Research Paper

Improving Supply Chain Performance by Adopting Performance Measurement Models

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ABSTRACT

Nowadays, dynamic changes are significantly driving forces to companies to re-focusing on utilizing of people and research based on organizational objectives. Organisations need to provide a performance measurement system (PMS) to evaluate the resource utilisation so that they can strategically manage and properly control to achieve their objectives and goals. PM's role is dominantly increasing and it is growing in its scope and importance. However, the literature on performance measurement (PM) has changed over the past few decades. Due to limitation of traditional PMS that focusing on financial measures (ROI, cash flow), modern PMS focusing on non-financial measures such as time, quality, flexibility which has been adopted.

The paper examines on issues related to PMS designing and implementation. It also presents on how to develop effective PMS. Furthermore, it discusses on how to link and integrate companies' mission, vision, and strategy into organizational strategy. The literature review leads to a conclusion that a study is needed to reliably

and accurately measure activities in which the flow of material, information and cash, through transformation processes, to finished product. It also presents a gap occurred from existing PMS (e.g. lack of continuous improvement approach), and in order to overcome the gap, it proposes the model of PM system. Including identifying the areas which further research is needed.

1. Introduction

The subject of PM is encountering increasing interest in both the academic and managerial ambits *(De Toni & Tonichia, 2001)*. Various pressures (e.g. globalisation, intense competition, and rapidly changing in customer requirements) are significantly driving force to organisations in order to re-focusing on utilising of people and resources based on organisational objectives. Organisations need to provide a PMS to evaluate the resource utilisation so that they can strategically manage and properly control to achieve their objectives and goals. *Schermerhorn and Chappell (2000)* point out that PM is a vital part of controlling process in order to take action for ensuring desired results.

Parker (2000) addresses some reasons for organisations measure performance, namely,

1. Identify success;
2. Identify whether they are meeting customer requirements;
3. Help them understand their processes: to confirm what they know or reveal what they do not know;
4. Identify where problems bottlenecks, waste, etc., exist and where improvement are necessary;

5. Ensure decisions are based on fact, not on supposition, emotion or intuition; and
6. Show if improvement planned, actually happened.

Similarly, *Neely (1999)* provides seven main reasons why many people become so interested in business PM; the changing nature of work, increasing competition, specific improvement initiatives, national and international awards, changing organizational rules, changing external demands, and the power of information technology.

Parker (2000) also states measuring performance is something that all organisations do. The PM is also an important aid to making judgments and to making decisions. Neely, *Gregory, and Platts (1995)* support importance to have on a variety of functional disciplines. After utilising resources in their operations, organisations need to ensure achievement of their goals and objectives, therefore, the purpose of PM is *to evaluated, control, and improve operation processes (Ghalayini & Noble, 1996). Horovitz, (1979)* who surveyed some 52 European companies, found little evidence to suggest that firms actually use strategic controls. Only one firm used their PMS to reinforce the importance of customer service. *(Parker, 2000).*

Thus for research in this area has been undertaken in a multi-disciplinary ways such as accounting *(Chandler, 1977; Kaplan & Norton, 1996),* business strategy *(Chakravarthy, 1986; Simons, 1995),* human resource management *(IPM, 1992),* manufacturing and operations management *(Dixon et al., 1990;Neely et al., 1996),* marketing *(Fornell, 1992)* and organizational behavior *(Meyer & Gupta, 1994).* These studies have common goals namely, they all seek to address one of the two fundamental questions associated with business PM, namely: what are the determinants of business performance; and how can business performance be measured?

This paper provides the framework on a review of literature related to PM. While there have been attempts to develop a framework for measuring performance in organisational functions, and among the organisations, suppliers and customers. *This paper however provides a framework which focuses mainly on PM in organisational functions.*

The objective of this paper is *to explore and investigate issues related to PM in SC.* It also explores previous methodological issues to provide guidance and insights for future research papers. After reviewing the literature, gaps or unclear issues, related to the subject will be identified. Seven research questions will be answered as follows:-

How have key terms been defined (e.g. PM, SC)? *(Neely, Mills, Platts,).*

What is the key component of PMS design? *(Neely et al. 1994)*

What distinguishes between traditional from modern (so-called as financial and non-financial respectively) PM systems? *(Ghalayini & Noble, 1996)*

What will be measured? *(Morash, Droge & Vickery, 1997)*

How will it be measured? *(White, 1996)*

How can these measures be used to evaluate, improve and control the functions? *(Beamon & Ware, 1998)*

What is the effectiveness and efficiency of current PM systems? *(Neely et al. 1994)*

2. Definitions of Performance Measurement

The literature on PM has changed over the past few decades *(Ghalayini & Noble, 1996).* The definitions of PM have also changed *(Kennerley & Neely, 2002; Beamon, & Ware, 1998).* Traditional PMS which begun in the late 1880s and up to the 1980s, focused on financial measures such as ROI, liquidity ratio *(Ghalayini et al, 1996).* Due to limitation of traditional PM system, modern PMS which has been

adopted in the late 1980s focused on non-financial measures such as time, quality, flexibility *(Kennerley et al, 2002).*

Neely (1995) points out that the definition of PM remains a broad topic and is rarely defined. However the authors define PM as follows;

- Process of quantifying the efficiency and effectiveness of action *(Neely et al. 1994).*
- Metric used to quantify the efficiency and/or effectiveness of an action. *(Kaplan, 1990; Gunasekaran et al., 2001)*
- Set of metrics used to quantify both the efficiency and effectiveness of actions *(Neely, 1994)*
- Process of assessing and evaluating on effectively and efficiently utilising people, resources, and technology of an organisation. *(Schermerhorn & Chappell, 2000).*

The above definitions may be mostly seen in two common aspects in term of *quantifying,* and *efficiency* and *effectiveness* are always used precisely in this context. The word of quantifying has been measured through evaluating or monitoring to the processes. While the authors define the words of *effectiveness and efficiency* in different aspects and contexts, for example, if they are used in marketing, *effectiveness* refers to the extent to which customer requirements are met, while *efficiency* is a measure of how economically the firm 's resources are utilised when providing a given level of customer satisfaction *(Neely, Gregory, and Platts, 1995).*

On the one hand, if they are used in management area, *effectiveness* is an output measure of task or goal accomplishment, and *efficiency* is a measure of the resource cost associated with goal accomplishment. *(Schermerhorn & Chappell, 2000).*

Therefore this paper defines the definition of PM as *"process of measuring, monitoring and evaluating to quantify the achievement in term of effectiveness and efficiency"*. The definition points out critically that measuring performance on an activity within supply chain may be in a form such as monitoring or evaluating. The key point would be on how we can quantify the performance. To provide scope and framework narrower, the achievement would be in term of effectiveness and efficiency.

