Key performance indicators of supply chain management

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Abstract - Supply chain management generates value for stakeholders, industry and customers interacting throughout the supply chain. Performance measurement of supply chain management practices with respect to supply chain variables and key performance indicators is the key area under research. Measurement of supply chain management practices in industries ensure the firms efficiency and effectiveness in all the aspects of supply chain followed by the firm. Industries perception towards adopting supply chain management practices creates value for performance measurement. The three perspectives of performance measurement including operational performance, economic performance and environmental performance. Variables stemming from performance measures such as fissures in quality improvement, customer satisfaction, cost minimization, lead time reduction and service level improvement.

Keywords - supply chain management, perspectives, performance measures.

I. INTRODUCTION

A supply chain is a network of facilities and distribution that gears the functions of procurement of materials, designing and transformation of these materials into semi-finished and finished products and the distribution of these finished products to customers through the distribution channel. Supply chain exist in both services and manufacturing organizations, although the complexity of the chain may vary greatly from industry to industry. Supply chain have multiple end products with shared capacities, components and facilities.

Performance of supply chain is described by its ability to remain awareness without losing the integration through its chain. Performance measurement is the process of quantifying and qualifying the effectiveness and efficiency of firm action towards goal achievement of the industry.

Efficiency measures explains how economically a firms resources are utilized to achieve the prearranged level of customer satisfaction while effectiveness is the extent to which the customer expectation are met. Performance measurement is an essential aspect of successful supply chain management. The development of economy of the country is reinforced by growth of its manufacturing industries. In order to persist, every industry has to struggle to improve productivity in all spheres of activity.

Indian industries play an imperative role in the economy expansion of the country and have vast approaching for employment generation. Increasing small sectors also results in decentralized industrial development, better distribution of wealth and investment and entrepreunial talent.

II. EVOLUTION OF SUPPLY CHAIN PERFORMANCE MEASUREMENT SYSTEM

Performance measurement has its origins in early bookkeeping systems. According to Gomes et al. (2005), performance measurement advanced through several phases. During 1880's first phase get started and the second phase in the late 1980's. The first phase was characterized by its budget secretarial alignment. This orientation intended at helping managers in evaluating the appropriate costs of operating their industry. It combined financial measures like return on investment and profit. A study has directed that by 1941 about half of US industries were using budgetary control in one form, budgets were used for overall control of performance of the industry by Bourne et al. 2003. These accounting based performance measurement of industry is internally focused, hesitant looking and more likely concerned with very few performance of the industry than with the overall performance of the business.

These financial based performance measurement system failed to integrate and extent all the acute factors to business success. The mid 1980's was the important phase in the literature of performance measurement system, as it marked the beginning of the second phase. This phase related with the development of global business activities and the changes fetched about by such growth. In the late 1980's, a broader view of performance measurement started to appear. They underlined the need for the association of financial and non-financial measures in order to be in accordance with business tactic. These development integrated the better performance measurement system and the structure of the business organization. During 1990-2000 automation of business processes gets emerged, performance measurement system enhanced to include process, quality and customer focus. During 2000-2010 e-commerce and borderless business activities gets developed resulting is the balanced view of the organizational and inter process activities.

III. MEASUREMENT SYSTEM FOR SUPPLY CHAIN PERFORMANCE

Lambert and pohlen, 2001 specified that the lack of suitable metrics might be the major reason for the following breakdowns and failure in the Supply Chain are incapability to meet satisfaction of the customer, sub-optimized performance of firms, missed-opportunities for exceeding competition, creating clashes inside Supply Chain. Measuring the performance would

be critical for improved Supply Chain. Some researchers considered that once price is marketplace victor moreover service level excellence and lead-time are qualifiers for market. Once the service level could be the topmost prerequisites to become champions (available in right time at the right place) as well as quality, cost lead-time are contenders for market, at that time being responsive would be the crucial measurement. Therefore, cost and time are critical indicators for performance measurement. To improve the Supply Chain more effectual and operative, it is required to assess the performance of Supply Chain. Measurement of Supply Chain performance should offer the business as summary of how their Supply Chain are economical and sustainable. Several researchers discussed that which indicators for performance measurement of lean and agile Supply Chain are key metrics. Nevertheless these may be collected as quality, customer service, cost and lead time. Anderson, 1989 expected that the measurement system of performance would include a poised collection of few measures of performance from the following: customer satisfaction, quality and productivity.

