and the ease or flexibility of adapting to the changes of internal and external environments could also be used. This justifies why a value-adding approach should be adopted, rather than using just financial analysis, as value-creating activities are not identified by financial analysis. There are alternative performance measurement tools like customers' satisfaction, competitive advantage, product quality, resources, and value creation. Basically, how the management of the firm handles these categories will determine financial implications for shareholders' value (Olusegun, Alexander, Mojisola & Akinjare, 2021).

Economic Value Added (EVA) is performance measurement that measures the economic profit of an organization and not the accounting profit. The focus of EVA is to determine the earnings that are above the required cost of capital for the shareholders and other providers of funds. If the firm earns more than the required rate of return, then value has been created for the shareholders. Economic Value Added (EVA) emphasizes the accounting profit minus economic or implicit costs. Olusegun et al (2021) posit that accounting costs or explicit costs are expenditures firms make to acquire the resources necessary for production, while economic or implicit costs consider the opportunity costs of using the resources provided by the owners of the firm. EVA therefore becomes a better measurement application used by firms during the decision-making process when capital expenditure in plant and equipment are made for the benefit of the stakeholders (Uwah, 2019).

EVA could be used as a capital allocation tool for capital rationing for a firm and the economy at large. Using EVA, a minimal acceptable performance rate could be set as the expected return of the sector. A return below this average return means that the owners of the firm and the economy at large could have allocated their fund to another company or industry and be better off in terms of net-worth (Sabol & Sverer, 2017).

Cost of capital and economic value added.

Albrecht et al (2008) say that economic value added (EVA) was proposed by a US firm, Stern Stewart, and Company in 1993, and that it is a commercialized performance measurement system that emphasizes the incremental income which an organization can make over and above the required income meant to cover costs of capital which is invested by both debt and equity holders in the organization. Hill (2008) also summarized this by saying that if firms make money profits that exceeds their overall cost of

funds, they create economic value to its shareholders. This concept which is quite like the residual income concept is given as: (return on capital invested × cost of capital). That is,

Capital Invested = after tax operating income – (cost of capital × capital invested).

= *Net operating profit after tax – (cost of capital × invested capital).*

There is similarity between the residual income formula and the economic value added (EVA) formula. But Meigs and Meigs (1995) pointed out that though the two concepts seem similar, there are remarkable differences which are that while the residual income concept focuses on operating profit before tax, the EVA insists on net operating profit after tax. This shows that EVA considers the effect of taxation when calculating profit. This assertion is corroborated by Albrecht et al (2008) who further pointed another difference, being that residual income considers a minimum required rate of return (hurdle rate) as a variable for measuring the minimum level of income which is earned from using the organization's assets. They maintained that the hurdle rate is normally set by the management and may be used on the cost of acquiring the assets or capital for the organization. EVA on the other hand, according to them is focused on using the firm's specific cost of capital to establish the rate of returns required on the capital used by the firm for the project(s). This return must be the average, expected by both shareholders and debenture holders. *This is the concept of weighted average cost of capital,* which represents the investors' opportunity cost of taking risk by investing funds in a company.

According to Olusegun, et al (2021) the total cost of a company's capital is known as the weighted average cost of capital (WACC). Each type of finance's cost is weighted according to its share in the firm's finances to get the WACC. The proportions are often based on market prices. Since debt is typically less risky than stock, it tends to lower a company's cost of capital. This benefit is made even more appealing by the fact that interest paid on debt is tax deductible, a feature known as the "tax shield" on debt. A firm's economic value added is influenced by its averaged cost of capital, total assets, and operational profit after taxes.

WACC becomes the appropriate discount rate to value a firm. Considering a firm as a going-concern, which has an unlimited life span, the value of the firm is given as:

$$V = \sum_{t=1}^{n=\infty} \frac{FCF_t}{(1+k_o)^t}$$

Where: V= Firm's value; FCF= Free cash flow; K_0 = Weighted average cost of capital (WACC).

In a firm where FCF remains constant forever (in perpetuity), the firm's value is:

$$V = \frac{FCF}{k_0}$$

A major difference between residual income and economic value added, as opined by Albrecht et al (2008) is that residual income has a combination of the hurdle rate and average total assets to determine the minimum income required by the firm, while EVA uses invested capital which is concerned with interest-bearing debt plus all the shares invested in the firm. It is also noted that non-interest-bearing operating liabilities, such as accounts payable are excluded by EVA in the residual income equation. This gives a new equation in invested capital assets as "Interest-bearing debt + total equity." It can also be computed as "Total assets – non-interest-bearing operational liabilities." Albrecht et al (2008) therefore submitted that operating liabilities are not included in this computation because they do not generate any explicit interest expense for the firm. The operating liabilities rather represent a free source of capital for the firm's use to generate further operating profits. It is carried that economic value added is the profit after-tax that is greater than the minimum return on capital. Many authors see EVA as the best measure of true profitability (added value) or otherwise (value reduction) of a firm, and it varies with the cash flow instead of earnings per share (EPS).

