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Scenario of Productivity Measures and Their Applications in Improving Operational Performance of Manufacturing SMEs

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Abstract

This study investigated the overall scenario of the application of productivity measures in manufacturing organizations of Bangladesh. It also verified the applicability of different productivity measures in strategic decision making, particularly in operational performance. For this, multiple case studies have been carried out to build up a scenario of how the manufacturing SMEs in Bangladesh measure their productivity and how the productivity measures are applied in operational strategy. Finally, a longitudinal in-depth case study has been conducted to verify what type of productivity measures are suitable in decision making in terms of improving operational performance. The findings of the study confirm that the case organizations do not apply any scientific productivity measures either for strategic decision making or for assessing operational performance. Rather, they assess their overall business performance solely based on total profit or loss. The outcomes of the longitudinal case study confirm that a single measure of productivity alone cannot be appropriate as a strategic decision making tool while measuring operational or business performance. Rather, the single measure can easily mislead the decision. The study finds the loopholes in applications of different productivity measures used in decision making on operational performance. This paper presents the reasons behind not utilizing productivity measures in case organizations and highlights the key issues involved in different productivity measures and their applicability in practice.

Keywords: *Productivity, Measurement, Application, Manufacturing Organization*

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1.0 Introduction

The manufacturing sector contributes significantly to GDP growth in Bangladesh. This sector recorded an impressive seven percent average annual growth over the 1991-2005 period, increasing its share in GDP from 13% to 16%, compared with just 5% average growth in the 1980s (World Bank, 2007). It has more potential to contribute to the increase of GDP. To unleash the full potential of this sector, there is a necessity of strengthening its competitiveness to a considerable level. In other words, the sector should work on increasing its productivity level. At the enterprise level, the major key to sustain global competitiveness and to achieve a durable industrial success is productivity growth. Generally, higher productivity decreases unit cost and increases the firm's profitability. Although productivity gains are almost automatically connected with price competitiveness as a result of lower production costs, they simultaneously reflect and permit greater efficiency (OECD, 1993). Productivity growth not only improves international competitiveness of an industry but also contributes to industrial growth. Thus, international competitiveness can be examined with relative levels of productivity measures (Jorgeson and Kuroda, 1995). Scientific measures of productivity growth can represent inter-firm or inter-industry operational performance. The word `productivity' is, therefore, increasingly important in manufacturing industry due to the background of increasing world-class standards as a crucial pillar in the performance context. The accurate measurement of productivity growth plays an important role in providing the information to management of a company needed to put forth better policy and operational activities. It is obvious that scientific productivity measures permit managers to take necessary decision for making input-output balance in the context of sufficient profit and desired growth. A company can measure total productivity and/or partial productivity. The question is which one gives appropriate information regarding operational performance? Moreover, which one is better for dynamic, multi-period evaluation of the organizational performance? Total factor productivity growth can reflect on gross measure of productivity changes. However, it does not distinguish among the sources of productivity growth. In fact, total factor productivity is an ambiguous concept either in theory or in practical measurement. Various approaches to this measurement can lead to different interpretations and empirical results because of aggregation problems. Despite having some shortcomings, partial productivity measures can provide useful insights to root causes of high or low productivity. Thus these provide practical guidance for identifying productivity problems and thereby to improve operational performance.

This article reviews the findings of three case studies conducted in export oriented Ready-made Garments (RMG) sector in Bangladesh. Of the three, one organization was finally selected for in-depth longitudinal case study with the following specific research objectives:

i) assessing the productivity level of the company using both total and partial measures of productivity,
ii) identifying productivity growth of the company over the certain periods, and
iii) comparing the usefulness of different productivity measures in identifying underlying problems in productivity.

2.0 Literature Review

Productivity is defined as the ratio of what is produced to what is required to produce it. It measures the relationship between outputs such as goods and services produced, and inputs that include labor, capital, material and other resources (Hill, 1993). To improve productivity, operations managers should look at improving the technology, interface between departments, organizational aspect, supply chain as well as people management in a broad and systematic way. In short, both technical and human aspects play major role for any productivity improvement program. Commonly, two specific types of productivity are measured in manufacturing organizations. These are 'labor productivity' and the 'total factor productivity'. The labor productivity measures the outputs in terms of hours worked or paid for an employee. On the other hand, the 'total factor' productivity measures the outputs in terms of the cost involved with labor, equipment, energy and material. According to Kaydos (1991), productivity and subsequently performance measurement are regarded as a prerequisite for continuous improvement. Economists have designed many approaches such as the total factor productivity (TFP), or Bureau of Labor Statistics (BLS) multifactor productivity techniques (Duke and Torres, 2005; Meyer and Harper, 2005; Tsai et al., 2006) at the industries, national, and international levels. Partial productivity relating total output to one class of input is also used at the level of an enterprise. Total factor productivity approach, however, relates total outputs to the sum of all tangible input factors (human, materials, capital, energy, other expenses, etc.) as stated in Sumanth, 1985 and provides the company with a holistic perspective of the economic health and the efficiency of the firm's assets – its divisions, branches, products, process, etc. This approach, if used in conjunction with partial productivity measures, focuses the management's attention toward the strengths and the weaknesses of individual plants and firm operations, and the areas of equipment investment,

employee training, and continuous improvement. Regardless of the assessment method or mix of methodologies selected for integration, productivity benchmarking is an important aspect for goal setting decision-making and goal achievement determination. Benchmarking productivity entails the calculation of a productivity index (PI_t) based on a ratio of the current period productivity value (PV_t) to a specified earlier period productivity value (PV_o). In most instances, productivity benchmarking should be integrated into the productivity assessment methodology or mix of methodologies selected for integration (partial, factor, or total) using one or more of the following criteria: (i) change in productivity over a fiscal period (ratio of current fiscal year to previous fiscal year or ratio of 1st quarter of current year, 2nd quarter of current year, etc to previous fiscal year); (ii) change in productivity between quarterly periods (ratio of 2nd quarter to 1st quarter of current year); and (iii) change in productivity before and after a specific change or improvement (ratio of current period to some earlier period).