3. Definitions of Supply Chain Management

Supply chain management (SCM) appears in current dialogue as a new terminology but definitions of what it encompasses are at best vague *(Tan, 2001)*. The literature provides several approaches to define supply chain *(Bytheway, 1995a; 1995b; Waters-Fullerr, 1995; Lamming 1996; New, 1996; Mabert & Venkataramanan, 1998; Milgate, 2001; Cox et al., 1995)*. The development of an idea of the supply chain (SC) owes much to the emergence from the 1950s onwards of systems theory, and the associated notion of holism *(New, 1997; Cavinato, 1992)*. This may be summarized by the segregated analysis of its constituent parts *(Boulding, 1956)*. *New (1994)* addresses that the SC metaphor is used in many ways, but three meanings dominate discussion: the SC from the perspective of an individual firm; a SC related to a particular product or item; and SC used as a handy synonym for purchasing, distribution and material management.

Cox et al. (1995) describe the SC as *"processes from initial raw materials to the ultimate consumption of the finished product linking across supplier user companies and functions within and outside a company that enable the value chain to make pro ducts and provide services to the customer"*

Beamon (1999) also provides a similar definition. It is *"an integrated process wherein raw materials are manufactured into final products, then delivered to customers"*. He states that it contains four echelons (supply, manufacturing, distribution, and consumers), where each level (or echelon) of the chain may comprise numerous facilities".

In recent years, the definitions of SCM have changed in 2 aspects. First it emphasizes more on value added on products or services. Second, numbers of stakeholders in SC activities are more various. For example, *the Logistics and Distribution Institute report (2000) defines SCM as "an integration of business processes from end user through to the original suppliers of the products, services and information that add value for customers and other stakeholders"*. Similarly **Handfield & Nichols (1999)** define SM as *"all activities associated to the flow and transformation of goods from the raw material through the end customer. It is encompassing the information flows up and down the supply chain"*.

The definitions can view in two common characteristics. First, it is a holistic and systemic view that goes beyond the value chain put forward by *Porter (1985)*. Second, the information flows imply that relations within the chain are bi-directional not only downstream oriented. The SC is viewed as a number of organizations - at least three - working cooperatively with at least some shared objectives *(Holmberg, 2000)*.

3.1 Performance Measurement 's Role on SC Activities

Interest in managing SC is growing rapidly among companies around the world *(Holmberg, 2000)*. Major forces behind this development are increasing competitive pressure and a belief that working cooperatively in SC can create and enhance competitive advantage.

SCM has strategic implications for world-class manufacturers because the supply system can be used to achieve important competitive priorities *(Falah, Zairi*

& Ahmed, 2003). Internally, it is deeply involved in the co-ordination of key operations in the enterprise such as purchasing, production, information systems, and logistics. Externally it closes the gap between extended operations outside the enterprise toward their vendors, or what should be locked in as partners.

Although the SCM is recognized for its importance and power, but research studies present disappointingly results. *Quayle (2003)* surveyed 288 SME firms in UK on issues attracting the highest priorities at site, these can be directly addressed by effective SCM. The importance of SCM is medium or least. Only 25 per cent have a strategy for and operate SCM. They also mention two major reasons why they did not use a strategy for SCM, *namely; overcoming traditional practices and insufficient knowledge of SCM.*

The structure of the SC is clearly undergoing rapid transformation *(O'Keeffee, 2001).* Consumer pressures for lower prices and higher quality of service are forcing retailers, manufacturers and distributors to achieve greater cost-efficiencies and improve lead time - making SC efficiency a key factor in gaining competitive advantage. As a result, both retailers and manufacturers are increasingly looking across the supply chain, to form partnerships, with the aim of creating a seamless flow of goods and information from raw materials supplier to the end consumer.

As having mentioned the significance of managing SC, the key issue is that how companies or stakeholders can evaluate or monitor what are their strengths or weaknesses, and what is their current performance, so they can provide a strategy to improve or enhance performance. As a result, the role of measuring performance is dominant, including to providing foundation for formulating and implementing a strategy.

One of difficulties is *the design of PMSs in SCM. A PMS* plays an important role in managing a business as it provides the information necessary for decision making and actions. The authors *(Holmberg, 2000)* point out that although this area has been studied many times as strategically important, it is still not sufficiently understood.

Coordinating activities in a SC is another difficulty *(Holmberg, 2000)*. Unsuccessful companies are functionally oriented and narrowly focused, for example, faced the problem was not a lack of ideas about what to do, but instead about how to coordinate the efforts in order to avoid *"dying the death of a thousand initiatives"*. The difficulties are partly due to the complexities induced by the large number of related and interdependent activities in the SC.

3.2 Integrating Performance Measures into Supply Chain Activities

PM in supply chains is increasingly becoming important. The literature includes performance measures to SCM, in addition to SC models *(Caplice and Sheffi, 1995; Kaplan & Norton, 1992)*. The performance measures utilized in these models directly affects their real-world applicability *(Beamon, 1999)*.

Generally PM research focuses on analyzing PMSs that are already in use, categorizing performance measures and then studying the measures within a category, and building rules of thumb or frameworks by which PMS can be developed for various types of systems. *Neely et al. (1995)* for example, present a few of the categories in the literature, including: quality, time, flexibility and cost. *Beamon (1999)* also addresses a number of characteristics that are found in effective PMS and can be used in evaluation of these measurement systems.

A large number of different types of performance measures has been used to characterize supply chain systems, particularly production, distribution, and inventory systems. Such a large number of available performance measures makes performance measure selection and design difficult *(Beamon, 1999)*. Further, one of the most difficult areas of performance measure selection is the *development of PMSs*. This involves the methods by which an organization creates its measurement system. The following questions would be often referred: *what to measure, how are multiple individual measures integrated into a measurement system, how often to measure, how and when are measures re-evaluated.* The next section examines important issues related to PMS design.

4. Types of Performance Measurement Systems

Basically, the literature concerning PM has had two main phases *(Ghalayini et al, 1996)*. The first phase began in the late 1880s and went through the 1980s. In this phase, the emphasis was on financial measures such as return on investment, return on asset *(Christopher, 1992; Levy, 1997)*.

The second phase started in the late 1980s, as a result of changes in the world market. Companies began to lose market share to overseas competitors who were able to provide higher-quality products with lower costs and more variety. To regain a competitive edge, companies not only shifted their strategic priorities from low-cost production to quality, flexibility and short lead time, as non-financial measures *(Bower & Hout, 1988; Rushton & Oxley, 1989)*, but also implemented new technologies and philosophies of production *(Wild, 1995; Levy, 1997)*, and TQM *(Berger & Pyzdek)*.

Referring to previous research studies, PM systems have generally been classified at ***strategic, tactical*** and ***operational*** levels *(Gunasekaran et al., 2001).* **Table 1** shows a framework for the performance evaluation of supply chains. Although there have been attempts to establish criteria to measure in a specific level, but it however, lacks a clear distinction between measures at the strategic, tactical and operational levels *(Ghalayini et al, 1996). Gunasekaran et al. (2001)* state that metrics used in PM influence the decisions to be made at levels. They go on to add that using a classifi cation based on these three levels, each metric can be assigned to a level where it would be most appropriate.