However, economic value added (EVA) can be measured using the three basic inputs in its definition, i.e. current value of capital in the investments; returns earned on capital invested; the initial cost of capital. Though there is a difference between market value and book value, when EVA is measured, these variables can be taken only at book value and considered as proxy of the firm's market value. The invested capital in assets at hand and the expected future growth make up the market value while the book value reflects the accounting information of the current period and the accounting decisions made over time, regarding depreciation of the assets, valuation of inventory and dealing with acquisitions. Therefore, adjustments in the book value are made to get a value of the market that is reasonable. This adjustment is made by subtracting from the current value of capital, the book value of capital (Fabozzi & Peterson, 2003).

Throughput accounting practice and organisation's goal

In the manufacturing sector, the focus of management is on cost reduction and efficiency, and probably looking at automation but little consideration is given to knowing if these variables have major impact on profitability. The study of throughput accounting has revealed that efficiency in cost reduction may not support profitability on a standalone, as level of inventories may keep on increasing because of efficient

production, but unsatisfactory sales and meeting of customers' needs may be played down factors (Udoayang, Uwah & Asuquo, 2020).

The Association of Chartered Certified Accountants (ACCA, 2022) opine that organisational goal in manufacturing is to make profit, but this needs to be more clearly defined. The operational goal should be achieved by increasing throughput whilst simultaneously reducing inventory and operational expense. This is based on the proposition that 'throughput' is the rate at which the system generates money through sales; 'inventory' is all the money that the system has invested in purchasing things that it intends to sell, while 'operational expense' is all the money that the system spends to turn inventory into throughput.

Bottleneck concept

Uwah (2019) avers that bottlenecks are the components of the manufacturing process which could be machine, facility, department, or resource which is already at its full capacity and cannot handle any additional manufacturing demand placed on it. It limits the throughput of the associated process. Within an organisation, the theory of constraints is implemented by concentrating on and following a few measures that could help with bottlenecks. To help organisations, deal with these restrictions (bottlenecks) in the system, Goldratt (1984) created tools, from identifying the bottlenecks, exploiting them and elevating same for the entire system rather than any discrete unit within the organisation. Asuquo, Udoayang and Uwah (2021) maintain that identifying the bottlenecks is the initial step, and the company will next decide how to exploit the system's inefficiencies.

Ensuring that the resource at the bottleneck is actively exploited as much as feasible and creating as many units as possible is part of the system exploitation. Therefore, the crucial words in this context are "productivity" and "utilisation." Manufacturing processes cannot eliminate idle time because the process must wait for the bottleneck units to reach capacity once the non-bottleneck resources have completed their tasks. At this stage, the company's idle time is spent waiting for the bottlenecks to reach capacity (ACCA, 2022).

According to Uwah (2019), the bottleneck should receive more attention than other departments because its production capability should dictate the organization's overall production schedule. Idle time is inevitable, according to Zeyneb et al (2014), and must be recognised if the theory of constraints is to be successfully used. As the system becomes congested, adding more work than the constraint can handle causes extra work-in-progress, longer lead times, and the creation of what appear to be additional bottlenecks. The non-bottleneck resources must occasionally be idle because the system does not require that they be utilised to their maximum potential.

According to Uwah (2019), the company has a variety of options that can be used to elevate the bottlenecks. Elevation typically calls for greater financial investment. A new bottleneck will eventually develop once an existing one has been widened. This might take the shape of an additional device that can now process fewer units than the elevated bottleneck. But ultimately, market demand is likely to be the system's biggest obstacle. The theme of the theory of constraints is to never become complacent, regardless of what the next bottleneck is. Since nothing stays stable for a very long, the system should be one of continual improvement. A bottleneck can be exploited of by increasing throughput through the creation of an ideal production plan. This necessitates the use of the simple key factor analysis principles, also referred to as limiting factor analysis or principal budget factor (ACCA, 2022).

Limiting factor analysis and throughput accounting

An organisation must decide how to make the most of its bottleneck resource after it has identified it. Most firms produce more than one type of product, or they provide more than one sort of service, thus figuring out the best production strategy based on increasing throughput per bottleneck resource is a part of the exploitation process. Souren et al (2005) say the key factor analysis would first determine the contribution per unit for each product, and this then determines the contribution per unit of scarce resource by determining how much of the scarce resource each unit needs to produce it. A very similar calculation is made in the context of throughput accounting, though it is not contribution per unit of scarce resource, which is calculated, but throughput return per unit of bottleneck resource.

The term "selling price less direct material cost" refers to throughput. This differs from the computation of "contribution," in which the selling price is reduced by variable overhead costs as well as labour costs. This is a crucial distinction because, according to the fundamental tenet of throughput accounting, all costs other than those for direct materials are largely fixed. As a result, working from the maximisation of contribution premise is flawed because it includes costs that are inherently uncontrollable in the short term.

