UNIT-13

Supply Chain Performance Measurements

Learning Outcomes

By the end of this unit the learner will be able to:

- ✓ Explain Supply Chain performance measurement categories
- ✓ Understand the framework for Supply Chain Measurement

Unit 13

Supply Chain Performance Measurements

Supply chain companies serve four main markets: the growing, established, mature and developing markets, with each of the four represented by occupying four different quadrants. The different types of supply chain companies that exist to serve the needs of different types of markets have to adopt different performance measurement methods when evaluating each of the markets. The key to the success of supply chain companies is to collaborate with each other and take advantage of the opportunities across the markets. This is achieved by categorising market evaluation into four different categories in the form of a simple model. Although the model may not be an exact representation of reality on the ground, it is a useful tool to guide you in the right direction for both evaluating markets and measuring the performance of the services rendered by the supply chain companies.

Market Performance Categories

Different types of market require a different approach of supply chain services, tailored to meet the needs of each market type. The performance of a supply chain in delivering services can be assessed by analysing the markets they serve. The aim of every performance measurement involving the evaluation of the market is to identify the effectiveness of the supply chain operation and to improve on areas that are under-performing. To this end, some simple models may be formulated to categorise the different types of markets performance, and also to point out the opportunities available to each market and how these can be exploited. Companies that are able to respond to changes in the market measured by these four indicators and improve performance in each category will generally end up with the highest profits.

The four measure measurement categories (models) include:

- Customer Service
- Internal Efficiency
- Demand Flexibility
- Product Development

Customer Service

It is important for companies in the supply chains that wish to be profitable to understand and meet customers' expectations in the specific markets they serve. Some customers expect companies to deliver quality items within a short timeframe, while others are willing to have their orders processed over longer periods. The nature of the expectations of customers invariably depends on the type of market they operate in.

Internal Efficiency

All companies have one main goal, which is of course to make a healthy profit. Internal efficiency measures the ability of companies to streamline operations for the sake of profitability. The level of profit is normally determined by the nature of the market. Well-developed markets provide lower margins of profits due to lower levels of risks and uncertainty. Developing markets on the other hand usually come with higher risks and uncertainty, and so larger profit margins are to be expected to make up for the time and resources required to run supply chain operations in this kind of market.

Demand Flexibility

Demand flexibility is a key characteristic of matured markets. It shows how supply chain companies are able to meet higher levels of demand and their ability to supply additional and wider ranges of products, compared to what they currently supply to customers.

Product Development

The dynamic nature of markets means companies need to adapt quickly to changing expectations. Product development refers to a supply chain's ability to produce and deliver new products to meet new demand and on time. This usually applies primarily to developing markets.

A Framework for Performance Management

To respond effectively to performance expectations of the markets means having to provide the level of performance people require. This leads to higher profitability for the provider of those who capitalize on these opportunities offered by the markets. Certain key performance metrics or indicators would have to be identified, measured and monitored, in order to determine the extent of fulfilling the performance obligations to the customers. Each of the four categories of measurements needs to be measured for individual companies or a range of supply chain companies. However, the information needed to carry out such measurements may be difficult to obtain due to confidentiality issues or the reluctance of companies to share such information, fearing that such actions may lead to rivals using the information against them.

Customer Services Metrics

Customer service metrics are measurements which highlight how effectively customers have been served by companies and how supply chains are able to meet the needs of markets. Two main customer service metrics are used: the build to stock (BTS) and the build to order (BTO) metrics. Supply chains or companies may fall under any of these two classifications. Examples of build to stock metrics include:

- Complete Order Fill Rate and Order Line Item Fill Rate
- On-Time Delivery Rate
- Value of Total Backorders and Number of Backorders
- Frequency and Duration of Backorders
- Line Item Return Rate

Popular metrics for a build to order situation are:

- Quoted Customer Response Time and On-Time Completion Rate
- On-Time Delivery Rate
- Value of Late Orders and Number of Late Orders
- Frequency and Duration of Late Orders
- Number of Warranty Returns and Repairs

Build to Stock (BTS)

This includes common items supplied to large markets which customers expect to obtain instantly when they make requests for them. This implies that suppliers need to keep a large inventory available to meet the high demands. Items in this category include building materials, cleaning supplies and other simple consumables. But sometimes, the supply chain may be overwhelmed by the wide range of items that customers order and may not have sufficient storage space to keep thousands of these items. In such cases, companies tend to have contingency plans by having a backup provided from a secondary location, and also making provisions for the items to be delivered at specific times whenever customers make request for them. Alternatively, items may be substituted with a close match or a much higher quality item when stocks of a particular item become depleted. The order fill rate performance metrics measures the percentage of total orders that are supplied immediately, whereas the line fill rate metrics measures performance in terms of the percentage of total line items on all orders which are filled immediately.

