Chapter 2

Literature Review

The previous Chapter provided a brief overview of the entire research work including relevance of the present research and the motivation for the study. This Chapter provides an extensive examination of related literature on Supply Chain Performance Measurement (SCPM). Desirable characteristics of Supply Chain Performance Measurement Systems (SCPMS), evolution of SCPMS, fundamental processes of SCPMS, examination of performance measures and metrics, classification of SCPMS, survey of most widely cited PMSs, gaps identified in the literature, implementation of SCPMS, success factors and selection of SCPM System are the topics discussed in this Chapter.

2.0 INTRODUCTION

This chapter provides an overview of the previous research that has direct consequences to performance measurement in SC. The Chapter aims to study literature in the area of performance measurement related to SCs to study the recent approaches, find out research gaps and make clear the research plan. The need for conducting a proper review of SCPMS literature in context of SC follows from topic of the thesis. A relative analysis of some higher cited performance measurement systems has been undertaken and it specifies that rationality of many of the measurement frameworks needs to be established through further study. The process of choosing appropriate SCPMS is difficult because of the intricacy of these systems. The chapter provides an outline of performance measures employed in SC systems followed by a critical evaluation.

2.1 Definition of SCPMS

Most of the literature on organisational performance measurement consider performance measurement as a system within the boundaries of the organisation (Maestrini, Luzzini, Maccarrone, & Caniato, 2017). Kennerley & Neely (2002) defined Performance Measurement System (PMS) as: *"a balanced and dynamic system that enables support of decision-making processes by gathering, elaborating and analysing information*". The idea of ''balance'' and "dynamicity'' mentioned in the definition was elaborated further by Taticchi et al. (2010). ''Balance'' indicates necessity of employing diverse attributes and viewpoints

that when brought together provide complete understanding of the organisation. Concept of ‘‘dynamicity’’ indicates the importance of continuous monitoring, regular feedback and even updating the measurement criteria periodically.

Bititci, Carrie, & McDevitt (1997) defined SCPMS as “*the reporting process that gives feedback to employees on the outcome of actions*”. Maestrini et al., (2017) defined SCPMS as “*a set of metrics used to quantify the efficiency and effectiveness of SC processes*”. Performance in the words of Tangen (2004) is the “*efficiency and effectiveness of action*” which in turn has given the following definitions:

1. “Performance measurement is defined as the process of quantifying the efficiency and effectiveness of action”.

2. “A performance measure is defined as a metric used to quantify the efficiency and/or effectiveness of an action”.

3. “Performance management system is defined as the set of metrics used to quantify the efficiency and effectiveness of an action”.

2.1.1 Proposed definition for SCPMS

Based on the existing definitions and incorporating the major aspects of the highly cited literature, following definition is proposed for SCPMS:

“SCPMS is a system of methods and metrics used to quantify and report the efficacy and effectiveness of SC processes within and across organisations in order to monitor, control and progress the SC objectives.”

2.2 Objectives of SCPMS

Effective SCM is connected to the diversity of benefits such as improved consumer value, lower cycle times, improved profitability, minimum inventory fluctuations and also improved design of products (Christensen, Germain, & Birou, 2007). Designing an appropriate SCPM aims to therefore enable and ensure improved efficacy and success of the SCM. Main objective of SCPM frameworks is to enable decision makers to measure and understand firm performance, and progress working efficacy by means of improved decision-making procedures (Tangen, 2005b).

SCPMS can facilitate communication among silos of a business enterprise. Further, a well planned SCPMs facilitates integration and understanding among SC partners. There is also an argument that PMS's can be a vehicle for bringing in organisational change and development (Tangen, 2005b). Another opportunity presents by good SCPMSs is that it helps managers to identify potential opportunities for future growth and reducing risks. PMSs gives a feedback on effectiveness of strategies. PMS are integral to the decision making process and also helps in process re-engineering and re-aligning firms strategies and goals (Charan, Shankar, & Baisya, 2008; Tangen, 2005b).

2.3 Desirable Characteristics of SCPMS

A number of suggestions have been offered by various experts on the subject of designing PMSs. Beamon (1999b) presents several characteristics that are found in effective PMSs, which include the following:

1. Measurability (data essential are quantifiable)
2. Inclusiveness (measurement of all relevant features)
3. Consistency (measures reliable with organisation objectives)
4. Universality (permit evaluation under different operating conditions)

As proposed by Gunasekaran et al. (2001), to improve aligning and monitoring of SCs, performance measurement objectives need to reflect overall SC objectives including the measures to be employed. SCPMS matrices need to indicate a well-adjusted method and need to be categorised at operational, tactical and strategic levels.

A set of necessary attributes of SCPM resulting from various studies (Beamon, 1999a; Gomes, Yasin, & Lisboa, 2004; Gunasekaran et al., 2001; Tangen, 2005; Thakkar, Kanda, & Deshmukh, 2009) is given at Table 2.1. Part of these characteristics relate to all measures and some relate to a restricted amount of a company's measures. Achieving all the expectations from a single PMS is difficult. Thus designing a PMS is challenging (Tangen, 2005).

Table 2.1 Desirable characteristics of SCPMS

Desirable Characteristics of SCPMS	Source/ Reference
1. Performance standards should be selected from the company's goals 2. Performance standards should facilitate evaluation of firms that are in similar areas 3. Objective performance measures should be preferable to subjective performance measures 4. Objective of all the performance standard should be indistinct 5. Performance standard must be chosen through deliberations with stakeholder consultation (consumers, managers, employees)	Globerson (1985) as cited by Neely et al. (2000)
6. The performance standards must be connected to company's production strategy 7. Non-financial attribute is necessary to be measured 8. As circumstances change, measures will deviate 9. Standards deviate between situations and locations – one PMS may not be appropriate for all facilities or locations.	Maskell, (1991)
10. Simple and easy to use PMS will be sucessful. 11. The measures should deliver quick response. 12. The measures should be planned in such a manner that they kindle constant improvement rather than only monitor.	Gunasekaran et al., (2001); Thakkar et al., (2009)
13. Meaningful and performance traceable to the financial statements (everything linked to the bottom line) 14. Clear, easy to understand 15. Visible and shared with all employees 16. Used to drive the continuous improvement process 17. Performance objectives must reflect process maps, competitive analysis, and benchmark studies 18. The basis of incentive compensation.	Gomes, Yasin, & Lisboa, (2004b); Grinsven, (1991)
19. Lead to segregate and reduction of waste 20. Apply to both lasting and immediate goals of company 21. Non-Financial and financial criterion should be associated and fit within a strategic model 22. Measures must replicate their strong association with multiple stages in decision making such as operational, tactical and strategic.	Kurien & Qureshi, (2011); Stefan Tangen, (2005)

2.4 Evolution of SCPMS

Performance measurement has its roots in early accounting systems. According to Gomes, Yasin, & Lisboa, (2004b), performance measurement developed over two stages. The first stage started in late 1880s, whereas the second stage began in early 1980s. The cost accounting positioning was the evident feature in the first phase. Evaluating costs and benefits in financial terms helped decision makers in managing their organisations. Examples of such financial measures are profits, return on investments and costs at various levels. However, these cost accounting measures could not capture all the relevant factors that contribute to business progress. This awareness led to the second phase in the 1980s. This decade also saw beginning of globalisation and enterprises spanning continents. A broader PMS incorporating financial and non-financial measures started appearing by mid 1980s (Gomes et al., 2004a). Integrated PMSs started having operational and quality measures. PMSs aligned to strategic objectives started gaining significance. The emphasis was on the development of better integrated PMSs.

The structure of the business organisation also evolved during this period. The early 19th century saw the birth of systematic large organisations. During the 1980's the business organisations became global and 1990's was significant with automation of business processes. The 2000's saw the emergence of e-commerce and boarder less business activities. PMSs also changed with this evolution of business organisation from cost accounting system (before 1980s), mixed financial and non-financial systems (1990's) to balanced integrated approach (2000's). Table 2.2 summarises the evolution of SCPM in an organisational context.

Table 2.2 Evolution of PMS in an organisational context (Balfaqih, Nopiah, Saibani, & Al-Nory, 2016; Gomes et al., 2004a; Morgan, 2007)

Period	Characteristics of business organisation	Characteristics of PMS
Before 1980	Systematic and large organisations	1. "Cost accounting positioning" 2. "Retroactive style and outcomes used to help organisational efficiency, enable budgeting and attract capital from outside entities" 3. "Performance standards controlled by transaction expenses and profit calculations"

Period	Characteristics of business organisation	Characteristics of PMS
1980 - 1990	"Business organisations became global"	1. Cost accounting positioning 2. Retroactive style and outcomes used to enable organizational efficiency 3. Performance measurement improvement to consider operations and value adding approaches
1990 – 2000	"Automation of business processes"	1. Mixed retroactive and proactive method 2. Mixed financial and non-financial alignment 3. Performance measurement improved to contain process, quality and customer focus 4. Results are used to control the whole organisation
2000 - 2010	"e-Commerce and borderless business activities"	1. More proactive method 2. Balanced and integrated alignment 3. Measures are employed to improve organisational responsiveness 4. Performance measurement aimed at providing a comprehensive view of the company and incorporated SC actions.
2010 onwards	Business analytics, mobile platforms, cloud-based systems	1. Emergence of business analytics, big data analytics 2. Use of mobile platforms and cloud-based systems start emerging

Literature survey indicates development of several Performance Measurement Models since 1980s. Many of the PMS frameworks have undergone experiential testing and some others only undergone theoretical developments. Based on literature review, the most popular PMSs are the Balanced Scorecard (1992), "the performance measurement matrix" (1989), the SMART (1988), and "the integrated dynamic PMS" (1997). There are many studies done to measure performance at organisational level in the Indian context, but at an inter-organisation or at a SC context there are very less research available (Saad & Patel, 2006). Table 2.3 lists the major Performance Measurement Models based on literature survey.

