In Search of a Suitable Productivity Measurement Model for Smes with Special Emphasis on Systems Approach

Prof. Vaishali Maheshwari1, Dr. D.T. Manwani2, Dr. Snigdha Banerjee3
1Acropolis Institute of Technology and Research, Indore, Madhya Pradesh, INDIA
2Sanghvi Institute of Management, Indore, Madhya Pradesh, INDIA
3School of statistics, D.A.V.V. Indore, Madhya Pradesh, INDIA

ABSTRACT
Productivity measurement has travelled a long way since the early period when it was first defined as the ratio of outputs to inputs. Since productivity is directly related with profit and in current scenario profits are getting thinner due to competitive environment, efficient supply chain management, use of information systems etc. is of interest to all. A lot of research has been done on productivity measurement till now. But since the society and the organizations are facing new challenges and opportunities all the time due to dynamic work environment, changing nature of operations, change in types of outputs and inputs, changing concept of quality etc., there is a need for exploring the trends and identifying new productivity measurement and improvement opportunities and challenges to orient productivity research for future. This is a review paper throwing light on the available models of productivity measurement, their critical analysis and the usability of these models in SMEs with the special emphasis is on systems approach as it found suitable for SMEs diversified environment.

Keywords: Productivity measurement, SME, Systems Approach, measurement models

I. INTRODUCTION
Productivity measurement has travelled a long way since the early period when it was first defined as the ratio of outputs to inputs. Since productivity is directly related with profit and in current scenario profits are getting thinner due to competitive environment, efficient supply chain management, use of information systems etc. is of interest to all. A lot of research has been done on productivity measurement till now. But since the society and the organizations are facing new challenges and opportunities all the time due to dynamic work environment, changing nature of operations, change in types of outputs and inputs, changing concept of quality etc., there is a need for exploring the trends and identifying new productivity measurement and improvement opportunities and challenges to orient productivity research for future.

There are a number of ways given by different authors to measure productivity at firm level or industry level depending on their suitability and relevance. Suitability of productivity measurement tool in turn depends on the objectives, nature, scale, data available, level and phase of the investigation. It is found that there is no harmony on any one model which is suitable for all kind of organizations and situations. There is a lot of variation in the model and every model is suitable in a particular condition. Even the interest of different people like economist, industrial engineer, accountants, managers are different in productivity measurement, but the ultimate goal is to improve firm’s performance and profitability. Hence the selection of tool to measure productivity and performance is very sensitive and crucial.

Even after recording an impressive growth in the recent years the SMEs of India face many challenges, like Infrastructure needs to be developed in rural areas, Technology needs to be evolved in business, lack of information about inputs, labor, machines as well as appropriate performance measurement system which helps them to take right and timely decisions. As it is said that ‘what you can control and improve is what you can measure’. So there is a pressing need for the development of tools or models for measuring productivity which may be applied to most of the SMEs.

II. DIFFERENT APPROACHES FOR PRODUCTIVITY MEASUREMENT
In order to cover different types of productivity studies and their measurement models Pritchard (1995) classified them broadly in three categories:
1. Economist/Engineers Approach(productivity is defined as efficiency = output/input)
2. Approach where Efficiency (output/input) and Effectiveness (output/goals) are evaluated simultaneously to measure productivity.
3. Broad approach which consists of all the things which makes an organization to function better.

III. Productivity measurement

Models based on Different approaches

Productivity management and measurement is one of the most important functions in any organization. This function is carried out in different ways in different firms. McKee (2003) says that the range of management approaches and measurement tools is quite large. If we go through the literature we review the general classification can be summarized as:

- Production function based models
- Financial ratios used to measure productivity
- Production based models
- Product based models
- Surrogate models
- Economic utility based models
- Systems approach models etc.

Prior to World War II, most of the measures used for productivity measurement were of simple variety which is output per worker or per hour. The concept of productivity function which involves labor and capital as inputs developed in 1920 which can be used to estimate parameters statistically which initiates new economic attempts to measure marginal productivity and quantify the demand for input factors.

