

Review the Role of Total Quality Management in Supply Chain System

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Abstract— This paper reviews the application of the modern TQM principles in supply chain quality management. This system requires modern quality management thinking. To maintain the supply chain operation, TOTAL QUALITY MANAGEMENT (TQM) plays important role and is widely accepted. It has already started implementing TQM for achieving a high goal in this competitive world of market. Therefore, the implementation of TQM in supply chain system has become an exquisite premise for the survival of enterprise an attempt has been made to conceptualize the bridge between Supply Chain Management (SCM) and quality control. TQM is more focused on continuous quality improvement while SCM emphasizes on supplier relationship and management. Due to increasing competition in all industries, SCM has gradually been embraced as a proven managerial approach to achieving sustainable profits and growth. Thus, SCM has become a vital issue for manufacturers, professionals and researchers. It is not a measure but a tool to improve the total quality management in industries. In managing a complex supply chain, industries have developed close relationships with both direct and indirect suppliers. In this competitive environment in business it is quite difficult for the sustainability of any industry on the bases of cost cut-off and quality. This paper represents how Total Quality is achieved using SupplyChain Management principles in industries or business.

Key words: Supply Chain System, Total Quality Management

I. INTRODUCTION

Quality is one of the basic features which is required everywhere, from quality life to quality products and services. Quality management practices, mainly for manufacturability, whereby product and process decisions are developing in new products simultaneously, and effective product designs geared toward the final customer requirements result in less product and process variation. One of the main objectives of quality control is to locate and identify the process faults in order to control the defectives, scrap and waste and then to take necessary corrective measures to maintain the quality of product. Statistical tools are used to check the quality by quality professional. Moreover standardization can help to maximize compatibility, interoperability, safety, repeatability or quality [1]. Enterprises cannot respond rapidly to the customer's demand through traditional operation mechanism thus with the change of era SCM has been one of the kind of new operational mechanism. The industries which keep policy of quality assurance have quality control inspector at the time of dispatch also. In this way companies are upgraded with customer satisfaction offices and quality control departments at every stage of production. Each & every stage of manufacturing, from selecting the raw material to finished product, is defined by technically sound & experienced people. More quality goods are supplied, more customers get satisfied and thus customer prefers buying goods from the same company or dealer [2].

Supply chain management is an approach to integrating suppliers, manufacturers, distributors and retailers, such that products are produced and distributed at the right quantities, to the right location, at the right time, with the mutual goals of minimizing system wide costs and satisfying customer service requirements[3]. It is an integration and coordination of business process that manages the flow of material distribution from supplier to customer. Supply Chain system deals with analysis of information from different points on the Supply Chain to reduce operational cost. It is network of facilities and activities that perform the functions of product development and procurement of material from vendors, the movement of materials between facilities, the manufacturing of products and distribution of finished goods to customers [4].

II. LITERATURE REVIEW

“Supply chain quality management is a systems-based approach to performance improvement that integrates supply chain partners and leverages opportunities created by upstream and downstream linkages with a focus on creating value and achieving satisfaction of intermediate and final customers”[5]. “Quality means doing it right when no one is looking”. The quality of a product is the ‘degree of perfection’. The series standards of ISO9000 are implementing in many industries, such as manufacturing, service, health care, non profit organizations, educational institutions, even public bureaucracies. Technology push and market pull work in combination to create more dynamic and unstable conditions, thereby making the concept of manufacturing strategy ever more crucial for firms. Quality control is defined as an industrial management technique by means of which products of uniform acceptable quality are manufactured. It is concerned mainly with making things right rather than discovering and rejecting those made wrong.

The report of Indian Education Commission states [6], “The destiny of India is being shaped in classrooms. The most important and urgent reform needed in education is to transform it, to endeavour to relate it to the life, needs and aspirations of

the people, and thereby make it a powerful instrument of social change necessary for the realization of national goals". According to the American Society for Quality[3], the definition of quality is "A subjective term for which each person or sector has its own definition.

III. TOTAL QUALITY CONTROL

Quality control is a process for checking and maintaining the proper set of standards in the development of product and services. It is an inspection drive process and conducted throughout the process for quality assurance by taking corrective actions as when required. Quality control inspectors make sure that products meet standards of quality and safety. For example, they measure and weigh products, examine samples and test them. Quality control inspectors make sure that everything from raw materials to finished products meets quality and safety standards specified in the purchasing documentation. All production processes, whether large or small, requires elements of quality control and all inspection and testing is carried out to specified requirements that have been agreed between the purchaser and the supplier [2].