Another issue is that *which PMS is the best (or better),* when it is applied for measuring performance in a firm or an organisation. **It is hard to exactly point out, as many companies have realised the importance of both financial, and non-financial performance measures** *(Stewart, 1995; Kaplan & Norton, 1992; Gunasekaran et al., 2001).* It would consider that how well the measures have accuracy enough to spot significant differences between what is really taking place and what was originally planned *(Schermerhorn et al., 2000).* **Each PMS and its dimensions may be appropriate with specific circumstance and function.** Traditional performance measures should not compete with non-traditional measures. Rather, it should complement them by providing understanding about complex phenomena *within their context. Further, they would also facilitate* continuous improvement and process control *(Beamon & Ware, 1998).*

Table 1 – Framework for Performance Evaluation of Supply Chain Activities

Level	Performance Metric	Finance	Non-Finance	Reference
Strategic	Total cash flow time		•	Stewart (1995)
	Rate of return on Investment	•		Christopher (1992); Dobler & Burt (1990)
	Flexibility to meet particular customer needs		•	Bower & Hout (1988); Christopher (1992)
	Delivery lead time		•	Rushton & Oxley (1989)
	Total cycle time		•	Christopher (1992)
	Level and degree of buyer-supplier partnership	•	•	Toni et al. (1994); Mason-Jones & Towill (1997)
	Customer query time		•	
Tactical	Extent of co-operation to improve quality		•	Graham et al. (1994)
	Total transportation cost	•		Rushton & Oxley (1991);
	Truthfulness of demand predictability/forecasting methods		•	Fisher (1997); Harrington (1996)
	Product development cycle time		•	Bower & Hout (1988)
Operation	Manufacturing cost	•		
	Capacity utilization		•	Wild (1995)
	Information carrying cost	•		Steward (1995)
	Inventory carrying cost	•		Levy (1997); Lee & Billington (1992); Stewart (1995); Dobler & Burt (1990); Slack et al (1998); Pyke & Cohen (1994)

Source : Adapted from Gunasekaran, A., Brunel, C.P. & Tirtiroglu, E. 2001, "Performance Measures and Metrics in Supply Chain Environment"

However, companies always fail to understand them in a balanced framework *(Gunasekaran et al., 2001).* Markell *(1991)* points out that for a balanced approach, companies should bear in mind that, while financial PM are important for strategic decisions and external reporting, day-to-day control of manufacturing and distribution operations is better handled with non-financial measures. He also suggests that companies would carefully consider and decide on using good few metrics.

5. Distinguishing between Traditional and Non-Traditional PMS

Traditional PM based on financial measures (such as *return on investment, cash flow*) is no longer appropriate or representative of the information needs of today 's competitive global market *(Ghalayini et al, 1996).* To gain competitive edge, modern organisations however, have shifted their strategic priorities from financial measures to alternative PM, which focuses on non-financial measures, such as *quality, flexibility, and short lead-time.*

Most research studies *(Christopher, 1992; Toni et al., 1994),* have mainly emphasised on traditional PM, but there are few studies focusing on non-financial PM. Table 2, distinctly presents comparison between traditional performance measures which focusing on financial measures, and non-traditional performance measures which focusing on non-financial measures.

Table 2 - The traditional and non-traditional performance measures

Traditional performance measures	Non-traditional performance measures
1. Based on outdated traditional accounting system	1. Based on company strategy
2. Mainly financial measures	2. Mainly non-financial measures
3. Intended for middle and higher Managers	3. Intended for all employees
4. Lagging metrics (Weekly or monthly)	4. On-time metrics (hourly, or daily)
5. Lead to employee frustration	5. Simple, accurate and easy to use
6. Neglected at the shop-floor	6. Frequently used at the shop-floor
7. Have a fixed format	7. Have no fixed format (depends on needs)
8. Do not vary between locations	8. Vary between locations
9. Do not change overtime	9. Change over time as the need change
10. Intended mainly for monitoring Performance	10 Intended to improve performance
11. Not applicable for JIT, TQM, CIM, RPR, etc.	11.Applicable for JIT, TQM, CIM, RPR,etc.
12. Hinder continuous improvement	12. Help in achieve continuous improvement

Source : Adapted from Ghalayini, A.M. & Noble, J.S. 1996

Traditionally, performance measures have been primarily based on management accounting systems *(Ghalayini et al, 1996)*. This has resulted in most measures focusing on financial data (i.e. *return on investment, return on sales, sales per employee, productivity, price variances, and return on asset*). Of these, ***productivity*** has been considered the primary indicator of performance. *Teague and Eilon (1973)* state four issues concerning the importance of measuring productivity as follows; *strategic* (i.e. comparison with competitors or related firms); *tactical* (i.e. management control of the performance of the firm); *planning* (i.e. comparison of the relative benefits from the use of different inputs); and internal *management* (i.e. collective bargaining with trade unions).

Traditional PM is continuously evolving, the use of information in the financial analysis of firms or organizational performance is critical *(Schermerhorn et al., 2000)*. These financial aspects of organisational performance are typically assessed using a variety of financial ratios which can provide for historical comparisons within the firm or in external benchmarking relative to industry performance.

However, traditional performance measures have many limitations that have been discussed by many authors *(Kaplan, 1983)*. The limitations make traditional PM less applicable in today's competitive market. The following will present the eight most commonly cited limitations. **Traditional management accounting systems, Lagging metrics, Corporate strategy, Relevance to practice, Inflexible, Expensive, Continuous improvement, Customer requirement and management techniques.**

Apart from the above eight general limitations, *Skinner (1986)* also point out that traditional performance measures also have three specific limitations: **productivity** *(Neely et al. 1995)*, **cost** *(Skinner, 1986, p. 58)*, **profit** *(Globerson,1985)*

Traditional performance measures have many limitations that make them less applicable in today competitive environment. It is seen from the previous discussion that there is a need for new performance measures that can overcome the stated limitations. *Kaplan (1990, p. 35)* states that *"traditional summary measures of local performance - purchase price variance, direct labour and machine efficiency - are harmful and should be eliminated,* since they conflict with attempts to improve quality, reduce inventories and increase flexibility. He goes on to say that direct measurement is needed for quality, process time, and any other operating performance criterion that needs to be improved.

The characteristics of non-traditional measures that have been *mentioned include: measures related to manufacturing strategy,* that they can provide managers, operators with information required for daily decision making; *simple measures* so that shop-floor operators can easily use and understand them; *measures should foster improvement versus just monitor it;* and *measures should change as is required by a dynamic marketplace.*

One of failure in PMS design and implement is stated by *Schermerhorn et al. (2000)* that a common failure in organisations is an *unwillingness or inability* to rigorously measure performance. More recently *Goold and Quinn (1988)* surveyed 200 of the largest British companies and report that only 11 percent of them claimed to have a strategic control system, particularly providing formal PMS.

Interestingly, when organisations need to measure their performance, how they would consider and apply to their activities or functions, between traditional and non-traditional PM systems. As recommended from previous research with different views and ways. *Leong, Snyder & Ward (1990)* suggest that the manufacturing task, and the key dimensions of manufacturing performance, can be defined in terms of *quality, time, price* and *flexibility.* Other authors take a different stance. Following their study of PM in the service sector, *Fitzgerald et al. (1992)* however

suggest that there are two basic types of performance measure in an any organisation - those that relate to results *(competitiveness, financial performance),* and those that focus on the determinants of the results *(quality, resource utilisation and innovation).* They go on to suggest that it should be possible to build a PM framework around the concepts of results and determinants.

