

## **TOTAL QUALITY MANAGEMENT IN AN AUTOMOTIVE SUPPLY CHAIN IN THE UNITED STATES**

**by**

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### **ABSTRACT**

In order to compete in the world markets, American businesses are striving to improve their competitive edge, and one aspect of which is quality. Quality is not only an order winning criteria but also is an order qualifier for many companies, and total quality management (TQM) has been widely accepted as the ways and means for maintaining supply chain quality. Multitudes of businesses in manufacturing industry have already implemented or started implementing TQM for achieving a competitive edge in the world market place. From part-suppliers to retailers or dealerships, businesses are accepting TQM approach for achieving quality excellence through out the supply chain management. This paper attempts to describe how a TQM approach can be implemented for achieving supply chain quality management in manufacturing industry and uses the automotive industry in the United States as an example.

### **INTRODUCTION**

A supply chain includes a firm's internal functions which include all transformation processes, its upstream suppliers, and its downstream distribution channels reaching the end customers which includes distributors and retailers (14). In case of an automotive company, it includes the tier II suppliers of raw materials and parts, the tier-1 suppliers, the sub-assemblers, and the original equipment manufacturers (OEMS,) or the assemblers of automobiles, the wholesalers or distributors and the retailers or dealers of automobiles. The supply chain management involves a collaborative strategy linking cross-enterprise business operations for achieving a shared vision of the market opportunity (8). This shared vision in automotive industry has been the improving the competitive edges, through cost cutting and continuous improvement of quality( 15). The supply chain quality management encompasses all quality management activities associated with the flow and transformation of goods from raw material stage through the end users(finished product) stage along with flow of all information related to quality(8) . Materials as well as information flow both up and down the supply chain. The operating environment of a supply chain includes customers

demand and expectations related to product quality and delivery schedule (8). Product quality in a supply chain can be insured through total quality management while delivery schedule can be assured using demand forecasting, demand management, production planning and master scheduling(14).

## **TOTAL QUALITY MANAGEMENT (TQM) IN A SUPPLY CHAIN**

As advocated by A. V. Fiegenbaum in the U.S. and Kauro Ishikawa in Japan, Total Quality Management (TQM) involves management and control of quality throughout the entire organization or the entire supply chain (7), TQM emphasizes (1) top management commitment, (2) focus on customer satisfaction, (3) product design and manufacturing for quality, (4)continuous improvement, (5) extensive education and training of employees, (6) employees involvement and empowerment , (7) development and maintenance of an effective in house quality assurance system, as well as an effective suppliers quality management system(7).

### **Top management commitment and TQM**

Top management commitment is essential for TQM. Top management must commit to quality by clearly stating quality objectives in mission statements and commit sufficient amount of resources for successfully accomplishing quality objectives. Top management commitment should be collaborative throughout the entire supply chain for achieving competitiveness in world market place using a common vision of quality excellence which starts with focus on total customers satisfaction.

### **Total Customers satisfaction and TQM**

In a TQM approach most important goal is customers' satisfaction. Only satisfied customers come back and bring more business. Therefore, companies must design their products to satisfy their customers, Products should not only meet the needs but exceed the expectations of the customers, to make customers happy(7). A company must know its customers and their expectations about its products. This information must be regularly collected by marketing department through customer surveys.

### **Customer Survey**

Many companies in the United States regularly collect customer expectation data for designing a new product and for continuously upgrading existing products. Customers' expectation

data related to product's quality gathered by customer survey are generally passed to the product design department .

### **Product design and manufacturing and TQM**

Product design translates the customer expectation data into technical specifications of the product design not only to meet the needs but also to exceed the expectations of the customers. Innuchi Taguchi recommended a number of methods such as (1) design of experiments, a statistical technique for analyzing customer expectation data, and prioritizing expectations for building them into the quality of product design, (2) failure mode analysis, for building reliability in the products operating life and (3) robust design techniques for designing the product to withstand any changes in its operating environment. It is the product designer who set the quality of the product at the first place. Therefore, product designers must be qualified and well trained in Taguchi's methods of product design for quality. Then, the product's drawings with specifications, dimensions and tolerances developed by product designers must be verified and validated by appropriate authority, and properly recorded and passed down to process engineering. Similarly,

### **Process engineering and TQM**

Process engineering prepares processing instructions for manufacturing of the product conforming to product design specifications and tolerances. Sometimes, product design and process engineering work simultaneously to speed up the process of designing the product and developing the processing instructions and tooling requirements for manufacturing. This practice is commonly known as simultaneous engineering, and has been successfully applied by Cadillac Motor Company which won the Malcom Baldrige Award in 1990. Processing instructions are passed down to the shop floor where the product is manufactured and quality control verify and insures conformance using inspection and process control.