Quality control inspectors normally work in a laboratory, workshop or office. This data is important in helping suppliers to improve their performance and for making decisions regarding which suppliers can be relied on to meet specified requirements. The testing methods that quality control inspectors use vary, depending on the type of product they are working with. Automated systems are often used to very quickly test thousands of samples. Quality control inspectors keep records of all the tests they have carried out. They use charts and statistics to analyse their results. They may then write and present a report to show their findings. The inspector may be responsible for declaring that a product is not safe or is not of the specified quality. If there is a problem, quality control inspectors meet with production staff to work out the root cause of the problem and to decide whether current processes need to be changed. They might make recommendations for improvement [2].

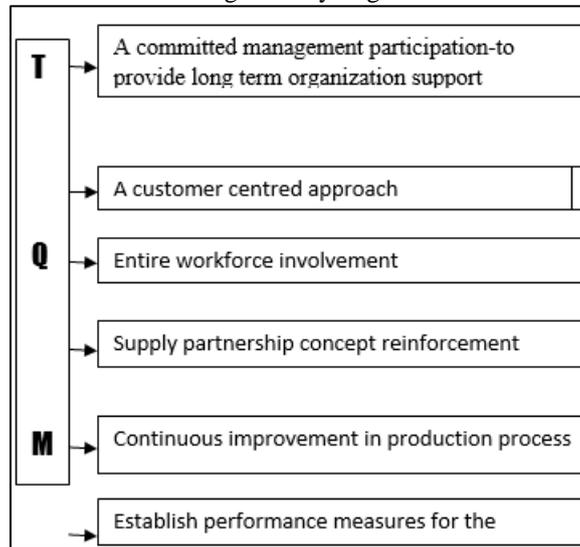


Fig. 1: TQM requirements [7]

A. Common Types Of Charts

- X-bar chart. In this chart, the sample means are plotted in order to control the mean value of a variable (e.g., size of piston rings, strength of materials, etc.).
- R chart. In this chart, the sample ranges are plotted in order to control the variability of a variable.
- S chart. In this chart, the sample standard deviations are plotted in order to control the variability of a variable [2].

IV. HISTORICAL PERSPECTIVE OF QUALITY CONTROL

The progress of industrialization, development of new techniques has led to the development of large industrial organization with multiplant and multilevel operations. Over the years, the focus and emphasis have shifted from productivity to productivity and quality. The quality revolution therefore assumes a tremendous importance in this highly competitive world. Quality Management has moved away from Inspection – oriented approach to prevention – oriented approach. Quality management covers aspects of technology, Statistical Process Control (SPC), quality assurance system as well as techniques for identification of problems and problem solving [8].

No.	Period	Q.C. Strategies
1.	Before Industrial Revolution	Craftsmanship The craftsmanship was responsible for Quality control. In doing so he was using his own judgement and experience.
2.	During Industrial Revolution	Supervisory Practices Quality control was experienced through checks and supervision of workers by

		following inspection techniques generally visual in nature.
3.	Dawn of the 20 th century	Inspection Techniques The emergence of mass production led to the development and sophistication in inspection techniques.
4.	After the World War	Statistical Quality Control(SCQ) Basic statistical principles were introduced like 'Sampling Tables' and 'Control Charts' to control the quality of products during the manufacturing stages. Statistical analysis was used as a feedback to bring appropriate changes in process and also for controlling the process.
5.	Modern Era	Quality as an Emergent Property The concepts like Total Quality Control(TQC), Quality Assurance, Company Wide Quality and Creativity(CWQC), and zero defect quality control are developed. Inspection approach is changed to prevention approach, by detecting problems before they occur and solving them.

Table 1:

V. TQM PRINCIPLES

A. Customer Focus

Organizations depend on customers and therefore understanding current and future customer needs, should meet customer requirements and strive to exceed customer expectations. However, more than half of the quality problems in supply chain are resulted by specifications because of the inadequate communications between the members of supply chain. Therefore, the core enterprise must pay attention to the needs and expectation of end users, and all the members of supply chain must pay attention to the needs and expectation of their backward users [8].

