PERFORMANCE EVALUATION OF SUPPLY CHAIN NETWORK IN APPAREL INDUSTRY: A CASE STUDY

By

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A thesis submitted to the Department of Industrial and Production Engineering,Bangladesh University of Engineering and Technology, in partial fulfillment of therequirements for the degree of Master of Engineering in Industrial and ProductionEngineering.

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CERTIFICATE OF APPROVAL

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It is hereby declared that this thesis or any part of it has not been submitted elsewhere for the award of any degree or diploma.

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ABSTRACT

Supply chain management has become one of the most discussed topics in businessliterature and is by many organizations considered a key strategic element. Today,markets have become more dynamic with rapid changes in customer requirements.These rapid changes have increased the importance for companies to ensure thatmaterials and information flow smoothly between the actors in a supply chain.

Being able to measure supply chain performance is important since it leads to a greater understanding of the supply chain and provides important feedback on the improvement progress. In spite of companies' and managers' recognition of the importance of supply chain management, they often lack the ability to develop effective performance measures and metrics. In addition, relatively little literature covering PMSs and the selection of performance measures in the context of supplychain management exists.

Here evaluated performance of supply chain in East west Industrial Park Ltd. A performance measure, or a set of performance measures, is used to determine the efficiency and/ or effectiveness of an existing system, or to compare competing alternative systems. Performance measures are also used to design proposed systems, by determining the values of the decision variables that yield the most desirable levels of performance. Due to complexity of supply chain nature, it is very difficult to measure its performance. In this study Supply Chain Operation Reference (SCOR) model has been used to measure supply chain performance. Four Key Performance Indicators (KPI) have been measured following the measurement of overall KPI which indicates the ultimate supply chain efficiency. The four KPI values are; Quantity and Timely Delivery 55.00%, Adherence to Production Target 69.30%, Quality Capability 14.18% and On-Time Shipment 82.83%. Overall efficiency of the supply chain is only 64.24% which is not well enough. Only On-Time-Shipment has higher KPI value. Other individual KPI values can be enriched by improving backward linkage, labor, management and production line efficiency and also improving the quality level. However, PPC and TQM will play a vital role to improve overall KPI.

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CHAPTER ONE

INTRODUCTION

1.1 Introduction

Among developing economies such as Cambodia, Sri-Lanka, China, etc, Bangladesh has achieved a strong position as one of the global suppliers of RMG, mainly due to having one of the cheapest labor costs among the apparel manufacturing countries. The globalization of industries created pressure for location based manufacturing economies which were also supported by the US and European Union (EU) import policies. The 'multi-fiber arrangement' (MFA), a quota system imposed by the US federal government forced US importers to source from less developed countries with the aim of fostering their manufacturing ability and supporting the growth of the apparel industry in countries from South Asia, China and other developing nations. After the MFA system became defunct in 2005, Bangladesh started to counter more rivalry, both anticipated and unanticipated, from many producers and suppliers because it turned into an open market for all. Now, the RMG industry of Bangladesh is struggling with many global competitors in terms of cost, quality, customer service, and lead time.

In recent years many reputable organizations are purchasing products, and sourcing, distributing and selling simultaneously from different corners of the world. This globalization of operations has become inevitable because cheap labor is available in some countries while raw material is readily available in others. Moreover, the time, cost and quality sensitiveness are also significantly varied among customers in different regions of the world. Through an efficient implementation of integrated supply chain management, the RMG industry in Bangladesh could stay competitive by maintaining the required efficiency and responsiveness. This was the traditional view of all companies that they existed as single and complete units and operated their businesses separately.However, the business environment has changed in the 21st century such that working alone is less competitive while collaborative working among upward and downward supply chain partners is more profitable. Through managing the supply chain, the ultimate objective of companies is offering maximum value to customers for the deliveredproducts or services by achieving either responsiveness or efficiency. To add dynamic capability to the RMG

sector and enhance supply chain performance, manufacturers should plan and work collaboratively with the upward suppliers of fabric and accessories as well as the downward buyers and partners of the supply chain [1].

Scott and Westbrook and New and Payne describe the supply chain as "the chain linking each element of the manufacturing and supply processes from raw materials to the end user, encompassing several organizational boundaries" [2-3]. According to this broad definition, supply chain management (SCM) "encompasses the entire value chain and addresses materials and supply management from the extraction of raw materials to its end of useful life". Farley explains that SCM "focuses on how firms utilize their suppliers'' processes, technology, and capability to enhance competitive advantage".Houlihan defined SCM as the technique of combining various key departments such as production, finance, marketing and human resource of a company so that this unified chain links tier-one suppliers and distributors to enhance performance by reaching the final customers on time. There is already some scholarly work that shows focal companies can utilize vendors manufacturing expertise and other R&D assets to design new products at lower costs through collaboration among trading partners [4-5].

1.2 SCM in the RMG Sector

Some of the key characteristics of the fashion industry are that the life cycle of any new styles of apparels is continuously decreasing, end demand for any garments is highly fluctuating and changing over time, various kinds of designs and styles are evolving everyday worldwide, and the total chain from yarn and cotton supplies to final garments through a lot of suppliers from many countries is very dynamic and difficult to manage [6]. So, apparel manufacturing companies of any country should manage the supply chain in a way that meets the total needs of the end consumers. This has caused the fashion industry to become increasingly complex and dynamic, and this sector has attracted many new market entrants and thus has triggered intense competitions [7].

The business of the fashion industry is so volatile and competitive that the driver for successful entrepreneurship is capitalizing on opportunities and scopes by integrated efforts among supply chain partners [6]; apparel manufacturers and traders are engaging

themselves to utilize integrated supply chain management as a source for improving their business performance. Lam and Postle found in their study that supply chain management consciousness was still comparatively low among the apparel manufacturers and traders in Hong Kong. Lee and Kincade mentioned some of the key dimensions they found in the US apparel supply chain including "partnership, information technology, operational flexibility, performance measurement, commitment of top management and demand characterization" [8-9].

The current RMG manufacturers of Bangladesh are importing most of the required woven fabrics from China, India, Pakistan and Indonesia. As a result, the total lead time is becoming longer, putting a negative edge on competitiveness. It is possible to reduce the total lead time through supply chain integration among upstream and downstream partners to make RMG manufacturers more competitive. Supply chain integration makes it possible to manufacture fabrics before taking orders from buyers but requires more collaboration among buyers, fabric suppliers and garment manufacturers in Bangladesh.

Realized that a long lead time was one of the greatest problems of the RMG sector in Bangladesh and that its top five causes constituted the issues of integrated supply chain management (SCM). Its emphasize that SCM is basically a complex process for countries, and a new in the apparel sector especially in the least developed countries like Bangladesh. A country like Bangladesh may create a remarkable position in the world's total apparel export by managing the partners of supply chain to reduce the lead time [10].

SCM encompasses the planning and management of all activities involved in sourcing, procurement conversion and logistics management activities that include coordination and collaboration with channel partners. Through an efficient and effective supply chain management, a business organization could get the right goods and services to the place needed at the right time, in proper quantity and at acceptable cost. Recently, SCM has become one of the most important strategic aspect of any business entity and increasingly important in a global economy. The supply chain process is complex, composite businessprocess comprising a hierarchy of different levels of value delivering business processes. Designing a high performance supply chain is a very challenging task due to the complex structure of the supply chains and ever changing business. Some of the important reasons for the complexity of the decision making process are large scale nature of the supply

chain networks, hierarchical structure of decision, randomness of various inputs and operations and dynamic nature of interactions among supply chain elements.

1.3 Imperatives of supply chain performance measurement

Today, supply chain management (SCM) has become one of the most discussed topics in business literature and is considered a key strategic element [11]. Performance measurement plays a vital role in identifying the behavior that impacts the performance of supply chains. Measuring supply chain helps organizations in meeting greater customer demands by maintaining lower cost. It also helps the organization in assessing the supply chain and realizing whether their chain has improved or degraded. Supply chain measurement directly impacts the controlling behavior and indirectly, it impacts and improves the performance [12].Performance measurement is an essential element of effective planning and control, as well as decision making. It can provide necessary feedback information to reveal progress, enhance motivation and communication, and diagnose problems. In supply chain context, performance measurement can further facilitate inter understanding and integration among the supply chain members. The measurement reveals the effect of strategies and potential opportunities in SCM [13].

