# UNIT 13 PERFORMANCE MEASUREMENT AND EVALUATION OF SCM

**Objectives**

After reading this unit you would be able to:

- Justify the need for supply chain performance measures
- Describe supply chain performance measurement systems
- Compare supply chain performance measurement systems
- Select measures for measuring the supply chain performance

**Structure**


13.1 Introduction
13.2 Need For Supply Chain Performance Measures
13.3 Measurement Systems
13.4 Supply Chain Performance Measurement Systems
- 13.4.1 Supply Chain Balanced Scorecard
- 13.4.2 Hierarchy Based Measurement System
- 13.4.3 Function Based Measurement System
- 13.4.4 Perspectives Based Measurement System
- 13.4.5 Supply Chain Operations Reference Model
- 13.4.6 Dimension Based Measurement System
- 13.4.7 Interface Based Measurement System

13.5 A Comparison of Measurement Systems
13.6 Selecting Measures
13.7 Methods for Setting Performance Targets
13.8 Total Cost of Ownership
13.9 Summary
13.10 Self-Assessment Questions
13.11 References and Suggested Further Readings


## 13.1 INTRODUCTION

In today's world, Supply Chain Management (SCM) plays a key strategic role in increasing organizational effectiveness and accomplishment of organizational goals such as enhanced competitiveness, better customer service and increased profitability. Today's management can't afford to focus only on company's performance in a vacuum; there is an emerging requirement to focus on the performance of the extended supply chain or network in which company is a partner. An extended supply chain is one that involves not only tier one buyers and suppliers, but also the end supplier (suppliers' suppliers) to end buyers (buyers' buyers). The competition is at a chain or network level, i.e. supply chain vs. supply chain, with emphasis on continuous improvement across the extended supply chain.

There is a shift in focus from an intra organizational performance to inter organizational integrated supply chain performance. Firms have now realized the potential of SCM, but many of them still lack in selecting the proper performance measures for a fully integrated supply chain.

In a supply chain the problem lies at the interfaces that is at the boundary of two organizations. The reason for this is the high level of interdependence intermingled with independence and autonomy of the firms in an integrated SC. Every member is fully autonomous but highly dependent on the performance of other members. Supply chain performance measures differ from traditional performance measures as it crosses company boundaries i.e. it includes suppliers and distributors. Supply chain performance also crosses all functional links like procurement, manufacturing, sales and distribution etc. This makes the choice of supply chain performance measure(s) difficult.

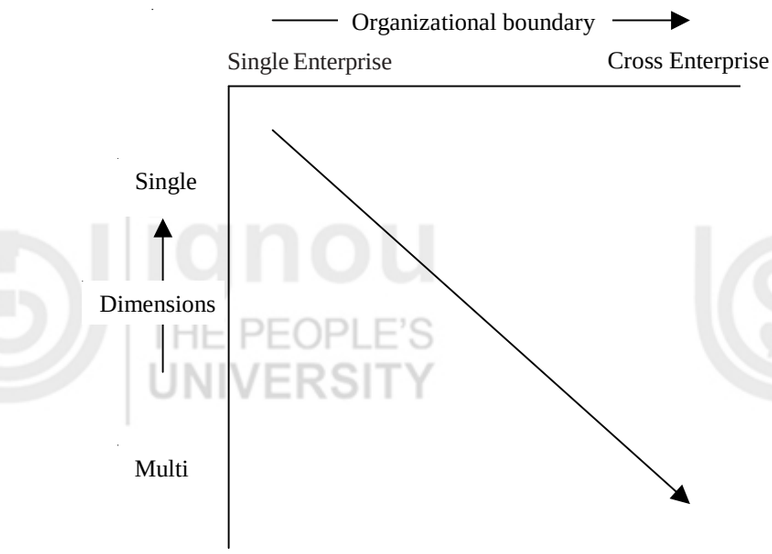
Single performance measure for entire supply chain is not adequate for effective supply chain because it will not cover all pertinent aspects of the supply chain. In many companies, the metrics that management refers to, as supply chain metrics are primarily internally focused functional measures like lead-time, inventory levels etc. In many instances, these measures are purely financial (for example return on assets, overall profits etc.), but they do not indicate how well key processes have been performed or how effective the supply chain is in meeting the primary objective like customer satisfaction.

In an increasing number of instances, the organizations have started measuring performance beyond the traditional boundaries of firm, but it is limited to measuring the performance of immediate SC i.e. tier one buyers and suppliers. These measures do not capture how the extended supply chain has performed and fail to identify areas of improvement in competitiveness, stakeholders' value for each firm in the extended supply chain.

Like in any other case, in order to evolve an efficient and effective supply chain, SCM needs to be assessed for its performance. However, there is often lack of insight for the development of effective performance measures and measurement system needed to achieve a fully integrated extended supply chain. The process of choosing appropriate supply chain performance is difficult due to the complexities of supply chain. This complexity is due to many factors and one of them is the objective of SC itself. The objective of managing the supply chain is to synchronize the needs or demands of the customers with the flow of materials from suppliers to achieve a balance between the conflicting goals of customer service and satisfaction and low supply chain cost. These conflicting goals cannot be accomplished together at a time and hence there is a need to strike a balance between them, which makes the decision of selecting the right performance measures more difficult.