B. Leadership

Leaders establish unity of purpose and direction of the organization. They should create and maintain the internal environment in which people can become fully involved in achieving the organization's objectives. The core enterprise must act as leadership to consider adequately the needs and expectation of the other members, establish a clear, realizable and coincident holistic target, and then lead and inspire the other members to strive jointly for the target.

C. Involvement of People

People at all levels are essence of an organization and their full involvement enables their abilities to be used for the organization's benefit. Each employee should understand his/her role and responsibility in the supply chain system, solve the problems forwardly as master ship, and learn the principles, skills and technologies of TQM and ISO9000.

D. Process Approach

A desired result is achieved more efficiently when activities and related resources are managed as a process. It is the requirement of the quality management system of ISO9004:2000 and the essential difference of modern and traditional quality view. In each step of supply chain, there are many correlative processes, such as procurement, logistics, production, inventory, selling, service, etc. These processes have their own independent objectives and programs.

E. Management By System Approach

Identifying, understanding and managing interrelated processes as a system contributes to the organization's effectiveness' and efficiency in achieving its objectives. The coordinated effect and mutual promotion among the sub-systems will make the whole effect greater than the sum of the improvement of each sub-system and improve the validity and efficiency of the realization of final targets. In supply chain circumstance, enterprise should confirm the mutual dependence relationship among the processes in supply chain system, break the boundary among supply chain members, construct and integrate the processes in supply chain system. Understand the issues concerned with planning the supply chain. While developing supply chain they will have to analyse the critical factors for external and integration .The totality of SCM would be incomplete without the distribution and return management of goods.

F. Continual Improvement

Continual improvement of the organization's overall performance should be a permanent objective of the organization. Not only the core enterprise but also the other members, such as suppliers, sellers, and logistics providers, must improve their product and service respectively so as to construct the continual improvement of products and services all over the supply chain process. Self-assessments resulted in improvements in many areas of Burton-Apta's operations, including management commitment, strategy and planning, human resources, resources and processes, customer satisfaction, employee satisfaction and social impact.

G. Factual Approach To Decision Making

Effective decisions are based on the analysis of actual data and information. In supply chain circumstance, enterprise should collect data and information of not only itself but also the other members of supply chain to record and analyse the current operation situation of each member. Therefore, the potential problems in any step of supply chain can be found duly according to the results of data analysis.

H. Mutual Beneficial Supplier Relationships

An organization and its supplier are independent and a mutual relationship enhances the ability of create value. Currently, at least 50 percent of TQM organizations collaborate with their suppliers in some way to increase the quality of component parts. Often these organizations send out "quality action teams" to consult with their major suppliers. The objective is to help suppliers use TQM to analyse and improve their work processes [9].

VI. LOGISTICAL AND STATISTICAL REVIEW

India is the fourth largest country in terms of Purchasing Power Parity (PPP) and constitutes one of the fastest growing markets in the world. Statistical Quality Control is a technique where a set of statistical tools are used to check the quality by quality experts. Logistics and SCM may be defined as a set of activities undertaken to promote effective and efficient management of supply chains which include supplier partnership, physical movement of goods, meeting customer demands and information sharing throughout the supply chain. There are multi-billion companies which have shifted focus from courier and cargo to logistics and supply chain; from being freight forwarders to integrated shippers; and from customs clearances to consultants [10].

VII. OPTIMIZATION IN SUPPLY CHAIN

Supply Chain Management is a field of growing interest for both companies and researchers. It consists of the management of material, information, and financial flows in a logistics distribution network composed of parties like vendors, manufacturers, distributors, and customers. Operations Research (OR) techniques continue to have significant impact on traditional application areas such as transportation and logistics, production planning and scheduling, inventory control, facility location and layout. Within the field of distribution logistics a number of developments have occurred over the past years. We have seen a globalization of supply chains in which national boundaries are becoming less important. Fisher introduces the concepts functional and innovative to classify products. Functional products are the physical products without any added value in the form of, for instance, special packaging, fashionable design, service, etc. [11].

