Application of Break-Even Analysis In Industrial Development through Flexible Manufacturing Systems (FMS)

Okpala Arinze Chibuzor, *Member, IAENG*

Abstract – This paper presents the adoption of flexible manufacturing systems in industries. It presented the use of cost-volume-profit analysis to establish cost effectiveness of FMS. The economic and social justification of FMS lies on the cost effectiveness over years. From the analysis, it was observed that FMS had a break-even point at annual output of 10,000 units with total cost $9,000. The variable cost was observed to contribute insignificantly to the total cost.

Keywords - Computer Numeric Control Machine (CNC), Flexible Manufacturing Systems (FMS), and Stand-alone Machine.

I INTRODUCTION

In recent years, advances in computer and its applications has given rise to a stiff competition in the manufacturing industries. Computers are central in computer integrated manufacturing systems. This has led to quick delivery of products of high quality and accurate standard, thereby making conventional method of manufacturing unattractive. With significantly shortened product life cycles, manufacturers have found that they can no longer capture market share and gain higher profits by producing large volumes of a standard product for a mass market in the face of economic meltdown and dwindling energy supply. Flexibility in product design and manufacturing are necessary in today's ever changing socio-economic society. It is imperative that manufacturers have to modify their operations to ensure a better and faster response to needs of customers, ever higher quality of products, increased flexibility and faster response in introduction of new products as respond to the needs of market place.

Majority of third world countries manufacturers had failed to braced up to the challenges of rapid changing economic structure. This has resulted to capacity underutilization and gradual winding up.

In order to redress this ugly situation, flexible manufacturing system should be adopted by manufacturers in the third world countries. FMS is a combination of microelectronics and mechanical engineering in manufacturing process that adapt automatically to random changes in every possible aspect [1].

Manuscript received March 2017. Okpala Arinze Chibuzor, Paritz Investment Nigeria Limited, Nigeria. E-mail: opkala.arinze31@gmail.com

It combines the flexibility of job shop with the high volume production of fixed automation. In this paper a cost-volume-profit analysis is done to justify the initial cost of FMS.

II SYSTEM DESCRIPTION

FMS consists of NC or CNC machine tools equipped with tool magazine and tool changers, set of pallets and fixtures, part buffers, a tool storage area, a part loading and unloading station and tool transport system. It has the capability of producing variable mixture of product at medium production rate. It has the capacity of changing part program and physical set-up without loss of production time [2].

FMS gives a comprehensive flexibility in manufacturing system. These flexibilities include process flexibility, product flexibility, production flexibility, machine flexibility, operation flexibility, volume flexibility and routine flexibility. This is achieved with the aid of well-structured computer programs, see example in figure 1.

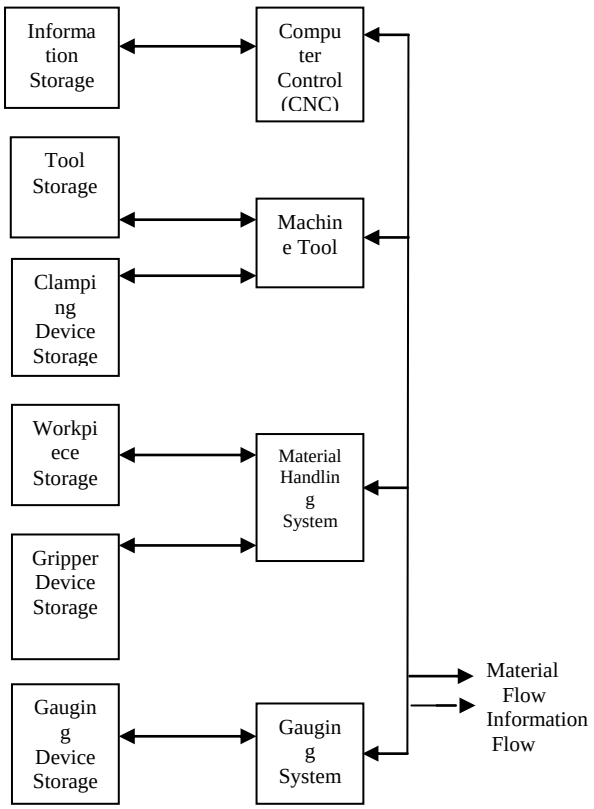

Figure 1: Configuration of Flexible Manufacturing Cell

ISBN: 978-988-14048-9-3
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

A. Cost Function

Cost analysis scheme is important to show how a FMS should be financially justified. Changes in variables like unit variable cost, unit sales price, total fixed costs per period, sales volume and sales mix will affect profit. Cost-volume-profit analysis is a study of how total revenues and total costs vary with changes in sales volume. Knowledge of nature of costs and cost behavior is a pre-requisite for better understanding and appreciation of cost-volume-profit analysis that are essential for decision making [4].

Nature of cost: Manufacturing processes broadly involves two types of costs; manufacturing costs and non-manufacturing costs. In typical analysis, costing deals with manufacturing costs only. Manufacturing costs are classified broadly between capital and revenue costs. Capital costs are items retained in business permanently for use in generating future revenues. Revenue costs are expired costs. In other words, whilst capital items are carried in balance sheet as assets for generation of future revenues, revenue expenditure are written off in the profit and loss account of the period which they were consumed.

Cost behaviour involves the consideration of the behaviour of costs at various levels of activity, and how this affects cost in decision making. A good knowledge of cost behaviour will disclose the pending costs and benefits which shall result from the decision to be taken. In essence, it educates the managers on possible outcomes and the cost implications of their action [5]. FMS leads to high volume of product with reduced man-hour, thereby reducing the total cost of manufacturing.

