Review of Productivity Measurement and Improvement procedures in Small and Medium Scale Manufacturing Industries

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Abstract: **Most performance information in organizations is traditionally based on financial result measurements. These models are excessively complicated methods and are not widely used. Partial productivity ratios are widely used in industry but as such they are too narrow to give a comprehensive picture of the productivity improvements at the business unit level. The article is a review of productivity measurement and improvement procedures in small and medium scale manufacturing industries in the area of management in small and medium scale manufacturing industries at the business unit level.**

Keywords: Productivity; industries; partial

1. INTRODUCTION

In recent years the pressure of global competition has compelled firms to focus on strategies for productivity improvements. Improving productivity, or any other important factor, is difficult without knowing the impact of the decisions made. This is why we need performance measurement. Most performance information in organizations is traditionally based on financial result measurements. Financial measures reveal the results of the actions already taken, and non-financial operational measures tell us more about the drivers of future performance. In this context, total productivity measurement is needed in order to improve the internal efficiency and thereby the competitiveness of a business unit. Total productivity is commonly used as the measure of competitiveness at the business unit and even at the national level. At the business unit level, productivity measures belong mainly to the group of non-financial measures. Any of the operational stages of a business unit, including production, purchasing, marketing, finance, sales, and support services, contribute to total productivity. At the business unit level, most firms have not implemented adequate productivity measures. This is somewhat surprising, because most productivity efforts have recognized the importance of measurement as a part of productivity improvement.

The article concentrates on review of productivity measurement and improvement procedures in small and medium scale manufacturing industries in the area of management at the business unit level, since productivity advances are considered mainly as the consequences of managerial acts. Measurements can rather be seen as tools to evaluate the performance or the level of operations in organizations for adequate action. Performance measurement is a critical component in the general management process. Reliable measurement systems constitute a sound basis for continuous monitoring and control of organizational performance. This enables the managers to point out the bottlenecks and potential factors of improvement and to evaluate the success of previously implemented projects. Productivity is a measure of performance for the production activity and refers to the amount of output produced per unit of input. It is possible to express this via the following equation:

Productivity = Output / Input

Here, output stands for a weighted sum of various products, whereas input stands for a weighted sum of various inputs. Profitability is usually the main concern of the managers of profit maximizing firms. It is a measure of utilization of financial resources. Increases in profitability may be due to price recovery as well as productivity improvements. Price recovery shows the firm's ability to reflect the input cost changes onto output prices. Unless the firm has a monopoly in the market, price recovery is imposed by market conditions and is uncontrollable. Profitability increases based on productivity improvements are much more reliable in the long run than the ones motivated by just increasing the output prices. It is universally recognized that most organizations - including companies and non-profit organizations are basically input - output systems. This is also valid in the case of the subsystems of organizations, since any process can be seen as an input - output system. Most productivity models and definitions of productivity aim to consider the efficiency of these systems either directly or indirectly. Productivity is defined as follows:
"Productivity is a relationship (usually a ratio or an index) between output (goods and/or services) produced by a given

organizational system and quantities of input (resources) utilized by the system to produce that output".

In the case of only one output and one input, the situation is straightforward. In a more realistic situation when a firm produces multiple products and uses multiple inputs, it is necessary to aggregate the set of outputs and inputs so that the expression in numerator and denominator are scalar values. The same issue applies to measuring productivity changes. Inter-firm differences in productivity can be caused by factors which may or may not be influenced by the firms, such as inaccurate measurement, differences in production technology, in the scale of production etc.

Productivity has several sub-concepts. These are total productivity, total factor productivity and partial productivity. Total productivity is the most comprehensive productivity concept, since it is defined as the total output over the total input used to produce the output. At the business unit level total productivity measurement, monetary equivalents are used to express the amount of output and different inputs to eliminate the effect of inflation. Monetary equivalents mean that the quantity of outputs and different inputs must be expressed in deflated currency units, i.e. unit prices that are fixed to base year prices. Because of this, the static value of total productivity cannot be measured in practice, but only the changes of total productivity can be captured. In the field of management accounting, most total productivity measurement methods aim to achieve the productivity ratio in one way or another. Production function - based approaches are not commonly used.

While the total productivity concept is used in productivity measurement at the business unit level, a more common concept at the macroeconomic level is total factor productivity. This is defined as the ratio of net output (excluding material from gross output) and the sum of labour and capital inputs expressed in deflated monetary units. The net output is also referred to as value added output. Consequently, total factor productivity is sometimes called value-added productivity, because the numerator of the ratio is deflated Value Added. Total Factor Productivity is mainly used in productivity measurement at the macroeconomic level. Intermediate inputs and outputs or inter-firm purchases, like material and energy are taken out to prevent double counting.

Partial productivity is the ratio of gross or net output to single factor input. This expression can be further classified by the type of input:

- Labour productivity.
- Capital productivity.
- Material productivity.
- Energy productivity.

The problem with partial productivity measures is that the output over single input ratio does not address the problem of factor trade-offs. Many of the productivity improvement efforts of a typical production organization involve trade-offs between the factors of production rather than manipulation of a single factor. On the other hand, partial productivity ratios are much simpler than total productivity measures, and they are widely used in industry.

2. IMPERATIVES

Concern for productivity is all pervasive and permits all sections of society. It is argued that an increase in productivity will generate more funds, increase the revenue of the state, which in turn can help in providing better services so as to improve the standard of living. Community leaders find productivity as an answer for an increased employment level. Economists consider productivity vital for economic growth and for an increase in the real income of all sections of society. Business leaders, managers and executives view productivity as an answer to increased competition and a means to cut down costs of production and improve profitability. Supervisors and engineers in industrial undertakings link productivity with meeting of schedules of production, reduced rejections, better quality of goods manufactured, decrease in expenses and improved yield of materials etc. Although each section of society can be viewed to have some interest in productivity, the perceptions have varied.