There after among few decades many production function based models are proposed for productivity measurement. Ernst (1956) has proposed a model in which he considers output as a function of inputs for measuring productivity. Arrow et al. (1961) proposed the constant elasticity of substitution production function which is limited to two inputs. Teague and Eilon (1973) describe some of the major approaches for the measurement of the productivity of a firm or a part of a firm. Douglas (1974) suggested a model in which output is a Product function of Labor and capital; here time and exponential rate of technological growth is also considered. This model is a milestone in productivity measurement. The concept of total factor productivity is brought in picture by Jan Tinbergen in 1942 and further elaborated by John Kendrick in 1951. Kendrick and Vaccora (1980) written about the chronological progress of productivity measurement. Mohanty and Rastogi (1986) provided a detailed survey of productivity measurement models. They suggested eight different techniques which can be used to measure firm level productivity. Ghobadian and Husban (1990) examines the role of frontier and cobb-douglas production function in the measurement of company level productivity. Miller and Rao (1989) compared two Main line production measurement procedures, American productivity center’s total factor model and Ethyl corporations model where profitability is defined as the sum of Productivity and Price recovery and demonstrated that differences such as method of deflation can substantially affect the proper choice of the more appropriate procedure of productivity measurement. Kumbhakal et al. (1999) Deals with modeling total factor productivity growth in a flexible manner. Several competing models used by them to examine the robustness of result and are concluded that the empirical results are turnout to be model dependent.

Sumanth (1990) cited a unit cost approach which covers the unit cost of processing and reworks separately. It is known as quality-productivity ratio (QPR). This approach concentrates more on quality instead of quantity. Inter-Firm Comparison (IFC) approach comprises of comparing two firms by the use of basic ratios to financial performance. Dewitt (1970) proposed a model which is an elaboration of IFC. This model helps us to estimate the contribution of capital, facilities and personnel. This model is generally used for benchmarking. As it is said that the productivity is a concept of comparison, this model provides us many indicator for comparison which is made with other firms in the market. This model is useful for finding the position of a firm in the market. Liang et al. (2001) advocated that efficiency measurement through financial ratios can be a good measure of firm’s performance.

David (1984) suggested that regardless of which approach is taken output and input are always in monetary terms it is necessary to remove the deflation, the effects of price changes and thereby allow the measure to reflect physical quantity effects only. Over these two decades there are a lot of models developed by different researchers based on production function provided different productivity Index for productivity measurement but all of these models consider only the financial aspect of productivity measurement without seeing other aspects like Management strategies, human resource, working Environment, external factors etc. Production based models postulates quantification of output and input related to production.

Bhatia (1970) proposed a productivity index which is a ratio of weighted index of output to weighted index of inputs, but most of these models concentrate more and more on quantitative productivity. The intangible inputs and outputs are not accounted for which is a major concern of firms. Faraday (1971) and Ramsay (1973) also suggested total productivity measure and overall productivity measure which is considered as the relationship of output to input. Craig and harris (1973) does not believed on the partial productivity measures they proposed a model which is a effort to define total productivity as comprehensive output input ratio. Where output is total number of units produced and input includes labor, Capital, Raw material and other miscellaneous goods. Taylor and Davis (1977) suggested an advanced model on total factor productivity which has a significant advantage over other traditional models due to its holistic approach. It incorporates elements of net sales, inventory changes, wages and salary, investor's contribution, working and fixed capital.

Sumanth and Yavuz (1983) say that the improvement in the productivity level, and growth rate of a country, depends upon the efforts to improve productivity in the basic units of the national economy. He proposed a conceptual and analytical framework which helps managers to make more rational decisions to improve organizations productivity.