Globerson (1985) has stated that a PMS of an organisation should include: *a set of well-defined and measurable criteria; standards of performance for each criteria; routines to measure each criteria; procedures to compare actual performance to standard and procedures for dealing with discrepancies between actual and desired performance* .

Similarly *Maskell (1989)* offers seven principles of PMS design:

1. Measures should be directly related to the firm 's manufacturing strategy.
2. Non-financial measures should be adopted.
3. It should be recognised that measures vary between locations-one measure is not suitable for all departments or sites.
4. It should be acknowledged that measures change as circumstances do.
5. Measures should be simple and easy to use.
6. Measures should provide fast feedback.
7. Measures should be designed so that they stimulate continuous improvement rather than simply monitor.

Gunasekaran et al. (2001) point out that the characteristic of effective PM as follows: reflecting results, not the activities used to produce results, containing normalised metrics that can be used in benchmarking, it is seen to be practical and easily understood by all, providing a continual self-assessment, using reliable and robust measures, providing a benefit that exceeds that cost; and having clear ownership of all measures.

6. Performance dimensions and measures

Following a review of the functional strategy literature, as having mentioned, *Leong, Snyder & Ward, (1990)* claim that it is widely accepted that the manufacturing task and the key dimensions of manufacturing 's performance for example, can be defined in terms *of quality, delivery speed, delivery reliability, price (cost), and flexibility*. Despite this assertion, however, confusion still exists over what these generic terms actually mean. While *Wheelwright (1984)* uses *flexibility* in the context of varying production volumes, but *Tunalv (1992)* uses it to refer to a firm 's ability to introduce new products rapidly. Other authors *(Garvin, 1987; Schonberger, 1990),* have pointed out that the generic terms *quality, time, cost and flexibility* encompass a variety of different dimension *(Neely & Wilson, 1992).*

Table 3 - General framework for performance measurement system

Category of Measure	Measures used
Shipments	Actual, Performance-build plan, Current backlog
Inventories	Total (Weeks and $), Scrap, Excess,Obsolete
Variances	Purchase Price, Production Burden, Materials, Acquisition, Materials Burden, Material Usage, Labour
Labour Performance	Efficiency, Utilisation, Productivity, Overhead, Percentage, Overtime, Absenteeism, Indirect:Direct, Ratio
Capital	Appropriations, Expenditures
Spending	Salaries and Benefits, Controllable Expenses, Non-Controllable Expenses
Headcount	Direct, Indirect, Total, By Functional Areas

Source : Adapted from Neely, A., Gregory, M., Platts, K., 1997

It would however be impractical to review all the possible measures of functions' performance in this paper. Hence only a selection of the most important measures relating to *quality, time, cost* and *flexibility* will be reviewed. Table 4 shows the multiple dimensions of quality, time, cost and flexibility.

Table 4 - Multiple dimensions of quality, time, cost and flexibility

Quality	Time	Flexibility
Q1 : Performance	T1 : Manufacturing lead-time	F1 : Material Quality
Q2 : Features	T2 : Rate of Production Introduction	F2 : Output Quality
Q3 : Reliability	T3 : Deliver lead-time	F3 : New Product
Q4 : Conformance	T4 : Due-date performance	F4 : Modify Product
Q5 : Technical durability	T5 : frequency of Delivery	F5 : Deliverability
Q6 : Serviceability		F6 : Volume
Q7 : Aesthetics	Cost	F7 : Mix
Q8 : Perceived quality	C1 : Manufacturing Cost	F8 : Resource Mix
Q9 : Humanity	C2 : Value Added	
Q0 : Value	C3 : Selling Price	
	C4 : Running Cost	
	C5 : Service Cost	

Source : Adapted from Neely, A., Gregory, M., Platts, K., 1997

6.1 Performance measures relating to quality. Traditionally ***quality*** has been defined in terms of *conformance to specification* and hence quality-based measures of performance have *focused on issues such as the number of defects and the cost of quality. Feigenbaum (1961)* was the first to suggest that the **true cost of quality** is *a function of the preventive, appraisal and failure costs. Campanella and Corcoran (1983)* offer the following as definitions of these three types of cost : ***Prevention costs, Appraisal costs and Failure costs.***

. *Crosby 's* assertion *(1972)* that *"quality is free"* is based on the assumption that, an increase in prevention costs will be more than offset by a decrease in failure costs. Basically, the logic underlying the cost of quality literature is that for a given set of organisational conditions there is an optimal level of quality. The cost of quality is a measure of the extra cost incurred by the organisation because it is either under-performing or over-performing.

Plunkett and Dale (1988) point out that although conceptually appealing, the academic rigour of the cost of quality model is debatable. It is based on assumptions and estimates, rather than on data. And like the ***economic order quantity (EOQ)*** model, it is questionable whether an optimum level of quality really exists. *Crosby (1991)* points out that many companies fail to integrate the cost of quality model with their management process. That is, although managers estimate the cost of quality, but they fail to take appropriate actions to reduce it. The advent of ***total quality management (TQM),*** the emphasis has shifted away from "conformance to specification" and towards "customer satisfaction" *(Neely et al., 1995).* As a result, the use of customer opinion surveys and market research has become more widespread. The establishment of the *Malcolm Baldrige National Quality Award* in the USA and the *European Quality Award* reflects this trend well.

Other common measures of quality include *statistical process control (Deming, 1982; Price, 1982)* and the *Motorola six-sigma* concept *(Neely et al.1995).* Both measures of quality raise an important issue relevant to PMS design because they *focus on the measurement of the process rather than the output.*

6.2 Performance measures relating to Time. Examining the current literature of business strategy and PM reveals that time is proposed as the new strategic metric. The importance of time, according to *Stalk, 1988; Bockerstette, 1993,* can be realised from the following argument: *measuring, controlling and compressing time will increase quality, reduce costs, improve responsiveness to customer orders, enhance delivery, increase productivity, reduce risks since reliance on forecasts is reduced, increase market share and increase profits.*

Table 5 presents a summary of time-based measures and the frequency with which they appear in recent literature. The five measures appearing most often are below. The frequency of appearance of these five items suggests that they are key dimensions of time-based performance. In addition, customer responsiveness has recently been recognized in the agility literature as a key aspect of time-based performance *(Hendrick, 1994; Kim, 1994; Roth and Maruchek, 1993)*. The literature identifies rapid confirmation of orders and rapid handling of customer complaints as two key indicators of customer responsiveness *(Roth & Maruchek, 1993)*

The advantage of time-based performance measures presented by *Stake & Hout, 1990; Azzone et al. 1991; Barker, 1993.* They are simple and easy to understand and use. The main disadvantage of these performance measures is that they solely concentrate on time and neglect other operational performance measures such as quality, cost and delivery. Without controlling and improving these operational measures companies will not be able to compress time.

