

Supply Chain Performance Measurement using Benchmarking and Balance Score Card: A conceptual framework

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Abstract

A supply chain is the network of agencies to perform a set of operations from procuring raw material, transforming the raw material in to finished goods, storing them, distribution to the final customers and render the quality services through a team work of internal employees and external partners like suppliers, supplier's suppliers and distribution channel members. The core supply chain we can describe as a relay game in which the participant or each players either the facility or an individual pass on the baton effectively from one to other until it reaches the final player-"The customer". Supply chain has to be timely monitored for optimizing business processes through understanding better working processes and evaluating self performances, this can be done by benchmarking or using a Balance Score Card approach.

Keywords: Supply chain, Benchmarking, Balance Score Cards

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1. Benchmarking

Benchmarking is defined as measuring performance of your organization against that of best-in-class organizations, determining how the best in class achieve their dominance and those performance levels [1, 2]. Following steps are involved in the process of benchmarking:

- Identify the process to be benchmarked.
- Understand current performance of that process and documenting it with a clear understanding of circumstances leading to deviation from the normal routines.
- To decide the type of data to be collected and the methods to collect the same.
- Study the 'best in class' process.
- Compare and find the gaps between you and the 'best in class' organization / process.
- Use these findings to set the goals and objectives and start improving your process.

Benchmarking is generally done to achieve the business and competitive objectives and essentially involves imitating the performance of best in class organizations/ processes and finally reach best in class performance.

1.1 Benchmarking Supply Chain

Benchmarking is the process of admiring someone who is better at something and learning what to do to match them and even surpass them at it [4, 5]. The basic need of benchmarking is to imitate and introspect for deciding a path, monitoring a track of right direction at a defined frequency, shifting existing performance from a lower gear to the higher gear. The benchmarking can be made by comparing the performance of organizations from same or other industries and their processes in similar activities, operations or functions. Some examples of benchmarking are given below.

Problem Area	Compared With
Higher Inventories	Amazon.com
Fresh Deliveries of Products	Pizza Hut Deliveries
Lengthy set up of Machines	Formula 1 pit crews
JIT production system	Toyota
Customized product at lower cost	Dell

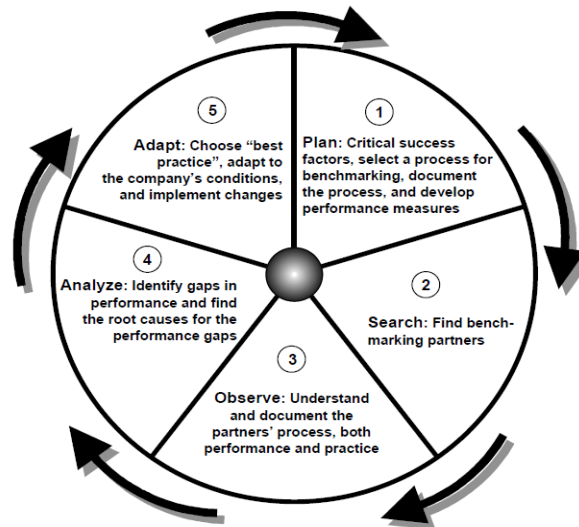
There are many ways to describe benchmarking. One of the best models in benchmarking has been explained by Andersen (Known as Benchmarking Wheel) in 1995 is as below[10].

The model presented by **Andersen [5]** is quite generic and can be applied to overall supply chain of any organization.

The benchmarking of supply chain can be done in four perspectives:

- Internal - process and operations
- External partners like suppliers and distributional channels.
- Financial Perspective and
- Customers

Fig 1: Benchmarking Wheel



After identifying reasons for gap in our performance and performance of benchmarked process it is essential to define a plan to mitigate those causes and achieve best in class performance. For that we have to define objectives, aims and way to track the improvement in performance. That can be done by using Balance Score Card.

2. Balance Scorecard

Balanced scorecard broadly known as BSC is a strategic planning tool that helps everyone in an organization to work towards achieving a common and shared vision. For any strategic business activity, such as supply chain management (SCM), identifying criteria for required performance measurement is essential and it should be an integral part of business strategy. Dozens of methods have been suggested over the years for SCM evaluation of any organization. Unfortunately, evaluation methods that rely on financial measures are not well suited for newer generation of SCM applications as these supply chains are very complex and seek to provide a wide range of benefits, including both tangible as well as intangible. As a result, it may be quiet appropriate to use a balanced approach to measure and evaluate supply chains.