Table 2.3 List of Commonly Cited Performance Measurement Models

Name of the model	Period of introduction	Source /Reference
"The ROI, ROE, ROCE and derivatives"	Before 1980s	Simons (2000) as cited by Taticchi et al., (2010)
"The economic value-added model (EVA)"	1980	Mocciaro, Destri, & Picone, (2012); Sharma & Bhagwat, (2007)
"The activity-based costing (ABC) – the activity-based management (ABM)"	1988	Askarany, Yazdifar, & Askary, (2010); LaLonde & Pohlen, (1996); Schulze, Seuring, & Ewering, (2012)
"The strategic measurement analysis and reporting technique (SMART)"	1988	Cross & Lynch, (1988)
"The supportive performance measures (SPA)"	1989	Keegan et al. (1989) as cited by Taticchi et al., (2010)
"The customer value analysis (CVA)"	1990	Taticchi & Balachandran (2008); Desarbo, Jedidi, & Sinha, (2001); Koh, Demirbag, Bayraktar, Tatoglu, & Zaim (2007)
"The performance measurement questionnaire (PMQ)"	1990	Dixon et al, (1990) cited by Bititci et al., (2000); Taticchi & Balachandran, (2008)
"The results and determinants framework (RDF)"	1991	Fitzgerald et al cited by Bititci et al., (2000); Ballantine, Brignall, & Modell, (1998)
"The balanced scorecard (BSC)"	1992	Kaplan & Norton (1992)
"The service-profit chain (SPC)"	1994	Heskett, Jones, Loveman, Sasser, & Schlesinger (2015)
"The return on quality approach (ROQ)"	1995	Rust, Zahorik, & Keiningham, (1995)
"The Cambridge performance measurement framework (CPMF)"	1996	Neely et al (1996) as cited by Taticchi et al. (2010)

Name of the model	Period of introduction	Source /Reference
"The consistent performance measurement system (CPMS)"	1996	Flapper et al., (1996); Pun & White, (2005)
"The integrated performance measurement system (IPMS)"	1997	Bititci, Carrie, & McDevitt, (1997)
"The comparative business scorecard (CBS)"	1998	Kanji, (1998); Kanji & Wong, (1999); Pun & White, (2005)
"The integrated performance measurement framework (IPMF)"	1998	Medori & Steeple, (2000)
"The business excellence model (BEM)"	1999	Wongrassamee, Gardiner, & Simmons (2003)
"The dynamic performance measurement system (DPMS)"	2000	Bititci et al., (2000)
"The action-profit linkage model (APL)"	2001	Epstein & Westbrook (2001) as cited by Taticchi et al., (2010)
"The manufacturing system design decomposition (MSDD)"	2001	Cochran, Arinez, Duda, & Linck, (2001); Oropeza, Tapia, & Cochran, (2001)
"The performance prism (PP)"	2001	Neely, Adams, & Crowe, (2001); Ryan, (2015)
"The performance planning value chain (PPVC)"	2004	Neely & Jarrar, (2004)
"The capability economic value of intangible and tangible assets model (CEVITA)"	2004	Ratnatunga, Gray, & Balachandran, (2004)
"The performance, development, growth system (PDG)"	2006	St-Pierre & Delisle, (2006)
"PMS for Service Supply Chains"	2012	Cho, Lee, Ahn, & Hwang, (2012)

2.5 Fundamental Processes of SCPMS

Fundamental processes of performance measurement according to Andy Neely (Powell, 2004) are the following:

1. "Measurement system design"
2. "Implementation"
3. "Managing through measurement"
4. "Refreshing the measurement system"

In "Measurement system design", the challenge is in selecting the correct attributes; it is recognizing what is essential to measure so as to focus on what is important. 'Implementation' involves ensuring contact to the correct data, and social matters, particularly employee's apathy of measurement. Once measures are implemented people try to play "games" to manipulate target-setting to confirm targets are attainable by them so that, later no responsibility can be attributed. In order avoid this tendency, stakeholders, must be trained to comprehend the objective and benefit of the PMS. In many organisations, a cultural change would be required to effectively employ a PMS which the employee uses appropriately. 'Refreshing' is to confirm that, when the firm changes the measurement scheme is updated and revised.

2.6 Performance Measures and Metrics

Sambasivan, Nandan, & Mohamed, (2009) define measure as "a more objective or concrete attribute that is observed and measured and metric as an abstract, higher-level latent attribute that can have many measures". They also states that "SC is a network of firms that includes material suppliers, production facilities, distribution services and customers linked together via the flows of materials, information and funds". Gunasekaran et al., (2001), classifies the measures as follows: "fund flow (cost and profitability), internal process flow (production level flexibility, order fulfilment and quality), material flow (inventory and internal time performance), sales and services flow (delivery performance, customer responsiveness and customer satisfaction), information flow and partner relationship process flow (supplier evaluation and sharing of information with suppliers and customers)". Figure 2.1 shows four basic links in a SC: plan, source, make/assemble, and deliver. Performance measures possible at these four links are depicted in Figure 2.1. However, according to (Bourne et al., 2003), frameworks on their own are not a complete solution. Frameworks provide different

perspectives for categorising performance measures, allowing one to consider the balance between the demands on the business (Gomes et al., 2004b).

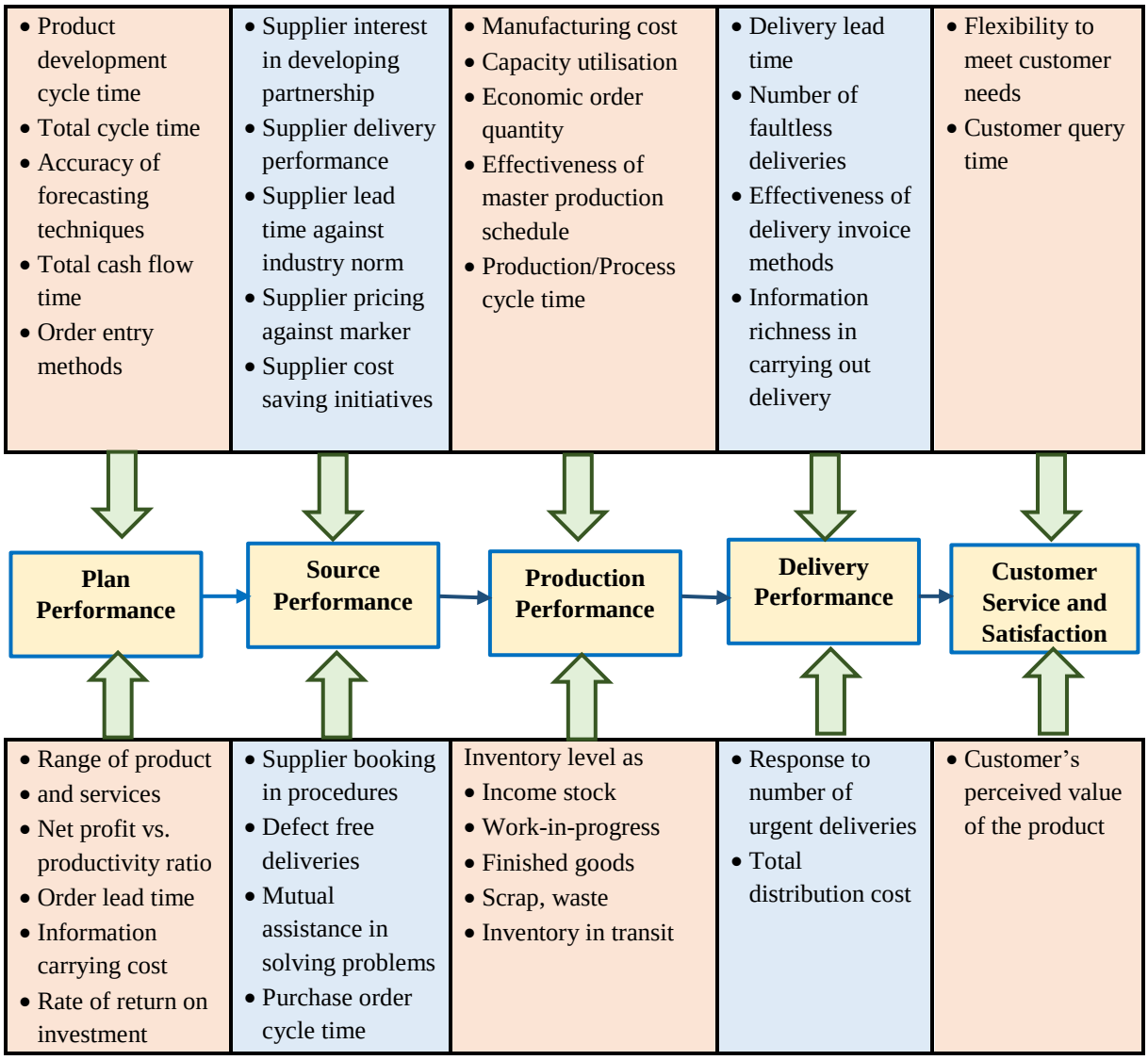


Figure 2.1 Measures and metrics at four basic links in a SC (Source: Gunasekaran et al. 2001)

According to Beamon (1999b), there are three different types of measues which a good SCPMS must give importance to. They are listed below:

1. "Resource measures (generally costs)"
2. "Output measures (generally customer responsiveness)"
3. "Flexibility measures (ability to respond to a changing environment)"

There could be different objectives and goals for these three types of performance measures. Resource measures normally measures the following: “inventory levels, personnel requirements, equipment utilisation, energy usage, and cost”. Output measures include: “customer responsiveness, quality, and the quantity of final product produced”. Flexibility measure is defined as “a system's ability to accommodate volume and schedule fluctuations from suppliers, manufacturers, and customers” (Beamon, 1999b).