Bramel and Simchi-Levi [3] claim that, in logistics management practice, the tendency to use decision rules that were adequate in the past, or that seem to be intuitively good, is still often observed. However, it proved to be worthwhile using scientific approaches to certificate a good performance of the supply chain or to detect opportunities for improving it. Many times this leads to a more effective performance of the supply chain while maintaining or even improving the customer service level. The vast literature devoted to quantitative methods in Supply Chain Management also suggests the importance of Operations Research in this field. Bramel and Simchi-Levi have shown the power of probabilistic analysis when defining heuristic procedures for distribution models. Geunes and Chang give a survey of models in Operations Research emphasizing the design of the supply chain and the coordination of decisions.

VIII. CAUSES OF VARIATION IN QUALITY

Common causes are the usual, historical, quantifiable variation in a system, while "special causes" are unusual, not previously observed, non-quantifiable variation. The central idea that some variation is predictable, at least approximately in frequency. This common-cause variation is evident from the experience base. However, new, unanticipated, emergent or previously neglected phenomena result in variation outside the historical experience base. Shewhart and Deming argued that such special-cause variation is fundamentally unpredictable in frequency of occurrence or in severity [12]. Common cause, failure has a more specific meaning in engineering. It refers to events which are not statistically independent. That is, failures in multiple parts of a system caused by a single fault, particularly random failures due to environmental conditions or aging. An example is when all of the pumps for a fire sprinkler system are located in one room. If the room becomes too hot for the pumps to operate, they will all fail at essentially the same time, from one cause (the heat in the room). The principle of redundancy states that, when events of failure of a component are statistically independent, the probabilities of their joint occurrence multiply. Thus, for instance, if the probability of failure of a component of a system is one in one thousand per year, the probability of

the joint failure of two of them is one in one million per year, provided that the two events are statistically independent. This principle favours the strategy of the redundancy of components [8, 13].

IX. TECHNIQUES FOR CONTROLLING

Statistical process control (SPC) is a method of quality control which uses statistical methods. SPC is applied in order to monitor and control a process. Monitoring and controlling the process ensures that it operates at its full potential. At its full potential, the process can make as much conforming product as possible with a minimum (if not an elimination) of waste (rework or scrap). SPC can be applied to any process where the "conforming product" (product meeting specifications) output can be measured. Key tools used in SPC include control charts; a focus on continuous improvement; and the design of experiments [8].

If the dominant assignable source of variation is detected, potentially they can be identified and removed. Once removed, the process is said to be "stable". When a process is stable, its variation should remain within a known set of limits. That is, at least, until another assignable source of variation occurs. Control is used by operating forces to meet the product, process and service requirements. It uses feedback loop and consist of the following steps:

- Determine items to be controlled and their units of measure.
- Set goals for the controls and determine what sensors need to be put in place to measure the product, process or service.
- Measure actual performance.
- Act on the difference.

Statistical Process Control (SPC) is the primary technique for achieving control. The basic tools are Pareto diagrams, flow diagrams, cause- effect analysis, check sheets, histograms, control charts and scatter diagrams [8].

X. REVIEW ON PRESENT SCENERIO IN DIFFERENT SECTORS: CASE STUDY REVIEW

The sugar industry faces co-ordination problems, especially when large number of cane suppliers are involved Sugar industries are the units, which are established on the principle of supplier partnership. Especially in co-operative sugar industries the shareholders are from the small landholdings. More than 60% amount is spending for the payment of cane suppliers. Customer and supplier have the same goal to satisfy the end user. The better the supplier's quality, the better the supplier's long term positron because the customer is satisfied with better quality. As customer and supplier have limited resources, they must work together as partners to maximize their return on investment [7].

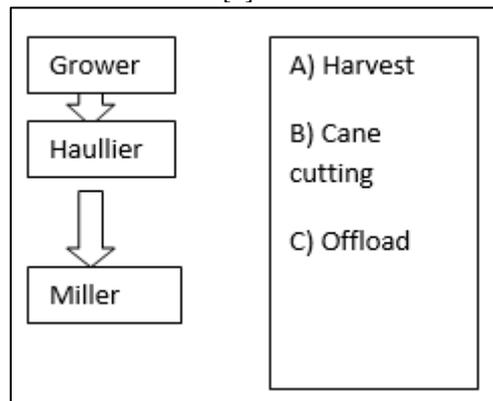


Fig. 2A: typical flow of material in a sugarcane supply chain [7]

According to automobile sector, ability to deliver vehicles of superlative quality and in the desired time frame depends heavily on the quality and robustness of their supply chain. Hence, supply chain management is a key component of their functioning and is an area they pay close attention to. All their suppliers are mandated to adopt ISO 9001/TS 16949 quality management systems, and they encourage them to implement ISO 14001 and OHSAS 18001 standards as well. In order to minimize turn-around time, reduce logistics cost, save fuel and reduce packaging. Their ultimate aim is to ensure that our supply chain contributes to our overall sustainability vision and strategy.