The goals of supply chain management are to reduce uncertainty and risks in the supply chain, thereby positively affecting inventory levels, cycle time, processes, and ultimately, end customer service levels. Effective supply chain administration requires a proactive management style focused on long-term continuous improvement of the supply chain. Performance measures that accurately reflect supply chain operations are required to support continuous improvement within a supply chain.Performance measurement supports strategy planning and goal setting. Without the ability to measure performance and progress, the process of developing strategic plans and goals is less meaningful. Performance measurement improves internal accountability. Measuring performance gives decision makers a significant tool to achieve accountability. Employees at all levels are accountable to upper level managers for their performance or that of their crew, and upper level managers are accountable to executives [14].

Supply chain performance evaluation becomes one of the biggest challenges for today's competitive companies. The best in industry and world class practices have to be identified to

analyze the current practices of the company. In recent years, organizational performance measurement has received much attention from researchers and practitioners. The role of these measures in the success of an organization cannot be overstated because they affect strategic, tactical and operational planning and control. Performance measurement and metrics have an important role to play in setting objectives, benchmarking, evaluating performance, and determining future courses of actions [15-16].

1.4 Research Problem

Since measuring performance is considered an important element in order to staycompetitive many models and approaches have been developed, but relatively few ofthem have been designed from a supply chain perspective. Even though some modelsexist there is still room for new approaches to be developed in order to complementexisting theories in this particular field of research. Models such as the Supply Chain Operation Reference (SCOR) model enable supply chain wide modeling, evaluation, and improvement of processes.

Thereby, the purpose of this thesis is to develop a structured framework for creating and evaluating supply chain performance indicators with the aim of facilitating organizations efforts when measuring supply chain performance. The framework will aim to help firms in their continuous improvement work by selecting and categorizing new performance measures, as well as evaluating existing performance measures.

1.5 Objectives of the study

Since measuring performance is considered an important element in order to stay competitive many models and approaches have been developed, but relatively few of them have been designed from a supply chain perspective. Even though some models exist there is still room for new approaches to be developed in order to complement existing theories in this particular field of research. Thereby objectives of this

- To develop a method to measure the performance of an apparel supply chain quantitatively.
- To find-out the metrics to measure supply chain performance.

1.6 Methodology

The following steps will be followed to study the problem:

- The study is firstly focus on the decision criteria that mean KPI selection.
- Collecting data (Quantity and Timely Delivery, Adherence to Production Target, Quality Capability, On Time Shipment) for one and half months from the selected apparel factory.
- Then SCOR (Supply Chin Operation Reference) model to be implemented.
- Important KPI selecting and then with the help of KPI value, statistical data is analyzed.
- Finally, evaluating the supply chain performance against the KPI value through a case study.

CHAPER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter gives an overall idea about historical background of supply chain operation reference (SCOR) model and performance evaluation. Next chapter will discuss the theoretical background that will help to understand KPI selection which is need to measure performance.

2.2 Historical background Supply Chain Operation Reference (SCOR) Model

Keith Oliver referred supply chain management to the processes of planning, implementing, and controlling the operations of the supply chain with purpose to satisfy customer requirements as efficiency as possible.

The Supply Chain Operations Reference (SCOR) model wasdeveloped by the Supply Chain Council in 1996. The SCOR model focuses on the supply chain management function from an operational process perspective and includes customer interactions, physical transactions, and market interactions.In the past decade, the SCOR model has been widely adopted by many companies including Intel, General Electric (GE), Airbus, DuPont, and IBM. The SCOR model has proven to be a powerful and robust tool set for describing, analyzing, and improving the supply chain.'' In the literature, several recent studies have reviewed the SCOR model. Many other studies have attempted to measure the SCOR model's impact on business performance. Trade journals have also reported the benefits of using SCOR model. [17].

Supply chain performance evaluation becomes one of the biggest challenges for today'scompetitivecompanies. SCOR model provides an integral and comprehensive performance measures and covering both external and internal facing environment comprising both operational and financial.

This paper focused on the performance measurement of supply chain by addressing on this following question: which supply chain performance measure is used practice? How was the metric evaluation implemented? What were the problems that occurred in the performance measurement of supply chain? They mainly focused on the problem of performance evaluation of supply chain.

The Supply Chain Operations Reference-model has been developed by the Supply Chain Council to describe the business activities associated with all phases of satisfying a customer's demand. The SCOR model integrates business process reengineering, benchmarking, and process measurement into a cross functional framework. The Model itself contains several sections and is organized around the five primary management processes of PLAN, SOURCE, MAKE, DELIVER, and RETURN.Here they used 13 performance metrics, such as delivery performance, fill rates, order fulfillment lead time, production flexibility total SCM cost, etc. They settled a target for them and calculate what their achievement. Based on their actual achievement, there are five different categories for supply chain performance, namely major opportunity (0-20%), disadvantage (>20-40%), medium (>40-60%), advantage (.60-80%), best in class (>80-100%).

2.3 Importance of supply chain performance

Increase supply chain performance, is being seen as a challenge for organizations and to win this battle it is necessary to know the past, understand the present and define the future, revolutions being long before they are officially declared. For several years, senior executives in a board range of industries have been thinking how to measure the performance of their business. They have recognized that new strategies and competitive realities demand new measurement systems. At the heart of this revolution lies a radical decision: to shift from treating financial figures as the foundation for performance measurement to treating them as one among a broader set of measures".

Measuring performance on Supply chain can be difficult task on definition and on evaluation. Supply chain becoming a concept of competitive advantage, once that the focus is on the management of organizational relations downstream and upstream with suppliers and customers, is order to give value to customers at lower cost to the whole supply chain, promoting activities coordination and searching performance improvement.Santos, Sonia,

Intend to identify and explore the factors to obtain higher levels of performance in the context of the supply chain model. They presented a framework for supply chain performance measurement. The framework was divided in a six set of measures:Customer, Financial, Internal processes, Innovation and Learning and a Supply chain Vision.Supply Chain Management is a relatively new and rapidly expanding discipline that is transforming the way that manufacturing and non manufacturing operations meet the needs of their customers.

The literature is used in describing the general context within which measurement of supply chain performance is undertaken. They used three kinds of level for supply chain performance metrics framework. Strategic level measures include lead time against industry norm, quality level ete. Tactical level measures include the efficiency of purchase order cycle time, cash flow ete. Operational level measures include ability in day to day technical representation, adherence to develop schedule etc. The metrics and measures are discussed in the of the following supply chain processes: plan, source, make, delivery. Effective SCM help to win customers and improve customer service [18-21].

The lead time is one of the main competitive factors among various garments. Lead-time refers to the time lag between placing an order and receiving it. The lead time is divided in two sections one is information lead times (i.e., the time is takes to process an order) and another is order lead times (i.e., the time it takes to produce and ship the item). They suggested that information lead time can be reduced by using verysophisticated and moderncommunication system while order lead time can be reduced through efficient supply chain management [22].

A famous researcher named Marc Smith explained lead time in two categories.

First is customer lead time and second is manufacturing lead time. Here,
Customer lead time= Information lead time+ order lead time and total lead time= Information lead time+ Manufacturing lead time + Shipping time for export final product. They found mainly four causes for increasing lead time.
These are

(a) Dependency on import for fabrics and accessories.
(b) Dilatory and cumbersome customs procedure and transportation problem.
(c) Delay of sample approval.

If we would be able to reduce about 29% of total lead time by efficient supply chain management and 55-60% of total lead time by avoiding import and abolishing import dependency attitude.

Some metrics for supply chain performance evaluation like order lead time, customer order path, delivery performance, total distribution cost etc. Here tried to identify KPI (Key Performance Indicator). The KPI can be defined as the performance indicators that have significant impact on the overall performance of an organization in the areas of strategic, tactical and operational planning and control. He showed in this paper supplier delivery performance emerged as the most important measure to the evaluation of supplier performance. It was the only highly important measure. He suggested for monitoring supply chain performance. A comprehensive control system will be necessary in order to assure effective and efficient performance measurement all along the supply chain. Performance measurement should monitor both the effectiveness and efficiency of members in accomplishing supply chain goals. Good measurement systems also assist continuous process improvement by allowing managers to focus on eliminating the causes of process variations.