The productivity index value less than 1.00 indicates the fact that productivity decreases as compared to benchmark value. With the increasing recognition that productivity growth is the key to sustained economic expansion, measuring productivity is becoming important to any industrial sector. Sumanth (1984) depicted the whole process of productivity cycles consisting of measuring, evaluating, planning and improving. The measurement is the first stage in order to increase the productivity in operations. Moreover, it is vital and can be seen on the argument raised by Peterson (2000), who said 'what gets measured gets improved', and by Chrysostomou (2000) from the British Research Establishment, who stated that 'to manage, you must measure, if you do not, you are only practicing'. Evidently, measurement is a vital component in the productivity improvement agenda and its accuracy of subsequent stages depends on the accuracy altitude of measurement stage. Broadly, productivity can be categorized as single factor productivity that links an output measure to a single measure of input or multifactor productivity, in which a measure of output is associated with a bundle of inputs (Wazed and Ahmed, 2008). Another differentiation, of particular relevance at the industry or firm level is between productivity measures relating some gross output measure to one or several inputs and those which uses a value-added concept to capture movements of output. Multifactor productivity measurement helps disentangle the direct growth contributions of labor, capital, intermediate inputs and technology. Multifactor productivity measures in manufacturing describe the relationship between output in real terms and the inputs involved in its production. These exclude intermediate inputs between manufacturing establishments from both output and inputs (Bureau of labor Statistics, 2014).

Multifactor productivity measure is not useful to measure individual contribution of inputs. However, this is an important tool for reviewing past growth patterns and for assessing the potential for future economic growth. Indeed, productivity is a measure of effectiveness and efficiency where organizational resources (inputs) are consumed to produce products and/or services (outputs) (Schroeder, 1985; Slack et al, 2001). This definition is clarified further by indicating that productivity measurement (change) is aggregated and concerned with measuring how the ratio Y/X changes over time, where Y measures an aggregate output and X measures an aggregate input (Sumanth, 1998; Chambers and Pope, 1996; and Heap, 2007). In this connection, productivity measurement is stated to be both a measure of input usage and an evaluation concerning whether or not input usage is growing more rapidly than output production. However, the difficulty of measuring productivity is how to construct the indexes of inputs and outputs as each factor possesses a weight corresponding to its individual contribution (Mohnen and Hall, 2013). That is why it is necessary to know the exact functional form of the production function to construct exact indexes in measuring multifactor productivity according to their contribution. Productivity growth is the key to sustained economic expansion, and therefore, measuring productivity is becoming important to economists and policy makers alike irrespective of industrial sectors. The accurate measurement of productivity growth plays a vital role in providing the information that top management of a company needs to put forth better policy making and operational strategy development. The debate lies in determining the acceptable figures of productivity growth for a company to survive and grow. A study shows that the average multifactor productivity growth in US manufacturing (from 1949 to 1992) was just above 1, while the growth in Apparel and related products manufacturing sector is 1.26 (Gullickson, 1995).

The review of the reported literature and experiences on productivity measure indicates that measures have differential complexity and practical usage. Single factor productivity (for e.g. labor productivity) measure can address the performance of the specific factor in connection with output. Whereas 'Total factor productivity' measure mirrors the collective performance of all input factors in connection with output. However, it does not ensure the performance of individual factor. So, if an organization wants to verify the performance of each individual input factor, single factor productivity measure would be a better option. On the other hand, if it focuses on the overall performance of a business unit, the total factor measure would be sufficient. Thus, the utilization of different productivity measures depends on organizational settings and business

strategy. In terms of productivity measures, this research aimed at verifying the applicability of different measures to improve operational performance.

3.0 Research Methodology

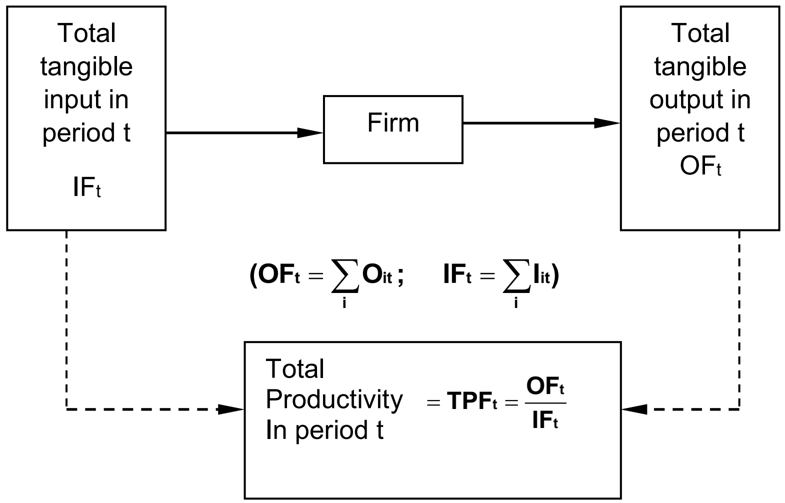
3.1 Tools and techniques for measuring productivity

There are various approaches to measure productivity in manufacturing organizations. Normally, economists, engineers and managers use different approaches in measuring productivity at the firm level. The choice of the productivity approaches depends upon the nature and aims of the study undertaken. In this study, total productivity model (TPM) approach that considers the impact of all input factors on the output in a tangible sense has been used as a total productivity measure and a set of partial productivity measures. Total productivity, as defined in the TPM (Sumanth, 1985), is

$$\textbf{Total productivity} = \frac{\textbf{total tangible output}}{\textbf{total tangible input}}$$

Where, Total tangible output = value of finished units produced + other income, and Total tangible input = value of (human + material + machine + energy + other expense) inputs used.