Supply Chain Performance refers to the extended supply chain's activities in meeting end-customer requirements, including product availability, on-time delivery, and all the necessary inventory and capacity in the supply chain to deliver that performance in a responsive manner.

Supply chain performance crosses organizational boundaries since it include raw material components, subassemblies and finished products and distribution through various channel to the end customer. Supply chain performance also crosses traditional functional linkages such as procurement, manufacturing, distribution, marketing &sales and R&D etc. Figure 13.1 shows the evolution of performance measures for SC from single enterprise single measure to multiple enterprises multiple measures.




Source: Warren H. Hausman (2000)

**Figure13.1: Evolution of performance measures for supply chain**

## 13.2 NEED FOR SUPPLY CHAIN PERFORMANCE MEASURES

To excel and win in the today's competitive environment, supply chain need continuous improvements. To achieve this goal, performance measures that support global supply chain performance measurement and improvement are needed, rather than narrow company-specific or function-specific measures, which inhibit chain-wide improvement.

Several factors that contribute to management's need for new types of measures for managing the supply chain include:

- The lack of measures that capture performance across the entire supply chain.
- The requirement to go beyond internal metrics and take a supply chain perspective.
- The need to determine the interrelationship between corporate and supply chain performance.
- The complexity of supply chain management.
- The requirement to align activities and share joint performance measurement information to implement strategy that achieves supply chain objectives.
- The desire to expand the "line of sight" within the supply chain.
- The requirement to allocate benefits and burdens resulting from functional shifts within the supply chain.
- The need to differentiate the supply chain to obtain a competitive advantage.
- The goal of encouraging cooperative behavior across corporate functions and across firms in the supply chain.

Recent studies indicate that supply chain performance affects more than 85 percent of a manufacturer's costs and a large percent of its revenues (Supply chain council 1998). Monitoring SC performance through proper measurements is, therefore, necessary and can help the organizations to identify opportunities for optimization. The successful companies are reengineering their supply chains to decrease costs and improve customer satisfaction. Effective reengineering requires an in-depth understanding of the supply chain processes and their linkages. An in-depth understanding can only permit the development of a performance system and the setting of improvement goals against benchmarks.

## 13.3 MEASUREMENT SYSTEMS

Management veterans argue that measurement is a key to continuous improvement. And this lead to variety of maxims like *" you can't manage what you don't measure "* and *"anything that gets measured gets done"*.

Measurement systems have been used in process management, and Ljungberg (1994), who focused on the order process in his work, has suggested the following definition of a measurement system:

A set of related measures – described by rules and procedures for the collection, compilation and communication of data—that in combination reflect key performance aspects and characteristics of the process in question effectively enough to admit intelligent analysis, if called for to action.

Characteristics of effective measurement system

An effective measurement system is one that has following characteristics (Beamon 1996):

- Inclusiveness: measurement of all pertinent aspects
- Universality: allow for comparison under various operating conditions
- Measurability: data required are measurable
- Consistency: measures consistent with organization goals

## 13.4 SUPPLY CHAIN PERFORMANCE MEASUREMENT SYSTEMS

A performance measurement system can be defined as the set of metrics used to quantify both the efficiency and effectiveness of action. Following questions must be addressed to create a sound performance measurement system.

- What to measure?
- How are multiple individual measures integrated into a measurement system?
- How often to measure?
- How and when measures re-evaluated?

In recent past quite a few supply chain performance measurement system are reported in literature, some of the important ones are discussed in the next section.

### 13.4.1 Supply Chain Balanced Scorecard

A measurement system based on balance scorecard (Kaplan and Norton 1992) uses four perspectives, namely financial perspective, customer perspective, innovation and learning perspective, internal business perspective.

When a supply chain point of view is embedded within the balance scorecard framework the internal perspective of the scorecard is extended to include both the inter-functional and inter-organizational partnership perspectives. The balance scorecard incorporates integrated measures, in addition to nonintegrated measure, that motivate employees to view their firm's success as dependent upon the success of entire supply chain of which they are part, rather then solely upon their firm itself.

SC balance scorecard emphasizes the interdependent as well as independent nature of supply chain and reorganizes the need to ascertain the extent to which firms effectively work together and functions are coordinated and integrated. It also stimulates management to create other measures appropriate to their unique circumstances but it lacks in aligning overall supply chain objectives with objectives for companies.

Brewer and Speh (2000) have developed a model for a balance scorecard in the supply chain context, which is shown in figure 13.2. This model describes the links of different perspective to goals of SCM and then what are the measures to be adopted in each perspective.