Multiple sources of information were combined in this study. The purpose and scope of this study were essentially exploratory. Based upon data, observations and interviews, a number of propositions were developed and integrated into a theoretical framework that should berefined and validated in future research. The scope of the research was limited in the sense that the supplier's side of the supply chain was not taken in to account [23].

The case study was limited in another sense as well. There are many other elements that affect supply chain performance. For example, the willingness to change, trust in suppliers and customers are some of the other factors that affect supply chain performance. Dr. George L. Harrisin the journal Evaluating and Assessing Your Supply Chain he offered a preliminary tool that can be used of the supply chain based on:

- ✓ Cost
- ✓ Quality Performance
- ✓ Lead Time

Here he tried to evaluate performance of supply chain with the metrics of cost, quality and lead time [24].

CHAPTER THREE

THEORETICAL BACKGROUND

3.1 Introduction

This chapter is to explore and gather all information in order to understand clearly about the performance evaluation, Supply Chain Management (SCM), Supply Chain Operation Reference (SCOR) model, KPI's, Quantity and Timely Delivery, Adherence to Production Target, Quality Capability, and On-Time Shipment. The information's is come from reference books, journals and thesis. These sections are mainly concern about related knowledge about Key Performance Indicators (KPI) have been measured following the measurement of overall KPI which indicates the ultimate supply chain efficiency. This particular area is discussed to give better understanding on what is purpose of this research.

3.2Supply Chain Operations Reference (SCOR) model

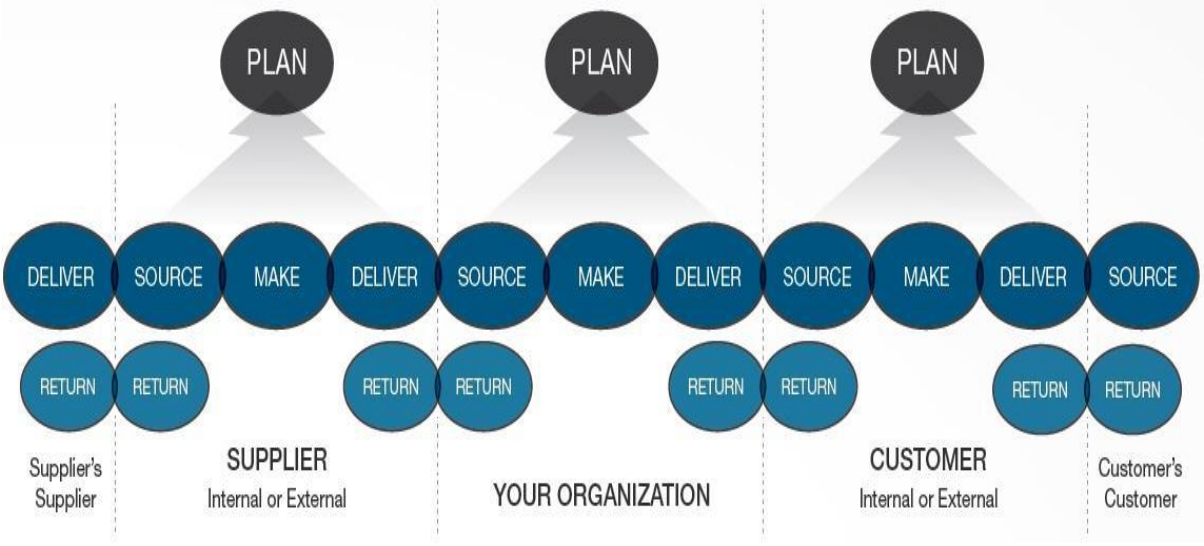

Figure 3.1: Interrelation of five key processes of SCOR
(Source: www.supply-chain.org, 2013)

SCOR has integrated three major processes that are process redesign or business process re-engineering (BPR), bench marking and determining best practices in an industry. As the figure 3.1 shows, SCOR model considers all phases of a supplier's supplier to a customer's customer. Thus, it is an integrated approach. SCOR uses five attributes that are reliability, responsibility, agility, cost and assets to set measurement metrics for any supply chain. Then SCOR sub-divides the metrics into three levels. Level 1 metrics are usually called key performance indicators (KPI) of the supply chain and these KPIs basically help to determine strategic objectives of an organization. Level 2 is a diagnostic of level 1 to identify causes of poor performances. Similarly, level 3 helps to diagnose and identify poor performances of level 2 metrics.

3.3Measures for delivery performance evaluation

An increase in delivery performance is possible through a reduction in lead-time attributes. Another important aspect of delivery performance is on-time delivery. On-time delivery reflects whether perfect delivery has taken place or otherwise and is also a measure of customer service level. A similar concept, on time orders fill, it as a combination of delivery reliability and order completeness. Another aspect of delivery is the percentage of finished goods in transit, which if high signifies low inventory turns, leading to unnecessary increases in tide up capital. Various factors that can influence delivery speed include vehicle speed, driver reliability, frequency of delivery, and location of depots. An increase in efficiencyin these areas can lead to a decrease in the inventory levels. Number of faultless notes invoiced: an invoice shows the delivery date, time and condition.

By comparing these with the previously made agreement, it can be determined whether perfect delivery has taken place or not, and areas of discrepancy can be identified so that improvements can be made. Flexibility of delivery systems to meet particular customer needs. This refers to flexibility in meeting a particular customer delivery requirement at an agreed place, agreed mode of delivery and agreed upon customized packing. This type of flexibility can influence the decision of customers to place orders, and thus can be regarded as important in enchanting and retaining customers.

3.4 Qualitative performance measures

Qualitative performance measures are those measures for which there is no single direct numerical measurement, although some aspects of them may be quantified. These objectives have been identified as important, but are not used in the models reviewed here:

Customer satisfaction: The degree to which customers are satisfied with the product and/or service received, and may apply to internal customers or external customers.

1. Pre-transaction satisfaction: Satisfaction associated with service elements occurring prior to product purchase.
2. Transaction satisfaction: Satisfaction associated with service elements directly involved in the physical distribution of products.
3. Post-transaction satisfaction: Satisfaction associated with support provided for products while in use.

Flexibility: The degree to which the supply chain can respond to random fluctuations in the demand pattern.

Information and material flow integration: The extent to which all functions within the supply chain communicate information and transport material.

Effective risk management: All of the relationships within the supply chain content inherent risk. Effective risk management describes the degree to which the effects of these risks minimized.

Supplier performance: With what consistency suppliers deliver raw materials to production facilities on time and in good condition.

3.5 Quantitative performance measures

Quantitative performance measures are those measures that may be directly described numerically. Quantitative supply chain performance measures may be categorized by: (1) objectives that are based directly on cost or profit and (2) objectives that are based on some measure of customer responsiveness.

Measures based on Cost

Cost minimization: The most widely used objective. Cost is typically minimized for an entire supply chain (total cost), or is minimized for particular business units or stages.

Sales maximization: Maximize the amount of sales dollars or units sold.

Profit maximization: Maximize revenues less costs.

Inventory investment minimization: Minimize the amount of inventory costs (including product costs and holding costs).

Return on Investment **Maximization**: Maximize the ratio of net profit to capital that was employed to produce that profit.

Measures based on Customer Responsiveness:

Fill Rate Maximization: Maximize the fraction of customer orders filled on time.

Products Lateness Minimization: Minimize the amount of time between the promised product delivery date and the actual product delivery date.

Customer Response time minimization: Minimize the amount of time required from the time an order is placed until the time the order is received by the customer. Usually refers to external customers only.

Lead Time Minimization: Minimize the amount of time required from the time a product has begun its manufacture until the time it is completely processed.

3.6 Developing efficiency measurement framework in apparel supply chain

There are varieties of measurement approaches that have been developed and traditionally used for measuring supply chain performance. Apart from the wildly popularized Balanced Scorecard, there are other measurement approaches like Supply Chain Council's SCOR Model, the Logistics Scoreboard, Activity-Based Costing (ABC) and Economic Value Analysis (EVA).SCOR model is designed and maintained to support supply chains of various complexities and across multiple industries. It spans all customer, physical and market transactions. This model is finally adopted to develop the measurement framework after a thorough investigation.