### **Quality Control and TQM**

Quality control includes inspection and process control. Inspection involves decisions regarding accepting or rejecting a lot qualities of product using test data. Two types of testing are run for collecting test data: (1) destructive testing which destroy the item, and (2) non destructive which does not destroy the item. For zero defect quality, 100% inspection which involves checking every item of the lot must be used, otherwise sampling inspection which inspect a sample from the

lot to determine the fate of the lot may be economical and acceptable. While destructive testing is used then 100% inspection cannot be used and may resort to sampling inspection. Inspection is carried out in three stages: (1) outgoing inspection, (2) work-in-progress inspection, and (3) receiving inspection.

### **Outgoing inspection in TQM**

For total customer satisfaction zero defect quality must be assured by outgoing inspection before any product is packaged and shipped to customer. Therefore, at the outgoing department 100% inspection is generally carried out. Each and every finished product is run through all possible test procedures and thoroughly inspected before it is packaged and shipped to customers. In the United States, auto sub-assemblers and auto assemblers generally run 100% inspection before packaging and shipping their finished products (5).

### **Work-in-progress inspection in TQM**

Work-in-progress inspection involves the inspection of parts at various stages of their production. Inspection of works in progress may involve 100% inspection, sampling inspection and process control (11). In order to insure zero defect quality, 100% inspection must be carried out. 100% inspection can be carried out by the operator or an inspector or by a robot at the workstation. Sometimes, a "Pokay Okay" or a mistake proof system may be installed on-line to prevent making bad product at the first attempt (20). Where zero defect quality is not required, sampling inspection may proved to be economical. However, the most effective and economical way to control quality for work in progress is Statistical Process Control ( SPC) in which the process is continuously monitored against the upper and lower control limits of a SPC chart predetermined for the process under control using statistical techniques (11).

### **Receiving inspection in TQM**

All incoming raw materials, parts and subassemblies must be inspected at the receiving inspection to insure zero defect quality or the quality requirements specified in the purchase agreement. If sampling inspection may be economical, it does not guarantee zero defect quality, and if sampling inspection is used, the sampling plan must be agreed upon by both the buyer and the supplier, as it involves risk for both parties (11). For minimizing cost of receiving inspection,

and insure high quality of incoming materials, customers prefer to choose high quality raw materials and parts suppliers using extensive quality audit of their potential suppliers' plants.

### **Suppliers' quality audit and TQM**

Supplier's quality audits are commonly performed by customer's quality auditors and is known as second party audit. Quality audits are performed against quality standards or requirements pre-established by the customer. Thus, multitudes of standards had been developed by large customers in various types of industries. However, once the businesses crossed countries boundaries and became international harmonization and internationalization of all standards was needed and ISO9000 series of quality standards was developed in early 1990s for suppliers quality audit. American automakers such as General Motors corporation, Ford Motor company and Chrysler Corporation have individually developed their own standards and applied them for their suppliers' audits in the past decades, and by mid 1990s U.S. auto makers and truck manufacturers together developed QS-9000 series of quality systems requirements for their suppliers' quality audit (5).

### **ISO-9000 and QS-9000**

ISO-9000 and QS-9000 standards are designed for audit of the quality system based upon the hypothesis that if a supplier has a good quality system in place, the supplier can be trusted for supply of good quality parts/products. ISO-9000 has twenty elements of requirements for examining the presence of an effective quality assurance system using TQM approach.. QS-9000 also uses these same twenty elements of ISO-9000 as core requirements along with the auto industry's specific requirements, and individual customer's specific requirements (5).

### **Third Party registration and TQM**

With the internationalization of businesses, and development of ISO-9000 and QS-9000 standards, a number of independent companies called "registrars" were formed all over the world for performing independent or third party quality audit of a company using ISO-9000 or QS-9000 standards. These registrars use third party or independent and certified quality auditors for performing quality audits. This type of quality audit is known as third party audit. After a third party audit if a supplier meets the compliance to the ISO-9000 standards, the supplier is issued a

certificate of compliance, and the supplier's name is placed in the register of ISO-9000 certified companies (19). Customers now prefer to do business with ISO-9000 certified companies to other suppliers, and they are gradually phasing out second party auditing. Similarly, U.S. automakers are currently demanding QS-9000 certification of their tier one suppliers prior to issuing any contract (5).

## CONCLUSION

Thus, starting from product design to supplier certification, the total quality management (TQM) approach can be effectively implemented in a supply chain for achieving quality excellence and competitiveness in a world market place. In the U.S. the big three automakers GM, Ford, and Chrysler, and many other companies like IBM corporation, Motorola Inc, have successfully implemented the TQM approach for gaining a competitive edge in the world marketplace.

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