Hawaleshka and Mohammad (1987) discussed the advantages and disadvantages of current productivity
indices and proposed an operational productivity model (OPM) which can be applied to manufacturing industry. Ray and Sahu (1987) developed a product wise productivity model by taken care of the interdependency among various stages of production in a manufacturing firm. Sumanth (1984) total productivity model is a major departure from the conventional approach he recommended for consideration of total productivity for each product. He defined total productivity as the ratio of total tangible output of the firm and total tangible input of the firm, where output includes finished units produced, partial units produced, dividends from securities, interests from bonds and other incomes. Whereas input includes labor, capital, material, energy and other expenses.

Bernolak (1997) says that at the company level the all inclusive single productivity measure is not useful, there is an urgent need for the broad application of an integrated productivity measurement system a family of interrelated productivity and profitability measures which are meaningful, understandable and of practical usefulness at the enterprise of company level.

Smith (1973) argues that the productivity of production system can’t be measured through conventional methods of cause and effect relationship but the real problem is more complex as it involves the interaction of various inputs and the performance in totality of all inter-related parts is of more interest instead of performance of one factor, he defined productivity as the Ratio of Total performance and total inputs. Sardana and vrut (1984) presented a detailed analysis of models of productivity measurement. Sink et al. (1985) has advocated that measurement is a natural part of analysis, Control, evaluation and management process; he had given three types of Productivity measurement normative productivity measurement (NPMM), Multifactor productivity measurement (MPM), Multicriteria productivity measurement techniques (MCPM). Muhammad (2004) compiled a detailed discussion on approx. fourteen models like Kendrick & Creamer Model, The American Productivity Centre (APC) Model, Taylor – Davis model, Bhatia Model, Ramsay Model, Cobb-Douglas Production Function, Husban & Ghabadian Model, etc in detail in his doctoral research.

After this decade this is felt that due to interaction with IT productivity measurement should also needs some supplement to old approaches. Murugesh et al. (1997) provides a five step review strategy on productivity which provides future direction to authors for productivity research. Hannula (2002) said that partial productivity ratios are two narrow and obsolete to present a comprehensive picture of today business world they are just for the use of academic research to users. He proposed a total productivity ratio which is made of usual partial productivity ratios and easy to use. Chinchou et al. (1999) suggested a practical approach to measure the productivity for the key technology of an enterprise. They proposed a powerful model for application to various product groups, tasks and project in both manufacturing and service organization.

IV. SOME RECENT DEVELOPMENT IN PRODUCTIVITY MEASUREMENT

Sedera et al. (2001) Addressed that “How Enterprise systems benefits can be usually measured with a ‘balance’ between qualitative and quantitative factors.” Ultimately a comprehensive ‘Enterprise systems benefits measurement instrument’ is proposed. Dubelaar (2002) says that the ratios used for retail productivity are the ratio of output such as sales and input such as capital and labor. But generally these are store-specific and influenced by other context-specific factors, they developed a composite set of measures of productivity for retail sector which includes exogenous factors also and empirically shows that some competitive factors and demand related factors play a significance role in the productivity of the stores. Teague (2005) after demystifying productivity and performance says that “Productivity means how much and how well we produce from the resources used. If we produce the same or better goods from the same resources, we increase productivity, or if we produce the same goods from lesser resources, we also increase productivity, by resources we mean all human and physical resources” from this statement it is clear that productivity must be in totality and holistic approach.

Busi and Bititici (2006) presented a detailed literature review on collaborative performance management where he emphasized that “Integrated performance management in collaborative enterprises is part of the process of using inter-organizational systems to collaboratively measuring performance of collaborative enterprise processes and using the measurement to enable-makers to proactively and strategically manage the collaborative enterprise itself.” Card (2006) Argues that no single measure of productivity is amenable to satisfy all the different needs of a complex software organization, which includes project estimation, tracking process performance improvement, benchmarking and demonstrating value to the customer, multiple measures may be needed for finding the performance of an organization. Oke et al. (2008) advocated the Taylor and Davis total productivity model Due to its holistic approach over other traditional models. They elaborated this model for a Manufacturing organization by using Derth’s model of comprehensiveness which covers the major aspect of a business. Shaw (2009) develops a theoretical model of systems performance criteria which provides a means to evaluate how well any living system like individual, organizational or societal performs its activities to achieve its goal. Hon (2008) says that “the monitoring and control of the input and output of manufacturing systems is an essential task for the system optimization.” He reviews the old patterns and new developments in manufacturing performance measurement within a systems framework.