Fig. 3.1: Total productivity of a firm, F as a ratio of tangible output to tangible input (Slack et al, 2001).



Total productivity as a ratio of tangible output to tangible input for the product i and the button manufacturing industry, F in a time period t have been illustrated in the Figs 3.1 and 3.2 respectively. Again, the total productivity index for the button unit in period t $(TPIF)_t$ is defined as

$$TPIF_t = \frac{TPF_t}{TPF_0}$$

where, $TPF_0 = \frac{OF_0}{IF_0} = \frac{\sum_i O_{i0}}{\sum_i I_{i0}} = \frac{\sum_i O_{i0}}{\sum_i \sum I_{ij0}}$ $\quad TPF_t = \frac{OF_t}{IF_t} = \frac{\sum_i O_{it}}{\sum_i I_{it}} = \frac{\sum_i O_{it}}{\sum_i \sum I_{ijt}}$

Similarly, the total productivity index for a product i in period t $(TPI)_{it}$ is defined as

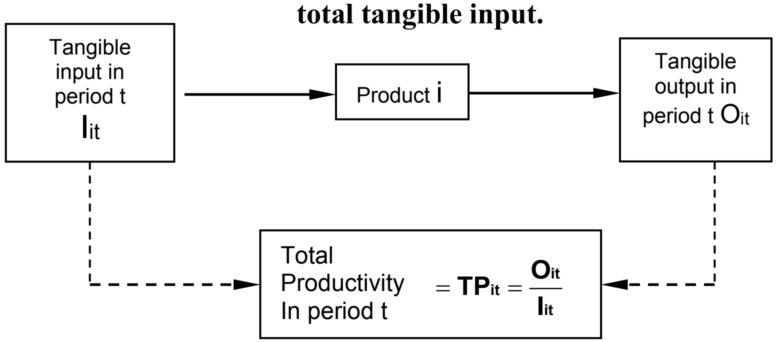
$$(TPI)_{it} = \frac{TP_{it}}{TP_{i0}}$$

$$TP_{it} = \frac{O_{it}}{I_{it}} = \frac{O_{it}}{\sum_j I_{ijt}} = \frac{O_{it}}{I_{iHt} + I_{iMt} + I_{iM/Ct} + I_{iEt} + I_{iXt}}$$

$$TP_{i0} = \frac{O_{i0}}{I_{i0}} = \frac{O_{0t}}{\sum_j I_{ij0}} = \frac{O_{i0}}{I_{iH0} + I_{iM0} + I_{iM/C0} + I_{iE0} + I_{iX0}}$$

Based on the data and the type of the organization, Total Productivity Model (TPM) developed by David J. Sumanth (1985) was selected to measure the total productivity indices for the whole production unit and a set of five partial productivity indices. It was also used to specify the particular input resources whose utilization were not at a satisfactory level and therefore, required corrective actions.

Fig 3.2: Total productivity of product, i as a ratio of total tangible output to total tangible input.



3.1.1 Weighted Analysis

The total productivity of a firm can be expressed in terms of the total productivities of its products and also in terms of the partial productivities of its different input variables. Such expressions are helpful in the Weightage analysis of the button unit. With the help of these expressions it would be possible to identify which product is contributing more in the total productivity gain of the button unit, thus enabling the management to make important strategic decisions in product management.

From definition, the total productivity of product i is the ratio of total output value of product i to the total input cost that is incurred in producing this output (Andersson, 1996). Thus

$$TP_i = \frac{O_i}{I_i} = \frac{O_i}{\sum_j I_{ij}} \text{----------------(1)}$$

Again partial productivity of product i with respect to any input factor j is the ratio of the total output value of product i to the input cost of factor j. Thus

$$PP_{ji} = \frac{O_i}{I_{ij}}\text{; for all j. ---------------(2)}$$

From equations (1) and (2), total productivity of the button manufacturing industry is calculated as

$TPF = \sum_i (TP_i) \times \frac{I_i}{IF}$; Where, IF is the total input of the firm.

$\Rightarrow TPF = \sum_i (TP_i) \times W_i$ -----------(3) ; where, $W_i = \frac{I_i}{IF}$

W_i represents the fraction of total input for product i with respect to the total of all such inputs combined for the N products manufactured by the production unit.

From the equation (3), it is evident that the total productivity of the production unit is weighted sum of the total productivities corresponding to each of the products. Equations (1) and (3) are useful for weightage analysis of the button production unit. Through this analysis, the particular input factors can be specified whose proper and satisfactory utilization would improve the productivity level of the button production section as a whole.

3.1.2 Relationship between profit and productivity

The relationship between the profit and total productivity has also been established with a view to understand the changes in profit due to changes in total productivity. Besides, this relationship shows the minimum total productivity level that need to be achieved by the firm if it wants to run its business profitably.