The Association of Chartered Certified Accountants (2022) agrees with this assertion because, studies from many firms indicate that it is not feasible, for instance, to hire employees daily and fire them if they are not busy. Rather, if there is work to be done, a workforce must be employed by the company and if a worker is made to sit idle behind a machine for a while in the short run, the worker must be paid. This will reduce the incidence of high labour turnover.

Influence of firm's size on business success

The heterogeneous nature of manufacturing firms under study drew our curiosity. To satisfy this curiosity, we decided to look at the empirical research conducted by Pervan and Visic (2012) on "Influence of firm size on its business success". Business success here smacked of long-term firm value through profitability. This empirical research investigated a perceived problem of non-recognition of economies of scale by manufacturing companies in Croatia. A simple regression analysis of this model, ROA = f(firm size, current ratio, asset turnover, debt ratio) was used for the study.

The ex post facto research design was used for the study for a nine-year period (2002-2010) of which data on 2,050 firms was obtained from the Croatian Financial Agency. That study used total assets and number of employees as variables of firm size. They found out that a firm can use its size, as a factor, to undertake certain capital investment projects which can bring about high value to the firm in the short and long term. The results of their analysis however showed that size of firm has weak positive impact on the profitability of those firms. The reason for this weak relationship was however attributed to the agency theory, where management of modern manufacturing firms have shifted their focus from profit maximization to managerial utility maximization. Expectedly, the study showed that the growth in assets utilization will increase the profitability of the firm, while huge indebtedness of a firm will lead to its low profitability.

Lee (2009) however found out that firm size and firm value have a positive correlation. It was observed that the financial flexibility of large firms accounted for this because they have ability to present positive cash flow to take advantage of investment opportunities. Large firms also access funds with lower financial difficulties and have the possibility of future growth. But Ilaboya et al (2016) argued that there is no significant relationship between firm size and firm value. This assertion was supported by the earlier study made by Banchuenvilil (2012), Becker-Blease, Kaen, Etebari and Baumann (2010). While Becker-Blease et al (2010) maintained that better measure of firm size are transactions, agency and span of control costs rather than assets and sales because their study showed that transaction and agency costs as indicated by value added or number of employees have no effect on firm value; Banchuenvilil (2012) postulated that return on equity (ROE) which is an indicator of firm value is negatively correlated with the number of employees in the firm. The gap created in this study was that sales, a variable of firm size was not used to measure its effect on business success. This informed us to use sales as an indicator of firm size as a confounding variable in this study.

2.2 Theoretical Framework

2.2.1 Goldrat's Theory of constraints

In the last few decades, various management ideas have emerged, including the Theory of Constraints (TOC), which was created by Eli Goldratt at the beginning the 1980s. This theory plays a crucial role in the method of determining, analysing, and removing restrictions that limit the process of a firm adding value. Even though it cannot address every issue with decision-making, a constraint-oriented perspective on management processes offers a different perspective in the direction of increasing profits (Drazic, Loivic, & Markovic, 2018).

Theory of Constraints facilitates short- and medium-term production decisions since it is constrained-focused and intended to be a direct costing technique. As a result, both in theory and practice, product mix decisions have been the primary in the field of throughput accounting (Souren, Ahn & Schmitz, 2005).

2.2.2 Relevance of the theory of constraints

Theory of Constraints (TOC) focuses on the weakest ring(s) in the performance chain. The concept surrounding theory of constraints is that the theory views processes as they are rings of the same chain instead of thinking they are independent from each other. At the same time, the theory focuses on the weakest points which are bottlenecks for the entire company and try to determine the relationship of these bottlenecks. This integrated management philosophy changes the way of thinking of managers and become an important tool for problem-solving. It can be used as a management philosophy which can be integrated with cost accounting system (Asuquo, Uwah, Effiong, Odey & Duke, 2021).

Zeyneb, Noyan and Ozalp (2014) stressed that the main aim of every company is increasing the profit. According to this point of view, constraints are main obstacles at achieving companies' aims. In this wise, everything which exists in the road of having more profit is considered as a constraint. So, if companies can handle constraints in their system and manage these constraints, they would have a continuous improvement management system which could help them achieve higher profits.

2.2.3 Net income theory by Durand

Net income theory, as propounded by David Durand in 1952 said that a firm can increase the value of the firm and reduce the overall cost of capital by increasing the proportion of debt in its capital structure to the maximum possible extent. Myers (1974) cited in Albrecht, et al (2008) stated that this theory was based on two considerations. One is that rates of interest are lower than rates of dividends owing to risk involved, and secondly, tax savings are derived, because interest is an expense that is tax-deductible. Durand (1952) also propounded the net operating income theory, otherwise called "Irrelevant Theory".

Albrecht et al (2008) opines that Durand's theory believed that the total market value of a firm is not affected by a change in its capital structure. This is what keeps at constant, the overall cost of capital without considering the debt-equity ratio. It is to be noted that this theory assumes the absence of corporate income tax.