2.6.1 Channel-Spanning Performance Measures

Good SCPMS are not restricted to monitor internal functions of the firm. They adopt actions and procedures that spread over to all the links in the SC, incorporating both service and financial metrics (Chan & Qi, 2003). Meeting the end users needs effectively is the objective of channel-spanning PMS. For this to achieve, some organisations are adopting the “common report cards” (Anderson, Britt, & Favre, 2007). These common report cards help SC partners focus on common targets and goals. Measuring service as attributes of the “perfect order” is an example of channel spanning PMS. This is because, an order that arrives when “promised, complete, priced and billed correctly, and undamaged” spans entire SC in addition to meeting the expectation of the customer (Anderson et al., 2007).

Chan & Qi (2002) proposed a channel-spanning PMS from a system perspective using fuzzy set theory. They also suggested channel-spanning contribution of performance measurement action with a Performance Measurement Team (PMT) consisting of the members from multiple management functional silos of the SC. It can also be argued that many SCPMS mentioned in this thesis as part of the literature review such as Balance Score Card (BSC), Performance Prism (PP), Medori and Steeple’s framework, “Supply-Chain Operations Reference (SCOR) model” and the Performance Pyramid can be categorised as channel-spanning PMS if appropriately designed and deployed.

2.7 Classification of SCPMS

Many researchers have grouped PMS in diverse ways. A basic classification offered by (Cagnazzo, Taticchi, & Brun, 2010) consists of grouping PMS models into:

1. Balanced models
2. Quality models
3. Questionnaire-based models

4. Hierarchical models
5. Support models

2.7.1 Balanced model

Non-financial measures are added to financial measures in balanced models. Diverse measures representing different perspectives including quality, customer etc are included independently in balanced measures. Examples of some balanced models are 1. Performance Measurement Matrix; 2. Balanced Scorecard (BSC); and 3. Performance Prism.

2.7.2 Quality models

Quality is considered as the most important attribute in these models. Business Excellence Model (EFQM-Model) is an example of a quality model (Wongrassamee et al., 2003).

2.7.3 Questionnaire-based models

The "Performance Measurement Questionnaire (PMQ)" and "TOPP System (a research study looking at productivity aspects in Norwegian companies)" are examples of questionnaire based models (Bourne, Mills, Wilcox, Neely, & Platts, 2000; Rolstadås, 1998).

2.7.4 Hierarchical models

Hierarchical models are SCPM models that are strictly vertical (hierarchical) which are known by cost and non-cost performance on different levels of aggregation. Examples of hierarchical models are: 1. "Performance Pyramid"; 2. "Advanced Manufacturing Business Implementation Tool for Europe (AMBITE)"; 3. "The European Network for Advanced Performance Study (ENAPS)" approach; and 4. "Integrated Dynamic Performance Measurement System (IDPMS)".

2.7.5 Support models

Support models are not essentially complete PMSs but helps in developing and implementing PMSs. Support models help in identification of features that impact performance. These models are: 1. "Quantitative Model for Performance Measurement System (QMPMS)"; and 2. "Model for Predictive Performance Measurement System (MPPMS)" (Cagnazzo et al., 2010; Suwignjo, Bititci, & Carrie, 2000).

2.8 Survey of Most Widely Cited PMSs

Since 1980s many frameworks and models for performance measurement have been proposed by different authors and experts. When each model is examined, it reveals some benefits and some limitations. Literature review indicates that empirical and theoretical validity of some of the frameworks are established whereas information about others is not available (Balfaqih et al., 2016; Bititci et al., 2000; H. H. Chen, Kang, Xing, Lee, & Tong, 2008). This section is an attempt to study and analyse few widely cited measurement systems.

2.8.1 Balanced Score Card (BSC)

BSC helps decision makers to view the organisation from a balanced perspective of four distinct viewpoints. The measures are derived from the four scorecards which is shown in Figure 2.2. These four scorecards provide responses to four basic enquiries (Tangen, 2004): 1. "How do we represent ourselves to the shareholders (financial perspective)?" 2. "What aspects should we concentrate to excel (internal business aspects)"? 3. "How do the consumers perceive the company (customer perspective)"? 4. "How can we create value while continue to progress (innovation and learning perspective)"?

The "financial performance measures" provides outcomes of previously completed actions. BSC balances the "financial performance measures" with other inclusive "operational non-financial performance measures". These "non-financial measures" can be the drivers of performance including financial performance in future. By providing insights from four viewpoints, the BSC reduces information surplus by restraining the amount of measures used. BSC also enables decision makers to concentrate on the a few of measures that are utmost critical. In addition, the usage of multiple perspectives watches against sub-optimisation by persuading senior leaders to consider all relevant measures and appraise whether enhancement in a selected area is attained at the expense of another.

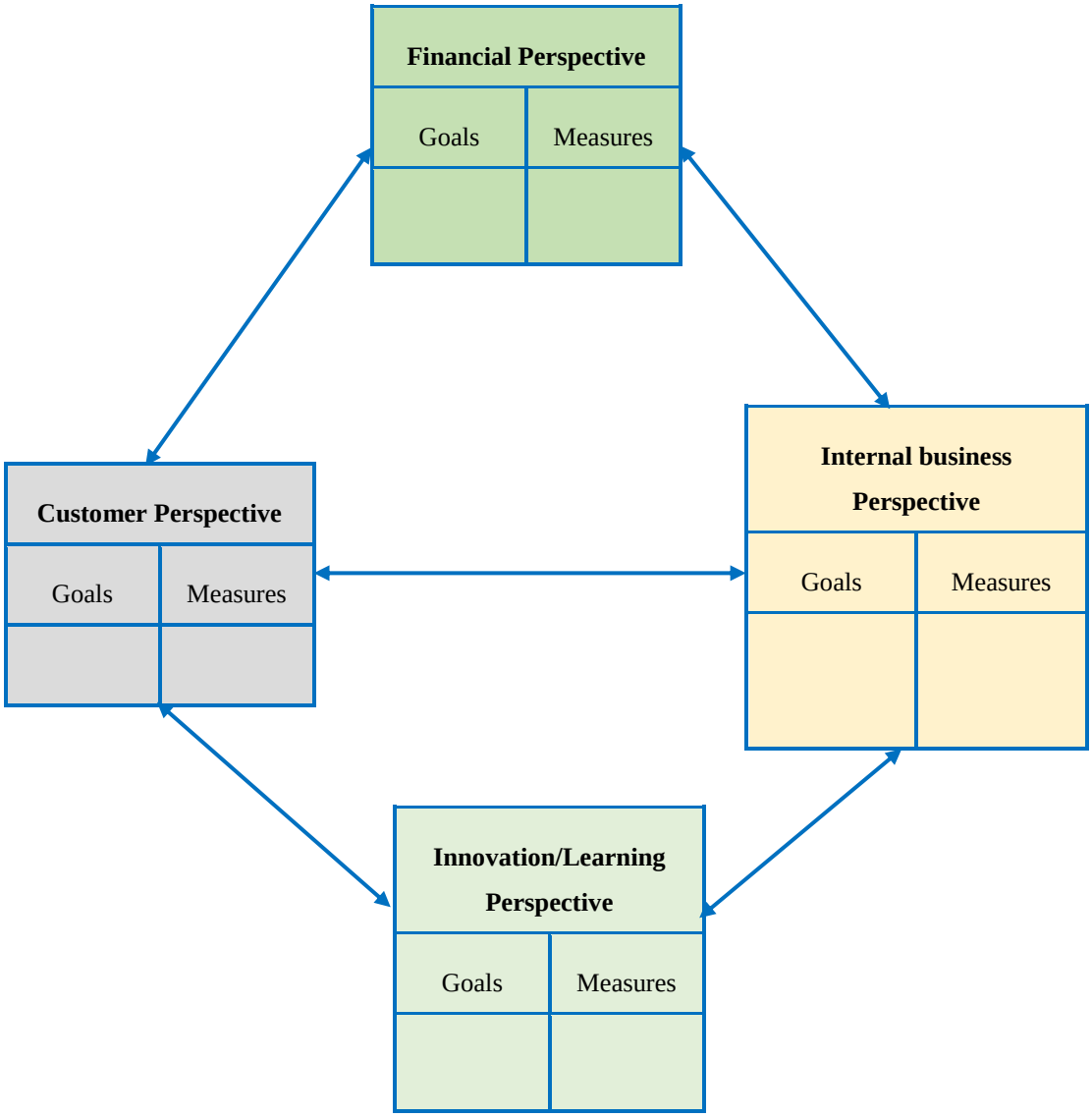


Figure 2.2 Balanced Score Card (Source: Tangen, 2004)

As proposed by Ghalayini & Noble (1996), the major limitation of this method is that BSC is mainly intended to offer senior leaders with a general performance assessment. Therefore, BSC is not envisioned for monitoring the plant processes. In addition, there is an opinion that the BSC is built as a "monitoring and controlling" instrument instead of a "development instrument". Besides, Neely et al., (2000) contend that though BSC is a valued model proposing significant zones where PMS might be useful. BSC do not offer direction on how the suitable attributes can be recognized, presented and eventually employed to succeed in its objective. Soni & Kodali (2010) also argues that BSC do not reflect the opponent viewpoint. It does not specify any mathematical or logical relationships among the individual's scorecard criteria. It is thus difficult to make comparisons within and across firms using BSC

(Soni & Kodali, 2010). Thus BSC is more like a strategic management tool, rather than a true complete PMS (Gomes et al., 2004a).