If P_i is the profit of product i, then the output of the firm can be written as (Sumanth, 1985)

$$O_i = I_i + P_i$$

$$\Rightarrow P_i = (TP_i \times I_i) - I_i$$

Profit of the firm,

$$PF = \sum_i P_i$$

$$\Rightarrow TPF = \frac{PF}{IF} + 1 \text{-----------------} (4)$$

As shown in equation (4), linear relationship exists between the profit and the productivity gains at the firm level.

3.2 Selection of the case studies

Three case organizations were selected to develop overall scenario about productivity measures. All organizations are engaged in global business. They export their products to international markets. Case-A organization was **e**stablished in 1982. The number of regular employees is 684 and part-time employees are 630. It produces mainly textile products. It exports its products to the markets in Italy, U.K, Netherlands, Spain, France, Canada, Japan, Korea, and Australia. This organization is the most established local retail brand in Bangladesh. It is the pioneer in developing a market for Bangladeshi craft and is a trendsetter in the local fashion industry. Case-B organization was established in 1990. The number of full-time employees is 700. It is vertically integrated with Knitting, Dyeing, Spinning - Lean based 100% compliant Ready Made Garments Industry. The main valuable customers are Tesco (USA), Carrefore (USA), Auchan (UK), Gemo (USA), Azda (USA), George (USA). It produces all types of knit items including T-Shirt- long sleeve & short sleeve, Tank top, Pajama, Hooded Jacket, Polo Shirt, Shorts, all types of kids' items, Jogging Sets, Woman's Night Gown etc. Finally, Case-C was selected for in-depth longitudinal study to address all the objectives mentioned in this article. It manufactures

various essential products for RMG sector. It supplies the products to some apparel manufacturing organizations engaged in exporting their products to UK and USA markets. The organization also exports its products to foreign markets. Button is selected as the product because the button section is one of the most important production units of the studied organization. Buttons manufactured in this organization are of two types: sheet button and rod button. Among the various production units, the button unit employs around 50 percent of the total strength of the organization and was responsible for the highest capital investment. Of the 88 employees working in the button unit, 18 are skilled, 32 are semi-skilled and 38 are unskilled. Buttons are manufactured against customer orders. Those buttons which are nonconforming to the specific customer requirements are usually sold in the local market at a reduced price. An additional income is also generated by selling the wastage of sheets to brickfields. This happens only in the case of sheet button manufacturing. The annual revenue of the button unit is found to be Tk 48.5 million. This case organization is, therefore, considered as a better representative of similar company operating in Bangladesh. For any benchmarking purpose, it would deem an ideal case. The research study has been conducted from June, 2013 to December, 2014. Full access to all relevant data sources was ensured by the case organization. To capture all activities and cost centers involved in button manufacturing, the production process of button manufacturing is studied first. The steps and activities involved in button manufacturing are shown in Fig 3.3.

1. Raw material mixing: In this step different raw materials in required proportion and quantities are mixed together in a drum equipped with motor driven mixture machine.

2 (a) Casting: this process is used only for sheet button. The mixture of raw materials goes through the casting process to form a thin sheet. Usually, 1.9 kg of raw material mixture is needed for making a sheet of 1 mm thickness. **(b) Rod making:** in case of rod button, the mixture is poured in tubes of a rod/horn making machine. Generally, 118 grams of raw material mixture are required to fill a tube. The length of the tubes is usually 900 mm. It takes several minutes for the liquid mixture to become a rod. It is then withdrawn from the tube.

3. (a) Punching: The produced sheets are punched in a punching machine to produce sheet button blanks. Usually, 12096 blanks are produced from a sheet. **(b) Rod cutting:** The fabricated rods are cut into blanks of rod button using TBO cutter.

4. Drilling and Turning: This is the most important step in button manufacturing. In this step, holes are made in the blanks of button by drilling and required shape and size are achieved through turning. Customized designs are made on customers' demand.

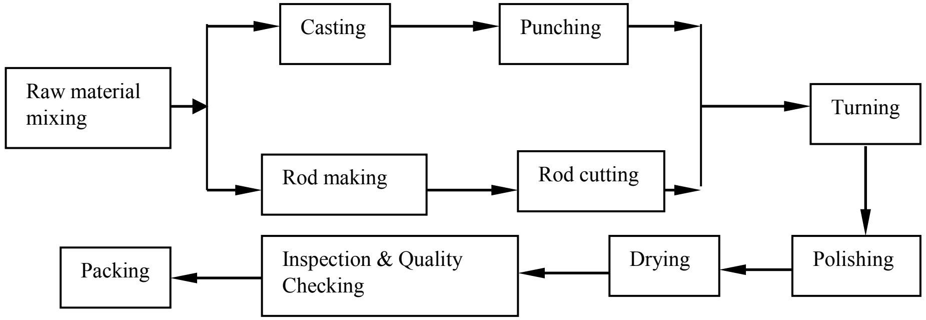
5. Polishing: Buttons produced by turning are polished in a rotating drum of a polishing machine. Different chemicals such as wax, acetone, pumice powder, trichloroethylene etc. are used as per requirements of a particular design.

6. Drying: The buttons are then dried in a hydro-dryer machine.

7. Inspection and quality checking: After drying, the buttons are fed to the speedy machine and defective buttons are separated from good ones.

8. Packing: Finally a semi-automated process is used to pack the buttons following the order quantities.

Fig 3.3: Flow diagram of button manufacturing process



The production process of button includes eight key steps and associated activities that involve human and mechanical inputs. The performance of human, machine, material and power (electrical energy) play vital role in productivity. For this study, five specific inputs factors including human, machine, material, energy and other expenses are, therefore, considered while calculating different measures of productivity. The price of the products produced in exchange of given inputs is considered to be an output measure.