Table 5 – Summary of time-based measures and frequency appearing in the literature

Author(s)	New product development time	New product introduction time	Manufacturing lead time	Delivery reliability/ dependability	Delivery speed	Customer respon siveness
Roth et al. 1989				X	X	
Chapman & Carter, 1990			X		X	
Stalk & Hout, 1990	X	X		X	X	X
Handfield, 1992				X	X	
Rosenthal & Tatikonda, 1993	X					
Roth & Maruchek, 1993				X	X	X
Tunc & Gupta, 1993	X		X	X	X	X
Hendrick, 1991	X		X			
Kim, 1991	X		X		X	
Miller & Roth, 1991		X	X			
Roth & Giffi, 1991		X		X	X	
Wood et al. 1991			X	X		
Zirger & Hartley, 1991	X	X				
Koufterros, 1995	X			X	X	
Handfield, 1995	X	X	X		X	
Safizadeh et al. 1996		X		X	X	X
Tersine & Hummingbird, 1995						
Vickery et al. 1995	X	X	X		X	
Ward et al. 1995		X	X	X	X	X
Carter et al. 1995	X	X				
Jayaram et al. 1999	X	X	X	X	X	X
Frequency Count	**11**	**10**	**10**	**11**	**14**	**6**

Source : Adapted from Jayaram, J, Vickery, S.K. & Droge, C., 1999

Time has been described as both *a source of competitive advantage and the fundamental measure of manufacturing (Stalk, 1988; Drucker, 1990).* The operations literature identifies two prominent strategies that should directly impact one or more dimensions of time-based performance as follows: *Integrated Product - Process Design; and Lean Manufacturing.*

Various time-related practices or programs are associated with each of these strategies. Programs engendering the ***integration of product and process design***

include *CAD/CAM, concurrent engineering (CE), design for manufacturability (DFM), standardization, and supplier partnership.* ***Lean production*** encompasses practices such as *just-in-time (JIT) manufacturing, set up reduction, continuous improvement, cellular manufacturing, preventive maintenance, JIT purchasing and supplier development.* Under the ***just-in-time*** **(JIT)** manufacturing philosophy, for example, the production or delivery of goods *just too early or just too late* is seen as waste *(Potts, 1986).* Similarly, one of the objective of optimised production technology is the minimisation of throughput times *(Goldratt, 1986).* In the synthesis of the literature that follows (see Figure 6), it identifies all 13 of these action programs as critical antecedents of time-based performance.

Table 6–Literature linking time-related action programs to time-based performance

Author(s)	A	B	C	D	E	F	G	H	I	J	K	L
Hyer & Wemmerlov, 1981									X			
Fry et al., 1987									X			
Roth et al., 1989							X				X	
De Myer & van Hooland. 1990					X							
De Myer & Ferdowns, 1990						X					X	
Cordero, 1991	X											
Susman & Dean, 1992			X									
Handfield & Pannesi, 1992												
Schmenner, 1992								X				
Bockerstette and Shell, 1993										X		
Hendrick, 1991			X		X			X				X
Handfield, 1991		X										
Carter et al., 1995								X				
Handfield & Pannesi, 1995				X								X
Eisenhardt & Tabrizi, 1995	X											
Koufteros, 1995		X					X		X	X		
Vakharia et al., 1996				X								
Swink et al., 1996	X											
Jayaram., et al., 1999	X	X						X	X	X		
Frequency Count	**4**	**3**	**2**	**2**	**2**	**1**	**2**	**4**	**4**	**3**	**2**	**2**

Notes: A = CAD/CAM, B = Concurrent Engineering, C= Design for Manufacturability, D = Standardization, E = Supplier Partnership, F = JIT Manufacturing, G = Set-Up Time, H = Continuous Improvement, I = Cellular Engineering, J = Preventive Maintenance, K= Supplier Development, L = JIT Purchasing

Source : Adapted and modified from Jayaram, J, Vickery, S.K. & Droge, C., 1999

Galloway and Waldron (1988a; 1988b; 1989a; 1989b) have developed a *time-based costing system* known as throughput accounting. However, practical example of the use of throughput accounting is still rare. One of the first to be published was the case of *Garrett Automotive (Darlington, Innes, Mitchell, & Woodward, 1992).* In that report it was claimed that throughput accounting was one of the factors that helped Garrett Automotive double its profits. Interestingly the authors however, identified three problems with adoption of throughput accounting, namely:

It can be difficult to identify the constraints and the bottlenecks correctly.

1. The reduction in stocks and work-in-process stemming from the use of through put accounting means a short-term profit problem as fewer overheads are carried forward in the stocks. This gives a one-off profit reduction.

2. Reduced inventories highlight problems, which have been hidden for years.

Some may argue that these problems are not due to *throughput accounting.* Indeed they appear to be more akin to the problems that arise from an optimised production technology implementation.

Fooks (1992) reports that *Westinghouse* has used similar cost-time profiles for more than a decade. Basically the idea is that any set of business activities or processes can be defined as a collection of costs over time.

Alternatively, an interesting approach to the design of time-based performance measures is proposed by *Azzone, Masella & Bertele (1991).* They suggest that companies that seek to employ time as a means of competitive advantage should use the generic set of measure.

6.3 Performance measures relating to cost. The development of management has been well documented by Johnson *(Jonhson, 1983)* among others, and his work shows that many of the *management accounting systems* used today are based on assumptions that

were made 60 years ago. Garners *(1954)* 's review of the accounting literature indicates that most of the so-called sophisticated cost accounting theories and practices had been developed by 1925 *(Kaplan, 1984). Johnson and Kaplan (1987)* 's thesis is that because the business environment has change dramatically in the last 60 years, *management accounting* is based on assumptions which are no longer valid. One of the most widely criticized practices is *the allocation of indirect labour and overhead according to the direct labour cost (Johnson and Kaplan, 1987).*

6.4 Performance measures related to flexibility. *Slack (1983)* identifies *range, cost* and *time* as dimensions of *flexibility,* although he later modifies this model so that it includes only *range and responses,* where *range* refers to *the issue of how the manufacturing system can change* and *response* focuses on *the question of how rapidly and cheaply it can change (Slack, 1987).*

Gerwin (1987) observes that very little is known about the implications of flexibility for manufacturing management and suggests that *"part of the problem arises from the lack of operational measures of flexibility"* after identifying various dimensions of flexibility, he suggests the following measures: Mix flexibility, Modification flexibility, Rerouting flexibility, Volume flexibility, Material flexibility.

7. Integrated Performance Measurement Systems (IPMSs)

After having discussed issues related to performance dimensions and measures in supply chain activities, the paper examines and discusses how organizations can integrate performance measures into PMSs selected. Issues on designing and implementing on integrated PMSs that existing in the literature will be discussed.