The Case Study has been done in East West Industrial Park Ltd. It has a 400,000 sq-ft floor area having central complex of 4 buildings and number of employs 9,000. It has 33 Trouser

and 10 Blazer production lines with a capacity of producing about 575,000 pcs. of standard size garments per month.Supply chain efficiency measurement framework is developed in terms of efficiency with respect to key functional parameters spanning four different operation domains namelysource, plan, make and deliver [25]. There are five primary key performance indicators (KPI) identified in each operation domain. Each KPI is expressed in percentage. Once all KPI are measured, weighted averages of all KPI would indicate the overall supply chain efficiency of the organization. Weightage on different KPI values are given management's opinion, higher the KPI, better the efficiency. While a 100% supply chain efficiency index would mean perfect organization, there is a possibility of any organizationhaving KPI value more than 100 percent. Table 3.1 shows different KPI that can be measured to find-out the overall supply chain efficiency.

Table 3.1: Different KPI described (Prabir, 2007)

OPERATION DOMAIN	KPI's
Source	1) Inward Material Quality
	2) Quantity and Timely Delivery
	3) Procurement Unit Cost
	4) Material Inventory Level
	5) Vendor Development Capability
Plan	**1) Adherence to Production Target**
	2) Sample Conversion Rate
	3) Material Utilization
	4) Cost Adherence
	5) Planned T&A v/s Actual T&A
Make	1) Capacity Utilization
	2) Production Cost Efficiency
	3) Quality Capability
	4) Change Over Time
	5) Operator Training Effectiveness
Deliver	**1) On Time Shipment**
	2) Order Fulfillment
	3) Claims and Discounts
	4) Quality at Delivery
	5) Transit time

All of these KPI are not needed or always possible to be measured. Due to lack of availability of data and resource in this study, only selected four KPI values, one from each operation domain, have been measured. In table 3.1 these four KPIs are bolded.

3.7 Performance Evaluation

Performance measurements or evaluations are becoming more and more important when SCM is coming into focus. Neely presents 7 drivers for the increasing interest in performance measurements.

- The changing nature of work. The cost of direct labor related to cost of material has dropped rapidly since the 1950s.
- Increased competition.
- Specific improvements initiatives ex JIT, TQM, BQR (Business process reengineering).
- National and international quality awards.
- Changing organizational roles changing from control to empowering employees by management by objectives.
- Changing external demands. Firms in the public sector must present information about their performance.
- The power of information technology.

What types of performance measurements are used today, are these measurements supporting system thinking and can we measure Supply chain excellence are questions that will be discussed in this section. There are a lot of different measurements for a company to choose from. Therefore it can be difficult to set up the right Performance measurements in a company. Some measurements are coming into more focus than others. Consultants companies working with Supply chain related questions are influencing companies with the terms they have chosen to work with. It is difficult to measure the performance in Supply chains according to Schmitz and Platts. According to Harrison and Ne half of the companies they contacted in their research had limited possibilities to do performance measurements in their Supply chain 19 percent couldn’t measure at all. Large companies often measure the effectiveness by key performance indicators and that these are too broad to fully capture supply chain effectiveness.

3.8 Types of performance measurements

Performance measurements based on financial accounting have for a long time been the primary tool according to Adams et al. The changes in the business environment from controlling of cost to customer value have changed the focus in performance management. The scope is larger writes Adams et al. and includes measurements in the customer service area like delivery precision and leadtime,in the internal efficiency area like ITO and yield and in the financial area like distribution cost and scrap cost. The main purpose of the traditional performance measure systems was to control costs and cash flows in the organization Vitale and Mavrina describe. In the end of the nineties two types of performance measurements dominate in the literature according to Beamon. These were cost and customer responsiveness. Customer responsiveness usually includes lead-time, stocking probability and fill rate. Cost is the sum of inventory and operating cost. Fill rate is a measure for in which grade a stock is filled. Keebler had the same thoughts and wrote that there are three principal categories of measurements, namely time, quality and cost. Both time and quality can be included in the customer responsiveness scope. To summaries the development for SCM you can see that the way companies measure the quality of their product and services has evolved from internal quality assurance to external customer satisfaction and from there to customer value.

The types of performance measurements are discussed with different focus. The focus can be on:

- Quantitative and qualitative measurements.
- What level “SCM” should be measured?
- Financial and non-financial measurements
- What measurements should be included?
- Internal and external measurements.

Beamon categorizes performance measures in existing literature into two groups’ qualitative andquantitative [26]. Qualitative measurements can’t be quantified. Some examples of qualitative measurements are customer satisfaction and HCI (Human capital index). Customer satisfaction can be measured by asking the customers to rate the company from a scale 1-5. HCI measures the empowerment and other things related to the persons working on the company. Some examples of quantitative measurements are delivery precision and Inventory Turnover (ITO). Delivery precision measure how many orders that are delivered in time. In time means the date that has been stated on the order-acknowledgement. ITO

measures howmany times the inventory turns around per year. Gunasekaran et al. discuss on what level “SCM” should be measured and mean that the measurements shall include all three of strategic, tactical and operational levels [20]. The highest management in a company can be interested in measuring “SCM” on a strategic level and consider the whole company. Management on level two or three can be interested in “SCM” measurements on a tactical level meaning that they measure on a part of the company. Measurements of “SCM” on operational level will be interesting for people working on operational level. ”SCM” measurements are a good tool for managing the daily work. Gunasekaran et al. say that the Supply chain performances should be measured beyond the organizational boundaries rather than focusing locally [20].

There is a lack of balanced approach to integrate financial and non-financial measures. Examples of financial measures are Supply Chain Cost and manufacturing cost per produced item. Supply Chain Cost is the total cost to run the whole Supply chain. Examples of non-financial measures are lead-time and yield. Lead-time means the time starting when a company receives an order and ends when the material on the order has been delivered to the customer. Yield is the amounts of items passing through the production process without any faults divided by the total amount of produced items. In a time when customer value is an important driver for success companies can’t only use conventional financial information in theirperformance measurements. Performance measurements are focusing on cost often in conflict with strategic goals and objectives. Shapiro says that a company should also concern about non-monetary objectives such as customer service, quality and time. lead time, delivery precision and customer satisfaction most often are difficult to measure in monetary terms[21-22].

Another focus in the “SCM” performance measurement is what measurements should be included. Three types of measures resources, output and flexibility. Resources mean how efficient the personal resources in a company are used and how effective other resources like for example production equipment is. Output measures are for example number of products shipped and invoiced amount of money. The extend of differentiated lead-times and differential customer service levels can for example be flexibility measures. There are three principal categories ofmeasurements, namely time, quality and cost. There are based on these three categories a lot of different measurements. Perfect order as a part of optimal operational performance. Quality in a Supply chain is to do everything right the first time. The order

should be complete in terms of service from order receipt to delivery. The concept of a perfect order is the logical extension of quality.

Another focus is on internal and external performance. Internal performance measures how a company performs from an internal perspective. Internal measures are important for detailed organizational monitoring. External performance measures how the company performs against the external customers. External performance is important to understand to be able to maintain the focus on customer perspective. One way to perform the external measurements is to send surveys to customers. Examples of categories in internal performance measurements are…

- Cost
- customer service
- productivity shipped/employee
- asset management
- quality claims

The term customer service includes many factors. Service as a competitive factor includes the availability of the product, delivery speed and delivery reliability. Improvements in internal performance normally lead to cutting of cost, but improvements in external performance normally lead to increased cost. Every system has conflicting objectives, which have to be balanced to achieve a good result. It can be lot size versus inventory, inventory versus transportation cost and production variety versus inventory. The most comprehensive tradeoff is between customer service and Supply Chain Cost [26].

Improving customer service often means that the total Supply Chain Cost increase. There are optimization models that can assist management in evaluating objectives. The Efficient Frontier isthe curve for how the total cost increase with higher service level. Higher service level means more service for the customer. The service can for example is short orderacknowledge time and high delivery precision.

A mix of measures; the measurements should cover the whole Supply chain. The measurements systems focus on short term results. The ideal measurement system covers both short term and long term results. The risk with measurements covering only short

termresults is that the management of the Supply chain might not lead to the best result in the long term. An example is companies that focus on minimizing stock levels and gets a very result in the short term. The cost for tied up capital in stock is low and the company can still deliver material to their customers. In the long term the company runs into problems with low delivery precision and long lead-time [27-29].

