A study on impact of Quality initiatives on select indicators of performance in respect of selected SME manufacturing industrial units with special reference to automotive sector during the period of 2011 to 2014 in Pune district.

Research thesis submitted to

TILAK MAHARASHTRA VIDYAPEETH, PUNE

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Submitted By

S.M. Deshpande

Under the guidance of

Dr. Shyamkant Shrigiriwar

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CERTIFICATE

This is to certify that the thesis entitled "**A study on impact of Quality initiatives on select indicators of performance in respect of selected SME manufacturing industrial units with special reference to automotive sector during the period of 2011 to 2014 in Pune district."** which is being submitted herewith for the award of the Degree of Vidyavachaspati (PhD) in Management of Tilak Maharashtra Vidyapeeth, Pune is the result of original research work completed by Shri Sudhir Madhavrao Deshpande under my supervision and guidance.

To the best of my knowledge and belief the work incorporated in this thesis has not formed the basis for the award of any degree or similar title of this or any other University or examining body upon him.

Research Guide

Place: Pune

Date:

(Dr. Shyamkant Shrigiriwar)

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I started this research work to have a detailed view of quality initiatives and the performance of the automotive SME suppliers in Pune. It was indeed a task of collecting and analyzing data from busy senior management team members of the SME organizations.

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ABSTRACT OF THESIS

The SME manufacturing sector is very important in India as it is considered to be the driving engine of the manufacturing activities in India. Also this sector generates large scale employment opportunities. The automotive sector SME is of particular interest to this research.

The globalization of manufacturing industries is opportunity as well as challenge. It depends upon the individual SME management to take decisions and actions to cope with it and satisfy their customer.

The quality of supplied products is most important to the car OEM companies. This research is attempting to find whether there is any relationship between the quality initiatives and the select indicators of the performance of auto SME.

Data was collected from 40 automotive SME suppliers in Pune from different locations with the help of questionnaire.

The data was analyzed using statistical techniques.

The data analysis has shown different aspects of the SME suppliers about the quality initiatives related to customer satisfaction, cost reduction etc. and the select indicators of performance like employee growth, new business starting etc.

The recommendations are made on how the auto SME organizations can have a quality system as per the requirement of the customer for better results in their business. A model has also been suggested which can be used by them to understand how the business performance can be achieved by taking into consideration the customer requirements and translate it into a robust quality system.

In fact, the competitiveness of the organization depends on it.

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CHAPTER-1

INTRODUCTION

During the last few decades, India is evolving as an industrialized country. Many efforts have been taken by governments, central as well as state and nongovernmental organizations to boost industries across India in general and in Maharashtra in particular. Due to growth in industrial activity the contribution of manufacturing sector in country's GDP is 15 %. The contribution of manufacturing sector is $189 billion in total GDP of India which stands at $ 1 Trillion. Today India stands at 9th position in the world's top ten industrialized countries. The National Manufacturing Policy is now trying to take various steps to boost industrial growth so that the contribution of manufacturing is 25 % of GDP by 2022.

It is estimated by eminent people and surveys that the future growth in Manufacturing in India will be in SME sector like Japan and Germany where SME sector plays a dominant role in their GDP.

The report prepared by Boston Consulting Group (BCG) and CII clearly indicates that there has to be manufacturing industrial growth more than 14% compounded annual growth rate (CAGR) in next one decade for this increase in GDP by 2022. This applies to SME sector in automotive and engineering as well.

Thus SME sector in general in India and SME manufacturing organizations in Pune district in particular are getting a big boost in terms of growth for next decade due to this latest initiative taken up by the central government.

In the industrialized countries like Germany the contribution of the SME sector in the GDP of the country is significant as also the employment generation is higher. The similar role can be played by the Indian SME sector and become a dominant sector contributing to GDP and employment generation.

The automotive SME sector is one of the fastest growing sectors in Indian scenario and in particular in Pune. There is a demand on the products made by automotive SME sector due to robust growth of automotive car manufacturing companies in Pune. Even many companies like

Maruti Suzuki motors from Delhi also procures their auto components from Pune region due to large number of automotive ancillary SME organizations in Pune.