The beauty of BSC is that it proposes a means to evaluate corporate performance from four different perspectives: the financial, the internal business process, the customer, and the learning and growth. Table-1 outlines these four perspectives.

Table-1: Four Perspectives of BSC

Perspective	Mission
Customer Perspective (Value-Adding View)	To achieve our vision by delivering desired value to our customer
Financial Perspective (Shareholders' View)	To succeed financially by delivering value to our stakeholders
Internal Perspective (Process improvement View)	To bring in efficiency and effectiveness in our business processes
Learning and Growth Perspective (Growth Sustainability View)	To achieve our vision changing capabilities through continuous improvement and preparation for future challenges

3. Performance measurement metrics for SCM

Performance measurement describes the feedback on activities implemented with respect to meeting strategic objectives. It identifies the areas with below expectation performance thus efficiency and quality can be improved [7]. In this section, we make an attempt to summarize some of the most appropriate performance metrics and measures of SCM.

3.1 Metrics for performance evaluation of planned order procedures

For any firm, the first and foremost activity to begin with is to win an order. Hence, the first step in assessing performance is to analyze the way the order-related activities are carried out. In this step main issues faced are: the order entry method, order lead-time and the path of order traverse. All of these issues to be considered and addressed.

3.1.1 The Order Entry Method

The order entry method determines the extent to which the customer specifications/requirements are captured, translated into meaningful information, and this information is passed down along the supply chain. Proper execution of the order is possible only when the order entry method is capable of providing timely, accurate and usable information at all possible levels upstream and hence, can be used as a metric of performance measure.

3.1.2 Order Lead Time

Order lead time also known as order to delivery time and it is the time which is spent right from the receipt of the customer's order to the delivery of the goods. This includes the following time elements:

- Order entry time
- Order planning time
- Order sourcing, assembly and follow up time
- Finished goods delivery time.

A reduction in the order cycle time leads to a reduction in the supply chain response time [6]. Reliability and consistency of the order lead-time is of utmost importance. Therefore, measurement of total cycle time is very important for customer satisfaction index

improvement, and to serve as a feedback to control the day-to-day operations.

3.2 Measuring customer service and satisfaction

This measurement is aimed at identifying how closely our product and processes comply with specification defined by customer in context of design, quality and delivery. It also contains product/service flexibility, customer query time, and after sales services.

3.2.1 Flexibility

Being flexible refers to making available the products/services as per changing demand of customers. The development of advanced technologies such as flexible manufacturing systems, group technology, and computer-integrated manufacturing has made it possible. By defining flexibility as a metric and by evaluating it, organizations can response rapidly to changing customer requirements.

3.2.2 The customer query time

Many a times, a customer enquires about the status of an order, stock availability or delivery. Providing such information genuinely helps the customers to schedule their activities, and helps the firm to retain them as customers. Measuring customer query resolved time helps reducing this time and adds to customer satisfaction.

3.2.3 After Sales Customer Service

The post delivery activities play an important role both as part of customer service, and for collecting valuable feedback for further improvements in the supply chain. For example, timely availability of spares helps companies to provide better customer service, and to trace the problems arising from warranty claims, then making improvements on products and services.

3.3 Production level measures and metrics

As an important and integral part of SCM, the performance of the production process also needs to be measured, managed, and improved. Suitable metrics are required for this purpose. This category consists of capacity utilization, and effectiveness of scheduling techniques.

3.3.1 Capacity Utilization

“No production planning process can be started without knowing the actual capacity.” From the above statement, the importance of “capacity” in determining the planning efficiency of all supply chain activities is clear. This highlights the importance of measuring and controlling the capacity utilization.

3.3.2 Effectiveness of Scheduling Techniques

Scheduling refers to the time slots at which production related activities are to be performed. Such fixing of time slots determines the manner in which the resources flow through an operating system. The effectiveness of his flow has a significant impact on the performance of

supply chain. Scheduling depends heavily on customer demand and supplier performance. Hence, it can be concluded that measuring and improving effectiveness of scheduling techniques will improve the performance of a supply chain.

3.4 Performance Evaluation of Delivery Link

These measures are designed to evaluate the performance of delivery and distribution cost in supply chain. The typical measures for delivery performance evaluation are reduction in lead time in the delivery process, on-time delivery, vehicle scheduling, warehouse location and distribution mode. The percentage of goods in transit, quality of information exchanged during delivery, number of faultless notes invoiced, flexibility of delivery systems to meet particular customer needs are also included in this performance measurement[8]. Sometimes this performance is also called as OTIF (On Time In Full) performance measurement.