Build to Order (BTO)

Some customers may provide product specifications for supply chain companies to work with, within specific time frame. This situation is referred to as a build to order (BTO) request. For example, a computer company may be asked by a customer to build computers with certain specifications. Performance is measured based on analysis of the quoted customer response time (how long the company is expected to take to deliver the product) and the on-time completion rate. Longer customer response times will assist the company in achieving higher on-time completion rates but this will, of course, be dependent on how soon the customer needs the product.

Internal Efficiency Metrics

This involves measuring how efficient companies are able to use all assets productively to generate profits. It includes both tangible and intangible assets. Any of the following tools may be used to determine internal efficiency:

- Inventory Value
- Inventory Turns
- Return on Sales

- Cash-to-Cash Cycle Time

Inventory Value

Keeping track of inventories and monitoring and measuring them at a point in time, as well as finding the average quantity over a period of time, is critical in controlling the quantity of inventory to store. Ideally, supply chain companies want to avoid keeping excess levels of inventory and keep just sufficient levels to meet demand. However, when companies anticipate higher costs of inventory, they may decide to keep excess inventory in order to avoid high cost of procurement.

Inventory Turns

The profitability of inventory can be measured using the expression:

$$Turns = Annual\ Cost\ of\ Sales / Average\ Inventory\ Value$$

This is also known as 'turn and earn'. It basically shows the rate at which inventory is sold. The higher the rate, the more profitable the supply chains over the course of the year. Lower rates are desirable when a business wishes to have demand flexibility, or when it wants to achieve higher standards of customer service.

Return on Sales

The formula for computing return of sale is given by:

$$Return\ on\ Sale = Earnings\ before\ tax\ and\ interest / Sales$$

Return on sales measures the effectiveness of managing fixed and variable costs and the level of profit made. A high value is a good indication of healthy operations. However, strategies to defend market share or for investing money to attain important business objectives can lower this value.

Cash-to-Cash Cycle Time

This refers to the time period between the company paying suppliers to provide raw materials and the time it takes for payment to be received from customers for products/services purchased.

This parameter can be calculated using the following formula:

$$\begin{aligned} Cash - to - Cash\ Cycle\ Time \\ &= \{Inverntory\ Days\ of\ Supply + Days\ Sales\ Outstanding \\ &- Average\ Period\ on\ Purchases\} \end{aligned}$$

Having a shorter cycle is a good sign for business. It is much easier to control and improve on this by eliminating billing errors and identifying clients with bad credit risks than dealing with issues concerning inventory.

Demand Flexibility Metrics

This is a measure of how a company or supply chain is able to respond quickly to new demands, in terms of the quantity and the range of products it can supply. This means companies need to have reserve or in-depth provisions made available, to deal with uncertainties in specific markets. The following can be used to measure how flexible companies are in meeting extra demands:

- Activity Cycle Time
- Upside Flexible Time
- Outside Flexibility

Activity Cycle Time

Activity cycle time refers to how long it takes to complete supply chain activities like product development, order fulfilment etc. This may apply to individual companies or the whole supply chain. It is good to have fast order fulfilment, not just by a single company, but more importantly across the entire supply chain for the sake of the final customer.

Upside Flexibility

This refers to the measure of increased order volumes companies are able to take on. It is usually measured by finding the percentage increase against expected demand.

Outside Flexibility

Outside flexibility refers to the ability to provide products which the company does not currently offer to customers, as markets mature and new technologies appear on the scene. The new product may target both new and existing customers, but skill is needed to persuade the older customers to try out the new products.

Product Development Metrics

The dynamic nature of markets resulting from the changing landscape of social, political, economic and cultural dimensions provides sufficient incentives for companies to adapt strategies accordingly. Product development measures a company's supply chain ability to design, build and supply new products to meet demands in specific markets.