2.8.2 Performance Prism (PP)

Five distinct and connected viewpoints of performance in incorporated in the Performance Prism framework (see Figure 2.3) (Neely et al., 2001):

1. Stakeholder satisfaction (Who are the stakeholders and what do they want and need?)

2. Strategies (What are the strategies we require to ensure the wants and needs of our stakeholders?)

3. Processes (What are the processes we must put in place to allow our strategies to be delivered?)

4. Capabilities (The combination of people, practices, technology and infrastructure that together enable execution of the organisation's business processes, both now and in the future, and what are the capabilities we require to operate our processes?)

5. Stakeholder contributions (What do we want and need from stakeholders to maintain and develop those capabilities?)

The performance prism has a much more comprehensive view of different stakeholders compared to other frameworks. These stakeholders includes (and not limited to) investors, customers, employees, regulators and suppliers. Neely et al. (2001) argue that there is a fallacy in the common belief that strategy is the start point and performance measures must flow from strategy. The primary consideration should be the wants and needs of stakeholders in place of strategy. Strategies should be planned to fulfil the needs and expectations of the stakeholders. Therefore, the first step has to be defining the stakeholder needs and wants clearly. Forte of this theoretical model is that, it primarily challenges the firm's current strategy before the process of choosing measures is underway (Neely et al., 2000; Ryan, 2015). Like this, the framework assures that PMS is built on a robust basis. The performance prism deliberates on all stakeholders (examples: shareholders, employees, customers, suppliers, and intermediaries) who are typically ignored while designing and creating performance frameworks (Powell, 2004; Tangen, 2005; Tapinos, Dyson, & Meadows, 2005).

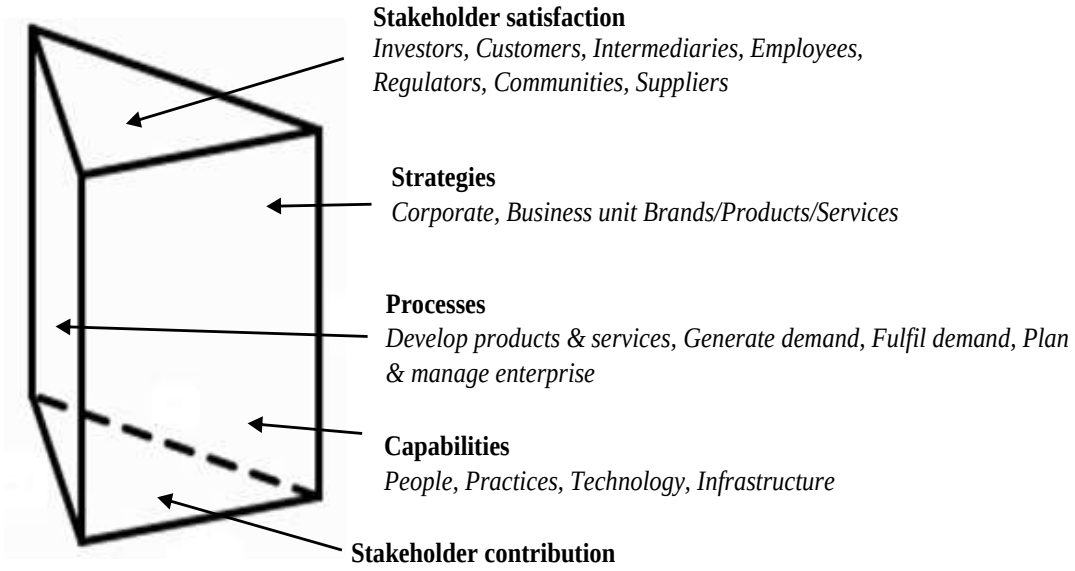


Figure 2.3 Performance Prism (Source: Neely et al., 2001)

The criticism of the performance prism model is that it is not elaborating or specifying how performance is going to be improved and how each attribute will be measured. Another weakness is its silence on other existing measurement systems companies are likely to use (Medori, & Steeple, 2000).

2.8.3 The performance pyramid

The "performance pyramid", proposed by Cross & Lynch (1992) as cited by Tangen (2004) includes a hierarchy of "financial and non-financial performance measures". Purpose of performance pyramid (refer Figure 2.4) is to linkage a company's goals with its processes through interpreting purposes from the top to bottom (based on customer choices) and evaluates after the bottom to top. "Performance Pyramid" comprises four stages of purposes that address company's peripheral efficacy (pyramid's left side) and its internal efficiency (pyramid's right side) (Tangen, 2004). The first step in developing a "performance pyramid" is defining a corporate vision at the global level. The global vision is then sub divided into individual business unit goals. Short term objectives of profitability and cash flow forms the level two. Then the gap between the top level and daily operational measures are bridged through the "business operating system". These "business operating systems" are: "flexibility, customer satisfaction, productivity etc.". The significant performance measures such as "delivery,

quality, cycle time, and waste" are then employed at work centres and departments on a regular manner. Ghalayini & Noble, (1996) proposes that significance of the "performance pyramid" is attributed to its effort to fit in organisational purposes incorporating relevant operational performance gauges. The criticism is that it fails to deliver any instrument to recognize key performance indicators. Continuous improvement approach is not also not addressed.

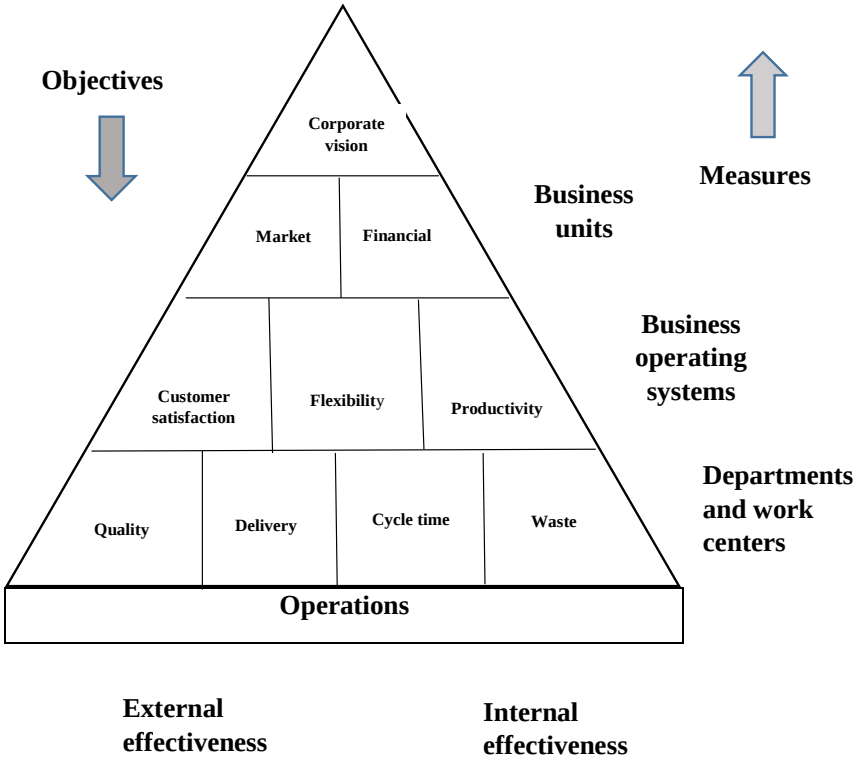


Figure 2.4 Performance Pyramid (Source: Tangen, (2004)

2.8.4 Theory of Constraints (TOC)

Goldratt proposed a method called the "Theory of Constraints (TOC)" as a procedure of continuing improvement (Goldratt, 1999). TOC largely concentrated on manufacture planning and scheduling procedures. TOC can also be used in performance measurement. Inside a structure, a constraint is defined as "whatsoever that confines the system from achieving higher performance comparative to its purpose". TOC proposes a methodical and intensive structured methodology that companies can employ to achieve ongoing development effectively. A set of three universal performance measures are employed for evaluating a business enterprise's capability in attaining the objective. These universal criterions are "ROI,

net profit and cash flow". In the present situation of information overload, TOC brings a focus and this is considered as a forte of TOC (Tangen, 2004). Easy comprehension and simple methodology are the other benefits of TOC. The criticism is that TOC cannot by termed as a comprehensive SCPM system. TOC consider that there always is an understandable constraint which is a limitation in the organisation, which may not be true always. .