Researchers have developed integrated PMSs in order to give an overall view of companies' performance and to guard against sub-optimization *(Cross & Lynch,*

1988). These integrated systems are appropriate for a world-class manufacturing firm in many aspects. In order to consider and decide for selecting a PMS, companies would ensure that the PMS selected remains dynamic, integrated, balanced, strategic, improvement oriented, efficient and effective at all times *(Bititci et al., 2000).*

A number of frameworks and models for PMS have been developed as follows:

- Balanced scorecard *(Kaplan & Norton, 1996);*
- SMART - Strategic measurement analysis and reporting technique *(Cross & Lynch, 1988-1989);*
- Performance measurement for world class manufacturer *(Maskel, 1989);*
- Performance measurement questionnaire *(Dixon et al., 1990);*
- Performance criteria system *(Globerson, 1996)*
- Cambridge performance measurement design process *(Neely et al., 1995; 1996); and*
- Integrated performance measurement systems reference model *(Bititci and Carrie, 199 ; Bititci et al., 1998a)*

Throughout the integrated PM, the researchers have conducted audits with collaborating companies. According to *Johnson & Kaplan, 1987,* the authors address key findings related to integrate PMSs as follows:

- It should be a dynamic system;
- Most organizations have only a static PMS;
- This, in turn, has a negative effect on the integrity of PMS as well as on the agility and responsiveness of the organization.
- The main barriers to an organization 's ability to adopt a more dynamic

approach to PMSs can be summarized as follows:

- Lack of a structured framework, which allows organizations to:differentiate between improvement and control measures; and develop causal relationships between competitive and strategic objectives and processes and activities.
- Absence of a flexible platform to allow organizations to effectively and efficiently manage the dynamics of their PMSs.
- Inability to quantify the relationships between measures within a system.

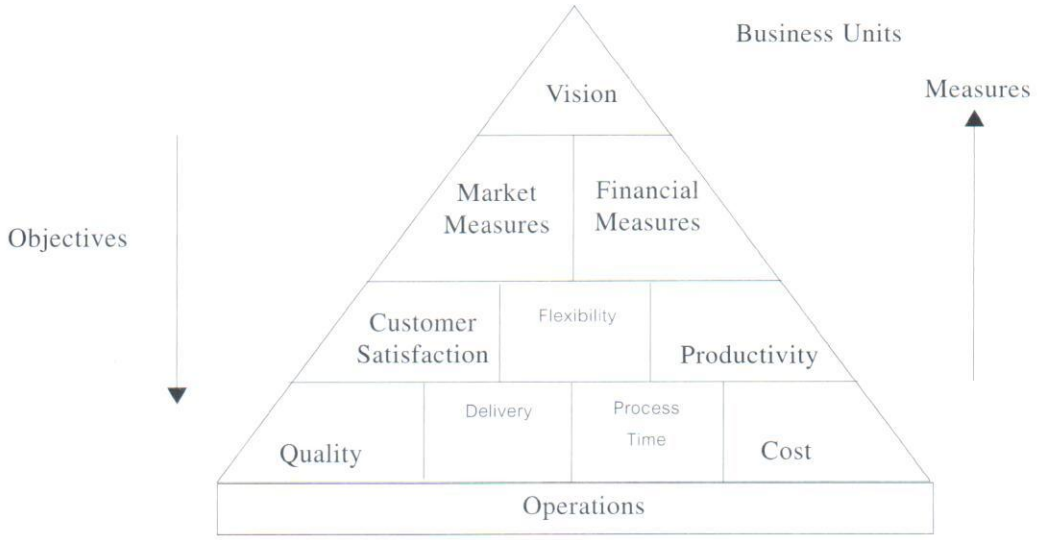
According to above key findings, the PM literature *(Cross & Lynch, 1998; Dixon et al., 1990; Kaplan & Norton, 1993; Neely et al., 1995)* suggests that integrated PMS should have:

- An external monitoring system, which continuously monitors developments and change in the external environment;
- An internal monitoring system, which continuously monitors developments and change in the internal environment and raises warning and action signals when certain perfor mance limits and thresholds are reached;
- A review system, which uses the information provided by the internal and external moni tors and the objectives and priorities set by higher level systems;
- An internal deployment system to deploy the revised objectives and priorities to critical parts of the system.

However, the paper will specifically review on three integrated PMSs that have been often found in the following literature.

7.1 "SMART" System

The *strategic measurement analysis and report technique* (SMART) system was developed by *Wang Laboratories,* Inc. as a result of dissatisfaction with traditional performance measures such as utilization, efficiency, productivity *(Cross & Lynch, 1988).* The objective was to *devise a management control system with performance indicators designed to define and sustain success.*



Source : Adapted from Cross, K.F. & Lynch, R.L. 1988-1989
Figure 1 - SMART Systems

The SMART system can be represented by a four-level pyramid of objectives and measures. Figure 1 presents SMART system. At the top is the corporate vision or strategy. At this level management assigns a corporate portfolio role to each business unit and allocates resources to support them. At the second level, objectives for each business unit are defined in market and financial terms.

At the third level more tangible operating objectives and priorities can be defined for each business operating system (BOS) in terms of customer satisfaction, flexibility and productivity. At the fourth level, the department level, customer satisfaction, flexibility and productivity are represented by specific operational criteria: quality delivery, process time and cost. As the foundation of the performance pyramid, these operational measures are the keys to achieve higher-level result and ensure successful implementation of the company strategy *(Cross et al., 1988, p. 28)*.

The main strength of the SMART system is its attempt to integrate corporate objectives with operational performance indicators. However, one weakness of the SMART system is that it does not provide any mechanism to identify key performance indicators for quality, cycle time, cost and delivery. For example, what are the most appropriate measures for assessing quality? Also, the SMART system does not explicitly integrate the concept of continuous improvement.

7.2 Performance Measurement Questionnaire (PMQ)

Dixon, Nanni and Vollman (1990) developed the PMQ to help managers identify the improvement needs of their organization, to determine the extent to which the existing performance measures support improvements and to establish an agenda for performance measure improvements.

Long run importance of Improvement	Improvement	Effect of current performance measures on improvement
None>>>>Great		Inhibit>>>>Support
1 2 3 4 5 6 7	Quality	1 2 3 4 5 6 7
1 2 3 4 5 6 7	Labor Efficiency	1 2 3 4 5 6 7
1 2 3 4 5 6 7	Machine Efficiency	1 2 3 4 5 6 7

Source : Adapted from Dixon, J.R., Nanni, A.J. & Vollman, T.E., 1990

Figure 2 – Section of Part Two of PMQ

Figure 2, illustrates a framework of ***PM questionnaire*** (PMQ). The PMQ consists of four parts. The first part provides general data to be used to classify the respondents. *Part two* is used to assess the companies' competitive priorities and PMS. It consists of items labeled as *"improvement areas". The third part* is similar to Part two except the focus is on performance factors (performance measures). *The final part* will ask the respondents to provide performance measures that best evaluate their own performance and any other general comments.

The results of the PMQ are evaluated in four ways; *alignment, congruence, consensus, and confusion. Alignment analysis* is conducted to investigate in general terms how well a company 's actions and measures complement its strategy. *Congruence analysis* is conducted to provide a detailed understanding of how well the measurement system supports an organization 's actions and strategy. *Consensus analysis* is carried out by grouping the data by management level or by functional group. This analysis shows the effect of communication. The goal of the *confusion analysis* is to determine the extent of consensus (standard deviation) regarding each improvement area and performance measure.