3.5. Supply chain finance and logistics cost

The core objective of any supply chain is to optimize cost of distribution. Determining the total logistics cost can assess the financial performance of a supply chain. It is a must to deduce strategies to reduce overall logistics cost in any supply chain. Inventory cost, warehousing cost etc are all included in logistics cost.

4. Performance evaluation framework for SCM

Many methods and techniques have been suggested by research scholars over the years for SCM evaluation. Most of the traditional methods focus on well-known financial measures, such as the return on investment (ROI), net present value (NPV), the internal rate of return (IRR), and the payback period. Unfortunately, evaluation methods that rely on financial measures are not well suited for newer generation of SCM applications due to complexity of supply chains in global world. The benefits of improving supply chain performance are not always tangible. And hence some other kind of tools and techniques has to be designed to measure intangible benefits.

The metrics discussed in this framework are classified into strategic, tactical and operational levels of management. The metrics are also distinguished as financial (Tangible) and non-financial (Intangible) so that a suitable costing method based on activity analysis can be applied.

Table 2: A framework of the metrics for performance evaluation of SCM

Level	Performance Metrics	Tangible	Intangible
Strategic	Total cycle time	Y	
	Total cash flow time	Y	
	Order lead time	Y	
	Net profit vs. productivity ratio	Y	
	Return on Investment	Y	
	Range of products and services	Y	
	Customer query time	Y	
	Delivery performance	Y	

	Supplier lead time against industry norms	Y	
	Level of supplier's defect free deliveries	Y	
	Buyer-supplier partnership level		Y
	Flexibility of service systems to meet particular customer needs		Y
Level	Performance Metrics	Tangible	Intangible
Tactical	Accuracy of forecasting techniques	Y	
	Product development cycle time	Y	
	Purchase order cycle time	Y	
	Planned process cycle time	Y	
	Supplier cost saving initiatives	Y	
	Delivery reliability	Y	
	Effectiveness of master production schedule		Y
	Supplier assistance in solving technical problems		Y
	Supplier ability to respond to quality problems		Y
	Responsiveness to urgent deliveries		Y
	Effectiveness of distribution planning schedule		Y
	Order entry methods		Y
	Effectiveness of delivery invoice methods		Y
	Level	Performance Metrics	Tangible
Operational	Cost per operation hour	Y	
	Information carrying cost	Y	
	Capacity utilization	Y	
	Total inventory cost	Y	
	Supplier rejection rate	Y	
	Frequency of delivery	Y	
	Driver reliability for performance	Y	
	Quality of delivered goods	Y	
	Achievement of defect free deliveries	Y	
	Quality of delivery documentation		Y

	Efficiency of purchase order cycle time		Y
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Balance Scorecard for SCM Evaluation

The BSC is applied to metrics shown in fig-2 with the intent to evaluate SCM performance comprehensively. All Four perspectives of the BSC are applied to these discussed metrics as shown in Tables 4-7. Each of the four perspectives should be translated into corresponding metrics and measures that reflect strategic goals and objectives. The perspectives should be reviewed at a defined frequency and should be updated if required. The measures included in the given BSC should be tracked and traced over time, and integrated explicitly into the strategic SCM process.

5.1 Measuring and evaluating financial metrics

Financial performance measures indicate whether the company's strategy, implementation and execution are effectively contributing to the bottom line improvement of a firm. Financial goals include achieving profitability, maintaining liquidity and solvency both short term as well as long term, growth in sales turnover and maximizing wealth of shareholders. Financial performance indicators are shown in Table 4.

Table 4: Performance metrics for the financial perspective

Customer query time
Rate of return on investment
Variations against budget
Supplier cost saving initiatives
Delivery performance
Cost per operation hour
Information carrying cost
Supplier rejection rate

5.2 Measuring and evaluating customer perspective

End of the day, each and every mission statement must be translated to customer service and BSC defines how this should be measured in terms of factors which matters the most to a customer. In short, term, a customer is generally concern about lead-time, quality of products and services and the cost effectiveness. In the era of globalization any firm's competitiveness lies on different customer related factors are shown in Table 5.