2.8.5 Medori and Steeple's PMS

Medori & Steeple (2000) suggested a cohesive agenda in order to review and enhance measurement frameworks. There are six specified stages in this framework which are illustrated in Figure 2.5. The first stage starts with articulating the company's production strategy and success drivers. The major task in the second stage is to identify the company's strategic expectations from the initial stage consisting of six specified competitive primacies (e.g. "cost, quality, time , flexibility, future growth, and delivery"). Afterwards, the choice of the best fit measures is done using a checklist of 105 different measures with detailed specifications which forms the Stage 3. After the choice of measures is completed, the PMS under consideration is checked to identify the current measures that can be retained (stage 4). Here (stage 5), the important action consists of the employment of the measures in which each measure is described by a set of eight items. They are: "benchmark, title, objective, data source, equation, frequency, improvement and responsibility". The final stage (stage 6) is created depending on regular assessment of the organisation's PMS.

This framework can be used by a measurement practitioner to plan a new PMS and also to improve an existing PMS. A description of how a PMS targets are to be achieved is also part of this framework. The constraints of this framework are mostly positioned in the second stage, where a performance measurement network is fashioned to provide the PMS its initial design. Much guidance is not provided here. The network is built from six competitive primacies (e.g. "flexibility, time, quality, cost, future growth and delivery").

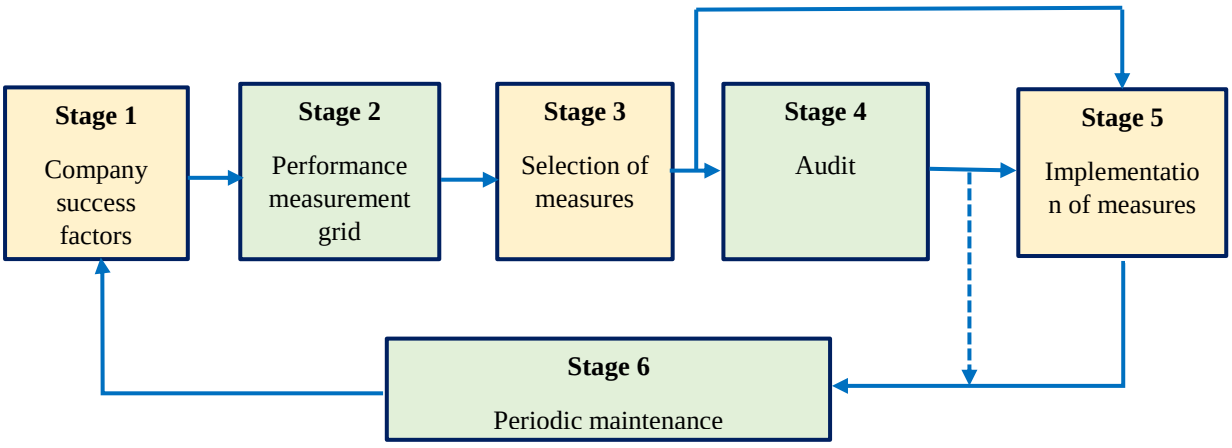


Figure 2.5 Medori and Steeple's framework (Source: Medori & Steeple (2000)

2.8.6 The Supply-Chain Operations Reference (SCOR) model

The Supply-Chain Council (SCC) later merged to APICS developed the SCOR model in the late 1990s to provide a process based and comprehensive model for SCPMS. SC integration and effectiveness were the goals of the SCOR model and it provided a platform for multiple SC partners to communicate (Huang, Sheoran, & Wang, 2004; Kocaoğlu, Gülsün, & Tanyaş, 2013; Archie Lockamy & McCormack, 2004; Stewart, 1997). SCOR model is designed as a tool to "describe, measure and evaluate any supply-chain configuration". The SCOR decision areas are: "plan, source, make, deliver, return and enable". There are 12 performance matrices as part of the SCOR model to measure process performance (Huang et al., 2004). These 12 performance measures are grouped as 1. Delivery reliability; 2. Flexibility and responsiveness; 3. Costs; and 4. Assets. Huang et al., (2004) is of the view that to derive at a quantifiable SC performance measure, there will be an additional requirement of Overall Supply Chain Efficiency Measure incorporated in the SCOR model.

SCOR model is later (SCOR Version 12, 2012) revised to add two more SC processes namely return and enable. The six distinct management processes: "Plan, Source, Make, Deliver, Return, and Enable" are briefly described below (Huang et al., 2004; Kocaoğlu et al., 2013; "Quick Reference Guide SCOR Supply Chain Operations Reference Model," 2017):

i. **Plan** – "Processes that balance aggregate demand and supply to develop a course of action which best meets sourcing, production, and delivery requirements".

ii. Source – Processes that procure goods and services to meet planned or actual demand.

iii. Make – Processes that transform product to a finished state to meet planned or actual demand.

iv. Deliver – Processes that provide finished goods and services to meet planned or actual demand, typically including order management, transportation management, and distribution management.

v. Return – Processes associated with returning or receiving returned products for any reason. These processes extend into post-delivery customer support.

vi. Enable – Processes being associated with the management of the supply chain. These processes include management of: business rules, performance, data, resources, facilities, contracts, supply chain network management, managing regulatory compliance and risk management.

2.8.7 Data Envelopment Analysis (DEA)

DEA is a performance evaluation tool that compares relative efficiencies of similar production units which are called decision making units (DMUs). It does multi-factor productivity analysis based on mathematical modelling (Talluri, 2000; Wong & Wong, 2007). DEA is a widely used tool for evaluating and benchmarking the performance of organisations. There are many examples available in literature of using DEA in performance evaluation of organisations such as hospitals, schools, production units, railway stations etc.

The advantages of DEA are that it take into account multiple attributes and does not require parametric assumptions of traditional measurement systems (Talluri, 2000). Both quantitative and qualitative measures can be evaluated using DEA. It is based on the concept of "efficient frontier analysis". DEA has a limitation on the limit of number of relationships that can be analysed between the input and output units. DEA also suffers another disadvantage that only likeable units can be compared hence all the decision making units must have same strategic goals and objectives (Caballer-Tarazona, Moya-Clemente, Vivas-Consuelo, & Barrachina-Martínez, 2010; Chen & Yan, 2011; Soni & Kodali, 2010; Zeydan & Çolpan, 2009).

2.8.8 Time-based performance measures

In the literature, four time-based models are seen more often, they are:

1. “New product development time”
2. “Manufacturing lead time”
3. “Delivery speed” and
4. “Responsiveness to customers”

The SC time based PMSs integrate strategic processes such as, “new product development, manufacturing, delivery, and customer service” to monitor and reduce cycle times. There are case studies supporting and validating efficacy of time-based performance measures. (Jayaram, Vickery, & Droge, 2000). Balfaqih et al., (2016) classified performance measurement frameworks based on techniques used for development and evaluation purpose and the result is summarised at Figure 2.6.

2.8.9 Other frameworks of SCPM

There are many frameworks other than the ones mentioned above in literature. They are in various stages of development, trials and implementation. Thakkar et al. (2009) suggested a model combining the features of BSC and SCOR to provide a complete performance measurement model for small and medium scale industries. The model consist of both tangible and intangible measures. The hard measures are: “cost, time, capacity, productivity, and utilisation” which are tangible and easy to collect and measure. The other soft., intangible measures are: “effectiveness, reliability, availability and flexibility”. These intangible attributes are difficult to directly measure and therefore need to be mapped to measurable indicators. Further, these measures are based on a cyclic view of the SC such as the procurement cycle, production cycle, distribution cycle etc. This approach facilitates linkages across the SC entities and also organisation specific performance measures. This makes the motivation behind a specific measure and related essential choices more unequivocal for decision makers.

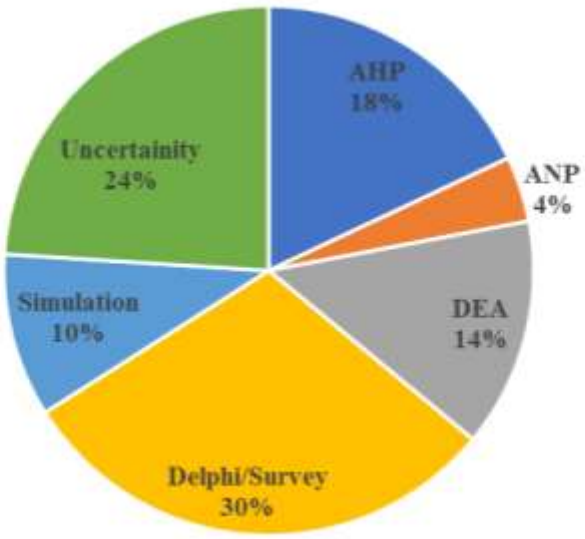


Figure 2.6. Technique wise summary of SCPMSs (Balfaqih et al., 2016)

Internal benchmarking for assessment of SC performance was proposed by Soni & Kodali (2010). An extensive use of performance value analysis (PVA) and strength, weaknesses, opportunities and threats (SWOT) analysis provided for diagnosis of SCs. This analysis can be useful in leveraging the SC drivers of various SCs belonging to same focal organisation and hence bring performance of all the SCs at the same performance level (Balfaqih et al., 2016; T. Chen & Gong, 2013; Maestrini et al., 2017). A comparison based on literature survey on the strengths and limitations of existing PMS has been done and is given at Table 2.4.