3.3 Data Collection

At first, structured interviews with the top management of each organization have been carried out in three case organizations to explore how they measure their productivity and how this index has been applied in decision making about operational performance. Then, longitudinal study has been carried out in Case-C over the time. A standard questionnaire was developed to collect quantitative and qualitative data regarding inputs and outputs of two types of products. As planned, five input factors, man, machine, material, energy (electricity, diesel etc.), and other expenses e.g. the packaging, distribution, and administrative costs, were structured into the questionnaire. Structured interviews with key persons like production in-charge, chemist, supervisor and accountant were conducted to collect product specific information particularly the quantity of various input factors used and their associated cost involvement. Direct observation of the production processes was used to note down time and cost information. Moreover, different archived documents were studied whenever necessary. Formal and informal interviews with supervisor, machine operators and labor were conducted to supplement the information collected. From these interviews and direct observation mostly qualitative data regarding problems and obstacles in manufacturing processes of two products were collected. The financial and other relevant data were collected for two different time periods: for base period, it was June 2013 and for current period, it was June 2014.

4.0 Results and Discussions

4.1 Overall scenario

The overall scenario of the studied organizations regarding the productivity measurement practice is found substantially weak. The organizations in practice do not measure productivity applying any scientific principles. They measure only the annual profit and continue their business accordingly. It is noteworthy to mention that all the organizations run on abstract concept about inputs and outputs. For example, while seeking the answer of a query on how the organization assess the productivity of individual product, the Accountant from Case-C stated "I can provide you with the unit total cost of purchasing raw materials, salary and wages given to employees for a particular period, machine depreciation, energy cost and other expense, similarly we can provide the revenue of sale of products for the same period, but cannot provide you with product specific information at unit level". Similar comment is made by production in-charge "I can tell you how much raw material and human effort is needed to produce a product. But, I cannot tell you the exact contribution of various inputs to a particular product. In fact we focus on target production for a specific time period." Interesting to note that they could indeed measure the productivity as they have data in some form, but they do not bother to measure the productivity as a strategic tool. Besides, since the management does not measure partial productivity, they fail to identify the input factors that need special attention for improving operational performance. However, considering the lack of practice in productivity measurements in the studied organizations, this study measured afresh both the partial and the total productivities of each product in the base period and current period for Case-C. The following section presents the specific findings.

4.2 Findings about productivity measures

The total and partial productivities of 'sheet button' and 'rod button' for two different time periods e.g. period 0 (base period) and period 1 (current period) are calculated and presented in Table 4.1. Through these total and partial productivity measures, whether a product is profit making or not can be figured out and in so doing, provide strategic planners with valuable information to help make decisions on diversification and phase-out of products. By using data given in the table, the efficiency of particular inputs can also be interpreted.

From Table 4.1, it is evident that there is a positive growth of productivity as the total productivity index is found to increase over the study period for both the sheet button and rod button by 3.1% and 25.9% respectively. It confirms that productivity of the rod button unit is substantially more than that of sheet button unit. The result demonstrates an impressive average gain in total productivity of the whole button manufacturing unit and hence, indicates the efficient utilization of its associated resources at gross level. However, the partial productivity indices show the actual status of use of different input factors. For instance, as shown the aforementioned table, despite the fact that partial productivities of material and other expense of the sheet button decreased, the total productivity increased over the time.

Table 4.1: Total and partial productivities for individuals products.

		Sheet Button		Rod Button	
		Base period	**Current period**	**Base period**	**Current period**
Total productivity:	Value	2.117	2.218	2.201	2.771
	Index	1.000	1.031	1.000	1.259
Partial productivities:					
Material productivity	Value	3.373	3.286	3.582	3.953
	Index	1.000	0.974	1.000	1.104
Human productivity	Value	12.988	17.167	14.433	21.291
	Index	1.000	1.322	1.000	1.475
Machine productivity	Value	18.007	22.159	15.884	26.297
	Index	1.000	1.231	1.000	1.656
Energy productivity	Value	34.897	38.584	35.395	40.681
	Index	1.000	1.106	1.000	1.149
Other expense productivity	Value	67.603	57.988	68.623	72.922
	Index	1.000	0.858	1.000	1.063

At the same time, total productivity of the rod button was found to increase following an increase in partial productivities of all its input factors. From these facts, it can be inferred that the rod button manufacturing performs better than the sheet button. Further investigation reveals that, as stated by the management, partial productivities in material and other expense terms of the sheet button unit decrease due to complicated design and color characteristics of the sheet buttons produced in the current period. A large amount of raw materials gets wasted since after getting a customized order a trial and error method is used to achieve the required characteristics of sheet buttons. These results also indicate the fact that other expense factors (packing, distribution and administrative expense) are increasing faster than the output values of the sheet button. Although partial productivities of human, machine, and energy factors for sheet button increase by 32.2%, 23.1%, and 10.6% respectively, the growth in total productivity of the sheet button is found to be only 3.1% in current period as compared to benchmark value. These two input factors, therefore, need more attention by the management of button manufacturing unit and their proper utilization need to be ensured so as to improve the total productivity of individual product as well as the button manufacturing unit.