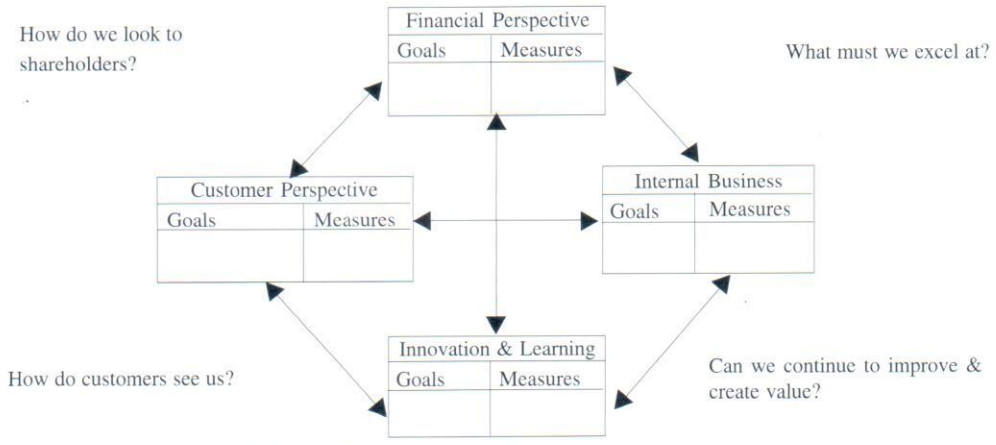
The PMQ has the advantage of providing a mechanism to identify the improvement areas of the company and their associated performance measures. In addition, it tries to determine the extent to which the existing measurement system supports such improvement areas. Its disadvantage is that it can not be considered a comprehensive integrated measure system. More work is required to link these areas of improvement and performance measures to the factory shop-floor. Another weakness is that it does not take into account the concept of continuous improvement.

7.3 The Balanced Scorecard (BSC)

Kaplan & Norton (1992) developed a framework for an integrated PMS for s trategic, operational and financial measures. The BSC provides answers to four basic questions as follows;

- How do customers see us? (Customer Perspective)
- What must we excel at? (Internal Perspective)
- Can we continue to improve and create value? (Innovation and Learning Perspective); and
- How do we look to shareholders? (Financial perspective) *(Kaplan et al. 1992, p. 72).*

For each of the above perspectives goals are set by the managers. Similarly, specific measures are specified in order to achieve each goal. **Figure 3,** presents a framework of the BSC. The BSC has two main strengths. First, it summarizes in one management report many of seemingly disparate elements of a company's competitive agenda. Second, it prevent, it prevent sub-optimization by forcing senior managers to consider all operational measures at the same time.



Source : Adapted from Kaplan. R.S. & Norton, D.P. 1992

Figure 3 – The Balanced Scorecard

The BSC attempts to integrate four important performance perspectives in one simple and easy-to-use management report. The main weakness is that it is primary designed for senior managers to provide them with an overall view of performance. Thus, it is neither intended for, nor applicable at, the factory level. *Gregory (1993)* states that *"Clearly, much work would need to go on below the level of the scorecard to provide systems which could deliver these generally rather aggregated measures".*

After reviewing the literature related to integrated PMSs, it found that they have limitations as follows;

- They are mainly constructed as monitoring and controlling tools rather than improvement tools.
- They do not explicitly consider the integration of continuous improvement.
- They do not provide any mechanism for specifying which objective should be met in a specific time horizon.
- They are not dynamic systems. They do not allow any systematic revision of critical areas, performance measures, historical data.
- They do not look ahead to predicting, achieving and improving future performance. They are only concerned with present performance.
- Although some of them stress the importance of global optimization versus local optimization, they do not provide any mechanism to achieve this, especially at the operational level.
- Most of these systems do not stress the importance of time as a strategic performance measure.
- None of the models provides a specific tool that could be used model, control, monitor and improve the activities at the factory shop-floor.

8. Proposed Model of Performance Measurement System

According to literature review, the paper develops a framework in designing a model of PMS. The proposed model links a company's *mission,* vision (vision includes to *goals* and *objectives*), and strategy to PMS (see Figure 4). It also integrates environmental factors influencing for designing and implementing the PM system. It consists of five key components, namely:

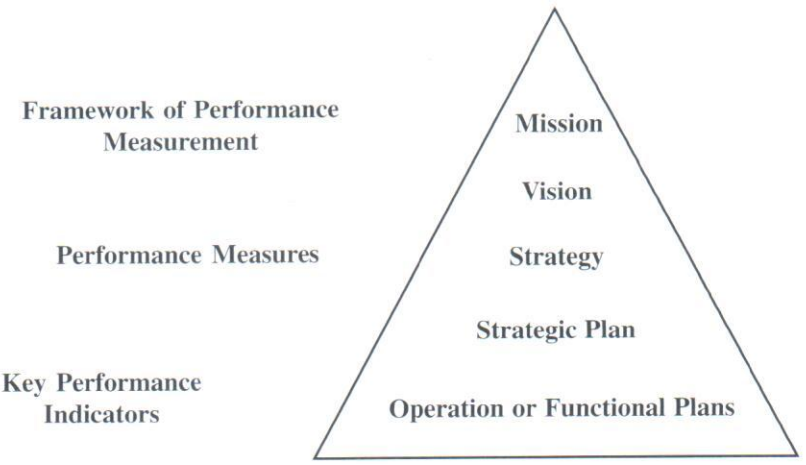


Figure 4 Proposed Performance Measurement System

1. Mission is the purpose or reason for the organization's existence *(Wheelen & Hunger, 2002).* It is foundation for a company to produce a product or service in order to respond customers.

2. Vision includes to the company's ***objectives*** and goals by providing guidance on where the company is going or attempting to achieve. While objectives are the end results of planned activity. They state what is to be accomplished by when and should *be quantified* if possible. *(Wheelen et al. 2002).*

3. Strategy Mintzberg & Quinn (1998) define a strategy as *"the pattern or plan that integrates an organization's major goals, policies and action sequences into a cohesive whole".*

4. Strategic plan *"is a company's overall direction in terms of its general attitude toward growth and the management of its various businesses and product lines"* (Mintzberg et al. 1998).

5. Operation plan is *"approach taken by a functional area to achieve corporate and business unit objectives and strategies by maximizing resource productivity".*

To effectively design the PM system, the key components need to be explored. After clearly examining the components, companies need to identify what is key area which the companies wish to achieve, or which performance measures the companies expect to be competitive weapon, consistently with mission, vision, and strategy. The proposed model provides framework of PM as ***performance measures*** (see Table 7). Within framework of each performance measure, ***key performance indicators*** need to be explored and identified. The advantage of proposed model facilitates for matching all plans with the company's vision and objectives, including providing effective framework to assist management for developing strategic plans. However, some disadvantages occur as developing planning and implementing processes, e.g. time consuming for scanning environments and it needs to set a company's clear vision and objectives. According to literature review, authors suggest that using of few key performance indicators can assist companies to monitor and manage in effective way.