1.1 PUNE DISTRICT INDUSTRIAL AND EDUCATIONAL SCENE

The industrial growth in general and the SME sector growth in particular in Pune district has a history of about 60 years and SME (Small and Medium Enterprises) organizations have been supplying various engineering manufactured goods to various engineering and automobile companies in Pune as well as outside of Pune ever since 1960. The initial automobile sector companies in India were limited to few companies like TELCO (Now it is renamed Tata Motors Ltd.), Leyland, Force motors, Fiat India etc. which were few in numbers. Two wheeler manufacturer giant Bajaj Auto Ltd. is also a big player in Pune district. Automotive OEM companies from other regions also procure their components from Pune industrial zone.

Pune has a big advantage of availability of highly educated and trained manpower. In fact Pune is also considered as the education hub of Maharashtra where all kinds of technical institutes are there to train the essential manpower for the high level of demands of industries. The industry requires institutes like ITI, engineering diploma and graduate level educating institutes to train the operators and engineering institutes for training the engineers. Due to growth of industries in general and automotive industry in particular the tremendous growth of industries in Pune over last 50 years has caused Pune to emerge as one of the highly industrialized city of India. The institutes which cater to needs of the industry like technical and management education has also been met with the growing number of engineering and management institutes in Pune.

Thus the Pune industrial zone is self sufficient as far as the availability of trained work men, engineering and management staff is concerned. Also due to the presence of the industry in Pune region for the last 50 years there are highly industry trained and experienced employees readily available. Also the various support industries needed for the running of the manufacturing industries are also set up here over the last many decades like steel supplying industries.

1.1.1 ROLE OF MIDC IN INDUSTRIAL DEVELOPMENT OF PUNE

The Maharashtra Industrial Development Corporation (MIDC) has played a significant role in creating excellent infrastructure and transport facilities for the industries. Such network of different MIDC organizations has been created by government in many other cities in Maharashtra which contributing to industrial development in those respective cities. The excellent facilities developed by MIDC have attracted big and small industrial units in MIDC of Pune district particularly Pimpri and Chinchwad industrial area.

Also due to the policies of the government the MIDC land is being made available to big industries like the OEM car manufacturing companies to set up their manufacturing companies in and around Pune. Such industries like Ford motors in Pune produce millions of car every year and hence require huge number of components for the assembly line. These components are either made in house or imported from other countries whenever cannot be made in India or procured from ancillary units.

1.1.2 HOW PUNE DEVELOPED AS DETROIT OF INDIA

Detroit city in USA was having large base of automotive industries of big car manufacturers like Ford motors and General motors. Due to manufacturing costs rising in the advanced countries like USA and UK nearly all the big car manufacturing original equipment manufacturers (OEM) organizations have set up their manufacturing companies in and around Pune where they have availability of highly trained manpower at reasonable cost compared to the advanced country norms, good roads, other essential infrastructure and availability of land due to government

policies. To support the efforts taken by the various organizations and the government to boost the automotive industry and the SME organizations to supply the necessary components to the OEM organizations the government and other organizations like MCCIA have collaborated to form **Auto Clusters** in Pune who can train the SME organizations in and around Pune in areas where they do not have facilities to train their manpower. Such efforts boost the capabilities of auto SME organizations to become more competitive. These auto clusters try to conduct various training programmes for the SME employees like SPC (statistical process controls), CNC programming etc. As the car manufacturers tend to source their components from the local industry to keep the costs low the Pune based automotive suppliers which were supplying to local companies like Tata motors, Force motors and Bajaj auto also started supplying to these multinational car manufacturer companies.

All these efforts have resulted in Pune becoming a similar city as Detroit so far as automotive manufacturing companies are concerned. Hence Pune is called as Detroit of India.

1.2 THE SME INDUSTRIES IN PUNE DISTRICT

The Reserve Bank of India has made the definition of SME (Small and Medium Enterprises) organizations which is applicable to all categories of small and medium sector companies.