Now, if the total productivity of the button manufacturing unit as a whole i.e. the total productivity at firm level is only considered, some information might appear anomalous. In this regard, the results presented in Table 4.2 could be analyzed. As can be seen that despite the decrease of material productivity of the sheet button, integrated material productivity is increasing. This means that due to integration, materials performance for the sheet button is hidden in the value. The organization might have misleading information that the overall material utilization is satisfactory, though this is not the reality. In case of the factor like other expenses, the result shows that the partial productivity decreases by 7%. From this information alone, it is difficult for the organization to identify the products causing this productivity loss. However, this aspect can easily be identified from Table 4.1. Moreover, from Table 4.2, it can easily be ascertained that there is a 12.5% increase in total productivity of button manufacturing unit despite a little decrease in partial productivity of other expenses by 6.9%. Total productivity could have been higher if the expenses incurred by the non-value added activities could be reduced. The management of the button manufacturing unit thus has a very objective picture ahead of it to monitor productivity improvements in the future.

Table 4.2: Total and partial productivities of the button manufacturing unit as a whole.

		Base period	Current period
Total productivity:	Value	2.144	2.412
	Index	1.000	1.125
Partial productivities:			
Material productivity	Value	3.439	3.604
	Index	1.000	1.048
Human productivity	Value	13.432	18.619
	Index	1.000	1.386
Machine productivity	Value	17.247	23.657
	Index	1.000	1.372
Energy productivity	Value	35.059	39.401
	Index	1.000	1.124
Other expense productivity	Value	67.936	63.196
	Index	1.000	0.930

It can be said that the organization is running well in terms of its productivity growth. However, it cannot be confirmed which of the input factors is more contributory to the total productivity. From the management's point of view it is important to know which factors should receive more attention. In this context, further analysis was conducted for weighted contribution. The weighted analysis has been accomplished by calculating different weightage for the two products-sheet button and rod button, and for the five input factors – material, human, machine, energy, and other expense. The goal was to identify the particular input factor whose proper and satisfactory utilization can improve the productivity level of the button manufacturing unit as a whole. The overall result of weighted analysis is presented in Table 4.3.

From Table 4.3, it is evident that raw material is the most weighted factor among the five input factors for both the individual product and the button unit as a whole. Weightage of the material input factor is found to be notably greater than the combined weightage of all other factors. The second most weightage to be given is the utilization of the human resources. The raw material in combination with the human factor contributes almost 80% of the total inputs. It can be seen that the contribution of materials for both products increases over time. These results indicate the fact that the management should focus more on efficient utilization of raw material and human resources involved in button production so as to enhance the total productivity of the button manufacturing unit and to maintain it. However, a question still remains as to which product the management should be more concerned with. As a response to this, it can be stated that the management should work more with sheet button manufacturing.

This can be inferred from the results obtained for relative contribution of each product to total productivity. The results are shown in Table 4.4.

Table 4.3: Relative weightage of the input factors.

Input factor	Weightage					
	Sheet Button		Rod Button		Button unit	
	Base period	Current period	Base period	Current period	Base period	Current period
Material (W_M)	0.6275	0.6749	0.6146	0.6583	0.6233	0.6691
Human (W_H)	0.1629	0.1292	0.1525	0.1301	0.1596	0.1295
Machine ($W_{M/c}$)	0.1175	0.1000	0.1385	0.1053	0.1242	0.1019
Energy (W_E)	0.0606	0.0574	0.0621	0.0681	0.1611	0.0612
Other expense (W_X)	0.0313	0.0382	0.0320	0.0380	0.0315	0.0381

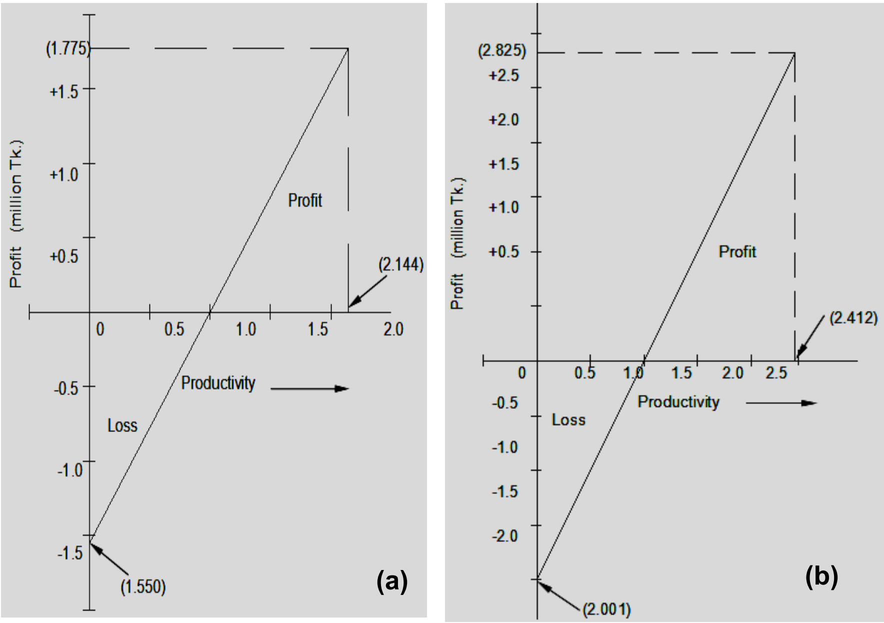
Table 4.4: Weightage for the individual products

Product	Weightage	
	Base period	Current period
Sheet Button	0.6791	0.6495
Rod Button	0.3209	0.3505

From Table 4.4, it is clear that the weightage of sheet button is almost double that of rod button. This indicates the fact that the organization needs to focus more on sheet button instead of rod button for further improvement of total factor productivity of button manufacturing unit. It would even be better if the organization work with both products. In conclusion, it can be said that the management should take necessary measures to enhance the performance of material utilization and the human resource engaged in sheet button manufacturing with the aim of improving the total productivity of the button unit to a significant level.