Table 7 Linking Performance Measurement to Organisational Strategy

Linking the company's performance measurement to strategy		
Performance Measure	**Key Performance Indicator**	**Strategy**
1. Financial	• ROI • Cash Flow	
2. Internal Processes	• Turnover of inventory • Time for new productdevelopment per a number of New products	
3. Customers and Markets	• Market Share • Satisfactory Index in the company 's product	
4. Competitors	• Market Share • Satisfactory Index in the company 's product	
5. Human Resource	• Training hours per employee • Ratio of Turnover	
6. Environments	• Money paid for maintaining environments • Fines per violating government regulations	

9. Implication for proposed performance measurement model

Generally companies have variety of different processes and activities, as it does not tend to adopt and apply the model to every company. Some companies using the model would ensure that their prime objective is to improve and enhance organizational performance. Establishing the PMS need leadership and enthusiasm from top management and managers in all levels. While it need commitment and participation from all people in the organization.

The proposed PMS will start with establishing a committee or team from various functions who takes responsibility for monitoring, evaluating and controlling the PM system. The committee has authority to immediately access to top management when the system has been deviated. They have a meeting to clarify and define the company's key components. After defining key components, concerned people would participate to identify performance measures and key performance indicators. In addition, formulating strategy to achieve the goals and objectives.

There are several key issues would be considered on designing the PMS. First, most companies may not be clear on their mission, vision and strategy. Thai auto-part suppliers, for example are local manufacturers might not have defined the key components. Therefore, when they adopt the model to their businesses, it is difficult to establish the PMS that consistent with the company 's direction and strategy.

Secondly, all people must commit to processes of designing and implementing the PMS. They would participate in the activities in order to motivate and encourage them in a positive way. The key point is that how the company would create and develop commitment and motivation. Thirdly, lacking of communication is a major problem found. It includes to providing of two-ways communication among people. Fourth, it is difficulty of translating mission, vision and strategy into practices. Finally, lack of continuous monitoring and evaluating the PMS.

10. Conclusion

The literature review shows that PM is growing in its scope and importance. The academic and practitioners have been increasingly paying attention on how to design and implement for PMSs. However, there are continuously changes in its natures and context. There is a shift for example, from the traditional performance measures that focused on financial data *(i.e. ROI, ROA),* to non-traditional performance measures that focused on non-financial data *(i.e. quality, flexibility).*

Previous works in PM have generally focused on following key issues, namely: Developing new performance measures for specific applications; benchmarking; categorizing existing performance measures; and providing problems and difficulties associated with development of PMSs.

However, many of the existing models use inappropriate or ineffective performance measures that are limited in scope (non-inclusive). The review of the literature related to

performance measurement points out that it need to develop both performance measures and performance measurement systems to remains dynamic, integrated, balanced, strategic, improvement oriented, efficient and effective at all times *(Bititci et al., 2000).*

One of the issues has discussed above, is that research in the field, however, is being undertaken by academics from a wide variety of discipline. The biggest hurdle facing the field is that few academics cross these functional boundaries. Review the work in accounting and you will find references mainly to the work of other accountants. Review the work in operations and we find references to the work of other experts in operations. Several factors compound this problem, but the main one is ***language.*** *Academics in different disciplines talk different languages.* They have different mental models of what constitutes good research. While excellent progress has been made in the field in recent years, substantive breakthroughs are likely to arise when these academics learn to talk and work with one another. *Neely (1999)* addresses that one of the fundamental challenges facing the field today is how to achieve this? How can a common language and shared research agenda be developed?

Another interesting issue that has been often found from the literature is its limitations. In order to overcome the previous limitations associated with PMSs, various integrated PMSs have been developed. However, they also suffer from a variety of limitations. Thus, there is still a need for an integrated dynamic PMS that has the following characteristics *: a clearly defined set of improvement areas and associated performance measures that are related to company strategy and objectives; stresses the role of time as a strategic performance measure; allows dynamic updating of the improvement areas, performance measures and performance measures standards; links the areas of improvement and performance measurement to the shop-floor; is used as an improvement tool rather than just a monitoring and controlling tool; considers process improvements efforts as a basic integrated part of the system;*

utilizes any improvements in performance; uses historical data of the company to set improvement objectives and to help achieve such objectives; guards against sub-optimization; and provides practical tools that could be used to achieve all of the above. (Ghalayini, 1996)

Finally it provided overviews and definitions of PM and SC. It also discussed on the role and importance of performance measures are increasing playing to supply chain activities in order to assist organization to monitor and improve their effectiveness and efficiency. It provided discussion concerning a framework for designing PMS. Its key components that constitute together as a PMS were examined.

The paper also discussed the distinguishing between traditional and non-traditional PM systems. The literature points out to the needs and importance of both traditional and non-traditional performance measures. The former should not be used, by viewing, in order to compete with the latter. Rather they should complement another measure by providing understanding about complex phenomena within their context.

The paper explored performance dimensions and its measures. The literature presents many different performance dimensions and metrics are being used. It would however, be impractical to review all the possible of functions' performance in this paper. It therefore, only selected to only review on the most important measures relating to *quality, time, cost* and *flexibility.*

It also addressed on types of existing PM systems, that have only three integrated PM systems were deeply reviewed. Finally, the paper proposed PMS. The aim of the proposed model is to adopt and apply to specific industry. The successful result would base on how well the model fit or match with the industry.

The literature review leads to a conclusion that the study related to PM systems is vitally needed to reliably and accurately measure activities in which the

flow of material, information and cash, through transformation processes, to finished product. PM is *a power tool that assists firms or organisations to evaluate resource utilization* so that they can strategically manage and properly and continuously control to achieve their objectives and goals.

11. Further research

The literature provides significant foundation of designing and implementing PM. While authors point out dynamic changes on the PM system designing by focusing on non-financial measures, instead of financial measures. The dominant approaches are *Kaplan and Norton (1992)*'s balance scorecard, *Brignall et al. (1991)*'s results and determinants framework, and *SMAC (1997)*'s economic value added. However the literature reveals a gap of using current PM systems. The PM systems tend to identify current positions and directions, but no PM systems really provide an approach to continuously improving the processes and activities. It needs a PM system which focuses on performance measures and key performance indicators, including integrating on methods or procedures of continuous improvement.

Developing the PM systems has been undertaken by academics and practitioners from disciplines. They have variously and differently mental pictures on viewing issues of PM. The framework of measuring performance for example, some authors use word of "focus", "measure" or "perspective" These words in the PM systems have same or similar meaning. Therefore, it needs a study to provide and integrate definitions, natures or characteristics of words using in PM literature.

Due to various industries, implementing PM models vary on natures and characteristics of industries, companies and functions. No research study identifies whether specific model is mostly appropriate or fit with specific industry. Therefore, it needs a research study to examine and identify adoption of each model to the specific industry.

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