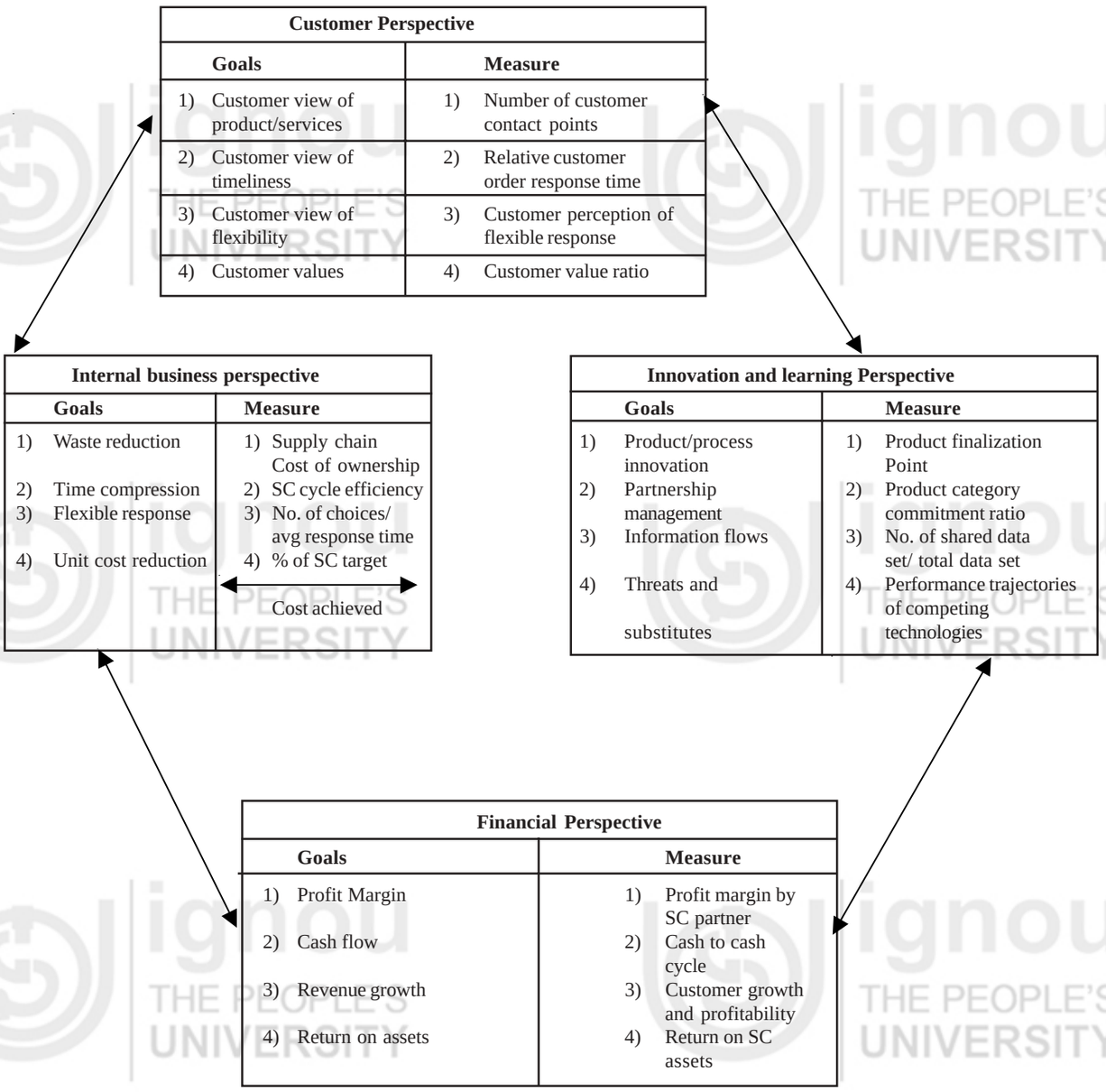



**Figure 13.2: Supply Chain Balanced Scorecard Framework (Brewer and Speh, 2000)**

### 13.4.2 Hierarchy Based Measurement System

Under hierarchical framework measures are classified into strategic, tactical and operational levels of management. This is done to assign them where they can be best dealt with by the appropriate management level, and fair decisions can be made. As shown in table 13.1, the accuracy of forecasting techniques, assigned to the tactical level based on an overall system decision in a supply chain, can be used and managed by the middle management. A similar explanation can be given for the rest of the metrics given in table 13.1.

**Table 13.1: Hierarchical Based Measurement System (Gunasekaran 2001)**

| Level | Performance metrics | Financial | Non-financial |
|---|---|---|---|
| Strategic | Total supply chain cycle time | | * |
| | Total cash flow time | * | * |
| | Customer query time | * | * |
| | Level of customer perceived value of product | | * |
| | Net profit vs. productivity ratio | * | |
| | Rate of return on investment | * | |
| | Range of product and services | | * |
| | Variations against budget | * | |
| | Order lead time | | * |
| | Flexibility of service systems to meet particular customer needs | | * |
| | Buyer supplier partnership level | * | * |
| | Supplier lead time against industry norm | | * |
| | Level of supplier's defect free deliveries | | * |
| | Delivery lead time | | * |
| | Delivery performance | * | * |
| Tactical | Accuracy of forecasting techniques | | * |
| | Product development cycle time | | * |
| | Order entry methods | | * |
| | Effectiveness of delivery invoice methods | | * |
| | Purchase order cycle time | | * |
| | Planned process cycle time | | * |
| | Effectiveness of master production schedule | | * |
| | Supplier assistance in solving technical problems | | * |
| | Supplier ability to respond o quality problems | | * |
| | Supplier cost saving initiatives | * | |
| | Supplier's booking in procedures | | * |
| | Delivery reliability | * | * |
| | Responsiveness to urgent deliveries | | * |
| | Effectiveness of distribution planning schedule | | * |
| Operational | Cost per operation hour | * | |
| | Information carrying cost | * | * |
| | Capacity utilization | | * |
| | Total inventory as: | | |
| | - Incoming stock level | | |
| | - Work in progress | | |
| | -Scrap level | | |
| | -Finished goods in transit | * | |
| | Supplier rejection rate | * | * |
| | Quality of delivery documentation | | * |
| | Efficiency of purchase order cycle time | | * |
| | Frequency of delivery | | * |
| | Driver reliability for performance | | * |
| | Quality of delivered goods | | * |
| | Achievement of defect free deliveries | | * |