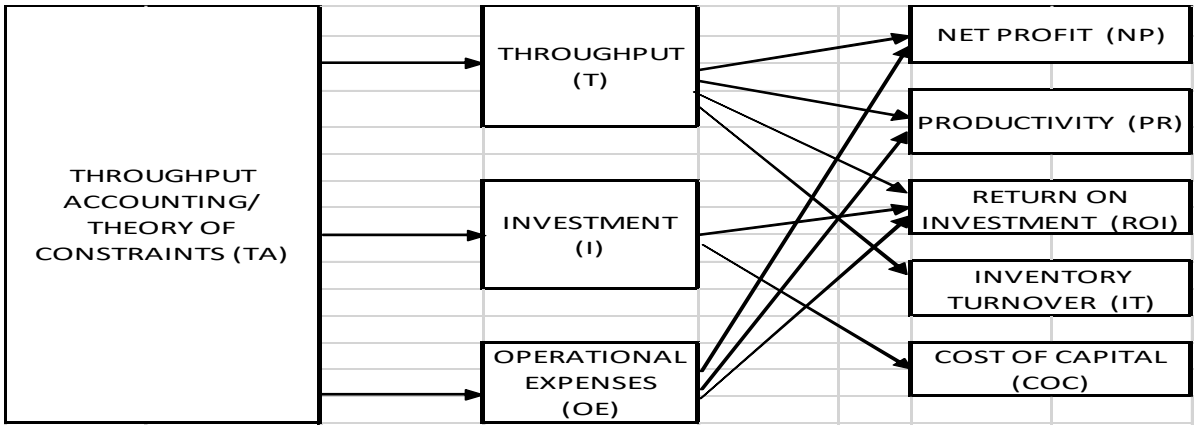

FIG.1: Schematic representation of conceptual framework, showing how indicators of Economic value Added (EVA) depend on throughput accounting/theory of constraint, Adapted from**:** Holcomb (2016)

From Fig. 1 above, "Throughput Accounting" (TA) helps Management to evaluate effect of operational decisions on profitability before they are made. TA uses three key metrics to evaluate each decision, calculated from existing data: Throughput (T), Investment (I) and Operating Expense (OE). The Economic Value-Added metrics, Net profit (NP), Productivity (P), Return on investment (ROI), Inventory turnover (IT), and Cost of capital COC) are indicated to depend on Throughput accounting/Theory of constraints' metrics for day-to-day operational decisions for greatest business performance.

The foundation of throughput accounting is the division of the production cost items into groups based on how they interact with the raw material, which is the only variable factor. The remaining components are combined into a single category termed operating expenses, which are short-term fixed costs and predetermined costs. The number of inputs required to produce the product unit, which is manufactured and subsequently sold, should not be greater than or less than a specific amount since, in the event of a shortage, the product is not finished. If the amount increases, it will be moved into warehouses, and the organization's costs will rise because of loss, damage, and retention (Bragg, 2022).

From the foregoing, the hypothesis for this study is derived from the schematic representation in fig.1 above where Throughput accounting is categorised into three variables, throughput, fixed cost, and operational expenses. Throughput (T) is cash inflow from sales over a unit period, minus variable costs

tied to each sale. Fixed costs are represented by Investment (I), which is the value of cash yet to be converted to Throughput (e.g., inventory, finished goods, work in progress and equipment). Operational expenses (OE) on the other hand are represented by all costs divided by the period required to generate Throughput (T) e.g., labour, utilities, and rent.

The dependent variable, Economic Value Added (EVA) is categorised into five variables: Net profit, NP = (T - OE); Productivity = (T/OE); Return on Investment, ROI = (NP/I); Inventory Turnover, IT = (T/I), and Cost of Capital, WACC.

Development of hypotheses

From the conceptual model, null hypotheses were developed to test the relationship between throughput accounting and economic value added of firms. The conceptual model is based principally on the already stated Goldrat's theory of constraints and the net income theory by Durand.

Hypothesis 1: Throughput does not significantly relate with net profit of manufacturing companies in Nigeria.

Hypothesis 2: Throughput has no significant relationship with productivity of manufacturing companies in Nigeria.

Hypothesis 3: Throughput does not have any significant relationship with return on investment of manufacturing firms in Nigeria.

Hypothesis 4: Throughput has no significant relationship with inventory turnover of manufacturing firms in Nigeria.

Hypothesis 5*:* Investment as fixed cost does not significantly relate with cost of capital of Nigerian manufacturing companies.

Hypothesis 6: There is no significant joint relationship between Throughput accounting/Theory of constraint and combined value of Net profit, productivity, return on investment, Inventory turnover & Cost of capital, representing Economic value Added of manufacturing companies in Nigeria.

3. Methodology

The study used an ex post facto and correlational research design and a quantitative panel methodology. This study's co-relational topic called for a design that would assess the link between two variables, specifically the relationship between throughput accounting and economic value added in Nigerian manufacturing firms. The Nigerian Exchange Group (NGX) Fact Books and the companies' published financial statements for a seven-year period were utilised as the primary sources for secondary (panel)

data analysis (2015-2021). Thus, "Throughput accounting" was used as an independent variable in this study while "Economic added value" served as the dependent variable.