Further analysis has been carried out to find the relationship between productivity and profit of the organization. The ultimate goal was to figure out the loss or profit situation in the context of total productivity for each product. Figs 4.1(a) and (b) illustrate the relationship between the profit and productivity of the button manufacturing unit for the base and current periods respectively. From the figures, it is evident that the button manufacturing unit incurs the maximum financial loss if its productivity becomes zero. The maximum profit that the manufacturing unit can make is theoretically unlimited depending on the level of total productivity it can reach. The total productivity gained at the firm level, however, ought to be greater than unity if the button manufacturing unit wants to make profit. The higher the total productivity of the firm is from unity, the more is the profit. Besides, the firm has to maintain its productivity level as high as possible in order to stay in business in today's highly competitive open market. For the studied organization, total profits were found to be Tk. 1.775 million and Tk. 2.825 million for its firm level productivity of 2.144 (in base period) and 2.412 (in current period) respectively.

Fig. 4.1: Profit analysis of the button manufacturing unit for (a) base period and (b) current period.



4.3 Discussions

The previous section presented the key findings in the context of the research objectives. It presented the existing scenario about the application of productivity measures of the case organizations. It discusseed the numerical figures of productivity measures (partial and total) calculated in two different periods during the research intervention. It is noted that the organization does not follow any scientific method to assess its productivity growth either through partial or total productivity. However, after the intervention of this research, the status of productivity measures in two different periods has been identified. The study

confirms that the Case-C organization is performing relatively well in the context of measured values of total productivity of both products. However, it is not performing well in the context of partial productivities. In fact, it is losing its potential to grow further because of decrease in partial productivity growth for different input factors, materials in particular. This has been reflected through the measures of partial productivities. This study concludes that total productivity measure cannot alone be a strategic and/or operational decision making tool as it does not reflect the actual operational performance. The productivity growth rate using total factor productivity measures can only indicate how the organization is performing overall. But, this cannot confirm how the input factors individually are contributing to the total growth. Thus, the organization cannot recognize the true potential of the input factors for productivity improvement at large as it does not measure the partial productivities of all input factors and does not take their comparative measures for productivity growth. Thus, it can be concluded that both measures, partial and total, should be used for strategic and operational decision making while considering productivity and its growth for any firm.

This research also concludes that partial productivity measures (absolute and growth) are very useful tools to assess the operational performance of manufacturing organization as these clearly indicates the actual performance of input factors for creating the desired outputs. The strengths and weaknesses of the organization concerning the utilization of the input factors become visible to the decision makers. For an example, a negative growth of material productivity for sheet button manufacturing is found to be 2.58% (Table 4.1), while overall partial productivity growth of the button unit increases by 4.8% (Table 4.2). Though the overall productivity growth of materials is found somewhat satisfactory, this will surely be misleading information concerning the performance measurement of material utilization, which is reflected through the material productivity growth for sheet button. Regarding the negative growth of material productivity for sheet button, further investigation is likely to be carried out to identify the root causes. Further investigation reveals that the studied organization produces buttons on made-to-order basis fulfilling customer demands based on the specifications of their supplied samples. Depending upon the color and other specifications, the chemists first confirm whether the sample button is sheet or rod button. Accordingly, they proceed for mixing of the raw materials applying trial and error method for obtaining the required color and other specifications. As a result, a huge amount of raw materials and value adding time are wasted. This means that the more the customized orders the more the material wastage. This happened in the current period for manufacturing sheet button. The material productivity consequently went down. Surprisingly, the organization itself has no way to address the issue as it does not measure or even preserve any documentation regarding the wastages. Thus, it is unaware of what is happening in terms of productivity. In connection with labor productivity, it is found that no formal training is provided to supervisors, machine operators, helpers on their respective jobs. Informal in-house training is provided to few people. As a result, most employees spend more time than the estimated one for performing their assigned tasks. Moreover, the quality of work becomes substandard most of the time. Another issue discovered is that some employees frequently visit their families at the employee quarters located inside the factory boundary. This eventually is responsible for losing significant productive labor hours. It is another indicator of unprofessional attitude of the employees. Unhygienic and toxic working environment in some workstations are also responsible for decreasing human productivity.

Turning machines are used to create different designs for buttons. Since, each design requires special attachment and setup, considerable amount of time is spent for changeover. Thus, machine productivity growth cannot reach its potential. Considerable number of defective buttons is observed to be produced during the studied period that contributed to the loss of partial productivities. Majority of the machines used in the manufacturing of button are electrical power driven. The productivity of energy depends largely on the effective operation time and efficient utilization of the machines. Productivity of other expenses again depends on effective operational performance of the button manufacturing unit. It is noted that through the reduction of various wastages, the productivity of other expenses increases. Productivity growth rate is an important decision parameter. There is significant relationship with productivity growth and the total profit. It is found from the study that total profit of the case organization varies positively with the increase in total productivity. However, the organization should not be happy with the constant productivity level. Rather, it should strive to increase its productivity growth, which is what the organization gains over the period unknowingly and hence, stays in the business.

This article has overviewed the findings of the case study in light of three research objectives. The practical insights of the productivity measures can hopefully add value and assist the researchers and the practitioners working in the field of productivity measures. The overall status of the productivity measures and practical scenario about the utilization of productivity measures of the case organization can be taken as true reflection of the leading manufacturing organizations in Bangladesh. The findings of the study can directly be useful for the policy and decision makers of the respective sector. Simple tools for productivity measures and their interpretative applications in operational and

strategic decision making can be very useful for productivity improvement in the manufacturing sector in Bangladesh. Moreover, the necessity of simultaneous application of partial and total productivity measures can enrich the knowledge of existing literature.