Gunasekaran, Patel and Tirtiroglu, 2001 considered that Supply Chain performance should be assessed from a tactical level, strategic level and operational level as well as from a commercial and non-commercial perspective. Bearing in mind this approach of thought, some measures offered by these researchers are accurateness in forecasting demand predictability, lead time of delivery, elasticity in meeting particular customer requirements, proper volume utilization, total cycle time as well as amount of buyers\suppliers partnerships, inquiry-time for customer, amount of partnership to improve quality, total cost of transportation, cost of booming inventory; cycle time for product-development, cost of manufacturing, investment rate of return, cost of carrying information and total time of cash-flow. Above mentioned measures try to quantify the Supply Chain performance in relations to suppliers, delivery, order planning, strategic planning and production.

Cumbo, Kline and Bumgardner, 2006 recommended following measures for performance includes: order till delivery lead-time, changeover or setup times, the skill to when it is actually needed, timely shipments and reduction in inventory. Schroer used performance measures as following including Delivery time, customer satisfaction, quality, productivity and costs. vachon, 2007 absorbed the following methods for assessing impacts of Supply Chain practices over operational-performance of Supply Chain, specifically on flexibility, cost, delivery and quality. Regarding the Supply Chain Management paradigms which are focused in this especial research, a set of antecedents to measure Supply Chain performance are affixed in the following below table 1.

Table 1. Antecedents to measure Supply Chain performance

Performance Measure	Supply Chain Antecedent
Operational Performance	Inventory Levels Quality Time Customer Satisfaction
Economic Performance	Cost Environmental cost Cash-to-cash Cycle
Environmental Performance	Business waste

IV. KEY PERFORMANCE INDICATORS

To make rapid resolutions in today's fast-acting environment, we need shrewd time saving, easy to interpret and most importantly decision subsidiary key performance indicators.

PERFECT ORDER MEASUREMENT

The perfect order measurement calculates the error-free rate of each stage of a purchase order (errors in order forecasting for procurement, errors in warehouse process, errors in billing and errors in delivery orders etc.). The percentage of orders that are error-free. Perfect order measurement is calculated by difference between the total orders from error orders divided by total orders multiply by 100.

CASH TO CASH CYCLE TIME

Cash to cash cycle time is dealings with the amount of time operating capital is tied up. During this time cash is not existing for any other resolves. A fast cash to cash cycle time indicates a lean and profitable supply chain in the industry. The number of days between paying for materials and getting paid for products, typically averaged for all orders for a week, month, quarter etc..

CUSTOMER ORDER CYCLE TIME

Customer order cycle time: measures how long firm takes to deliver a customer order after the purchase order (PO) is received. Customer order cycle time is calculated by difference between the actual delivery date and purchase order creation date. A variant of this is the promised customer order cycle time is the difference between the requested delivery date and purchase order creation date.

FILL RATE

The percentage of customer's order that is filled on the main shipment. This can be signified as the percentage of items, Stock Keeping Units or order value that is included with the first shipment. Fill rate can be important to customer satisfaction and has implications for carriage competence. Fill rate is calculated by (1-((total items- shipped items)/total items))*100.

SUPPLY CHAIN CYCLE TIME

Supply chain cycle time directs the overall efficiency of the supply chain. Tiny cycles make for a more efficient and responsive supply chain. Analysis of this critical metric can help distinguish discomfort points or competitive advantages. The time it would take to fill a customer order if inventory level were zero.

INVENTORY DAYS OF SUPPLY

Inventory days of supply specifies the number of days it would take to run out of supply if it was not refilled. Supply chain management pursues to diminish inventory days of supply in order to reduce the risk of excess and obsolete inventory. There are other economic benefits to diminishing this metric - excess inventory tends to tie up higher operational cash flow.

FREIGHT BILL ACCURACY

Billing accuracy is key to productivity and customer satisfaction. Freight bill accuracy is calculated by dividing the number of freight bills with error free by the total number of freight bills in the period. Errors can include inappropriate pricing, improper weights, partial information etc.

FREIGHT COST PER UNIT

Freight cost per unit is usually measured as the cost of freight per item or stock keeping unit. Supply chain management pursues to reduce freight cost per unit. Freight cost per unit is calculated by dividing the total freight cost by number of items.

INVENTORY TURNOVER

Higher inventory turnover indicates an efficient supply chain in which number of times that a company's inventory cycles per year. Inventory turnover is calculated by dividing the cost of goods and chattels sold by average inventory.

DAYS SALES OUTSTANDING

Days sales outstanding (DSO) is a extent of the average number of days that it takes a company to collect expense after a sale has been made. DSO is often strong-minded on a monthly, quarterly or annual basis and can be calculated by dividing the amount of accounts receivable during a given period by the total value of recognition sales during the same period and multiplying the result by the number of days in the period measured. Days sales outstanding is an element of the cash adaptation cycle and is often referred to as days receivable or average collection period.