Searcy (2008) Argues that the existing performance measurement systems are rarely enough to improve the organizational performance. He criticizes that they encourage local optimization, they will concentrates more on financial performance, do not reflect the fact that an organization have multiple goals and do not
recognizes that an organization operates in dynamic internal and external environment. He advocated the systems approach for sustainable development of an organization, since "sustainable development is generally interpreted to require improvement in the areas of economic, environmental and social performance; these three dimensions represent the "triple bottom line of organizational performance and are often referred to as the three pillars of sustainable development."

Rechard et al. (2008) studied the effect of innovativeness of the performance measurement of a firm. Wang (2011) argue that traditional models, such as Key performance Indicators, Balance score card, Activity based costing, are all process oriented and they are not suitable for Service oriented enterprises (SOE) due to their loosely coupled, dynamic and flexible environment. He believes that Economic Value Added (EVA) reduces distortions in accounting activities and produces more accurate results, and can be a better estimator of company’s true performance. He developed a service oriented economic value added (SO-EVA) model for performance measurement of service industries. Srimai (2011) presented a detailed literature review on the basis of operations management, strategic management, management accounting and organizational behavior.

V. CRITICAL ANALYSIS OF DIFFERENT MODELS AND APPROACHES

A measurement system consists of multiple measures. A measure is a quantitative value that can be used for comparison. A specific measure can be compared to itself over time, compared with a preset target or can be evaluated along other measures. In the current scenario of tight budgets and increased outsourcing it is very difficult for an organization to get a good measure of productivity measurement which will suits to its specific needs. After the detailed review of literature it is observed that no single productivity measure is applicable in all situations for all purposes, Instead the organization have to craft a productivity measure which is appropriate to its processes and information needs.

Production based models are concentrated only on tangible output and input to find productivity. A model given by Bhatia is most popular in this approach where productivity is defined as the ratio of weighted output to weighted input. In this model of productivity every output and input given a proper weight, but there is no set method for giving weight to any input or output. It is arbitrary and can create much confusion; different values can give different results which is main weakness of this model.

The econometric approach to productivity measurement involves the estimation of parameter of a specified production function (or cost, revenue, or profit function, etc) in which there is no place for intangible aspects of a firm, it show only the financial performance of the organization but not the total performance. Some of these models can be used only for time series data.

Models based on value addition and product orientation which provided a new rationale for defining inputs, but again the concentration area is measurable input with technology and energy concerns. Sumanth (1990) total productivity model is a product oriented model and a nice effort to go far from traditional approaches but again tangible inputs and outputs are not considered.

Economic utility models opened a new stream by considering the concepts of multi ratio’s each ratio reflecting on a particular economic activity or utility function and even input, output boundaries are also enlarged from conventional to some more including technology, energy, new designed generated etc. but again something is left which is very important in today’s cut throat business environment i.e. human aspects, social environment and interaction among different bodies of an enterprise. Seder et al. (2001) advocated the approach by finding the suitability of this in public sector, but again he didn’t consider the external environment effect and fails to attend its holistic nature.

Different Frameworks and models are provided for measuring business performance and frequently adopted by organizations to measure their performance at enterprise level like BSC, EVA, Activity Based Costing (ABC), Customer Value Analysis (CVA), Action-Profit Linkage Model (APLM) Etc. but most of them not considering the holistic approach of a firm, some of them concentrate on financial factors or some of them relate to production and manufacturing only, but in an organization every department is important and makes a contribution to the whole performance of the enterprise. The output or productivity is optimum if they work in synergy and everyone is considered important according to his contribution. If one part is not working to its optimum efficiency the total performance gets affected, however systems approach models due to its strength of considering each part of an enterprise may be more useful in current scenario.