. As per the circular of RBI the SME category is defined as –

1] A **small enterprise** is an enterprise where the investment in plant and machinery is **more than Rs. 25 lakh but does not exceed Rs. 5 crore;** and
2] A **medium enterprise** is an enterprise where the investment in plant and machinery is **more than Rs.5 crore but does not exceed Rs.10 crore.**

There are different types of SME organizations in Pune. The SME organizations in Pune could be written as

1. Automotive ancillaries
2. Engineering ancillaries

3. Maintenance related.
4. Packaging
5. Chemical
6. Fabrication and casting manufacturing
7. Agro product
8. Plastic processing and molding industries

In this research the detailed study of automotive SME organizations in Pune district will be studied for their select quality initiatives and select indicators of performance.

1.2.1 RELOCATION OF BIG CAR MANUFACTURING COMPANIES IN PUNE OPPORTUNITIES TO AUTO SME

Many manufacturing companies in industrialized countries like USA, UK and Germany are being shut down or relocated in countries of lower cost of manufacturing and less stringent environmental norms because of higher cost of operations in those countries. The automotive business in Detroit started declining way back in 1950 due to union and higher operating cost problems.Also the environmental norms are very stringent in those countries which make the manufacturing organizations operations unviable. That is why the manufacturing base of the developed countries is being shifted to countries like China and India in general and Pune in particular. Now Pune is proud to have big factories of big international players like BMW, Fiat motors, General motors, Volks Wagon, JCB, Ford India Ltd. etc.

The entry of such world class automotive OEM companies in Pune has created a lot of opportunities to the local auto SME sector. This has obviously thrown a challenge to these SME automotive SME organizations whether they are really capable of understanding the Quality, cost and delivery requirements of these OEM companies. These Pune based automotive SME organizations have to compete not only with local competitors but they also have to compete with the suppliers all over the world who can supply the components with lower costs and higher reliability.

The automotive industry in the advance countries have really has advanced in technology, manufacturing methods, quality management etc. due to lot of competition in the car market. The primary concern of these car makers is the quality of the components supplied by their suppliers. As always the quality expectations of the OEM automotive companies from their suppliers is really stringent and based on the experience of the researcher the SME organization supplying components to them must have following quality and manufacturing requirements-

- Organization must have TS 16949 certification.
- It must have latest set up and techniques of manufacturing like CNC machines.
- Availability of latest equipments in quality control like CMM machines (Coordinate measuring machine).
- Highly trained and qualified staff for the quality management functions.

All such things make it difficult for the SME organization even to understand the real quality requirements of OEM Company. These requirements are valid for the Tier I, Tier II and Tier III SME organizations.

Some organizations that understand it and have the resources to invest go in for it and set up plants like this.

A published report by ACMA is reproduced here just to understand the present status of automotive industry in general and the projected turnover up to 2021. It clearly shows that the trend is raising turnover over the given period. Also the graph shows that the assembly wise distribution of components.