B. Break-Even Chart

Break-even chart shows the effect of changes in output level on the costs of different method of manufacturing. The break-even point for this chart is the output level at which the cost for the manufacturing methods are equal. It should be noted that when more than two manufacturing methods are plotted on the same chart, there will be break-even point for each pair of production methods.

For adequate cost-volume-profit analysis, total costs of the firm must be separated into fixed and variable costs. If all the costs of the firm were variable, break-even point will occur at zero sales volume on the other hand, if all the costs where fixed, the break-even point would occur at a point where revenues will equal the total fixed costs, and therefore, profit will be equal to the sales revenues.

The break-even point can be computed by dividing fixed costs by contribution per unit [3];

$$B = \frac{F}{C} \qquad (1)$$

where B = break even point
F = Fixed costs
C = Contribution per unit

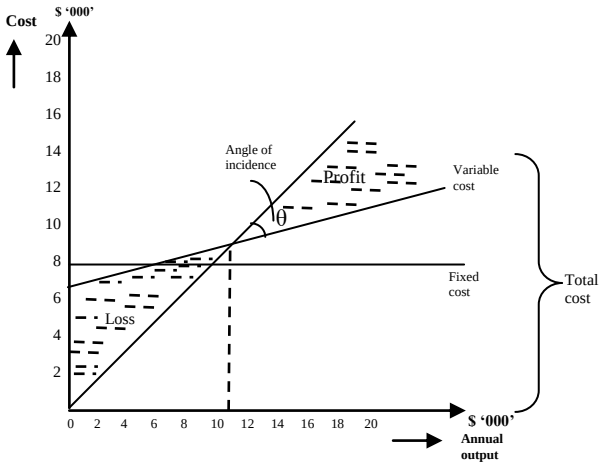

Figure 2: The break-even chart for FMS for the period of twenty years annual output.

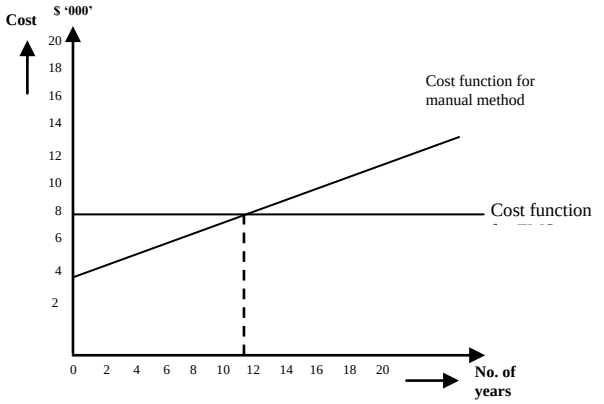

Figure 3: The break-even chart for FMS for the period of twenty years.

C. Discussion

Fig.2 shows the cost volume profit plot of a FMS. The break-even point is at annual output of 10,000 units. It has a good angle of incidence indicating reasonable profit margin. The contribution of the variable is negligible because cost reduction is associated with FMS. From the plot so far, it represents a perfect break-even chart for flexible manufacturing system which will in turn fast track the industrial development of the third world countries [6].

Fig.3 shows the comparison of FMS and manual method on cost-volume plot. At higher annual output, it becomes necessary to adopt FMS. In today's global market standardization, high volume, cost effectiveness and reliability are essential ingredients of manufacturing system and FMS gives these features and more [7]. Therefore, for third world manufacturers to be relevant in the modern trend, they have to adopt FMS to fast track the development of industries.

ISBN: 978-988-14048-9-3
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

III CONCLUSION AND FUTURE WORK

- This work reviewed the cost-volume-profit analysis to justify the initial cost of FMS.
- Flexible manufacturing system is a complete system that takes care of the process flexibility, product flexibility, production flexibility, machine flexibility, operation flexibility, volume flexibility, routing flexibility etc.
- The cost analysis shows that the changes in variables like unit cost, unit sales price, total fixed cost per period, sales volume and sales mix affect profit.
- From the break-even analysis, figure 2 shows how the angle of incidence indicates reasonable profit margin and the variables negligible because of the association of cost reduction with FMS while figure 3 shows the necessity to adopt FMS at a higher annual output thereby making the third world manufacturers develop their industries.

REFERENCES

[1] Jain K.C., Jain Sanjay, Principles of Automation and advanced manufacturing systems, first edition, Khanna Publishers, 2004.

[2] Jain Er. R.K., Jain, Production Technology, sixteenth edition, Khanna Publishers, 2006.

[3] Pius, V.C. Okoye, Cost and Management Accounting, basic concepts, Applications and Issues, The ABC Approach, first edition, Printed by Snaap Press Ltd., 1999.

[4] Fulkerson, Bill, A Response to Dynamic Change in the Market Place, Journal of Decision Support Systems, Vol. 21, pp. 199-214, 1997.

[5] Heikkila, Jussi, From Supply To Demand Chain Management, Efficiency and Customer Satisfaction, Journal of Operations Management, Vol. 20, pp. 747-767, 2002.

[6] Helander, Martin / Jiao, Jianxin, Research on E-product Development (Epd0 for Mass Customization, Technovation. Vol. 22, pp. 717-724, 2002

[7] Koste, Lori / Malhotra, Manoj, A Theoretical Framework for Analyzing the Dimensions of Manufacturing Flexibility, Journal of Operations Management, Vol. 18, pp. 75-92, 1998.

ISBN: 978-988-14048-9-3
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)