The metrics are further distinguished as financial and non-financial so that a suitable costing method based on activity analysis can be applied. In some cases, a metric is classified as both financial and non-financial. For example, the buyer-supplier relationship can be quantified in terms of financial performance achieved, such as cost savings, and in terms of tangible and intangible benefits, like improved quality, flexibility and deliverability.

Hierarchy based measurement system ties together the hierarchical view of supply chain performance measurement and maps the performance measure specific to organization goal. A clear guideline can't be made in such a system to put the measures into different levels that can lead to low level of conflicts among the supply chain partners.

### 13.4.3 Function Based Measurement System

In this system the measures are aggregate to cover the different processes in the supply chain. The figure 13.3 below shows the customer order path and then it covers what are the measure available in each process.

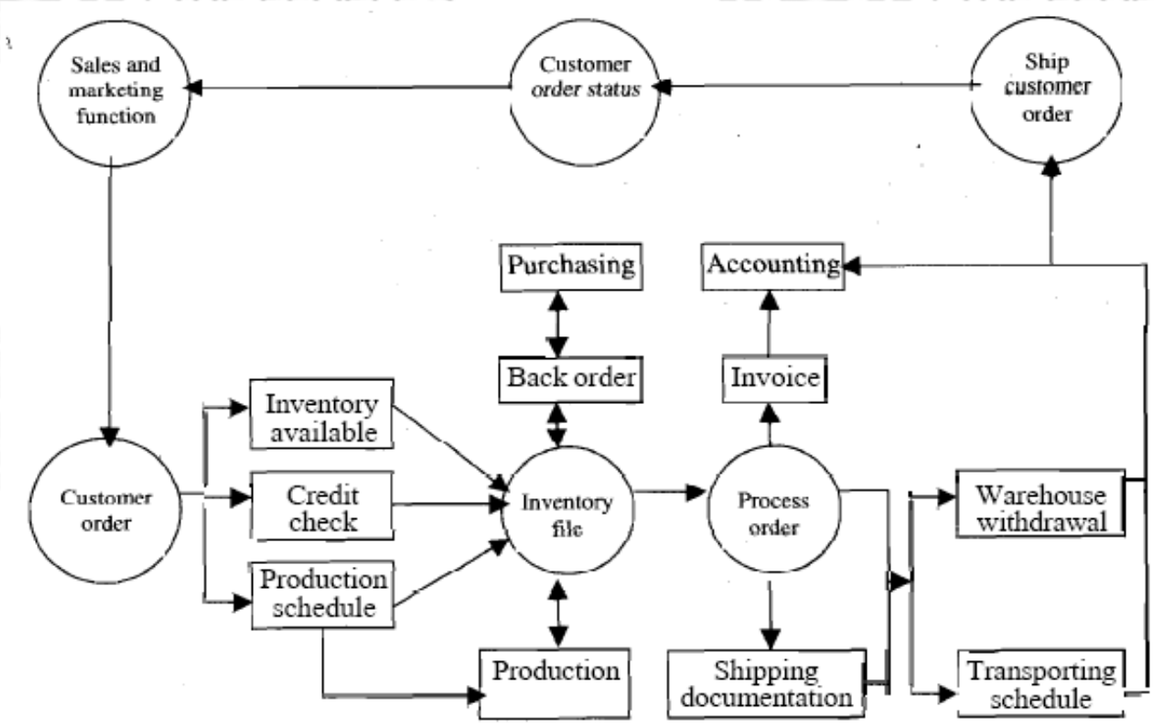



**Figure 13.3: Customer Order Path (Christopher 1992)**

Function based measurement system covers the detailed performance measures applicable at different linkages of supply chain. Approach is easy to implement and targets can be dedicated to individual departments. It doesn't provide the top-level measures to cover the entire supply chain with the company strategy. Looks at the entire chain in isolation, which gives the localized benefits that may harm the total supply chain benefits.

### 13.4.4 Perspectives Based Measurement System

This system presents six unique sets of metrics to measure performance of SCM. The different approaches to SCM lead to different awareness of what should be measured to assess performance. The six different perspectives as shown in table 13.2 are: System Dynamics, Operations Research/Information Technology, Logistics, Marketing, Organization and Strategy.