The population of this study was the 83 manufacturing companies that were listed on the Nigerian Stock Exchange, as of December 2021. These companies are in the various sectors in the manufacturing industry. The Taro Yamane formula was used to arrive at the sample size of 69 manufacturing companies, and the researcher adopted the non-census sampling (probability sampling). The stratified random sampling technique was used so that the sample could be truly representative of all units or strata of the population. The strata include manufacture of consumer goods, construction, food and agricultural processing, manufacturing of healthcare and pharmaceutical products, industrial goods manufacturing, mining, oil and gas production and processing of beverages.

The sampling procedure used was the proportional stratified sampling. The percentage composition of the manufacturing companies listed in the NSE were 12 percent of agricultural and food processing sector, 20 percent of consumer goods sector, 33 percent of industrial goods sector, 10 percent of healthcare and pharmaceutical, 5 percent of mining and construction sector, 10 percent of oil and gas production and 10 percent of food and beverages sector. This means that the researcher studied 69 manufacturing companies quoted in the Nigerian Stock Exchange, as sample size made up of 8 in agriculture and food processing, 14 in consumer goods, 23 in industrial goods, 7 in healthcare and pharmaceutical products, 3 in mining and construction, 7 in the oil and gas production, and 7 in the manufacture of beverages. The percentages were calculated thus: Number per sector divided by sample size × 100. Data for this study were sourced from the Nigerian Stock exchange fact books as secondary data.

Model specification

A relationship was established among the variables, using an adopted model from Uwah (2019), following the general equation for regression,

Y = f (X), indicating that Y depends on X,

Model: *Economic value added (EVA) = f (Throughput Accounting)*

i.e. EVA = f (TA).

Therefore, EVA $= a_0 + \beta_1 LogTPT_{it} + \beta_2 LogINV_{it} + \beta_3 LogOEP_{it} + FS_{it} + \mu_{it}$.....(1)

Where: i = 1,2,3.....69, and t = 1,2,3,4,5,6,7.

Y = $\alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \mu$

Where, α is the intercept, and $\beta_1, \beta_2, \beta_3,$ are the coefficients of variables $X_1, X_2, X_3,$ respectively, which show the kind of relationship existing between dependent and independent variables and μ is known as the error term. The control variable in this model is the firm's size (FS), which is shown as the natural logarithm of sales for the sampled manufacturing companies.

In this model, i represents the i[th] cross-sectional unit and t represents the t[th] time. The dependent variable is Economic Value Added (EVA), here hypothesized to depend on the natural logarithm of: Throughput (TPT); Investment (INV), Operation expenses (OEP), and Firm size (FS) as control variable. These are all proxies of Throughput accounting/Theory of constraints. The hypotheses are for each manufacturing firm, i on the sample over the t, 2015 – 2021 analysis period.

EVA as a dependable variable is indicated by Net profit (NPF), Productivity (PRD), Return on investment (ROI), Inventory turnover (ITO) and Cost of capital (COC). Vector variables for measuring Throughput accounting (TA) were represented by TPT, INV, and OEP were regressed against the vector variables for measuring Economic value added, represented by NPF, PRD, ROI, and ITO, for hypotheses 1 to 4. Other vector variables of TA were INV and OEP which were used to regress against ROI and COC as vectors of EVA, for hypothesis 5 and NPF, PRD and ROI respectively for hypothesis 6. The measurement is shown as follows:

Hypothesis 1: NPF = $a_0 + \beta_1 LogTPT_{it} + \beta_2 LogINV_{it} + \beta_3 LogOEP_{it} + FS_{it} + \mu_{it}$.....(2)

Hypothesis 2: PRD = $a_0 + \beta_1 LogTPT_{it} + \beta_2 LogINV_{it} + \beta_3 LogOEP_{it} + FS_{it} + \mu_{it}$.....(3)

Hypothesis 3: ROI = $a_0 + \beta_1 LogTPT_{it} + \beta_2 LogINV_{it} + \beta_3 LogOEP_{it} + FS_{it} + \mu_{it}$.....(4)

Hypothesis 4: ITO = $a_0 + \beta_1 LogTPT_{it} + \beta_2 LogINV_{it} + \beta_3 LogOEP_{it} + FS_{it} + \mu_{it}$.....(5)

Hypothesis 5: COC = $a_0 + \beta_1 LogTPT_{it} + \beta_2 LogINV_{it} + \beta_3 LogOEP_{it} + FS_{it} + \mu_{it}$.....(6)

Hypothesis 6: NPF = $a_0 + \beta_1 LogTPT_{it} + \beta_2 LogINV_{it} + \beta_3 LogOEP_{it} + FS_{it} + \mu_{it}$..... (7)

PRD = $a_0 + \beta_1 LogTPT_{it} + \beta_2 LogINV_{it} + \beta_3 LogOEP_{it} + FS_{it} + \mu_{it}$.....(8)

ROI = $a_0 + \beta_1 LogTPT_{it} + \beta_2 LogINV_{it} + \beta_3 LogOEP_{it} + FS_{it} + \mu_{it}$.....(9)