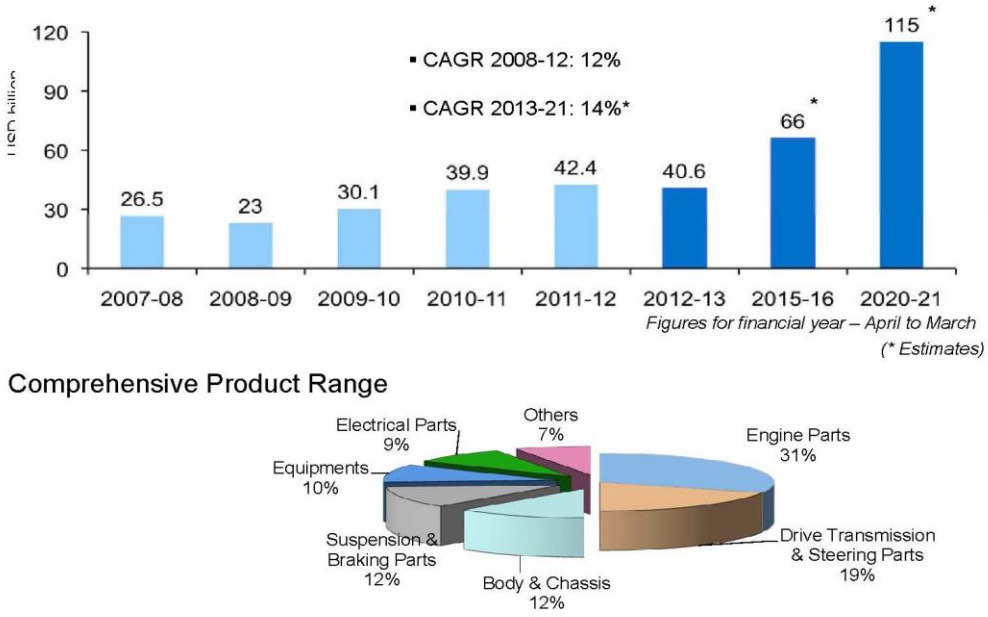

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FIG 1-THE AUTOMOTIVE COMPONENTS INDUSTRY PROFILE AND THE PRODUCT RANGE BY ACMA

1.2.2 EMERGENCE OF QUALITY STANDARDIZATION IN AUTO SECTOR

Initially the quality standards expected from the auto components manufacturer SME companies was not very stringent nor was the competition as fierce as it is today. Hence the SME companies struggled with their manufacturing methods and quality control systems. Hence a need was felt worldwide for a standard related to quality and the ISO 9000/1987 series of standard came into existence in 1987as a generic standard which was based on the British military standard applicable to all organizations which were conscious about the quality of their product or their services. Also the ISO 9001 standard came later on for the manufacturers to follow and have standardization in quality initiatives. Later on the big companies like Ford, Chrysler and General Motors found that the ISO 9001 is highly inadequate to take care of the requirements of the highly advanced automobile sector.

Hence a new standard named QS 9000 which was entirely meant for the automotive sector was promoted by these companies. This standard QS 9000 was then converted to TS 16949 standard in the year 2000 which is the latest manufacturing standard meant for the auto components supplier companies. The new automotive standard TS16949 takes into account the customer requirements of big three car companies (DaimlerChrysler, Ford and General Motors) and the Truck manufacturer's associations in addition to the ISO 9001 as a base standard.

The modern automotive SME organizations are required to have a set up containing one or more of such technologies like following ones.

1] CAD/CAM/CAE.

2] CIM (computer integrated manufacturing)

3] A decent conventional manufacturing set up for Tier II and Tier III organizations.

Such technologies make the SME auto companies more agile in the sense that they can respond to customer needs rapidly, flexibly and in customized way. Such SME companies can produce a wide range of products and options with short notice due to inherent flexibility of the CNC machines.

There are not many studies conducted on SME sector in Pune region about their performance.

1.3 QUALITY INITIATIVES AND PERFORMANCE OF ORGANIZATIONS

The industrialization speed of India and in particular Maharashtra accelerated after the 1991 globalization drive. Many world class automobile companies like General motors, Skoda, Chrysler, Nissan and Toyota have either set new plants or expanded their businesses in addition to many large scale companies in Pune like Bajaj Auto, Tata Motors Ltd., Force Motors Ltd. etc. Company like Force Motors Ltd. from Pune has joined hands with multinational company BMW to manufacture car engines and set up a plant in Chennai. Also many car manufacturers have established their operations in India some of them being Nissan, Skoda India, Honda and Hyundai etc. All of these car OEM companies have their components vendors in Pune thus making Pune a global supplier of components. The business imperatives for such global giants are being competitive in the global market by reducing cost of manufacturing and produce world class quality products. Such world class status can only be achieved by consistent efforts to reduce their costs, improve the customer satisfaction and product differentiation through higher performance. Due to this the auto companies, wherever they are located, they source their manufactured components and subassemblies from auto hub like Pune. The fundamental competitive factors for all the auto giants are *Quality, Cost (Price) and Delivery* and all of these competitive factors are affected by the performance of their suppliers performance.