Table 5: Performance metrics for the customer perspective

Customer query time
Level of customer perceived value of product
Range of products and services
Order lead time

Flexibility of systems to meet changing customer needs
Delivery lead time
Delivery performance
Effectiveness of delivery invoice methods
Delivery reliability
Responsiveness to urgent deliveries
Quality of delivery documentation
Driver reliability for performance
Quality of delivered goods
Achievement of defect free deliveries
Effectiveness of distribution planning schedule

Table 6: Performance metrics for the internal business perspective

Total supply chain cycle time
Total cash flow time
Supplier lead time against industry norms
Effectiveness of master production schedule
Capacity utilization
Product development cycle time
Purchase order cycle time
Planned process cycle time
Accuracy of forecasting techniques
Total inventory cost
Efficiency of purchase order cycle time
Level of supplier's defect free deliveries

5.3 Measuring and evaluating internal business perspective

Every internal process is supposed to deliver as per customer's requirement and hence the internal measures for the BSC stems from the business process that have the greatest impact on customer's satisfaction factors that affect cycle time, quality, skill of the employees, and of course, productivity. Performance metrics for the internal business perspective are shown in Table 6.

5.4 Measuring and evaluating innovation and learning perspective

A company's ability to innovate, improve and learn is foundation of company's value. Innovation and continuous learning process can bring about efficiency in operating domain of the business. Moreover, it ensures product differentiation and cost reduction to achieve leadership position in market. As a result, it increases market share and strengthens the financial ability through earning higher profitability. Performance metrics for the innovation and learning perspective in a BSC includes measures as shown in Table 7.

Table 7: Performance metrics for the innovation and learning perspective

Ability to respond to quality problems
Cost saving initiatives
Accuracy of forecasting techniques
Capacity utilization
Order entry methods
Range of products and services
Product development cycle time
Flexibility of service systems to meet particular customer needs
Level of customer perceived value of product

6. Development of BSC

In order to put the BSC to work, companies should articulate goals for time, quality, performance and service and then translate these goals into specific measures. Firms should stop navigating only by financial measures but with combination of operational measures for day-to-day business operations too. In building a firm specific balanced SCM scorecard, following steps are recommended:

- (1) Create awareness for the concept of balanced SCM scorecard in the organization;
- (2) Collect and analyze data on the following items:
 - Specific objectives and goals related to corporate strategy, business strategy and SCM strategy;
 - Traditional metrics already in use for SCM evaluation;
 - Potential metrics related to four perspectives of balanced scorecard;
- (3) Clearly define the company specific objectives and goals of the SCM function for each of the four perspectives;
- (4) Develop a preliminary balanced SCM scorecard based on the defined objectives and goals of the enterprise and the approach outlined in the paper;
- (5) Receive comments and feedback on the balanced SCM scorecard from the management, and revise it accordingly;
- (6) Communicate both the balanced SCM scorecard and its underlying rationale to all stakeholders.

It is essential to have well defined specific goals and objectives before developing the balanced SCM scorecard. The metrics included in the balanced SCM scorecard should meet three criteria. They should be quantifiable, easy to understand, and ones for which data can be easily collected and analyzed in cost-effective manner.

7. How do we do it with Apollo Tyres Ltd.:

Apollo Tyres Ltd (ATL) is the 7th largest tyre manufacturing company of the world with total revenue close to USD 6.5 bn. ATL is one of those companies that have already developed and institutionalized BSC for its SCM operations.

ATL sells tyres through 3 channels such as After Market Tyre sellers (Replacement), Directly to OEMs and Export. In Replacement market, ATL has got its sales offices in close to 160 locations in India and these locations are supplied with tyres from 12 RDCs(Regional Distribution Centres) which are supplied tyres from 4 tyre manufacturing Plants. ATL also supplies tyres to 90% of the OEMs present in India and exports tyres to close to 70 countries of the world.

ATL's SCM function has got a fairly stabilized organizational structure with different teams responsible for supplying tyres to different sales channels. In addition to supplying team there are also teams responsible for Demand Forecasting, Production planning and Transportation management. Each of these teams has got its own monthly KRAs with end goal being minimum loss of sales due to stock unavailability and hence the highest customer service level. There are very well customer service level measurement metrics for each type of customers as expectations of each customer is different.

Basis this structure and overall company objective in mind, BSC developed for ATL's SCM function is given below:

Customer Perspective	Replacement Service Levels
	OEM Service Levels
	Export Service Levels
	OEM Customer Visit
Financial Perspective	Outbound Freight Cost (Rs/KG)
	Space Cost (Rs Mn)
	Vehicle Detention Cost (Days)
	Inventory Cost (Days)
Process Perspective	Forecast Accuracy
	Production Deviations
Learning/ Development Perspective	Training Hours
	Improvement Projects

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