3.9Methods for performance measurements

Balanced scorecard, SCOR model and benchmarking are three methods that are used for performance measurements within the industry. These methods are also frequently discussed in the academicals world.

3.9.1 Balanced Scorecard

The Balanced Scorecard is a framework for measurements of the performance in an organization. The scorecard includes both financial and non-financial data. There is no general definition of what measurements that shall be included in the scorecard. The measurement criteria differ between companies and also between departments in the same company. Four general categories are:

- Financial measures
- Customer-related measures
- Internal performance
- Learning

Financial measures focus on economic value added and return on investment. Customer-related measures are customer satisfaction and market share. Internal performance includes quality, response time and cost measures. The learning category includes employment aspects such as skill development, retention and information technology.

The Supply chain mission shall be linked to the balanced scorecard framework. Management decides what shall be included in the scorecard. The scorecard can for example be divided into areas like financial, customer, competitive position, internal efficiency and employee.

3.9.2 SCOR Model

The Supply chain Council has developed the SCOR model. The model is a reference model and SCORstands for Supply Chain Operations Reference. The purpose for the model is to:

- Provide a standard language for SCM that can be used cross-industry
- Facilitate external benchmarking
- Establish a basis for analyze of Supply chains
- Compare the current Supply chain with the target for the future.

The aim of SCOR is to provide a standard way to measure Supply chain performance and to usecommon metrics to benchmark against other organizations according to Christopher.
The SCOR model is based on four management processes:

- Plan: balances Supply and demand
- Source: procurement of products and services
- Make: transforming of products and services into finished goods

The SCOR model has three levels:

- Top level: defines the scope and content for the Supply chain.
- Configuration level: designs the Supply chain
- Process element level: gives detailed information on each process.

A process is composed of process elements and the elements are composed of tasks. Tasks are a set of activities. The activities are standardized to make comparison between Supply chains possible. The SCOR model has 12 performance metrics. The most effective way to develop a close customerrelationship is by understanding customer behaviors and designing and sustaining a Supply chain tailored to deliver value to each customer segment.

CHAPTER FOUR
CASE STUDY

4.1Introduction

An important component in supply chain performance evaluation is the establishment of an appropriate performance measures. A performance measure, or a set of performance measures, is used to determine the efficiency and/or effectiveness of an existing system, or to compare competing alternative systems. Performance measures are also used to design proposed system, by determining the values of the decision variables that yield the most desirable levels of performance. Performance measurement reflects the need for improvement in operational areas which are found wanton in performance measures. Lack of adequate performance measurement has been identified as one of the major obstacles to efficient supply chain management. It is an established fact that in order to improve supply chain effectiveness and realize a smooth flow of resources within it, there is a need to measure its performance.

Measurement of performance will also reveal whether there is need for an organization's continuation in its current method or adopting a re-engineering of its system to affect the areas which are found different.

Performance measurement describes the feedback on operations which are geared towards customer satisfaction and strategic decision and objectives. To measure efficiency of supply chain due to fulfill our performance evaluation of supply chain. To measure efficiency of supply chain, used Key Performance Indicator (KPI).

4.2Case study of SCOR model in East West Industrial Park Ltd.

History:

East West Industrial Park, one of the very few RMG Industries from the early 1980's has been in this business for over 37 years. Over the years it has been able to establish the export dress Pant, Blazers and Suits in the worldwide market which is one of the pioneers of the formal Trousers and Suits product from Bangladesh.

East West Industrial Park Ltd. was initiated in 1979. In late 1979, it started the first project of the company- East West jute products. This unit-exported jute made handicrafts to different parts of U.S.A.

After 6 years, it started the first garments unit East West Fashion Garments Ltd., in Mirpur, Dhaka. By 1986 another unit, Fashion Trousers Ltd., was started.

For better manufacturing capability these two units moved to 186, Tejgaon Industrial Area, Dhaka in 1988. After 8 years, to compete in the global RMG sector, of the 90's lead the company to move further with their quality and manufacturing capacity.

Company bought 6 Acres of land in 1996 in chaydhana, Gazipur. It's objective was to create and design an international standard manufacturing RMG manufacturing complex with the most latest and ethical infrastructure. By January 1997, our first 5- storied building was completed. Three new units-Fashion Skirt Ltd. Fashion Trouser Ltd and United Fashion Ltd. were set up in this building to put into production.

By early of year 2000, completed the second identical building of the first one, which is a 7 storied building. The previous two units, East West Fashion Garments and Fashion Trousers Ltd. were transferred from Tejagaon to this new Gazipur site the year 2003, set-up own textile mill unit named "East West Suiting Mills Ltd." in Savar with an annual capacity of weaving 9 lac yds of woven fabric. Produce 100% Poly and 100% Cotton fabric mainly.

Currently, all units are running in Gazipur along with a unit of washing plant.

Background:

- An export oriented vertical suit and dress pant central manufacturing complex.
- Established in 1979 by MD Harun-Ar- Rashid, Managing Director and Founder East West Industrial Park.
- First business was Handy crafts, Exported to USA.
- Later in 1985 started off as one of the early RMG Manufacturing companies in Bangladesh.
- Focused on Dress Pant business in UK.
- Moved from the City in 1994 to facilitate growing needs of the buyers and for a better environment for all.
- Started first floor in Gazipur in 1997.
- Later years added new floors and buildings keeping priority on product ranges and brand.

Key Facts:

- Central complex of 4 Buildings
- 13 sewing and 3 cutting floors
- Family of 9,000 people
- Central store, finished goods and cargo loading areas
- 33 Trouser and 10 Blazer lines
- Area 400,000 sqft

- Sample Room Capacity

  Blazer: 200 pcs per month

  Trouser: 550 pcs per month

- Production Capacity

  225,000 pcs of Blazers /month

  350,000 pcs of Trousers/month

  100,000 pcs of Waist coat/month

- Product Range:

  Men's – Blazer, Trouser, Waist Coat etc.

  Ladies-Blazer, Trouser, Skirt, Outwear etc.

  Boys &Girls-Blazer, Trouser, Skirts, Shorts etc.

- Yearly Turn Over: $43 M (2014). Projected 2015: $50 M.
- Production Efficiency: 40% Avg. (2014). Target: 50% (2015)

Principal customers- Tesco, Link international (Japan), Raymond (India), H&M, Littlewoods (UK), DEWHIRST (UK), Jdwilliams, C&A , M&S, SHOP DIRECT, next MATAL AN, daici, etc.

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4.3 Data collection

Collected some relevant data from East West Industrial Park Ltd Such as

1. Quantity and Timely Delivery.
2. Adherence to Production Target.
3. Quality Capability.
4. On-time Shipment.

4.3.1Quantity and Timely Delivery

This parameter shall evaluate whether the quantity ordered is delivered on time or not for all the materials. The time to be considered is a percentage of the lead time of the raw material. However in case of late delivery the penalty shall be according to the % lead time delay and quantity supplied as per matrix below. A percentage of the lead time is being taken as different materials have lead times varying from one to sixty days. Only the quantity and time are considered as quality has been covered in earlier parameter. The points can be allotted as:

Table 4.1: Allotted points for Quantity and Timely delivery[30]

Qty.Red. / Time delay	100%	99-75%	74-50%	49-25%	>25%
0%	100	70	50	30	0
Upto 20%	70	50	30	10	0
21-50%	50	30	20	0	0
>50%	0	0	0	0	0
<20% early	30	40	50	70	80

Moreover if the material was ordered in bulk to be delivered in lots, then the quantity will be taken as cumulative, higher the KPI, better the efficiency.

4.3.2 Adherence to Production Target

Many times the planned targets are not met due to non availability of raw-materials (as raw-material did not arrive on time) or due to decision pending (like fit-approval delays, material quality approval delays). This parameter measures actual production achievement in comparison to planned one. Production achievement is measured in terms of timely completion and fulfillment of target. This KPI measures average daily deviation of target production for three departments, namely cutting, sewing and finishing and points are allocated. Cutting schedule is compared with actual cut completion dates and express as percentage. Similarly planed sewing and finishing dates for different styles are compared with actual. Datais collected over a minimum of 3 respective months and averaged. The KPI is calculated as

$$\text{KPI} = \frac{\sum (\text{Output} \times \text{Point})}{\text{Total output}} \%$$

The Points are allocated from table 3.