The typical automotive components that are manufactured by the SME organizations in Pune district can be grouped in broad categories as under.

1. Engine parts- Components that are assembled in the engine like crank shaft will be grouped in this category.
2. Drive transmission and steering gears- The components typically like different gears are grouped in these.
3. Electrical assemblies and electrical parts- The different wire harnesses and other electrical components fall under this category.
4. Suspension and braking parts- The suspensions assemblies and various braking assembly components fall under this category.

5. The body sheet metal parts- The different sheet metal components of the car fall under this category.
6. Various plastic/polymer parts- The components like dash board etc. fall under this category.
7. Heavy Forged and machined parts- Such components like knuckles etc. which require heavy forging and machining operations fall under this category.

The subcontracting is seen by the OEM organizations as a method of achieving efficiency and competitiveness in the ever competitive market by reducing their cost and increasing efficiency. The automobile market is user/customer dominated one in which the car manufacturing organizations which are fiercely competing against each other over the "price" factor have to keep their prices under tight control. Hence subcontracting is seen as a way of achieving higher efficiency thus reducing their costs.

Many of these automobile companies source their components and subassemblies from various tier 1 companies like Bharat Forge Ltd. and tier 1 companies source their semi finished components from Tier 2 SME companies in and around Pune. As the expectations of customers from these companies is increasing and the manufacturing is becoming complex, these companies have responded by using the most modern methods of manufacturing and of Quality management approaches by developing standardized approaches to quality, use of sophisticated quality management systems like ISO 9001 and TS 16949, and various tools and techniques of quality management to become the quality leaders in their respective domains.

As the quality of such world class OEM company's products depends upon the quality of the outsourced components and subassemblies, the SME companies which are the vendors of such big companies have to be very quality conscious.

What causes the specific SME to outperform other competitors is definitely a matter of research as this gives the organizations a path to undertake so that they can compete in the ever competitive market at the same time give the customers better and better products.

This research will attempt to find the relationship between the various quality practices in the auto component manufacturing SME organizations in Pune district and the select indicators of performance of the SME organizations.

Hence this research will attempt to find out the various Quality specific initiatives implemented in the organization and various practices in quality management in SME sector manufacturing companies in auto industries which enables them to outperform their competition and be the preferred supplier of the components or subassemblies to the OEM companies thus indicate a business growth. To produce components of consistent quality and with lower cost of poor quality, various world class quality initiatives need to be implemented with commitment of owner or Head of Organization towards quality.

The slow emergence of country like India on the industrialized countries map has resulted in use of latest techniques of manufacturing and designing in India which is a must for the mass production of components for the auto sector for consistent quality.

The automotive sector OEM companies are very sensitive to quality and cost and hence the auto ancillary units need to be having the manufacturing capability tuned to this requirement. There are many techniques of manufacturing which are being deployed all over the world to achieve world class quality and lower cost and the expertise of these techniques are many times shared by the OEM organizations with their suppliers, examples being the Toyota way of manufacturing.

The following latest techniques are being used in the designing of the quality system and manufacturing sectors in auto sector SME companies extensively and this is preferred by the OEM companies.

1.3.1 SELECT QUALITY INITIATIVE CONCEPTS DESCRIBED

The various manufacturing quality related initiatives and practices could include following-

1. The view of the organization owner/quality head/plant head about the quality initiative and how important they find the written quality system in the organization is very important in the way the quality practices will be handled by the concerned staff of the quality cell. It is intended here to find the way the quality is practiced in the organization. What the OEM car manufacturing organizations want is their auto component suppliers to be TS 16949 certified or at least ISO 9001 certified to be their supplier. The organization may not have a third party certification in the quality like ISO 9001-2008 or TS 16949-2009 but may have robust quality practice which may give them edge over the competitors. The researcher will attempt to find the understanding of the organization about the very important aspects of the quality like cost of quality, customer satisfaction through proper handling of the customer related grievance and various best practices like having written down quality management system(QMS) with documented departmental system, documented QA manual.