Table 2.4 Comparison of Performance Measurement Frameworks

PERFORMANCE MEASUREMENT FRAMEWORK	INVENTOR / RESEARCHER	BENEFITS/ SALIENCE	GAPS/ LIMITATIONS
ABC: Activity-Based Costing	Kaplan and Johnson (1987)	1. A relevant endeavor to determine a portion of the key deficiencies of customary cost accounting approach 2. Analyses costs and margins; variant of full costs, but goes beyond simple calculation of return costs 3. Results in a more precise recognizable proof of costs than customary cost allotment	1. In-depth knowledge of company along with its activities and processes are needed. 2. Information flow and material flow in SC are not given importance. 3. Non-financial measures need to be incorporated
Strategic measurement analysis and reporting techniques (SMART system)	Cross and Richard (1988)	1. Uses "a pyramid of measures to integrate performance through the hierarchy of the organisation" 2. PMS framework that recommends deploying metrics from strategic vision down to operations has also been proposed	1. The idea of continuous improvement is not part of this model. 2. Identification of key performance indicators is missing in this framework.
Performance Measurement Matrix	Keegan et al. (1989)	1. This is a balanced and easy to use performance measurement matrix. 2. It incorporates "financial, non-financial, internal and external classes" of business performance similar to BSC	1. The links between the multiple dimensions of performance is not explicitly stated. Adequate explanation of the framework is not available. 2. Measures that incorporating forward looking, focused on strategy could have been incorporated in the framework

PERFORMANCE MEASUREMENT FRAMEWORK	INVENTOR / RESEARCHER	BENEFITS/ SALIENCE	GAPS/ LIMITATIONS
Sink and Tuttle model	Sink and Tuttle (1989)	1.Incorporates seven relevant organisational criteria of an enterprise. 2. Model try to address the complex interrelationship between multiple performance criteria	Two major limitations are that the framework is not considering organisation's flexibility measurement and also does not consider the customer perspective.
Performance Pyramid	Cross and Lynch (1989)	1. Customer priorities and strategic alignment are well taken care of. 2. Caters to address the organisation's internal efficiency as well as external effectiveness. 3. Integrating operational performance measures with organisational strategy is facilitated	1. Performance pyramid approach does not provide key performance indicators. 2. Similar to SMART system.
Performance Measurement Questionnaire (PMQ)	Dixon et al. (1990)	1. Questionnaire based model which provides a system for focussing on specific areas for improvement within the firm 2. Identifying areas for attention is a strength of this model	1. Requires expertise to implement and monitor 2. The framework do not provide linkages between various areas for improvement

PERFORMANCE MEASUREMENT FRAMEWORK	INVENTOR / RESEARCHER	BENEFITS/ SALIENCE	GAPS/ LIMITATIONS
Theory of Constraints (TOC)	Goldratt (1990)	1. TOC is a process of ongoing improvement mainly applicable to manufacturing. 3. In the present situation of information overload, TOC brings a focus 4. Relatively simple and easy to comprehend approach	1. TOC is not a comprehensive, complete SCPMS. 2. TOC presumes that there always is a limiting constraint in the system which may not be true in all circumstances.
TOPP System	SINTEF (1992)	1. Questionnaire based model 2. Adaptability, effectiveness ane efficiency are integrated in TOPP system. 3. Suitable for self-audit and external audit of firms.	1. TOPP concentrates more on issues relating to competitiveness of an enterprise. Adequate importance is not given to quality. 2. Strategic impact on SC is limited.
Balanced Scorecard (BSC)	Kaplan & Norton, (1996)	1. BSC complements financial performance measures with more operational non-financial performance measures, which are considered as drivers of future financial performance. 2. By giving information from four perspectives, the BSC minimises information overload by limiting the number of measures used.	1. BSC is intended to offer decision makers with an overall view how the firm is performing. i. BSC is not effective at operational level performance monitoring. ii. BSC is not a complete PMS but a strategic management tool. 2. Execution of strategy becomes difficult due to the fact that integration at operational levels are not catered for.

PERFORMANCE MEASUREMENT FRAMEWORK	INVENTOR / RESEARCHER	BENEFITS/ SALIENCE	GAPS/ LIMITATIONS
		3. It also forces managers to focus on the handful of measures that are most critical.	4. It does not consider the competitor perspective.
"Supply Chain Operation Reference (SCOR) model"	Supply Chain Council (1997)	1. Provides a "framework for characterising SCM practices and processes that result in best-in-class performance with five planning needs: source-make-plan-deliver-return". 2. A very comprehensive framework which provides lot of guidance in terms of definitions methods and matrix. 3. Enable companies to measure across SC links	1. To derive at a quantifiable SC performance measure, there will be an additional requirement of Overall SC Efficiency Measure incorporated in the SCOR model. 2. The model cannot provide a link between strategy and performance outputs.
Business Excellence Model (EFQM-Model)	EFQM (1999)	1. Quality is given priority 2. Model is based on TQM principles. Weighted criteria are used for guidance. 3. identifies result areas that should be focussed 3. Suitable for award assessment, bench marking and quality initiatives.	1. EFQM is not designed as a comprehensive PMS 2. Difficult to operationalise; higher expertise is required. 3. Continuous improvement initiatives are difficult
Performance Prism	Neely and Adams (2000)	1. Stakeholder's need and expectations are given a priority	1. The framework does not specify how improvements are going to be acheived.

PERFORMANCE MEASUREMENT FRAMEWORK	INVENTOR / RESEARCHER	BENEFITS/ SALIENCE	GAPS/ LIMITATIONS
		2. The framework begins with identifying stakeholder needs and then align strategy to it. This facilitates a strong foundation for the PMS	2. Another weakness is that little or no consideration is given to the existing PMSs that companies may have in place
Medori and Steeple's Framework	Medori and Steeple (2000)	1. This model helps in evaluating and improving PMS through auditing 2. Guidelines for developing a new PMS is provided 3. It is a good tool for a practicioner	1. PMSs in practice would be of many more categories than those included in this framework. 2. The framework is limited to six competing priorities which is inadequate
Lambert and Pohlen Framework	Lambert and Pohlen (2001)	1. The framework can effectively manage relationships at each link of the SC. 2. Economic value add, impact of supplier relationship and customer engagement are effectively addressed	1. Operational aspects are relatively neglected. 2. There is a need to test the framework in actual business setting; barriers to implementation and benefits on use need to be ascertained.
Performance Measurement Matrix by Gunasekaran	Gunasekaran et al. (2001)	1. A comprehensive set of metrics and measures for SCPMS is presented 2. Measures and metrics at the SC links in a SC: "plan, source, make/ assemble, and deliver" have been specified.	1. The framework proposed aligns the measures with customer satisfaction. Stake holders other than customers are relatively ignored. 2. Though the measures and matrix are classified; weightages (priorities) of measures are not defined.
"Model for Predictive Performance	Unahabhokha, et al. (2004)	Identify significant factors that influence performance indicators	Unable to build a comprehensive performance measurement system connecting SC entities

PERFORMANCE MEASUREMENT FRAMEWORK	INVENTOR / RESEARCHER	BENEFITS/ SALIENCE	GAPS/ LIMITATIONS
Measurement System (MPPMS)"			
SCPM framework for small and medium scale enterprises by Thakkar et al.	Thakkar et al. (2009)	1. The framework is based on set of qualitative and quantitative insights gained during the case study research. 2. It integrates the salient features of BSC SCOR model to deliver a comprehensive performance measurement framework for SMEs. 3. Guideline on implementation and use of the framework is also given.	1. Framework is limited to SMEs in the Indian context. 2. Validation and testing in live situations is required

2.9 IT Tools for Performance Measurement

There are many IT based tools and systems that support SCPMSs. These tools facilitates measurement, feedback and control (Bititci et al., 2000). Few of such tools include:

1. IPM ("integrated performance measurement software" by Lucidus Management Technologies, Oxford, UK)
2. Ithink Analyst (by ISEE systems; formerly High-Performance Systems)
3. PerformancePlus (by InPhase Company, Gerrards Cross, Buckinghamshire, UK)
4. Pb Views (By Panorama Business Views inc.). Many ERP vendors such as SAP and Oracle are at different stage of designing integrated applications for SCPMS.

There are multiple benefits of using IT platform for PMS in a firm. Collection, storage and retrieval of information and PMS maintenance becomes easy and efficient wit IT integrated PMS (Bititci, Nudurupati, Turner, & Creighton, 2002). Based on a case study Bititci et al. (2002) concluded that well designed PMSs, with suitable IT platform will provide proactive management by increased decision making capability. Improved communication, better visibility and integrated team work are the associated benefits. However, Lockamy & McCormack (2004) are of the view that information technology alone cannot be a solution and are only part of the solution to provide better SC performance including its measurement.

When implementing IT as part of PMS, considering its intended and unintended consequences will help in making it an enabler rather than a limitation. Since IT integration is an organisation and people issue, care must me taken in addressing implementation strategy.