There is a need to develop a methodology which considers an organization with multiple objectives, considers the interaction between subsystems and also incorporate the effect of external environment. Systems approach which is a major departure from conventional approaches is a fruit of all this efforts towards finding a measure which incorporates all above factors in productivity measurement? Mason (1979) suggested that Productivity must be treated as a systems concept. After consideration of system environment he defines productivity as the ratio of Actual output to Maximal output. Shakun and Sudit (1983) proposed a measure of system effectiveness through total factor productivity and technology interaction facilitating value addition in productivity measurement. Sardana and vrat(1984) proposed a model which gets strength from systems approach and Management by objectives(MBO). This model is called Performance objectives-productivity(PO-P) model which consider system with different subsystems and external environment. Again Sardana and Vrat (1987) proposed a case study of productivity measurement in a large organization with multi-performance objectives based on PO-P approach.
A detailed literature review shows that there is no agreed definition of the term productivity generally it is taken in a narrow sense as something concern with efficiency or effectiveness of labor, in which some authors tried to include capital, material etc. to make it more representative of firm performance. Models present in literature are suitable in diversified conditions depending on objectives and data availability. Some of them either focus on one part of productivity of the organization or another part of it i.e. most of them considers only the partial productivity. This is also surprising that intangible aspects like customer satisfaction, working environment, brand value etc. have not been given proper attention by the researchers. There is a need to develop concept which took productivity in a broader sense which ultimately helps management to achieve objectives by suggesting some improvement to the system.

Among all of these, Systems approach has caught the attention of researchers from past few years as it sees the organization as a system in totality with the subsystems interacting with each other. The models classified under system approach consider both the tangible as well as the intangible aspects of organization which is the lacuna of most of the approaches of productivity measurement.

VI. PRODUCTIVITY MEASUREMENT AND SMEs

Global business trends indicate that small businesses are the major contributors to the country's economy and progress. In India, these businesses generate more than 65% employment across the country. India’s 7% GDP is contributed by SMEs and more than 35% export of India is contributed through SMEs. As per the 'Quick Results' Fourth All India Census, No of Micro Small and Medium Enterprises in India is 26100797. As per the statistics there are 1552491 units in registered sectors while 2454306 units are in unregistered sectors. While their significant economic contribution is well understood, their responsible business practices have not been extensively studied for any meaningful interpretation to be drawn. These SMEs may not be a significant influence like the large corporations, but their specific needs also, but it’s not possible for SMEs due to their resource limitations. Most of the tools used by SMEs are either partial productivity measures or the tools which designed for large scale organizations which mislead them by limited and inaccurate information for intelligent decision making.

Coca and Alberti (2010) advocated that the tools of performance measurement for SMEs must be simple and comprehensive; it should not be a miniature of the same tool which is used for large organization. For SMEs he designed an assessment tool that SMEs can use to evaluate the effectiveness of their performance measurement systems and can recognize the areas of improvement. Ahmad et al. (2010) studied the predictability of TPF for economic growth by using fixed effects regression model.

St-Pierre and Delisle (2006) suggest that the main assumption is to practice a good tool for SMEs, it is necessary to start from a detailed analysis of SMEs needs, taking into consideration SME characteristics. In order to be relevant for SMEs, an assessment tool should not be a simple miniature of the tools developed for large enterprises; it should remain simple, comprehensive, not too demanding in terms of recourses and its must be able to guide owner - managers towards action and improvement. Sardana (2009) elaborated his old model (PO-P) of performance measurement for SMEs by saying that for small firms their objectives, strength and weaknesses are different from large organizations so they required a different kind of framework and determinants to measure performance. Sahay (2005) discusses the concept of productivity in service sector and proposed a multifactor productivity model for performance measurement of a service based industry. He shows that how different factors of static, dynamic and development parameters can be taken in-to account for productivity measurement.

Jamil and Mohamed (2011) attempted to address the various performance measurement frameworks which can be used in SMEs. After analysis of eight different models of PM they argued that SMEs requires a PMS specifically designed and tailored to their characteristics and need. Manville (2006) says that though models exist to date there are still significant barriers in the implementation of these systems in context of SMEs.