This is an important measurement tool that needs to be taken seriously if a company does not want to become unviable. This parameter can be measured using the following:

- Percentage of total products sold in the previous year
- Percentage of total sales from products introduced in the previous year
- Cycle time to develop and deliver a new product

Operations that Enable Supply Chain Performance

The following 4 categories of supply chain operations should be measured and improved upon, with the objective of meeting the performance requirements of the markets:

- Plan operations
- Source operations
- Make operations
- Deliver operations

Key performance measurements such as line item fill rate, on-time delivery, order fill rate, product assembly and design, inventory turns and the like will improve significantly, provided activities are carried out effectively. Each performance category may be influenced by specific activities. For example, a company's order and line item fill rate and inventory turns are affected by inventory management, whereas return on sales and upside ability are influenced by procurement arrangement and execution. Companies are expected to collect data in the 4 categories of operations (i.e. plan, source, make and delivery operations) mentioned above and to monitor the results closely.

Plan operations has to do with measuring the number of stock keeping units (SKUs) carried, the number and percentage of order changes, the inventory carrying costs and production volume.

Source operations require measuring percentage raw material by geography, the number of suppliers and the percentage cost of purchasing by distance. The following may also be considered: payment period, supplier delivery performance and the percentage of items procured based on lead time.

Make operations involve consideration for the number of SKUs, manufacturing steps by geographical location, upside production flexibility and how capital is deployed. The management may also carry out assessment of performance by determining the build-to-order percentage, percentage of manufacturing order changes due to intern issues, percentage of value added and the number of work in progress.

Delivery operations are measured by considering the number of line items and shipments by channel, the number of orders by channel and the percentage of line items returned. There are configuration measures such as the number of channels and the geography of delivery locations to consider, when dealing with delivery operations. Important practice measures include determining the lead times, the order entry methods and the percentage of invoices containing errors.

Collecting and Displaying Performance Data

In years gone by, management made decisions based on data collected on past events, which was quite effective for the slow-paced and stable environment that existed back then. Fast-forward to today's world and this would not hold. The simple reason is that in today's fast-paced business environment, companies would not survive using the orthodox or historic approach. What is needed is business intelligence (BI) systems, whihc have inbuilt capabilities to cope with the sheer volume and speed of activities trending at the time. BI systems comprise three main levels of details:

- *Strategic*—to help top management decide what to do
- *Tactical*— to help middle management decide how to do it

- *Operational*—to help the people who actually do it

Strategic data includes data from all four categories of performance. The data includes information on current, past and planned activities which relate to all four categories. External data like market sizes, growth rates, demographics, GNP, inflation and interest rates also form part of strategic data. The data from the four performance categories may be compiled by each department of the company and eventually for the entire company, when the individual results are combined. These compiled data are most useful when compared against benchmark data for the level expected for each category. Trade associations or journals may supply such benchmarks for the markets under consideration. Strategic data is also known as 'level 1' data in the SCOR model (this refers to the supply chain council model).

Tactical data also requires carrying out measurement in all four categories of performance, but it is limited to branch office level data. This measurement monitors the plan, source, make and deliver operations of all companies in the supply chain. It is identified as 'level 2' in the SCOR model. 'Level 3' refers to operational data. This involves providing information to operational workers, who are engaged in executing activities, to enable them to understand events as they unfold and to help them adjust to situations to provide improved performance.

Obviously, it is easy to see that we are dealing with a vast array of data. This can be somewhat overwhelming and may render the objectives of management difficult to actualise. The SCOR model helps to present the data in a more convenient way, by organising it into three levels to enhance rapid analysis and decision-making. Strategic data is primarily meant for top level management staff, who may also decide to consult tactical and operational level data for classification purposes.

Tactical data is useful for middle level managers for planning and resource allocation, when executing directives from top management level. Operational data is most useful to line managers and operational staff for solving day-to-day issues.

The Data Warehouse

A data warehouse is a business intelligence system where important operational information sourced from primary sources is kept to be accessed by authorized personnel when the need arises. Data warehouses need to have automatic data capturing features to enable them to retrieve data on daily operations across different departments of a company. Manual data entry is not permitted for capturing data for data warehouse systems. Using database software with automated connections to nodes of other computers in a network is the best means of sourcing data to be stored on the data warehouse platform. In addition to using the best available databases to source data from primary sources, software for producing predefined reports and displaying data in a graphical format helps people to effectively monitor operations. Another feature for the software to have is the ability to enable authorised personnel to make ad-hoc requests for data and for them to perform further investigations into issues when needed.

The best approach for designing and building a data warehouse is to start on a small scale, with simple user interfaces for the users. As the users become more adept and experienced, more advanced features

could be added and the level of sophistication deepened to create more complicated systems. It's of course important to bear in mind that people are the most important part of the data warehouse system - their ability to use the system will determine the efficiency of the tasks they are required to perform. A data warehouse can be used not just to improve the efficiency of supply chain management, but also to enhance collaboration between companies in supply chains. Information can be shared between companies in a supply chain. Information can be obtained in standard report format at any time over the internet with similar user interface features which facilitate ease-of-use.