A summary of selected literature survey reported findings and gaps identified is presented at Table 2.5.

Table 2.5 Summary of Selected Literature Survey, Reported Findings and Gaps Identified

TITLE OF THE STUDY	RESEARCHER / PROPONENT	METHODOLOGY / APPROACH	MAJOR FINDINGS	GAP IDENTIFIED/ COMMENTS
"Variance vs Average: Supply chain lead-time as a predictor of financial performance"	William J. Christensen, Richard N. Germain, and Laura Birou (2007)	Study analyses the impact of SC cycle times and lead times. The paper is based on a questionnaire-based survey of 210 firms.	1. The financial performance of the firm decreases as the lead-times in the Sc increases. 2. Financial performance if not directly impacted by average lead time 2. SC lead time averages and variance are not correlated to organisational size or complexity	1. Study is limited to individual organizations; impact on SCs is not part of the study. 2. Emphasis is given to financial measures only; operational measures are not considered. 3. Only the outcome of cycle time on SC performance is s analysed; there are many other variables that might also be included such as "inventory management, use of data and communication systems, information availability and relationships between organizations".
"Performance measurement and management: A literature review and a research agenda"	Paolo Taticchi, Flavio Tonelli and Luca Cagnazzo (2010)	1. General literature review on PMS with Citation/co-citation analysis carried out 2. Provides a methodological	1. Important characteristics of PMSs highlighted from most cited works.	1. Gaps identified in following areas: a. PMS and sustainability, b. PMS and project management, c. PMS and risk management.

TITLE OF THE STUDY	RESEARCHER / PROPONENT	METHODOLOGY / APPROACH	MAJOR FINDINGS	GAP IDENTIFIED/ COMMENTS
		review PMSs developed. 3. Presents a research agenda	3. Argues that PMM literature for SMEs are inadequate	2. There is a ‘‘knowing-doing’’ gap when implementation of PMS models is considered.
“A literature review of manufacturing performance measures and measurement in an organizational context: A framework and direction for future research”	Carlos F. Gomes, Mahmoud M. Yasin and Joa˜o V. Lisboa (2004)	1. Literature review for the period 1988 to 2000. 2. Developed a model depicting manufacturing PMSs	1. There are difficulties regarding the *aggregation* and *integration* of PMSs 2. Characteristics of a good PMS would be integrity, inclusiveness, timeliness, completeness, universality, measurability, consistency, flexibility and ethical.	1. With new, powerful ERP packages, practical integrated PMS is within reach. 2. More work is needed in the area of implementation of PMS and daily measurement process.

TITLE OF THE STUDY	RESEARCHER / PROPONENT	METHODOLOGY / APPROACH	MAJOR FINDINGS	GAP IDENTIFIED/ COMMENTS
"Dynamics of performance measurement systems"	Umit S. Bititci and Trevor Turner (2000)	1. Developed a model for dynamic and inclusive PMS. 2. Provided a serious evaluation of current frameworks, against the model proposed.	1. A PMS should be a dynamic to be effective. 2. A combination of the existing frameworks with the IT platform could create a dynamic PMS. 4. PMS should be an integral part of the company's ERP platform.	1. Most organizations have only a static PMS. 2. *Review mechanism*, is not addressed by any of the frameworks considered. 3. Artificial intelligence techniques may provide a way forward and create review mechanisms. 4. Neural network technology may provide a means to learn from previous experiences to establish appropriate threshold values.
"Supply network performance measurement: Future challenges"	Chris Morgan (2007)	1. A research paper which identify key areas for development of SCPMS. The paper traces the history of PMS and examines future challenges that managers of supply networks may face.	1. SCs are evolving over time; 'dyadic' relationships are giving way to 'network' relations. 2. Focus for SC measurement must change as evolution of SC takes place.	1. PMS need to move away from existing: a. "Process only" to "process and process interface" based PMS. b. 'Measurement proliferation' to 'measurement simplification' c. 'Transaction' focused to Process focused 2. Cultural (soft issues) also need to be incorporated in future PMSs in a global scenario.

TITLE OF THE STUDY	RESEARCHER / PROPONENT	METHODOLOGY / APPROACH	MAJOR FINDINGS	GAP IDENTIFIED/ COMMENTS
				3. Existing PMSs are dyadic in nature whereas today's SCs have 'network' relations.
"Supply Chain Performance Measure framework for small and medium scale enterprises"	Jitesh Thakkar, Arun Kanda, S.G. Deshmukh (2009)	This research paper proposes an integrated SCPM framework for small and medium scale enterprises (SMEs). The framework is based on using set of qualitative and quantitative insights gained during case study research of 10 different SMEs.	1. The framework is an integration of balanced scorecard (BSC) and Supply Chain Operation Reference (SCOR) model. 2. It also outlines guideline for implementation and use of the framework. 3. The framework is useful in development of SME specific SCM software.	1. Most of the existing PMS frameworks relate to medium to large company context. PMS for SMEs require a different approach. 2. The framework does not define roles and responsibility for various inputs and outputs of processes and ownership of measures.
"Supply chain best practices – identification and categorization of measures and benefits"	Richard Cuthbertson and Wojciech Piotrowicz (2008)	1. The research paper is based on iterative triangulation which build theories from existing case studies.	1. Paper analysed cases and identified SC best practices. 2. Identified common measures based on best practices.	1. Inadequate measures at inter-organisational level - shared SC measures are absent 2. There is no mention of social and environmental measures

TITLE OF THE STUDY	RESEARCHER / PROPONENT	METHODOLOGY / APPROACH	MAJOR FINDINGS	GAP IDENTIFIED/ COMMENTS
		2. A methodology to categorise SC is presented in the paper		
"Performance measures and metrics in a supply chain environment"	A. Gunasekaran, C. Patel, E. Tirtiroglu (2001)	An integrated framework for PMS across the four links of SC is presented. In addition to the four links, it also presents measures at the multiple levels of strategic, tactical and operational.	1. A SC based approach considering all the links of the SC 2. Measures and metrics at four basic links in a SC: "plan, source, make/ assemble and deliver have been identified and laid out".	1. The paper identifies two gaps in existing PMSs viz: a. "Lack of a balanced approach". b. "Lack of a clear distinction between metrics at strategic, tactical, and operational levels". 2. The framework has following limitations: a. Stake holders other than customers are relatively ignored. b. Weight ages (priorities) of measures are not defined.
"Performance measurement and evaluation of suppliers in supply chain: An evolutionary fuzzy-based approach"	Rajkumar Ohdar and Pradip Kumar Ray (2004)	Evaluates supplier performance using Fuzzy based interface. Also uses genetic algorithm and fuzzy rule to suggest the PMS	1. Evolutionary fuzzy-based approach developed and used successfully in case of supplier evaluation. 2. The proposed methodology gave satisfactory results in a case study.	1. PMS has many situations warranting multi-criteria decision and linguistic inputs where there are limitations on using deterministic PMS models. 3. Approaches using Fuzzy Logic and Genetic Algorithms will have applications in SCPM.

TITLE OF THE STUDY	RESEARCHER / PROPONENT	METHODOLOGY / APPROACH	MAJOR FINDINGS	GAP IDENTIFIED/ COMMENTS
"Developing environmental supply chain performance measures"	Sarah Shaw, David B. Grant and John Mangan (2010)	The paper is based on literature review in four key areas: performance management, SCPM, environmental management and benchmarking.	1. Paper suggests that there is an opportunity to explore relationship between environment and logistics. 2. Environmental SC PMS should enable organisations to more effectively benchmark their SC environmental performance.	1. Environmental PMS in a SC context is in its infancy and a new area of development. 3. More research is required in the areas of: a. Determining indexes for environmental measures. b. Empirical testing of the framework. c. Incorporation of existing standards (e.g. ISO 14031) in measurement frameworks.
"Fuzzy performance measurement of a supply chain in manufacturing companies"	M. Adel El-Baz (2011)	1. This research paper present a fuzzy decision-making approach to deal with the performance measurement in SC 2. Fuzzy set theory and the pair-wise comparison of AHP are used.	1. A framework of PMS, with an example of its application in a manufacturing company has been presented. 2. The effects of different quantitative and qualitative factors on performance are aggregated into a single indicator using	1. Research confirms the utility of using AHP and Fuzzy Set Theory in PMS. 2. The framework is limited to one company; further research is needed to employ the method in a SC environment. 3. Implementation strategy needs to be specified.