ITO = $a_0 + \beta_1 LogTPT_{it} + \beta_2 LogINV_{it} + \beta_3 LogOEP_{it} + FS_{it} + \mu_{it}$.....(10)

COC = $a_0 + \beta_1 LogTPT_{it} + \beta_2 LogINV_{it} + \beta_3 LogOEP_{it} + FS_{it} + \mu_{it}$.....(11)

Testing of Hypotheses and Analysis

Hypotheses one to six were tested using SPSS. Proxies of Economic value added as the dependent variable were used against the proxies of Throughput accounting and the theory of constraints, as representatives of the independent variable. A confidence interval of 95% was taken and the decision

rule was to reject the null hypothesis if the calculated value, p, is less than the alpha value of 0.05 ($p<0.05$) and to accept, if otherwise.

Table 1. Calculation methodology for analysed variables

S/N	Variables	Description
1	Throughput accounting/ theory of constraints	Vector variable represented by natural logarithm of TPT, INV, and OEP.
2	EVA	Natural log of data collected and calculated as (Net investment) × (Actual ROI - Cost of capital). Cost of capital = WACC. Cost of equity = d/mve × 100. Cost of debt = F(1-t)/mvd × 100.
3	TPT	Data on cash from sales/period collected from NSE fact books (The Natural log).
4	INV	Natural log of data collected and calculated as: Cash value of capital expenditure not yet converted to throughput (Inventory and equipment)
5	OEP	Natural log of all costs value from financial statements ÷ period required to generate throughput (labour & utilities)
6	NPF	Natural log of TPT - OEP
7	PRD	Natural log of data collected and calculated as TPT/OEP
8	ROI	Natural log of Accounts NP/INV
9	ITO	Natural log of data collected from the NSE. TPT/INV
10	COC	Natural log of Cost of capital = WACC. Cost of equity = d/mve × 100. Cost of debt = F(1-t)/mvd × 100.
11	FS	Firm size is taken as Natural log of sales value collected from NSE.

Source: Researcher's compilation.

4. Results and Discussion

This section shows the tables and the findings from the study with the associated results.

Table 2. Showing multiple regression of the relationship between throughput and net profit of quoted manufacturing companies in Nigeria.

Model	R	R^2	Adjusted R^2	Unstandardized Coefficient		Standardized Coefficient	t	Sig.	Result
				B	Standard Error	Beta			
TPT	0.852	0.053	0.0572	0.864	0.357	0.852	2.595	0.007	Significant (Reject H0)
				ANOVA					
Model		Sum of Squares	df	Mean Square	F	Sig.			
TPT	Regression	1703.344	1	1703	6.215	0.007			
	Residual	15476.366	67	346.2					
	Total	17179.710	68						
Dependent variable: Net profit (NPF)									
Source: Field work Results									

Hypothesis one

Through-put does not significantly relate with Net profit of manufacturing companies in Nigeria.

The data in table 2 dealt with the data showing the extent to which throughput (TPA) relate with the net profit of 69 sampled companies for the period 2015 to 2021, used in the study. Table 2 shows a Beta value of 0.852 for throughput by Nigerian firms and its corresponding dependent variable, net profit. The analysis shows that about 85% of throughput contribute to the economic value added of firms in Nigeria, through the net profit approach. The two variables show significant values at 0.007 Sig. level. The table revealed that a value of 0.007 is the p-value. As this value is lower than the alpha value of 0.05, our Hypothesis one was rejected, following our decision rule. This decision therefore means that there is a significant relationship between throughput accounting by manufacturing firms in Nigeria with the net profit of these firms, representing the economic value added. This is reflected in the 0.007 Sig. value realized in the ANOVA of throughput accounting and theory of constraints as it relates to the economic value added of those firms.

Table 3. Showing simple regression analysis and its associated ANOVA of the relationship between throughput and productivity of quoted manufacturing companies in Nigeria.

Model	R	R^2	Adjusted R^2	Unstandardized Coefficient		Standardized Coefficient	t	Sig.	Result
				B	Standard Error	Beta			
TPT	0.087	0.008	-0.007	0.023	0.032	0.087	0.717	0.476	Insignificant (Accept H0)
				ANOVA					
Model		Sum of Squares	df	Mean Square	F	Sig.			
TPT	Regression	1.721	1	1.721	0.514	0.476			
	Residual	224.198	67	3.346					
	Total	225.919	68						
Dependent variable: Productivity (PRD)									

Source: Field work results

Hypothesis two

Through-put has no significant relationship with Productivity of manufacturing companies in Nigeria.