Table 4.2: On a scale of 100 points, the points allocated for Adherence to Production Target.[30]

Production completed	Points
99-75%	75
74-50%	50
49-25%	30
less than 25%	10

Often manufactures priorities different customers based on certain parameters, it is understood that to favor one customer the vendor has to compromise with other customer. Due to circumstances while any customer wants to measure true SC efficiency of any manufacturer the average data over a period of time should be taken into account and not only data pertaining to specific customer's orders.

In this study KPI measures average daily deviation of target production for sewing. Data was collected over a month and averaged.

Table 4.3: Adherence to Production Target line A

Date	Target output per day	Total output per day	Buyer
2	250	200	Sewing Shin
3	350	250	
4	400	200	
5	400	270	
6	400	270	
8	400	400	
9	400	109	
10	450	300	
11	375	300	
12	375	350	
13	380	300	
15	300	246	
16	300	016	
17	300	100	
18	350	220	
19	300	300	
20	350	325	
22	350	375	
23	400	350	
24	450	350	
25	450	400	
26	450	350	
27	450	400	
29	300	150	
30	350	100	
31	300	200	

Table 4.4: Adherence to Production Target line B

Date	Target output per day	Total output per day	Buyer
2	300	180	Sewing Shin
3	350	250	
4	400	320	
5	400	300	
6	400	300	
8	400	400	
9	400	107	
10	400	300	
11	375	300	
12	375	350	
13	380	300	
15	350	300	
16	300	16	
17	300	100	
18	350	240	
19	300	300	
20	350	325	
22	350	375	
23	400	350	
24	400	400	
25	400	400	
26	400	350	
27	400	400	
29	300	200	
30	350	100	
31	300	100	

Table 4.5: Adherence to Production Target line C

Date	Target output per day	Total output per day	Buyer
2	150	90	Raymond
3	150	70	
4	150	57	
5	150	230	
6	150	280	
8	200	200	
9	250	100	
10	250	212	
11	250	300	
12	250	115	
13	350	286	
15	350	350	
16	350	350	
17	400	421	
18	500	360	
19	450	450	
20	450	400	
22	450	340	
23	450	392	
24	400	260	
25	400	400	
26	300	300	
27	350	350	
29	250	400	
30	300	100	
31	250	150	

Table 4.6: Adherence to Production Target line D

Date	Target output per day	Total output per day	Buyer
2	300	300	Raymond
3	450	320	
4	450	230	
5	350	425	
6	400	131	
8	400	400	
9	250	154	
10	450	400	
11	425	425	
12	425	435	
13	400	420	
15	450	450	
16	550	500	
17	400	417	
18	500	400	
19	450	450	
20	450	392	
22	450	425	
23	450	388	
24	400	360	
25	400	400	
26	400	400	
27	350	350	
29	400	400	
30	400	450	
31	400	400	

Table 4.7: Adherence to Production Target line E

Date	Target output per day	Total output per day	Buyer
2	300	210	Raymond
3	450	280	
4	450	180	
5	350	310	
6	400	280	
8	400	400	
9	450	600	
10	425	428	
11	425	450	
12	400	420	
13	450	450	
15	550	500	
16	400	362	
17	500	302	
18	450	450	
19	450	400	
20	450	425	
22	450	398	
23	400	400	
24	400	400	
25	350	350	
26	400	400	
27	400	450	
29	400	400	
30	350	300	
31	380	350	

Table 4.8: Adherence to Production Target line F

Date	Target output per day	Total output per day	Buyer
2	350	250	LinkInternational
3	475	350	
4	475	365	
5	475	360	
6	475	350	
8	475	380	
9	475	450	
10	475	400	
11	475	400	
12	475	400	
13	475	395	
15	475	390	
16	550	490	
17	400	400	
18	475	380	
19	475	350	
20	475	390	
22	475	400	
23	475	405	
24	475	400	
25	475	450	
26	475	400	
27	475	415	
29	475	400	
30	475	420	
31	475	415	

Table 4.9: Adherence to Production Target line G

Date	Target output per day	Total output per day	Buyer
2	350	260	Link International
3	475	350	
4	475	380	
5	475	370	
6	475	365	
8	475	400	
9	475	470	
10	475	405	
11	475	513	
12	475	415	
13	475	420	
15	475	435	
16	550	510	
17	400	400	
18	475	410	
19	475	365	
20	475	430	
22	475	430	
23	475	435	
24	475	435	
25	475	450	
26	475	410	
27	475	450	
29	475	420	
30	475	465	
31	475	470	

4.3.3 Quality Capability

Quality is the important key performance indicator. It can be determined by Defect per Hundred unit (DHU) levels. DHU level is the defect per hundred unit calculated at the final stage of each department. For example, in the cutting department it can be calculated at the part checking or auditing stage, after the cutting and bundling process. Similarly in the sewing department it can be calculated at final checking or audited stage, after the complete sewing of garments from the line. In the finishing department, it can be calculated at final auditing or at final inspection stage. This KPI is calculated as= (1/DHU) ×100

Higher the KPI, the better the quality capability of the organization, For example, if the production of the sewing department one day is 800, out of which 200 pieces are checked and the DHU is 112, then the KPI is (1/112)×100=0.89%.

Source: Sharad Diwan, Prabir Jana, Prof. A.S. Narag and Dr. Alistair Knox December 2007.

10 line data for 16 days have been collected and averaged.

Table 4.10 Data for DHU

DHU in 11/07/17DHU in 12/07/17 DHU in 13/07/17

Line	DHU
A	11.8
B	11.6
C	10.8
D	10.8
E	10.7
F	2.8
G	2.7
H	2.8
I	2.7
J	2.5
Avg.	6.92%

Line	DHU
A	12.7
B	11.0
C	9.7
D	10.7
E	10.6
F	2.8
G	2.9
H	2.7
I	3.2
J	2.7
Avg.	6.90%

Line	DHU
A	11.5
B	10.5
C	9.3
D	9.5
E	10.4
F	4.4
G	2.9
H	2.9
I	3.7
J	3.3
Avg.	6.84%

DHU in 15/07/17

Line	DHU
A	12.7
B	13.2
C	10.7
D	10.1
E	10.8
F	5.8
G	2.4
H	2.9
I	2.3
J	2.7
Avg.	7.36%

DHU in 16/07/17

Line	DHU
A	14.3
B	12.3
C	10.2
D	10.2
E	10.2
F	4.5
G	2.4
H	2.6
I	2.2
J	3.0
Avg.	7.19%

DHU in 17/07/17

Line	DHU
A	10.9
B	12.2
C	10.2
D	10.4
E	10.4
F	4.3
G	2.2
H	3.1
I	3.1
J	2.9
Avg.	6.97%

DHU in 18/07/17

Line	DHU
A	10.6
B	11.3
C	8.7
D	12.0
E	10.4
F	4.6
G	2.5
H	2.5
I	4.0
J	3.0
Avg.	6.96%

DHU in 19/07/17

Line	DHU
A	11.1
B	11.5
C	9.4
D	12.2
E	11.1
F	4.6
G	2.7
H	2.7
I	3.3
J	3.0
Avg.	7.16%

DHU in 20/07/17

Line	DHU
A	12.2
B	10.8
C	9.8
D	13.2
E	10.0
F	4.2
G	2.5
H	2.7
I	3.8
J	2.8
Avg.	7.20%

DHU in 22/07/17

Line	DHU
A	11.8
B	11.4
C	11.9
D	9.7
E	9.4
F	3.7
G	2.6
H	2.8
I	3.1
J	2.9
Avg.	6.93%

DHU in 23/07/17

Line	DHU
A	12.1
B	11.5
C	11.5
D	10.1
E	9.8
F	4.1
G	2.3
H	2.9
I	3.4
J	3.0
Avg.	6.07%

DHU in 24/07/07

Line	DHU
A	12.6
B	11.3
C	11.2
D	9.6
E	9.2
F	3.1
G	2.4
H	2.3
I	2.9
J	3.1
Avg.	6.77%