Spotlighting Problems and Finding Opportunities

Senior management is responsible for identifying targets for performance monitoring in each type of market, in relation to demand flexibility, customer service, product development and internal efficiency. Data is collected and compared to the target mark to help them focus on areas that need to be improved upon. "Dashboards" showing a one-page display of information relevant to the person accessing it are common means of monitoring performance in the operations section or the financial department. The nature of information presented via the dashboard will differ for each level of management and from staff member to staff member, depending on the department they belong to. Senior management which sets performance target marks would require a dashboard that compares current data to the target set for a particular period. If performance meets target expectations, then no corrective action will be required. However, when current data diverges significantly, then management will need to take the necessary action to restore balance. The dashboard for middle management usually shows the plan and actual data on how the company is performing, compared to the expected target benchmark. If operation performances fall short of the target, they can zoom in to identify the problem spot, diagnose the issue and brainstorm possible solutions. Depending on the specific area of specialisation, the staff dashboard will be tailor-made to reflect their area of operations and will highlight key areas containing issues that need to be tackled. The key to success in supply chain management is how fast a company is able to use data to identify problems and resolve them, or how it is able to use data to identify opportunities and adjust operations to take advantage of them.

Market Migrate from One Quadrant to Another

Markets are dynamic and tend to evolve from one type to another over time, usually as a result of diverse factors such as changing technology, social, political and economic influences. This migration of markets from one quadrant to the next may even be brought about by the activities of supply chain companies themselves. Supply chain companies in the growth market whose performances are top-notch have high order fill rates and on-time delivery as a measure of their success. This is also an indication that they are maintaining good relationships with their customers.

When a growth market switches over to a steady market, companies that aspire to remain competitive and profitable have to ensure a high level of existing customer service and also extend the base of services offered. Coupled to this, companies would have to improve on their level of internal efficiency to remain relevant.

The transformation of steady markets into mature markets changes the focus of performance measurements. In the mature market, supply chain companies are expected to have demand flexibility to enable them to cope with the needs of customers in this type of market. While markets become mature, developing markets may emerge. Companies have to prepare adequately to take advantage of new opportunities to manufacture new products for consumers to purchase.

At each stage of migration, companies have to secure the necessary skill level needed to maximise their potential in each market – skills that will improve on performance in specific areas such as internal efficiency, demand flexibility etc., to meet the expected target mark set by top-level management. As a particular market served by a particular supply chain company shifts from one type to the next, the company is expected to also change focus from one category of performance to another. This calls for companies to continuously monitor supply and demand data to respond appropriately to changes.

Sharing Data across the Supply Chain

The reason for the need to share data amongst companies in supply chains is mainly to reduce incidents of wastage of resources, or inefficient resource use when decisions are made in the absence of accurate data. The company that is able to respond fastest to changing market events is the one that will survive in the long-term.

Sometimes companies may be major contributors to market shifts. For instance, a change in demand may cause forecasts of one company to request for more products than necessary, a situation which leads to excess products on the market (i.e. the bullwhip effect). This move causes a shift from steady market to mature market. Only when the excess products have been consumed does the market return to the steady position (quadrant). Obviously, the company that produced the excess product did not have accurate data to inform its decisions. To avoid such costly situations, companies in a supply chain need to have access to accurate demand data from both the end user and the intermediate customers (this could be other companies in the supply chain) to build the right capacity and stock the optimum level of inventory in order to perform well.

Decisions which could have a high impact on companies in the supply chain also have to be shared across the board. For instance, a decision by a retail store to undertake promotional activities for a specific product needs to be shared across companies making up the entire supply chain which produces and delivers the product to the retail store. Efficient supply chains can only be created when companies are able to share data efficiently, in turn contributing to their success as consumers prefer to do business with efficient partners, rather than inefficient ones.

Further Reading:

- ✓ *Michael H. Hugos, (2006), Essentials of Supply Chain Management*
- ✓ *B. Mahadevan, (2010), Operations Management: Theory and Practice*
- ✓ *Christine V. Bullen, Richard LeFave, Gad J. Selig, (2010), Implementing Strategic Sourcing: A Manager's Guide to World Class Best Practices*
- ✓ *Bozarth, (2006), Introduction to Operations and Supply Chain Management*