The analysis shown in table 3 is on the relationship between Throughput and productivity, a proxy of the Economic value added of manufacturing firms in Nigeria. From the Table, both R^2 and the adjusted R^2 values which measure the proportion of the variation in the dependent variable (PRD) are shown. The adjusted R^2 shows the modification for the limitation of R^2 and it is considered as a measure of the model's fitness. As shown in the table, the value of adjusted R^2 is -0.007, which indicates that the independent variable (TPT) explains less than 1% variation on the dependent variable. The multiple correlation coefficient (R) shows a value of 0.087, an insignificant 8% relationship between TPT and PRD. The R^2 value of 0.008 was realized, which shows a very insignificant relationship between the two variables. The table also reveals a p-value of 0.476 which is greater than the alpha value of 0.05. Therefore, hypothesis two was accepted which means that there is no significant relationship between Throughput (TPT) and Productivity (PRD), both proxies of Throughput accounting/Theory of constraints and Economic value added (EVA) respectively.

Table 4. Showing multiple regression of the relationship between throughput and return on investment of quoted manufacturing companies in Nigeria.

Model	R	R^2	Adjusted R^2	Unstandardized Coefficient		Standardized Coefficient	t	Sig.	Result
				B	Standard Error	Beta			
TPT	0.281	0.079	0.065	0.894	0.373	0.281	2.395	0.019	Significant (Reject H0)
				ANOVA					
Model		Sum of Squares	df	Mean Square	F	Sig.			
TPT	Regression	1401.685	1	1402	5.734	0.019			
	Residual	16377.376	67	244.4					
	Total	**17779.061**	**68**						
Dependent variable: Return on Investment (ROI)									
Source: Field work Results									

Hypothesis three

Throughput does not have any significant relationship with Return on Investment of manufacturing companies in Nigeria.

Data presented on Table 4 above reveal the relationship between Throughput and Return on Investment (ROI) of manufacturing firms in Nigeria. From the Table, TPT has a Beta value of 0.281, indicating an approximate contribution of 28% to ROI in the manufacturing firms under study. This result shows a positive correlation coefficient and a relatively average relationship. A p-value of 0.019 realized also shows that the value is less than the 0.05 alpha level, which makes us to reject the null hypothesis three. This indicates that there is a significant relationship between TPT and ROI in the companies under study. The unstandardized B value of 0.894 also explains that for any additional increase in the unit of Throughput, there is an increase of about 89% in the value of Return on Investment. The associated analysis of variance (ANOVA) reveals that the sum of squares for regression which is same as mean of square was 1401.685 and 16377.376 was the residual value for TPT. The mean squares value for TPT, in relation with ROI however shows 244.438. All these show a strong relationship, which supports the rejection of the hypothesis.

Table 5. Showing multiple regression of the relationship between throughput and inventory turnover of quoted manufacturing companies in Nigeria.

Model	R	R^2	Adjusted R^2	Unstandardized Coefficient		Standardized Coefficient	t	Sig.	Result
				B	Standard Error	Beta			
TPT	0.925	0.856	0.854	0.502	0.025	0.925	19.945	0	Significant (Reject H0)
				ANOVA					
Model		Sum of Squares	df	Mean Square	F	Sig.			
TPT	Regression	3910.149	1	3910	397.783	0			
	Residual	658.6	67	9.83					
	Total	4568.749	68						
Dependent variable: Inventory turnover									
Source: Field work Results									

Hypothesis four

Throughput has no significant relationship with inventory turnover of manufacturing firms in Nigeria.

As could be seen from Table 5, the relationship between Throughput and Inventory turnover is shown. The Table's analysis shows a Beta value of 0.925 which is about 93% of the total contribution of throughput to the economic value added of the firm. A multiple correlation coefficient (R) of 0.925 which also indicates a high correlation was observed to correspond with this beta value. The R^2 value of 0.856 which shows a relationship of about 86% between the independent and dependent variables was also observed. However, the value of the adjusted R^2 which is the modification for the limitation of R^2 was 0.854. This indicates that the independent variable in the model explains about 85% variation on the dependent variable. The unstandardized B value of 0.502 shows that as throughput increases or decreases by one unit in value, there is a corresponding 0.502 unit in the economic value received which increases or decreases in the sampled manufacturing firms. More so, the associated analysis of variance (ANOVA) reveals the sum of squares for regression and residual to be 3910.149 and 658.600 respectively, while the mean squares values are also shown as 3910.149 and 9.830 respectively, which indicates a significant relationship between the variables. Finally, the Sig. value reveals 0.000, which is less than the alpha value of 0.05 level and as such, the null hypothesis four was rejected, meaning that a significant relationship exists between throughput and inventory turnover, a proxy of the economic value added of the firm.

Table 6. Showing multiple regression of the relationship between Investment and Cost of capital of quoted manufacturing companies in Nigeria.

Model	R	R^2	Adjusted R^2	Unstandardized Coefficient		Standardized Coefficient	t	Sig.	Result
				B	Standard Error	Beta			
INV	0.034	0.001	-0.014	0.057	0.205	0.034	0.279	0.781	Insignificant (Accept H0)

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
INV	Regression	0.701	1	0.701	0.078	0.781
	Residual	603.841	67	9.013		
	Total	**604.542**	**68**			

Dependent variable: Cost of capital

Source: Field work Results

Hypothesis five

Investment as fixed cost does not significantly relate with cost of capital of Nigerian manufacturing companies.