   Quality management system (QMS) - It is a written down document of the intent of the organization and its approach towards the very important aspect of manufacturing i.e. Quality. This standard does not want to have uniformity of QMS across the different automotive organizations but the intent is to include all the requirements of the TS16949 standard in the QMS. The QMS document will vary from organization to organization depending upon the size of the organization, product manufactured, customer requirement and any particular needs of the organization. The same TS16949 standard can be used to build a robust quality system of an automotive SME organization of few employees to a bigger organization.

   Documented QA manual- This manual needs to be treated as utmost important guiding document of the QMS of the standard. It contains all the requirements of the quality assurance function in the organization. It fundamentally addresses the requirements such as quality management requirements of the organization and under the manual of Measurement system analysis (MSA) which is a mandatory requirement in TS16949. The MSA manual which is separate manual as published by the AIAG which is the apex body of the TS16949 committee deals with the measurement of the entire quality assurance system and whether this QA system is adequately addressing the internal requirements of the organization as well as the customer specific requirements. The QA function gives a

framework of how the internal working of the quality control related activities should be conducted and how those activities need to measured so that they continue to be effective to control various processes as intended.

2. The deployment of Quality function in the organization is also a very important aspect of robust quality system. Percolation of quality initiatives in the entire organization and in various other departments like HR, purchase, production etc. is very important from best manufacturing practices stand point. Also this means that the organization is including the vital departments in the manufacturing thus implying that the most important method of "multidisciplinary approach" is being practiced for the decision making in the various aspects of the manufacturing. The OEM companies would always want the component supplier to use multidisciplinary approach in the internal problem solving as well as while dealing with the problems associated with the customer that is the OEM organizations.
3. The process of continuous improvements in the organization in every business process including the quality function is fundamental to the health of the business organization. The various business standards including the various standards expect that every process in the organization including the manufacturing and customer related processes be subjected to continuous improvement. This is essential to take the effectiveness of the quality system of the organization to the next level through this process of "continual improvement". Hence an attempt will be made to understand their view about the continuous improvement process in the organization.
4. Trained and developed manpower availability for the manufacturing and quality requirement is a must. The employees need to be trained about the customer related developments, about the various processes under their control, about the various manufacturing processes which affect the quality, about important parameters as specified by the customer for the given component etc. The basic training which is expected to be given to the employees and operators depending upon what role each person is expected to carry out could be about how to use the various tools like 7 QC tools for the manufacturing and various quality related problem solving. For the employees who are performing higher task in the manufacturing like supervision of group of employees, higher level of training is expected like internal auditors. For this

requirement the emphasis of the organization should be to train and develop their existing and newly recruited manpower. The various business standards like “Malcom Baldrige Award” and the quality standards have various requirements from the organizations from the training of staff standpoint. It clearly means that unless the SME organizations have fully trained work force and managerial staff the goal of quality excellence cannot be achieved.

5. Written quality records about the goods supplied to customers is a primary requirement of the OEM organizations. Any material supplied from the supplier has be documented in the formats acceptable to the customer and presented to customer when demanded. This is important because the car manufacturers are responsible to the end customers that are the car users. If the OEM organization faces any type of litigation, failure or car recall situation on account of defective material supplied by any of their supplier then such documentation is useful for them to track down the original supply vendor. Hence the OEM organizations demand the warrants signed by the suppliers and the PPAP (Production part approval process) documents. The PPAP is a separate manual of TS16949 certification process and it is mandatory requirement.
6. Use of quality tools like seven QC tools on the shop floor before the manufacturing, during the manufacturing and the after the manufacturing for the analysis of data is a must for any auto component manufacturing company. This is very important because such quality tools enable the shop floor workmen and staff responsible for the manufacturing quality to have an ongoing control over the quality of the components. To use such quality tools like the “7 QC Tools” is fundamental to any manufacturing organization. These tools enable the SME organization ongoing control over the manufacturing. These tools enable the concerned quality staff to use them as a diagnostic tool for any fault in the processes as well as a monitoring tool for keeping the various processes under control and within the limits as prescribed by the customer.
7. Any internal organization/quality improvement programme undertaken by the SME organization like TPM, six sigma, Toyota production systems, TQM etc. which will drastically improve the quality in the organization is highly desirable by the OEM companies as it enables the SME organization a companywide improvement programme which will result into improved quality, thus giving them a competitive edge. In fact