**Table 13.2: Six perspectives of SCM (Otto and Kotzab 2002)**

| Perspective | Purpose of SCM | Performance measures |
|---|---|---|
| *System Dynamics* | Managing the trade-offs along the complete supply chain. | Capacity utilization, inventory level, stock-outs, time lag for demand information, time to adapt change in demand |
| *Operation Research* | Calculating optimal solutions with a given set of degree of freedom | Logistics cost per unit, service level, time to deliver |
| *Logistics* | Integrating generic processes sequentially, vertically and horizontally | Integration, lead times, order cycle time, flexibility |
| *Marketing* | Segmenting products and markets and combine both using the right distribution channel. | Customer satisfaction, distribution cost per unit, market share, channel cost |
| *Organization* | Determining and mastering the need to coordinate and manage relationships | Transaction cost, density of relationship |
| *Strategy* | Merging Competencies and relocating into the deepest segment of the profit pool | ROI, Time to market |

Perspective based measurement system looks the supply chain in all possible perspectives and provides measures to evaluate each perspective. It also provide a different vision to look supply chain .How to link different perspective to optimize global supply chain perspectives and there can be trade off exist between measure of one perspective with the measure of other perspectives.

### 13.4.5 Supply Chain Operations Reference Model

One way to understand a supply chain is to use a process model. The Supply Chain Council created the SCOR model which is a framework for examining a supply chain in detail, defining and categorizing the processes that make up the supply chain, assigning metrics to the processes, and reviewing comparable benchmarks. Many companies use the SCOR model to understand and improve their supply chains. These companies include aerospace and defense manufacturers, large consumer product manufacturers, and third-party logistics providers. The SCOR model is the only supply chain framework that links performance measures, best practices, and software requirements to a detailed business process model.

SCOR models integrate the well-known concepts of business process reengineering, benchmarking, and process measurement into a cross-functional framework.

SCOR defines supply chain as the integrated process of plan, source, make, deliver and return spanning suppliers' supplier to customers' customer, aligned with operational strategy, material, work and information flows.

The heart of the SCOR system is a pyramid of four levels (Figure 13.4) that represent the path a company takes on the road to supply-chain improvement.

**SCOR spans:**

- All customer interactions, from order entry through paid invoice
- All product (physical material and service) transactions, from your supplier's supplier to your customer's customer, including equipment, supplies, spare parts, bulk product, software, etc.
- All market interactions, from the understanding of aggregate demand to the fulfillment of each order

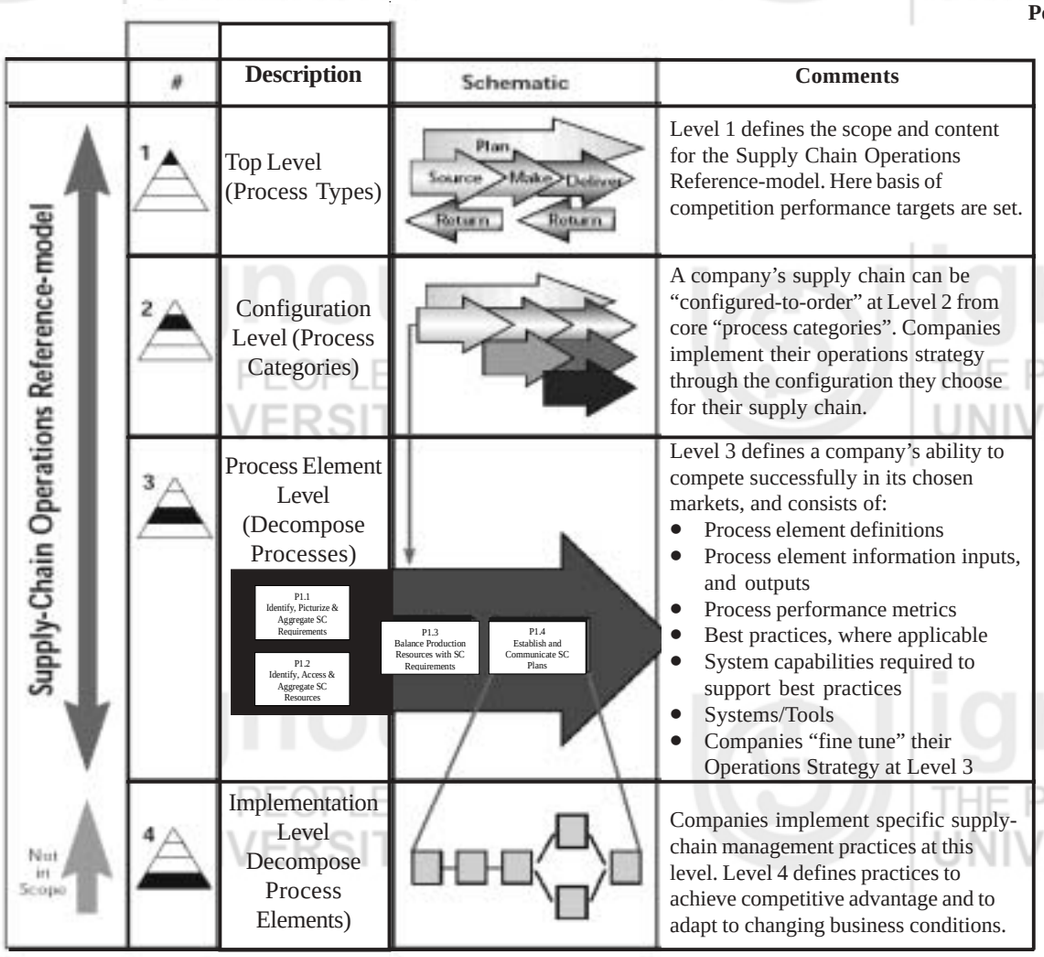



**Figure 13.4: Three levels of SCOR**

***Source*: Supply Chain Council)**

**SCOR does not attempt to describe following business process or activities:**

- Sales and marketing (demand generation)
- Research and technology development
- Product development
- Some elements of post-delivery customer support
- Links can be made to processes not included within the model's scope, such as product development etc.