At the international level concern for productivity is principally aimed at establishing competitiveness against the produce of different countries in terms of quality, technology, services and cost of production. Concern at the national level is with basic emphasis to improve the living standards of the citizens. The policy makers have to find resources and funds for expense on welfare activities, education, health and medical services and other social needs of the society. Another dimension of concern at the national level is to conserve the scarce resources and to encourage deployment or use of available resources in such a way as to maximize the yield. Increased employment is another objective which is sought to be met. Productivity is considered as an index of economic growth.

At the enterprise level, main concern is towards utilization of resources so as to produce optimal results of performance. There is a direct relationship between productivity and economic transformation.

3. LITERATURE REVIEW

Vedat Verter et al.[1990] proposed an aggregate measurement model, based on historical data to explain past behavior of the unit of analysis and its performance criteria. Productivity matrix is constructed as a basis for productivity analysis. A hierarchical, dynamic, aggregate productivity measurement model is provided and outputs of the model are explained in terms of elements of the productivity matrix. The multi-factor productivity measurement model of this study enables analysis of the relationships between productivity, price recovery and profitability. James Odeck [2000], applied a new approach based on frontier production function to study productivity growth of the Norwegian Motor Vehicle Inspection Agencies. The framework is that of data envelopment analysis (DEA). The DEA approach defines a non-parametric best practice frontier and then measures effciency relative to that frontier. The productivity growth of a unit (agency) can then be measured by a Malmquist index as improved effciency relative to a benchmark frontier. The Malmquist indices for a sequence of years can consistently be chained and the resulting total productivity

growth indices for each agency can be calculated as indices for frontier productivity growth and indices for catching up with the frontier.

Hans LoK fsten [2000] developed a partial maintenance productivity index, in which minimization of maintenance costs is incorporated as a subgoal, based on the maintenance inputs called for an `optimal budget. These imputed maintenance costs do not have to be calculated separately, but emerge as a by-product of finding a high productivity index. In partial productivity model, the output prices of the produced products and input prices (maintenance costs) will change over time. Hannu Rantanen [2001] identified, about the internal factors which restrain the ability of the firms to improve productivity, and the meaningfulness of each of these obstacles. The main reason for this kind of treatment is the fact that internal obstacles form the only category of obstacles which is clearly under the control of the firm. A second problem area was the shortcomings in knowledge and education on productivity. Mika Hannula, [2002] argued, simple and commonly used partial productivity ratios may be used in an industrial business unit in order to measure total productivity. Total productivity measurement based on partial productivity ratios seems to be appropriate for a firm which has already implemented at least some partial productivity measures and would like to achieve a more comprehensive picture of its productivity improvement. Jinlong Ma et al. [2002] proposed, technical efficiency and Malmquist productivity indexes of a sample of 88 enterprises producing 72 percent of the industry's output were determined for the period 1989–1997. (DEA) approach and MALM were used to measure technical efficiency and the changes in productivity of China's iron and steel industry. Ashraf A. Shikdar [2003], determined the manner by which production standards or goals, performance or production feedback and monetary or wage incentive affected or moderated the relationship between worker satisfaction and productivity in a repetitive production task in a fishing industry. Prem Vrat et al. proposed, Performance Objectives-Productivity (PO-P) model; draws its strengths from the systems approach to management and Management by Objectives. It considered an organization i) with multiple objectives,

ii) to work as a system with interacting sub-systems. Iii) under the influence of an external environment acting as a supra-system. Imad Alsyouf [2007] illustrated the decision-maker to trace how an effective maintenance policy could influence the productivity and profitability of a manufacturing process through its direct impact on quality, efficiency and effectiveness of operation. It was proved that maintenance is not a cost centre, but a profit generating function. Yan-Qun He et al. [2007], examines the relationships among productivity, consumer satisfaction and profitability using the conventional statistical regression and the new fuzzy regression approaches. Also highlights that, firms should balance their efforts in productivity and consumer satisfaction, possibly by employing appropriate information technologies to improve productivity while without hurting consumer satisfaction, to optimize their profitability. P. Kuhlang et al. [2011] introduced, methodical approach connects Value Stream Mapping (VSM) and Methods-Time Measurement (MTM) and offers new distinct advantages to reduce lead time and increase productivity based on lean principles and standardised processes. The identification and exploitation of productivity potentials is realised by the joint application of VSM and MTM focusing the (work) methods, the performance and the utilisation of the processes (the dimensions of productivity).

4. CONCLUSION

Manufacturing sector constitutes the largest of industrial enterprises employing all the resources, principally the human and the capital. It is also the most organized segment. The origins of productivity measurement can be traced to the manufacturing sector when its need was immediately realized after the industrial engineers and the behavioral scientists proposed methods, tools, industrial engineering practices, the motivation theories to increase the output per unit of input. It is therefore; appropriate to demonstrate application of the proposed productivity measurement and Improvement approach in the manufacturing sector.

Despite the fact that a number of total productivity measurement methods for business unit level have been presented in the literature, these models are excessively complicated methods and are not widely used. Partial productivity ratios are widely used in industry but as such they are too narrow to give a comprehensive picture of the productivity improvements at the business unit level.

5. FUTURE SCOPE

Productivity measurement approach of an organization as a system considering its sub-systems and key processing areas requires further attention. Unutilized and surplus resources in the organization can be addressed in the productivity measurement model. Development of a universal productivity measurement model, equally applicable for small, medium and large scale industries. The model should project optimal output attainable.

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