In managing a complex supply chain, we have developed close relationships with both direct and indirect suppliers. They continue to develop long-term strategic relationships with suppliers to support the development of parts, technology and production facilities. In order to improve the performance of our suppliers, we use a Vendor Management System across all locations. This system includes processes for enlisting new vendors, developing new products, early vendor integration, material scheduling, procurement and logistics, monitoring and improving vendor performance, make versus buy decision making and integrated cost reduction strategies.

According to iron and steel sector, purchase of goods and services accounting for approximately 50% of Steel's expenditure, hence a concerted attempt is being made to transform this value addition for our customers. Flexibility and rapid response is achieved through multi-skilling, cluster manning, BPR on supply chain management, flatter organizational structure and innovative reward and compensation schemes.[14]The efforts are also made by Supply Chain Division towards expeditious clearance of their bills. The Supply Chain Division of Tata Steel deals with all inbound and outbound supplies of goods and services. The service providers include both indigenous and foreign sources including government/semi government agencies.

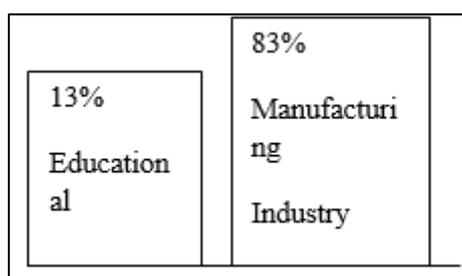


Fig. 3: A Comparative

Analysis of SCM in Different Aspects [12]

XI. POSITIVE RELATIONSHIP BETWEEN QUALITY MANAGEMENT AND SUPPLY CHAIN MANAGEMENT

Quality can be defined as meeting or exceeding customer expectations. According to the American Society for Quality, the definition of quality is "A subjective term for which each person or sector has its own definition. In technical usage, quality can have two meanings: 1. The characteristics of a product or service that bear on its ability to satisfy stated or implied needs; 2. A product or service free of deficiencies. According to Joseph Juran [14], quality means "fitness for use;" according to Philip Crosby [15], it means "conformance to requirements". The literature classification is done according to content and process issues of the article. Total of 153 articles from 55 refereed journals and international conferences are classified according to content (instrument, model, literature review, trans-national comparison, best practices, and economics) and process related issues of the articles.

Total quality management is a set of quality practices that seek to continuously improve quality in processes. The eight key principles of total quality:

- 1) Define quality in terms of customers and their requirements.
- 2) Pursue quality at the source.
- 3) Stress objective rather than subjective analysis.
- 4) Emphasize prevention rather than detection of defects.
- 5) Focus on process rather than output.
- 6) Strive for zero defects.
- 7) Establish continuous improvement as a way of life.
- 8) Make quality everyone's responsibility.

Efficient consumer response (ECR) is a supply chain management strategy that attempts to address the inefficiencies in the supply chain. Hoffman and Mehra (2000); Harries et al. (1999); Sparks and Wagner (2003) discussed efficient consumer response (ECR) as a supply chain strategy by analyzing the adoption of ECR strategy in some industries [11].

SCM is management of material, money, men, and information within and across the supply chain to maximize customer satisfaction and to get an edge over competitors. Customers want products at the right place and at the right time. Whereas Supply chain management is an approach to integrating suppliers, manufacturers, distributors and retailers, such that products are produced and distributed at the right quantities, to the right location, at the right time, with the mutual goals of minimizing system wide costs and satisfying customer service requirements. Since the quality movement began, improvements in one area enhance results in the other as quality management and supply chain management are clearly interdependent. It is a key focus area in the current scenario of global competitive market. In this market the company or organization having the quality in supply chain will only survive. It has been observed that quality in supply chain has not been focused in the literature related to supply chain management. In this paper almost half of the structure is discussed on supply chain operation related to total quality management. Thus supply chain quality management will promote the improvement of operation efficiency and competition ability of the whole supply chain system.

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