**SCOR assumes but does not explicitly address:**

- Training
- Quality
- Information Technology (IT)

SCOR provide the detailed and exhaustive list of performance measure for each activity and process, aligns the detailed performance measures with the strategic objectives and provides the best practices and IT sources for each measurement. It requires a well-defined infrastructure, resources and project based completion approach. Implementation of such an exhaustive system requires fully dedicated managerial resources and continuous business process reengineering to align the business with the best practices.

## 13.4.6 Dimension Based Measurement System

This system suggests that any supply chain can be measured on three key dimensions (source: Hausman 2000)

A) Service

B) Assets

C) Speed

Service relates to the ability to anticipate, capture and fulfill customer demand with personalized products and on-time delivery; Assets involve anything with commercial value, primarily inventory and cash; and Speed includes metrics which are time related, they track responsiveness and velocity of execution.

Every supply chain should have at least one performance measure on each of these three critical dimensions.

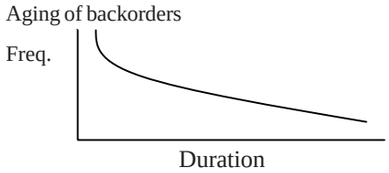
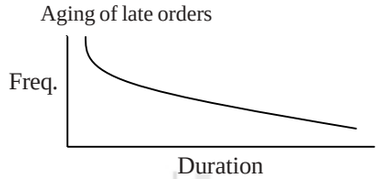
### A) Service Metrics

The basic premise for service metrics is to measure how well the company is serving (or not serving) its customers. Generally it is difficult to quantify the cost of stock outs or late deliveries, so the targets are set on customer service metrics. Also, the build-to stock situation differs from the build-to-order situation, so related but different metrics are used in these environments. Table 13.3 contains some common service metrics used in these two environments. These are time-tested measures, which continue to be valuable customer service metrics for supply chains.

The Line Item Fill Rate is the percentage of individual "lines" on all customer orders, which are filled immediately, while the Order Fill Rate counts as a success only those customer orders in which all "lines" have been filled.

"Aging" refers to maintaining data on how long it takes to fill a backorder, or how long it takes to complete an order, which is late. Tracking this data and maintaining it in an accessible database enables its periodic recall.

**Table 13.3: Customer Service Metrics (Hausman 2000)**

| Build to stock (BTS) | Build to order (BTO) |
|---|---|
| Line item fill rate | Quoted customer response time |
| Complete order fill rate | % on-time completion |
| Delivery process on time | Deliver process on time |
| $ Backordered/Lost sales | $ of Late Orders |
| No. of backorders | No. of late orders |
| Aging of backorders   | Aging of late orders   |

In the IT and especially Internet era, extensions of the customer order response time include the on-line service response time of a website as well as the response time required to complete delivery of the product or service.

### B) Assets Metrics

The major asset involved in supply chains is inventory throughout the chain. Two metrics generally used for inventory are:

1) Monetary Value ($, Yen, Euro, et cetera)

2) Time Supply or Inventory Turns

Inventory can be measured as a time supply, for example a 3-week supply of inventory, or as inventory turns, defined as

Turns = (Cost of goods sold)/(Inventory Value)

The Time Supply or Turns measures relate to inventory flows; the Value of inventory relates to inventory as an asset on the firm's Balance Sheet. Inventory Turns are calculated in isolation, by accountants with access to financial and inventory data but without corresponding access to customer service data.

C) **Speed Metrics**

There are a series of metrics related to timeliness, speed, responsiveness and flexibility

- Cycle (flow) Time at a Node
- Supply Chain Cycle Time
- Cash Conversion Cycle
- "Upside" Flexibility

Cycle Time Reduction- i.e. lowering lead-time and WIP inventory levels.

The Supply Chain Cycle Time - measures the total time it would take to fulfill a new order if all upstream and in-house inventory levels were zero. It is measured by adding up the longest (bottleneck) lead times at each stage in the supply chain.

The Cash Conversion Cycle (or Cash to Cash cycle time) attempts to measure the time elapsed between paying the suppliers for material and getting paid by the customers. It is estimated as follows, with all quantities measured in days of supply:

Cash Conversion Cycle = Inventory + Accounts Receivable - Accounts Payable

Upside flexibility refers to requirements in high-tech industry, that a vendor be prepared to provide say 25% additional material above and beyond the committed order, in order for the buyer to be protected when the buyer's demand is higher than forecasted.

Dimension based measurement system tries to cover the different dimension of the supply chain and also provide the detailed measure for each dimension. The system has limitation to provide the strategic alignment of different dimension and to measure the effect of different trade off between the dimensions.