4.4 Improvement Strategies

The Case organizations should utilize the productivity measures for both partial and total productivity. They should focus more on productivity improvement and productivity growth instead of focusing on total profit, while developing strategic and operational plans and assessment. In Case-C, although the growth of total productivity of button manufacturing seems alright currently, there is more potential to for further increase. In other words, if the organization does not improve its material utilization in the button manufacturing, especially for sheet button, it will continuously lose the cost advantage as raw material used for both the sheet and rod buttons is the most cost consuming input factor. The organization should take necessary measures to improve the utilization of other input factors. In this context, some easily implementable recommendations are discussed. To reduce the wastage of raw materials incurred in the mixing step, spectrometer machine can be used which, by scanning the sample button, can directly specify the quantities of raw materials required to achieve its desired color and other characteristics. This will also reduce the time required in the mixing step. Proper documentation should be incorporated to account for all the information regarding material utilization. People are the most important asset of an organization and their attitudes and motivational drives are a major factor in any successful organization. Undoubtedly, people are the most important and promising area of productivity improvement for any organization irrespective of available technology and resources available at its disposal. From the case experience, it is found that employees play major role in connection with increase or decrease in productivity. Appropriate training to the employees should be provided to increase their respective performance and to make them skilled. Some motivational techniques can be incorporated to enhance their loyalty towards the organization. To make the total work force more effective a “Job Card” system can be helpful. The job card for the studied organization might contain such information as identification of the worker, identification of the job to be performed by the worker, target level, time of starting and finishing each job, and achieved level. As a result, the performance of each worker can be measured easily and, in case of any faulty production, responsible workers or staff can be identified and necessary steps can be taken for their performance improvement. Working environment needs to be improved for the productivity improvement of people. Proper drainage system and sufficient ventilation should be the first priority. In the context of increasing machine productivity, production setup should be effectively planned so as to produce as much buttons as possible either in a single setup or with a minimal change in setup. This can be done by grouping the orders of the same or similar design before starting the turning operation. Moreover, while establishing a new setup for a particular product, setup time reduction techniques must be implemented. In this way, the production throughput can be increased minimizing the setup time which, in turn, would improve the total productivity of the button manufacturing unit.

To increase the performance of two other input factors, the organization needs to record the root causes of underutilization and thereby take necessary measures. For instance, if the organization can reduce the total production time for the same output, it could save energy. At the same time it would reduce the factory overheads. This would eventually save other expenses. From the case study, it is clear that there is some room for improvement of energy and other expenses. The organization can increase its productivity with the increase of the proper utilization of these input factors. The most important finding of this research is that an organization should assess its operational performance and effectiveness through the appropriate measures of productivity. Otherwise, the organization would develop its business strategy based on misleading information. For example, total productivity measure can point out the overall performance of an organization. But, it cannot specify the actual operational performance of the individual input factors. Therefore, partial productivity measures along with their relative contribution to input can be very useful tools for productivity improvement. Like the case organization, other organizations should measure the partial productivity of all major input factors and take necessary action accordingly. Major contributory input factor should be given more emphasis as it has more impact on total productivity.

5.0 Conclusions

Productivity improvement is an important issue of any organization to maintain required business growth in highly competitive and dynamic business environment. Therefore, productivity should be planned, measured, improved, and maintained. This paper elaborates the issues addressed in the research objectives. Firstly, it presents the existing scenario about the application of productivity measures (both partial and total) in the case organizations, which represent the manufacturing SMEs in Bangladesh. Secondly, it discusses the necessity of partial and total productivity measures for strategic and operation

decision making of a manufacturing firm. It is found that the studied organizations solely rely on total loss or profit margin while considering overall business performance. The managers of the organizations possess abstract knowledge about partial productivity measure even though they do not scientifically apply this method in practice. They lack expertise manpower for applying the productivity measures in decision making. The findings from the longitudinal study in Case-C confirm that inefficient use of raw materials, lack of sufficient skilled workers, lack of proper communication between various sections, lack of proper supervision are common. These result in underperformance. Based on the findings and analysis, this paper highlights some improvement strategies. The strategies are expected to be fairly useful in improving the productivity level. These can also be applied by other organizations involved in similar activities. After measuring both partial and total productivity of the firm over two periods, this study found that the firm is operating relatively well with regards to one product. But, it is underperforming with regards to the other product. Unfortunately, the latter product incurs more capital investment, has more potential to grow. Firm-wise total productivity growth is found to be about 12%, in which sheet button contributes 3% and the rod button contributes about 25%. Since the weightage of input contribution of sheet button is almost double that of rod button, total productivity growth of the firm becomes significantly low. The organization needs to focus more on sheet button to increase its overall firm level productivity. It is noteworthy to mention that partial productivity value or total productivity value alone cannot reveal the actual scenario of operational performance of a firm. Individual measure can sometimes mislead a strategic decision, which is what is reflected in Table 4.1 and Table 4.2. We see that the value of total productivity cannot ensure the exact contribution of individual inputs in productivity gain, which is otherwise reflected in partial productivity measures. To identify the potential of individual input factor, the partial productivity measure is a must. However, to measure the periodic productivity growth, the total factor productivity measure is the ultimate option. Again, for an organization that produces a number of products in the same organizational settings, the total factor productivity would be the good tool to compare the performance and contribution of individual products. Therefore, this study concludes that simultaneous application of both productivity measures (total and partial) should be the best option in the context of assessing the operational performance of a business unit. The methodology used in this research to assess and compare different productivity measures can be equally effective for similar manufacturing organizations.

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