Table 6 shows what relationship exists between Investment (INV) and Cost of capital (COC) as proxies of Throughput accounting/Theory of constraint and Economic value added respectively. The data show R^2 and the adjusted R^2 values to be 0.001 and -.014 respectively. The value of 0.034 was also seen as the multiple correlation coefficient (R), showing a meagre 3% of the relationship with the variables. The total sum of squares of 604.542 as a result of regression and residual values of .701 and 603.841 respectively was also revealed. It is indicative that when the sum of squares values is higher, the relationship becomes significant, but if the values are lower, there is an insignificant relationship. The table also shows a lower mean square of 0.701 which, in regression depicts an insignificant relationship. A Sig. value of 0.781 which is higher than the alpha level of 0.05 was observed. Therefore, using our decision rule, null Hypothesis five is accepted. This goes to show that Investment has no significant relationship with Cost of capital. This is at variance with the research result by Gilchrist and Zakrajsek (2007) which showed that a 1 percent point increase in the user cost of capital implies a reduction in the investment rate in the selected companies.

Table 7. Analysis of variance associated with multiple regressions on the joint relationship between variables of Throughput/Theory of Constraints and variables of Economic value added of quoted manufacturing companies in Nigeria.

Model	R	R^2	Unstandardized Coefficient		Standardized Coefficient	t	Sig.	Result
			B	Standard Error	Beta			
Constant	0.086	0.65	-15.499	6.493		-2.387	0.02	Significant
TA			0.540	0.074	0.568	7.291	0.000	Significant
Firm size			0.742	0.143	0.405	5.205	0.000	Significant

ANOVA

Source: Field work Results

Hypothesis six

There is no significant joint relationship between Throughput accounting/Theory of constraint and combined value of Net profit, Productivity, return on investment, Inventory turnover & Cost of capital, representing Economic value Added of manufacturing companies in Nigeria.

The data in table 7 shows the extent to which throughput accounting (TA) relate with the economic value added (EVA) of 69 sampled companies for the period 2015 to 2021, used in the study. The multiple regression analysis in Table 7 shows the SPSS result of what the relationship looks like when the control variable, firm size, was introduced. The multiple regression analysis shows a Beta value of 0.568 for throughput accounting by Nigerian firms and its corresponding dependent variable, economic value added of firms. A Beta value of 0.405 was revealed for firm size as control variable showing its relationship with economic value added of firms in Nigeria. These data inform us that about 57% of throughput accounting decisions contribute to the economic value added of firms in Nigeria, while about 40% of firm size contributes to the economic value added of firms. The variables, one independent and the other control, show significant values at 0.000 Sig. level. A multiple correlation between the dependent variable, economic value added of the firm (EVA) with the independent variable, throughput accounting (TA), and the control variable, firm size (FS) was also made. A multiple regression correlation coefficient (R) of 0.806 was seen. This indicates a high correlation of about 80%. The R square (R^2) value of 0.650 was

also realized. This implies that while about 80% of multiple correlations (R) were established between the independent and dependent variables, about 65% was realized as the contribution of the independent variable to the economic value added of firms in Nigeria with the firm size as a control variable factored in. The p-value here showed a value of 0.000. As this value is lower than the alpha value of 0.05, our Hypothesis one was rejected, following our decision rule. This decision therefore means that there is a significant relationship between throughput accounting decisions made by manufacturing firms in Nigeria with the economic value added of these firms. Even though there is heterogeneity in the size of firms in the manufacturing industry, this result also shows that the sizes of firms do not affect this significant relationship. This is reflected in the 0.000 Sig. value realized in the multiple regression analysis of throughput accounting and firms' size as it relates to the economic value added of those firms.

5. Conclusion and Recommendations

Conclusively, the study showed that throughput accounting and theory of constraints have a significant relationship with the economic value added of the manufacturing firms in Nigeria. Though there were insignificant relationships between some sub-variables used in the study, it did not affect the overall result which showed a significant relationship between the independent and the dependent variables. This result was revealed when there was a joint regression of all the sub-variables of throughput accounting with the all the proxies of economic value added in the perspective of the theory of constraint.

The following recommendations were therefore made from the study.

1. Management of manufacturing companies should see profit as a function of material cost, total factory cost and throughput. This is a paradigm shift from the provisions of the Generally accepted accounting principles that profitability can only be measured by price to earnings ratio.
2. Productivity should be seen as a measure of throughput and operating expenses by management. Though it is normally computed by dividing average output per period by the total costs incurred or resources consumed in a period, with throughput accounting it is a major determinant of cost efficiency when the bottlenecks are properly managed.
3. It is recommended that management of manufacturing companies in Nigeria should use throughput techniques to reduce costs which would increase their profitability, while still ensuring that its long-term return on investment is higher than its cost of capital.
4. Management of manufacturing companies should take a paradigm shift by not recognizing inventory as an asset but take it as the product of uncompleted manufacturing which stands between the company and profit.

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