### 13.4.7 Interface Based Measurement System

This framework aligns performance at each link (supplier customer pair) within the supply chain. The framework begins with the linkages at the focal company and moves outward a link at a time. The link-by-link approach provides a means for aligning performance from point-of-origin to point-of-consumption with the overall objective of maximizing shareholder value for the total supply chain as well as for each company. (Pohlen and Lambert 2001)

The framework consists of seven steps:

- Map the supply chain from point-of-origin to point-of-consumption to identify where key linkages exist.
- Use the customer relationship management and supplier relationship management processes to analyze each link (customer supplier pair) and determine where additional value can be created for the supply chain.

- Develop customer and supplier profit and loss (P&L) statements to assess the effect of the relationship on profitability and shareholder value of the two firms.
- Realign supply chain processes and activities to achieve performance objectives.
- Establish non-financial performance measures that align individual behavior with supply chain process objectives and financial goals.
- Compare shareholder value and market capitalization across firms with supply chain objectives and revise process and performance measures as necessary.
- Replicate steps at each link in the supply chain.

Interface based measurement system looks at the supply chain as a series of different links and to optimize the total supply chain a win-win approach is required at all linkages. Conceptually it looks good but in actual business setting it requires openness and total sharing of information at every link of the chain, which seem to be difficult to implement.

## 13.5 A COMPARISON OF MEASUREMENT SYSTEMS

Different measurement systems described above have different views for integrating the supply chain performance measures. These systems can be compared using five dimensions (1) Hierarchy (Strategic, Tactical and Operational), (2) Results (Financial and Non-financial), (3) Linkages (Integrated and Isolated), (4) Determinants (Quality, Flexibility and Time), and (5) Stability (Static and Dynamic). It is evident from the above explanations that supply chain balanced scorecard covers all the parameters. The system is easy to implement if the company strategy is well defined. Hierarchical based measurement system encompasses all parameters but at one time it tries to cover only one perspective, so a hybrid model of balance score card and hierarchical can be an another alternative i.e. at each hierarchical level we define the measure for each perspective. Perspective based system also sees the measures in isolated manner but it covers some unique perspectives which are not covered in balance scorecard like system dynamics and operation research which provides a great help in measuring dynamic capability of supply chain. SCOR covers all relevant parameters required in the system and tries to cover the whole supply chain in standard set of processes. It also covers the different dimensions at each level of the supply chain. The model applicability is easier where ERP and BPR practices are in progress and large set of data collection software's are already in place. In SMEs and especially in Indian context applicability is questionable due to extra cost of maintaining such an exhaustive system. Interface based measurement system doesn't cover the non-financial measures and strategic links to different linkages is not possible. The system gives more emphasis on strengthening the internal and external linkage to improve the overall supply chain.

## 13.6 SELECTING MEASURES

While the approaches described above provide guidance for supply chain measurement, they provide less help in assessing specific metrics to be used. In this regard, a key driving principle is that measures should be aligned to strategic objectives. Supply chain strategy depends upon its current competencies and strategic direction, which differs for every company. Companies, for example, can generally fall into the following developmental stages that will dictate the types of measures and the degrees to which they will need to focus:

- Functional Excellence - a stage in which a company needs to develop excellence within each of its operating units such as the manufacturing, customer service, or

logistics departments. Metrics for a company in this stage will need to focus on individual functional departments.

- Enterprise-Wide Integration - a stage in which a company needs to develop excellence in its cross-functional processes rather than within its individual functional departments. Metrics for a company in this stage will need to focus on cross-functional processes.
- Extended Enterprise Integration - a stage in which a company needs to develop excellence in inter-enterprise processes. Metrics for a company in this stage will focus on external and cross-enterprise metrics.

Most companies have focused their performance measurement on achieving functional excellence. With the advent of Supply Chain Management (SCM) principles aimed at integrating their supply chains, many have objectives to increase their degree of enterprise-wide integration and extended enterprise integration. In order to achieve these types of objectives, their performance measurement systems will need to align to them.

## 13.7 METHODS FOR SETTING PERFORMANCE TARGETS

An important issue in performance measurement is how a company can use measures to gauge its supply chain's performance. To do this effectively, a target for each measure needs to be established, providing the framework for determining the answer to three questions that arise when evaluating a performance metric:

- Has the metric improved from the last time it was reviewed?
- By how much?
- How close is the metric to where it should be?

In order to make this evaluation more meaningful the direction of improvement needs to be established. Also, performance targets need to be jointly, not individually, developed. To achieve objectives some metrics may need to increase and others may need to decrease. Each metric in the set has to be viewed in relation with the others to determine its proper target. Hence, while there a variety of ways in which performance targets can be set, they should always be jointly set in the context of strategic objectives. Generally, there are four methods that can be used to set performance targets (1) Historically based targets, (2) External benchmarks, (3) Internal benchmarks, (4) Theoretical targets.