DHU in 25/07/17

Line	DHU
A	12.3
B	11.8
C	11.5
D	10.9
E	8.6
F	5.0
G	2.5
H	2.6
I	2.7
J	2.9
Avg.	7.08%

DHU in 26/07/17

Line	DHU
A	12.4
B	11.6
C	12.5
D	8.5
E	10.8
F	4.4
G	2.9
H	2.4
I	3.7
J	3.1
Avg.	7.23%

DHU in 27/07/17

Line	DHU
A	13.2
B	11.5
C	11.2
D	11.2
E	8.6
F	4.4
G	3.1
H	2.4
I	3.0
J	3.1
Avg.	7.17%

DHU in 29/07/17

Line	DHU
A	13.1
B	14.7
C	13.1
D	12.1
E	8.9
F	6.1
G	3.3
H	2.3
I	3.2
J	2.9
Avg.	7.97%

4.4.4 On-Time Shipment

Shipment at the exporter's end is just the delivery of goods. When the contract is made for an order, the buyer fixes a favorable date. If these goods are exported by the manufacturer as per scheduled date then it is termed as on-time shipment. While delay in shipment is of great concern, and dealt with in this parameter, early shipment also draws a penalty.This KPI iscalculated as (Volume or value of orders shipped × weightage points)*100/(total volumeor value of orders).Higher theKPI better the on-time shipment performance. This parameter is measured on a monthly or yearly basis. KPI calculation can be done either based on volume or value.

$$KPI = \frac{\sum (\text{Volume or value of orders shipped} \times \text{Weightage Point of 100})}{\text{Total Value or Volume of Orders}} \%$$

CHAPTER FIVE

RESULTS AND DISCUSSION

Four calculated KPI values are as follows:

5.1 Quantity and Timely Delivery

Calculation for Quantity and Timely Delivery is shown in table 5.1. This KPI value is 56.67% as it is considered that all raw material orders have same weightage.

Table 5.1: Quantity and Timely delivery of Raw materials supply for last one month

Raw materials	Lead time (a days)	Time delay (b days)	(b/a)*100%	Order Quantity (c)	Quantity Received (d)	(d/c)*100%	Points
Fabric	56	6	11	3.60	3.40	94	50
Lining	5	2	40	0.68	0.66	97	30
Thread	15	3	20	10000	10000	100	70
Polythene	20	2	10	30000	30000	100	70
Button	20	3	15	20000	20000	100	70
Label	30	8	27	23000	23000	100	50
					Average point		55

$$\text{Average Point is} = \frac{50+30+70+70+70+50}{6}\ \%$$

$$= \frac{340}{6}\ \%$$

$$= 56.67\%$$

So, KPI value is 56.67%

5.2 Adherence to Production Target

Table 5.2: The sewing figure of one month for East West Industrial park Ltd.

Line No.	Buyer	Target output per day	Total output	Average output per day	% completed	Points	Average output× Points
A	Sewing Shin	368	6831	263	71	50	13137
B	Sewing Shin	366	7063	272	74	50	13583
C	Raymond	306	6963	268	88	75	20086
D	Raymond	413	10022	385	93	75	28910
E	Raymond	388	9242	355	91	75	26660
F	Link international	470	10205	393	84	75	29438
G	Link international	470	10763	414	88	75	31047
SUM=2350			162861				

$$\% \text{ completed in line A is} = \frac{263\times100}{368}\ \%$$

$$= 71.46\%$$

$$\% \text{ completed in line B is} = \frac{272\times100}{366}\ \%$$

$$= 74.31\%$$

$$\% \text{ completed in line C is} = \frac{268\times100}{306}\ \%$$

$$= 87.58\%$$

$$\% \text{ completed in line D is} = \frac{385\times100}{413}\ \%$$

$$= 93.22\%$$

$$\text{\% completed in line E is} = \frac{355\times100}{388}\%$$

$$= 91.49\%$$

$$\text{\% completed in line F is} = \frac{393\times100}{470}\%$$

$$= 83.61\%$$

$$\text{\% completed in line G is} = \frac{414\times100}{470}\%$$

$$= 88.08\%$$

$$\text{Average output} \times \text{ Points in line A} = \frac{6831}{26}\times50$$

$$= 262.7307692\times50$$

$$= 13136.53846$$

$$\text{Average output} \times \text{ Points in line B} = \frac{7063}{26}\times50$$

$$= 271.6538462\times50$$

$$= 13582.69231$$

$$\text{Average output} \times \text{ Points in line C} = \frac{6963}{26}\times75$$

$$= 267.8076923\times75$$

$$= 20085.57692$$

$$\text{Average output} \times \text{ Points in line D} = \frac{10022}{26} \times 75$$

$$= 385.4615385 \times 75$$

$$= 28909.61538$$

$$\text{Average output} \times \text{ Points in line E} = \frac{9242}{26} \times 75$$

$$= 355.4615385 \times 75$$

$$= 26659.61538$$

$$\text{Average output} \times \text{ Points in line F} = \frac{10205}{26} \times 75$$

$$= 392.5 \times 75$$

$$= 29437.5$$

$$\text{Average output} \times \text{ Points in line G} = \frac{10763}{26} \times 75$$

$$= 413.9615385 \times 75$$

$$= 31047.11538$$

From Table 5.2, it is found that Σ Output × Points = 162861 and Total Output = 2350. So,

$$\text{KPI} = \frac{162861}{2350} \%$$

$$= 69.30\%$$

5.3 Quality Capability

In the sewing department at final check or audited stage, 10 line it was calculate in average DHU in

11/07/17 =6.92%	20/07/17=7.20%
12/07/17=6.90%	22/07/17=6.93%
13/07/17=6.84%	23/07/17=6.07%
15/07/17=7.36%	24/07/17=6.77%
16/07/17=7.19%	25/07/17=7.08%
17/07/17=6.97%	26/07/17=7.23%
18/07/17=6.96%	27/07/17=7.17%
19/07/17=7.16%	29/07/17=7.97%

So, average DHU value

$$= \frac{(6.92+6.90+6.84+7.36+7.19+6.97+6.96+7.16+7.20+6.93+6.07+6.77+7.08+7.23+7.17+7.97)\%}{16}$$

$$= \frac{112.72}{16}\ \%$$

$$= 7.05\%$$

This KPI is calculated as

$$KPI = \frac{1}{DHU} \times 100\%$$

$$= \frac{1}{7.05} \times 100\%$$

$$= 14.18\%$$

5.4 On-Time Shipment

The order fulfillment on the shipment date onemonth has been given in Table 5.3

Table 5.3: The KPI Value of order fulfillment for East West Industrial park Ltd.

Buyer's name	Order Quantity (pcs)	Actual shipment (pcs)	Weightage Points	KPI Value
H & M	217278	188931	90	78.26
Raymond (India)	37727	26591	90	63.43
Link international (Japan)	19269	19312	90	90.20
Littlewoods (UK)	11506	11308	90	88.45
JDWilliams	33027	32126	90	87.54
DEWHIRST(UK)	20066	19872	90	89.12
82.83				

KPI calculation can be done either based on volume or value.

$$\text{KPI} = \frac{\sum (\text{Volume or value of orders shipped} \times \text{Weightage Point of 100})}{\text{Total Value or Volume of Orders}} \%$$

$$\text{H \& M, KPI value is} = \frac{188931 \times 90}{217278} \%$$

$$= \frac{17003790}{217278} \%$$

$$= 78.26\%$$

$$\text{Raymond (India), KPI value is} = \frac{26591\times 90}{37727}\ \%$$

$$= \frac{23931190}{37727}\ \%$$

$$= 63.43\%$$

Respectively,

$$\text{Link international (Japan), KPI value is} = \frac{19312\times 90}{19269}\ \%$$

$$= \frac{1738080}{19269}\ \%$$

$$= 90.20\%$$

$$\text{Littlewoods (UK), KPI value is} = \frac{11308\times 90}{11506}\ \%$$

$$= 88.45\%$$

$$\text{JDWilliams, KPI value is} = \frac{32126\times 90}{33027}\ \%$$

$$= 87.54\%$$

DEWHIRST(UK), KPI value is= $\frac{19872\times 90}{20066}$ %

= 89.12%

So from the table 5.3,

Average KPI value= $\frac{78.26+63.43+90.20+88.45+87.54+89.12}{6}$ %

= $\frac{497}{6}$ %

=82.83%

5.5 Overall KPI value

Overall KPI value is obtained by calculating the weighted average of all individual KPI values mentioned earlier. As summarized in table 5.4 the overall KPI value that is the Supply chain efficiency of East West Industrial park Ltd.is 64.74%.