TITLE OF THE STUDY	RESEARCHER / PROPONENT	METHODOLOGY / APPROACH	MAJOR FINDINGS	GAP IDENTIFIED/ COMMENTS
		3. The method is tested on a numerical example.	the fuzzy set theory and AHP.	
"A framework for analysing supply chain performance evaluation models"	Dominique Estampe, Samir Lamouri, Jean-Luc Paris, Sakina Brahim-Djelloul (2010)	1. The Research paper analyzes various models used to assess SCs by highlighting their specific characteristics and applicability. 2. Offers an analytical grid breaking these models down into seven layers.	1. Evaluation models for assessing suitability of PMS to different corporate settings have been brought out. 2. Highlights dissimilarities between different models used in SC evaluations.	1. Further work is required to analyse: a. How would different PMM model choices affect each of the firms in creation of value? b. What is the effect on a SC performance when each of its actors finds itself at a different level of maturity? c. What happens when new evolution concepts arise?
"The Supply Chain Matrix"	Douglas M Lambert, Terrance L Pohlen (2001)	Research work analysed existing PMSs and SCM practices and suggested a matrix for SCM and performance measurement.	1. The framework developed focus on managing customer relationships and supplier relationships at each SC link 2. Metrics are defined by analysing the impact of customer and supplier	1. Existing frameworks analysed by the authors are logistic measures with an internal focus; measures spanning entire networks are not available; measures do not consider SC strategy. 2. There is a need to test the framework

TITLE OF THE STUDY	RESEARCHER / PROPONENT	METHODOLOGY / APPROACH	MAJOR FINDINGS	GAP IDENTIFIED/ COMMENTS
			relationship management on the economic value added.	
"Performance measurement: from philosophy to practice"	Stefan Tangen (2004)	Presents an overview of the more common, more modern approaches to PMS and attempts to identify whether they have addressed the limitations of traditional ways of PMSs	1. Gives a critical analysis of most common existing PMSs. 2. Suggests framework for a PMS audit and enhancing method	1. Research indicate that many companies are still relying on traditional financial PMSs 2. Further work is needed so that the conceptual frameworks can be translated and tailored to fulfil the unique measurement needs of a specific organisation

2.10 Implementation of SCPMS

Many authors indicated that there are difficulties in implementing SC wide and balanced SCPMSs (Bourne et al., 2003). Implementation of any of the SCPM framework described above is fraught with complexity of varying levels and therefore implementation issues are critical for its success. According to Thakkar et al. (2009), Strategy, Leadership, Culture, and Capability are four critical factors that have a role in effective implementation of SCPM. Each of these elements is inter connected with each other and simultaneously exercises the influence on implementation of the suggested frameworks. Organisations are governed by strategy formulated by its owner and hence it is necessary to match the expectations of the leader for successful implementation of frameworks. Organisation's strategy implementation fails in absence of needed capabilities (technological or human resource capabilities) and long-term vision. A match between culture and capability is must for organisations which have highly lucid and flexible work culture. The link between culture and leadership is critical in a way that expectations and vision of owner/CEO dictate the practices and kind of value system to be adopted by people and hence influences the development of culture in an organisation.

According to Charan et al. (2008), for better results on implementation of SCPM, top management should focus on improving the high-driving power enablers such as awareness of PMS in SC, commitment by the top management, consistency with strategic goals, funding for PMS implementation, and effective information systems. Enablers of SCPMS implementation as suggested Charan et al. (2008) are: 1. Effective information system; 2. Employee's commitment; 3. Dynamic, inter-connectable, cross-functional and usable SCPM; 4. Partnership with dealers, distributors and retailers; 5. Appropriate performance metrics; 6. Overcoming mistrust; 7. Funds for PMS implementation; 8. Commitment by top management; 9. Awareness about PMS in SC; and 10. Consistent with strategic goals.

2.11 Success Factors

A PMS should be derived from the company's objectives. Otherwise, the PMS may support actions that have the opposite effect of those implied in the strategy (Tangen, 2004). A PMS ought to consist of various types of performance measures covering all important aspects agreed as representing the success of a company. There must in turn be a balance between the various performance measures in the SCPM. A PMS should be appropriately focused on short-

and long-term results, different types of performances (e.g. cost, quality, delivery, flexibility and dependability), various perspectives (e.g. the customer, the shareholder, the competitor, the internal and the innovativeness perspective), and various organisational levels (e.g. global and local performance).

As the performance measures by which employees are evaluated greatly impact their behaviour, an improper set of measurements can lead to dysfunctional or unanticipated behaviour. A PMS must therefore guard against sub-optimisation, possibly by establishing a clear link from the top of the company all the way to the bottom, to ensure that employee behaviour is consistent with corporate goals (Tangen, 2004). To create appropriate action, it is necessary to use a limited number of performance measures.

A PMS's main goal is to give important information, at the right time, to the right person. An important point to remember is that the PMS must be designed in such a way that information is easily retrieved, usefully presented and easily understood by those whose performance is being evaluated. (Tangen, 2004). A performance measure should have a clear purpose and be defined in an unambiguous way along with details of who will use the measure (e.g. collect the data, with what frequency, and how to act on the measure).

The reasons for failure in SCPM are varied and of diverse nature. Morgan (2007) suggests following reasons for failure of SCPM systems: 1. Preoccupation with dyadic relationships and a lack of supply network focus and strategy. Current SC relationships are of network nature and not just dyadic. 'Supply Chains' are usually not supply chains but supply networks. In these networks relationships are difficult to define; 2. Inability of many organisations to create SC visibility because of technical and system problems; 3. Poor connections between marketing and supply network activities; 4. A general lack of managerial awareness of the need to engage the organisation's PMS as a vehicle for organisational change.

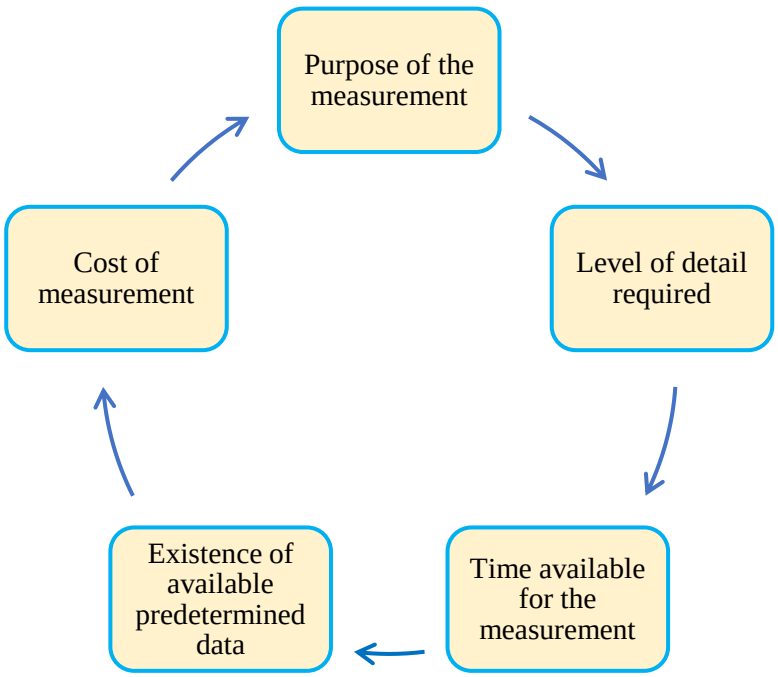
Bourne et al. (2003) lists four barriers to implementation of PMSs. These were identified through individual cases. These barriers are: 1. "Vision and strategy not actionable"; 2. "Strategy is not linked to department, team and individual goals"; 3. "Strategy is not linked to resource allocation"; and 4. "Feedback is tactical and not strategic". Bourne et al. (2003) also suggests three important factors for the success of a PMS; they are: 1. "Developing information architecture with supporting technology"; 2. "Aligning incentives with the new

measurement system"; 3. "The lead given by the CEO". Those firms which already have a structured information system infrastructure and adequately developed corporate information architecture are likely to have capability to develop and support SCPM.

2.12 Selection of SCPM System

A large number of different types of performance measures have been used to characterise systems, particularly production, distribution, and inventory systems. Such a large number of available performance measures makes performance measure selection difficult (Beamon, 1999b). These frameworks all have their relative benefits and limitations, with the most common limitations being that little guidance is given for the actual selection and implementation of selected measures (Medori & Steeple, 2000). Businesses rarely want to design PMS from scratch and usually managers are interested in eliminating any weaknesses in their existing system (Neely, 2004). According to Tangen (2004), the choice of a suitable measurement technique depends on a number of factors and these interlinked factors are depicted at Figure 2.7.

Figure 2.7 Factors affecting Choice of SCPMS (Source: Tangen, 2004)



A detailed model for selection of a suitable SCPM model for a SC is not found in literature surveyed. However, Balfaqih et al., (2016) suggests some guidelines for choosing the appropriate PMS framework.

2.13 Conclusion

For the SCs to be successful its members must shift their focus from individual-member performance to SC performance and this requires integration. Trust, commitment and communication between the SC members (managers) are critical to achieve integration (Sambasivan et al., 2009). The performance measures and metrics must reflect these initiatives.

Even though remarkable progress has been made over recent years in the design of performance measurement frameworks and systems, many organisations are still primarily relying on traditional financial performance measures(Tangen, 2004). The modern frameworks have indeed addressed the underlying conceptual issues but have rarely addressed the practicalities of measurement in ways that render them meaningful to practitioners. Studies reveal that some of the best practices proposed as mechanisms for improving overall SCM performance may not have the degree of impact often presented in the literature (Lockamy & McCormack, 2004). It shows that some best practices help to improve SC performance only in specific decision areas. Further research on this topic might indicate that some practices are industry or 'configuration' specific and do not provide the same results for every SC.

SCs need a structured method and guidelines to audit and evaluate existing PMSs (Medori & Steeple, 2000). Managing the variance in a SC network is more significant to an organisation's financial performance than managing average (Christensen et al., 2007). Many authors argue that there is a necessity to limit the number of performance measures to avoid information overload (Tangen, 2004). This exploratory study provided a direction for the present research on developing frameworks for SCPMS.