AVERAGE PAYMENT PERIOD FOR PRODUCTION MATERIALS

Average payment period indicates the average time period taken by the company in making payments to its creditors. It is figured by dividing the number of working days (in a year) by creditor's turnover ratio. Otherwise, the normal time from receipt of materials and payment for those materials. The longer the average payment period the additional efficient in the business.

ON TIME SHIPPING RATE

The ratio of items, Stock Keeping Units or order value that arrives on or before the requested ship date. The on time shipping rate is important key to customer satisfaction. A higher rate indicates an resourceful supply chin. The percentage of items, Stock Keeping Units that attains on or before the demanded ship date.

INVENTORY TURNOVER RATIO (ITR)

ITR helps us to measure the number of times we sell or turn our usual inventory kept in the warehouse. In other words, it measures the number of occasions to earn profit that we experience each year from our working capital invested in the inventory. It is calculated by dividing the Cost of Goods (COGs) sold by the average inventory asset. There is no particular benchmark for ITR. However, societies who are product crania in the market are likely to fulfil with ITR of 3-4 while operational fineness oriented organizations, such as low-cost airlines or traders aims at achieving 8-9 ITR. On the other hand, distributors handle a wide range of brands and strive to meet customer needs aims at keeping ITR around 5-7. Deciding the number of ITR is highly related to the gross margin generated by related Stock Keeping Units or brands.

TURN-EARN INDEX (TEI)

TEI helps us to conglomerate the gross margin and turnover. A logic behind TEI is to keep high ITR for Stock Keeping Units or brands producing low margins and to satisfy with medium or low level ITR for Stock Keeping Units or brands creating high margins. Realizing TEI between 150 and 180 is the best practice in terms of harmonizing unrefined margin and inventory.

GROSS MARGIN RETURN ON INVESTMENT (GMROI)

Gross margin return on investment signifies the amount of gross profit earned on the average investment made in inventory. It is measured by dividing gross profit by the average inventory investment. Chasing GMROI on a monthly basis provides an important clue in terms of having a clear understanding of which Stock Keeping Units or brand produce more gross profit in the inventory.

DAYS OF SUPPLY (DOS)

DOS is the most commonly used KPI by managers in measuring the efficiency of supply chain. It is calculated by dividing the normal inventory on hand (as value) by the average monthly demand (as value) and then multiplying it by thirty, when measuring on a monthly basis. There is no exact target for DOS, but measuring it by considering the following months sales forecast (as value) will help us to have a clear understanding of at which the level we need to keep our stock to be able to advance inventory management on a monthly basis. Yet, DOS does not help us to understand how well our inventory will match the demand.

INVENTORY VELOCITY (IV)

Inventory velocity is the calculation of inventory we are projecting to be consumed within the next period. Inventory velocity helps the manager to recognize how well the inventory on hand matched the demand. It is designed by dividing the opening stock by the sales forecast of the following period. Tracing on a monthly basis will provide significant clues in terms of line up the inventory level to the best level for corresponding supply-demand and avoiding extreme stock in the warehouse.

V. KPIS ARE KEY TO SUCCESSFUL SUPPLY CHAIN

KPIs can help identify the weak lines in the supply chain so that action can be initiated to enhance performance because the chain is affected by its weakest link. These weak lines are a primary concern for companies to improve the quality of the

process. The key performance indicators used across supply chain usually helps to improve quality of product, quality of processes and quality of design. These helps to detect and minimize the company risk and improve customer experience. Poor management practices can lead to increased scrap and rework cost, the effective key performance indicator helps the company to reduce the cost invested in scrap and rework. Major goal of many organizations key performance indicators are to minimize the cost of warranty support by procuring parts that are manufactured, shipped and transported correctly to avoid damage. Although the quality and manufacturing assemblies normally monitor the warranty costs and reasons for other costs, the supply chain organization also has a major role in reducing warranty costs.

VI. CONCLUSION

The evolution of Supply Chain performance shows that the performance measurement is growing in its scope and importance. The academicians and practitioners have been increasingly paying attention on how to design and implement performance measurement system for supply chain. However, there are continuous changes in its nature and context based on key performance indicators. The traditional performance measurement system focused on financial data like rate of interest while non- traditional system focused on non-financial data like quality, flexibility. This paper initially provides definitions of evolution of supply chain performance measurement system. It discusses the importance of performance measurement. Performance measurement is a powerful tool that assist firm to evaluate resource utilization so that they can strategically manage and continuously control to achieve their objectives and goals.

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