## 13.8 TOTAL COST OF OWNERSHIP

The concepts of total cost, life cycle costing, product life cycle costs, and total cost of ownership are all related constructs for procurement valuation, which suggest that supply managers adopt a long-term perspective, not a short-term, initial-price perspective, for the accurate valuation of buying situations. There are three ideas that support all of these procurement valuation constructs. First, cost must be examined from a long-term perspective and should include elements other than initial purchase price. Second, supply managers must consider the impact of other business functions on the valuation of a specific purchase. Third, to value a purchase situation accurately, a supply manager must understand, and measure, the cost impact of all the activities associated with the purchase. (Ferrin and Plank 2002)

Total cost of ownership (TCO) was originally developed in the late 1980s by the research firm Gartner to determine the cost of owning and deploying personal computers. Their initial findings, that PCs cost an enterprise nearly $10,000 per year, raised a serious concern in the technology community and among CFOs. Their methodology was carefully examined and has now been accepted as a standard method of evaluating costs. In simpler words, TCO consists of the costs (direct as well as indirect), incurred throughout the life cycle of an asset, including acquisition, deployment, operation, support and retirement.

### TCO in Supply Chain

Cavinato (1991, 1992) used the total cost concept to examine cost structures across the supply chain. Ferrin and Plank (2002) examined cost indicators and suggested 13 cost driver categories (shown in bold words in figure 13.8). Comparing supply chain entities based on these cost indicators can provide a basis for assigning specific supply chain processes and the firms can reduce their total supply chain costs by assigning specific supply chain processes to those firms in the supply chain whose cost structures are well suited to support the assigned processes.

## 13.9 SUMMARY

In this unit, the performance measurement and evaluation of SCM has been discussed with special focus on various common SC measurement systems used in practice. The discussion brings out the need for SC performance measurement and shows that managers need to understand the SCM properly in order to choose and adapt a particular measurement system and the performance metrics. A short comparison of various methods is also given along with a guideline to select measures and set performance targets. Finally the concept of TCO as applied to SC is discussed.

**Table 13.4: Categorization of identified TCO cost drivers (Ferrin and Plank 2002)**

| **Operations Cost** | **Quality** | **Logistics** | **Technological advantage** |
|---|---|---|---|
| Manufacturing | Durability | Freight | Design Obsolescence |
| Machine Efficiency | Replacement | Packaging | Suitability for intended use |
| Production to Schedule | Field Failure | Customer Service | Flexibility for new use |
| Labor savings | Customer Downtime | Availability | Technology |
| Assembly Cost | Inspection | Handling | Changing Technology |
| Operating Supplies | Cost of Quality | Instability in freight rates | Long term advantage |
| Long-Term Operating Costs | Calibration Cost | Outbound Cost | Supplier Ability to Change technology |
| Capacity Utilization | Rework<br>Scrap | Tariffs<br>Lead time | |
| Increase In Production Output | Customer Returns | On-Time Delivery | **Supplier Reliability and Capability** |
| Equipment Speed | Rejection Cost | Supplier managed inventory | |
| Cost In Use | Quality Improvement | Inventory | Partnering Costs |
| Line speed | Unplanned Downtime | Time to Schedule | Team costs |
| | Out-of-Service Costs | Warehousing<br>Duties<br>Area of the country customer must order from<br>Import fees<br>Entry and harbor maintenance fees | Trust |

| **Maintenance** | **Inventory cost** | **Life cycle** | **Initial price** |
|---|---|---|---|
| Supplies | Safety stock | Long term usage | Unit cost |
| Training | Design/procurement for inventory reduction | Projected life cycle | Initial purchase price |
| Downtime | Storage | Life of product | Long term price stability |
| Costs | Perishability | Life cycle stability | Initial capital expenditure |
| Labor | Turnover | Cost savings over life of product | **Customer related** |
| Parts | **Transaction cost** | Useful life | User satisfaction |
| Spare parts | Administration of post purchase agreements | Redesign cost | Customer perceptions |
| Long term maintenance costs | Ease of transaction | Life cycle obsolescence cost | Customer specifications |
| Repair frequency | Supplier conversion cost | | Opportunity cost |
| Reliability | Small orders | | Cost of money |
| Preventive maintenance schedule | Procurement | | Overhead |
| | Transactional activity | | |
| | Long term savings | | |
| **Miscellaneous** | | | |
| Taxes | Salary, benefits | Installation | Total installed price |
| Value chain | Indirect labor | Ease of operation | Lease rate factors |
| Warranty | Product use | Noise level | Flexibility of the supplier |
| Product design | Depreciation | Technical support | Tooling and fixtures |
| Availability from supplier | Lease or buy | Validation/registration cost | Environmental issues |
| Disposal costs | Supplier cost drivers (from requisition to receipt) | Overall competition | |
| Liability and indemnification | Safety | Service cost | |
| Obsolescence cost | Support costs | Disposal value | |
| | Utility costs | Currency exchange rates | |
| | | Direct labor | |

## 13.10 SELF-ASSESSMENT QUESTIONS

1) Why is Supply Chain Performance required to be measured?

2) "Today's management can't afford to focus only on company's performance in a vacuum; there is an emerging requirement to focus on the performance of the extended supply chain or network in which company is a partner". Comment!

3) What is the need for Supply Chain Performance Measures? What are the factors that contribute to management's need for new types of measures for managing the supply chain?

4) Discuss in detail about the supply chain performance measurement system. Highlight the similarities/ dissimilarities in any two of these measures.

5) What is the essence of the Balance Scorecard method of Performance Measurement?

6) Compare different measurement systems described in the unit by using five dimensions discussed in Section 13.5.

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