The concept of productivity must serve as a tool in the hands of management to take corrective steps for productivity improvement and should provide a ready reference for better decision making for their growth and even intimate them towards their low performance area which needs improvement to improve their overall enterprise productivity. But without practice a theory remains only for the use of academicians and not of any practical use to organization. There is a need to fill the gap between theory and practices and to develop a model, which will reduce the burden of model selection of the enterprise for productivity measurement (PM) in SMEs and provide the better benchmarking for improvement of productivity.
VII. SYSTEMS APPROACH AND PRODUCTIVITY MEASUREMENT

Most of the models from above concentrate on measuring productivity in financial terms or input output terms where input and output both are tangible; it shows only one facet of the organizational performance. All the organizations have many departments like production, planning, marketing, human resource etc, and if one is not working well this will affect the productivity of the whole enterprise so it is needed that we must have to measure the productivity of the enterprise as a whole. The concentration may always be on the improvement of weak areas of the enterprise. In current business scenario we can’t judge a company on its financial ratios there are a lot of other factors related to its social environment, which are hard to measure. If we measure firms productivity it is easy for us to compare the productivity for different firms and firms with in the same group and this can form a base for making an action plan for overall improvement. As pointed out by Kaplya et al. (2010) Productivity Measurement becomes more and more difficult in current scenario due to the influence of following trends in business.

1. Increase of services;
2. Growing significance of innovation activity and high-level of competence
3. Strengthening of information intensiveness
4. Growth of cross cultural interaction
5. Constant change and busyness
6. Development of technologies (ICT)
7. Internationalization and networking

As it is clear from the literature review that there are a lot of models and approaches, available for productivity measurement but systems approach can be proved as a better approach for productivity measurement in SMEs due to the following characteristics.

1. Systems approach emphasis on wholeness.
2. A systems approach deals with the components (sub-systems) of a system. The subsystems are interrelated so as to form a unitary whole and arrangement or interrelationship exists so as to attain particular objectives.
3. Inputs are not perceived as conventional inputs of labor, capital or material as these don’t themselves form a subsystem.
4. Outputs are not limited to production, sales or finished goods.
5. A system’s performance is total achievement and includes both tangible and outputs such as goods produced, services rendered, negative value outputs, service to society, customer satisfaction etc.
6. Productivity of a system signifies as to how well the enterprise is performing towards the attainment of its goals.
7. Interdependence is a vital factor in the performance of a system.

Vrat et al. (1998) says that “There is a recent trend to interpret productivity in its broader perspective as representing the performance in totality of an organization is considered to work as a system consisting of subsystems ( further…. Subsystems)” This concept has been used to develop models which are quite different from conventional models, in which all the inputs and outputs, tangible and intangible facets of an enterprise are considered since the enterprise is considered as a system and we are seeing the whole enterprise as a single entity which is made-up of some parts which are working independently but interacting with each other and even this mutual interaction has given proper weight-age. Globalization and information technology changed the whole scenario of current business; it’s not possible for any organization to work in isolation without interacting with its environment.

VIII. CONCLUSIONS AND FURTHER IMPLICATIONS

As written by Vrat et al. (1998), “any model of productivity measurement should basically translate the objectives of productivity measurement into a measureable index, formulation of objectives is very important. Productivity measurement should provide a measure of productivity of organization as a system in accomplishing objectives as compared to its potential” A detailed literature review will help the upcoming researchers to find out the research gap and establish a strong rational for the identification of the approach and model for productivity measurement which suits well in current scenario. Further different models can be developed and studied on systems approach. The models should be developed by taking care of special characteristics of SMEs and if accepted it will be a great help to enterprises for measuring their enterprise productivity and even also to identify the areas with low productivity. This helps a lot to an enterprise for its Productivity improvement. Even Available models on systems approach can be validated for their universal application on small and medium enterprises.

REFERENCES