Table 5.4: Overall KPI or Supply Chain Performance of East West Industrial park Ltd.

KPI	KPI value	Weightage	KPI value × Weightage
Quantity and Timely Delivery	56.67%	30%	17.00%
Adherence to Production Target	69.30%	25%	17.33%
Quality Capability	14.18%	10%	1.418%
On-time Shipment	82.83%	35%	28.99%
Total64.74%			

CHAPTER SIX

CONCLUSION AND RECOMMENATION

6.1 Conclusion

Performance measurement supports strategy planning and goal setting. Without the ability to measure performance and progress, the process of developing strategic plans and goals is less meaningful. Measurement improves accountability.Overall KPI value that is the Supply chain efficiency of East West Industrial park Ltd.is 64.74%.

It is obvious from above parameters that all KPI neither have equal weight in final measurement nor all KPI are equally important for all organizations. Organizations can decide priorities and weight at their will to finally arrive at the supply chain efficiency of an organization as a whole.

Supply chain performance evaluation is an important factor in garments factory. This evaluation can accelerate the productivity of the factory. Performance measurement describes the feedback on operations which are geared towards customer satisfaction and strategic decisions and objectives**.**

It is important to note that any organization may be strong in one area, but weak in other area. For example, organization A was found to be strong in plan and deliver with average KPIs of 81 and 95 respectively. The weak area was source and make with average KPIs of 62 and 44 respectively.While the summarized table shows the utility of this efficiency measurement models it is important to note that out of 20 KPI only 4 are able to be measured. The data secrecy, data ownership, poor record maintenance, and unauthentic data were the main reasons behind not all KPI being measurable. It was also realize that computerized data record maintenance is more reliable and better to retrieve than any manual method of maintain registers and files. This measurement process is currently at very nascent stage of testing for its usefulness and accuracy and relevancy will be clear with more testing and time.

6.2 Recommendation

The overall supply chain efficiency of East West Industrial Park Ltd. is not high enough to compare with world class organizations. Only KPI value of on-time-shipment is well. Other KPI can be enriched by giving sufficient focus on those and applying

- ✓ Lean manufacturing,
- ✓ Appropriate for Production planning and Control,
- ✓ TQM,
- ✓ Enrich of backward linkage,
- ✓ Quality level,
- ✓ Labor and line efficiency will definitely improve the overall supply efficiency of the organization.

To bring about improved performance in a supply chain and move closer to attainment of the real goal of supply chain optimization, performance measurement and improvement studies must be done throughout the supply chain.

References:

[1]Agarwal, A. and Shankar, R. "Modeling supply chain performance variables", Asian Academy ofManagementJournal10(2): 47-68, 2005.

[2] Scott, C. and Westbrook, R. "New Strategic Tools for Supply Chain Management", International Journal of Physical Distribution and Logistics 21(1): 23-33,1991.

[3] New, S. J. and Payne, P. "Research frameworks in logistics three models, seven dinners and a survey", International Journal of Physical Distribution and Logistics Management 25(10): 60-77, 1995.

[4] Houlihan, J. B. "International supply chain management", International Journal of PhysicalDistribution and Materials Management 17(2): 51-66, 1987.

[5]Houlihan, J. B. "International supply chains: a new approach. Management Decision",QuarterlyReview of Management Technology 26(3): 13-19. 1988.

[6] Sen, A. "The US fashion industry: A supply chain review", InternationalJournal of Production Economics 114: 571-593, 2008.

[7]Gunasekaran, A., C. Patel, and E. Tirtiroglu, "Performance Measures and Metrics in a Supply Chain Environment." International Journal of Operations & Production Management 21, no. 1/2, 2001

[8] Lam, J. K. C. and Postle, "Textile and apparel supply chain management in Hong Kong", International Journal of Clothing Science and Technology 18(4): 265-277,2008.

[9]Lee, Y. and Kincade, D. H. "US apparel manufacturers' company characteristic differences based on SCM activities", Journal of Fashion Marketing and Management7(1): 31-48, 2003.

[10] Nuruzzaman, M, Development of readymade garment business (RMG) in the process of lead time reduction- a study on Bangladeshi readymade garment sector, Master's Thesis, GBS, Gothenburg University, Sweden 2005.

[11] Peng Wong, W. & Yew Wong, K., "Supply chain performance measurement system using DEA modeling", Industrial Management & Data Systems, vol. 107 , no.3, pp. 361-381, 2007.

[12] Y.Narahari and Shantanu Biswas "performance measures and performance models for supply chain decision making", edited by Venkata NimeeshaPosa, Supply chain performance measurement and improvement; The Icfai University press; Hyderabad, first edition ISBN: 81-314-0583-4; pp 99-121, 2006.

[13] Felix T S Chan, H.J.Qi, H. K. Chan, Henry C. W. Lau, Ralph W.L. Lp, , "A conceptual model of performance measurement for supply chain", Management Decision 41/7 n pp 635-642,2003.

[6]Prabir, J, An investigation into Indian apparel and textile supply chain networks, PhD thesis, Nottingham Trent University, UK, 2007.

[14] Gunasekaran, A, Patel, C &McGaughey, RE, "A framework for supply chain performance measurement", International Journal of Production Economics, vol. 87, pp.333-347, 2004.

[15] Shamshuzzaman, M, Hossain, MD & Hassan, 'Performance evaluation of supply chain in a knitwear industry–a case study', B.Sc. thesis, Rajshahi University of Engineering and Technology, Rajshahi, Bangladesh, M 2010.

[16]Sudaryanto&Bahri, 'Performance evaluation of supply chain using SCOR model: the case study of Pt. Yuasa, Indonesia', Proceedings of the International Seminar on IndustrialEngineering and Management, Menara Peninsula, Jakarta, Indonesia, pp. c49-c55, R 2007.

[17] Davies, C., "Using the Supply Chain Council's SCOR Model."Supply Chain Europe 13(9):30-32, 2004.

[18]A. Gunasekaran; C. Patel; Ronald E. McGaughey, "A framework for supply chain performance measurement", International journal of production economics 87, pp 333- 347, 2004.

[19]Thomas, DJ & Griffin, 'Coordinated supply chain management', European Journal ofOperational Research, vol. 94, pp. 1-15 P M, 1996.

[20] A. Gunasekaran; C.Patel; E.Tirtiroglu"Performance measures and metrics in supply chain environment".

[21] Ahumada, O. & Villalobos, J.R. "Efficiency measures for inbound logistics performance", IIE Annual Conference. Proceedings, pp.1, 2004.

[22] Christopher, M, "The agile supply chain, competing in volatile markets" Industrial Marketing Management 29(1): 37-44, 2000.

[23] Dr. George L. Harris, 'Evaluating and Assessing Your Supply Chain'.

[6]Prabir, J, An investigation into Indian apparel and textile supply chain networks, PhD thesis, Nottingham Trent University, UK, 2007.

[25]Beamon, Benita M., "Performance Measures In Supply Chain Management",Proceedings of the Conference on Agile and Intelligent Manufacturing Systems,Troy, NY

[26] Smirch-Levi, David, Kaminski, Philip. And Smirch-Levi, "Desiging and managing supply chain", Edith 2000.

[27] Benita M. Beamon, "Supply Chain Design and Analysis: Models and Methods", International Journal of production Economics, Vol. 55 No. 3 , 281-294.

[28] Varma, S & Deshmukh, 'Evaluating petroleum supply chain performance: overcoming shortcomings of balanced scorecard', Global Journal of Flexible Systems Management, vol. 10, no.4, pp. 11-22, SG 2009.

[29] Beamon, BM, Victoria, CP & Chen, 'Performance analysis of conjoined supply chains', International Journal of Production Research, vol. 39, no. 14, pp. 3195-3218, 2001.

[30] Sharad Diwan, Prabir Jana, Prof. A.S. Narag and Dr. Alistair Knox December 2007.