many companies insist on initiation of projects in the supplier company. Various projects like TPM projects or Toyota Production System (TPS) projects are started in the supplier organization to make them compliant with the OEM car requirement. Example being companies like Bajaj Auto Ltd. insists on TPM implementation and the Toyota Motors insists on TPS implementation in the supplier plants.

1.3.2 SELECT INDICATORS OF PERFORMANCE DESCRIBED

The select indicators of the performance of the SME organization could be-

1. The OEM companies/Tier I companies have a documented method of selecting and evaluating their new vendors. Any suppliers already supplying auto components to them will also be evaluated every year based on their quality cost and delivery performance. During this evaluation the OEM companies give award to the suppliers for their good performance in Quality, cost or delivery. Also any new components that are required by the OEM organization will be given to such SME companies who are performing well on quality, cost and delivery front. As has been already mentioned in this research paper the other two competitive factors that is cost and delivery are very closely associated with the competitive factor of quality. Hence any award received by the SME supplier or these competitive factors will mean that the organization has good control over quality. Any quality related award given to the organization by their customer for good performance either in quality, cost reduction, production, logistics(delivery), preferred vendor, best vendor, vendor who supplies the components with low ppm customer returns etc. will mean that the concerned SME organization has an ongoing control over quality.
2. The positive business indicators like increase in turnover, increase in business, acquiring new customer, increase in number of components supplied to the customer, increasing number of employees, increase in shifts year over year, plans for expansion like generating more capacity through adding machines, utilizing the 100% capacity, starting new factory etc. will mean that the business is good for the SME organization and this is possible only through good manufacturing quality.

3. Many times the OEM organizations during their vendor evaluation process find that certain vendor/supplier is not complying to the quality requirements and hence such vendor is discontinued for further supplies of the that component. Such discontinuation of component by the OEM organization will mean that the supply quality is not satisfactory. This is a negative business indicator for the organization.

The select indicators of performance of SME organizations can be listed in broad terms as follows-

Table1: INDICATORS OF PERFORMANCE OF SME

FINANCE RELATED	Turnover increase	New machines purchased		
COST REDUCTION RELATED	Internal cost reduction	Product cost reduction	Inventory reduction	
INCREASE IN COMPETITIVENESS RELATED	Receive award in quality/productivity/delivery certification from customer.	More business than the competitors	Quality awards	
JOB CREATION RELATED	Increase in number of employees	Increase in number of shifts.		
BUSINESS GROWTH AND INCREASE IN ASSETS RELATED	Acquire new component from customer.	Acquire new customer	Set up new plant	Joint venture
CUSTOMER SATISFACTION RELATED	Customer satisfaction awards from customer	Customer loyalty by way of joint product development.	Repeat business	Customer complaint reductions

Thus the select indicators of performance of the organization can be listed down in one or many following ways-

1] Increase in number of employees over a period.- The SME organization which is performing well in the market and is getting good business will always try to increase its production activities thus requiring more man power. As has been discussed any organization in automotive component supplier field cannot even survive without the quality focus in its manufacturing.

2] Increase in the number of shifts in the organization.- Some SME organizations work in only one or two shifts thus keeping the third shift vacant. Such organizations after getting additional business start their shift which is in fact expansion of their production.

3] Increase in number of machines due to customer demand.- Depending upon how much capacity of machines is booked by the customer, the SME organization may decide to purchase additional machines and expand its production activities.

4] Turnover increase.- By getting additional business from their customer the SME company can deliver additional produced goods/components to the customer thus increasing their turnover.

5] Award given by customer for performance in quality, cost reduction or on time delivery.- AS has been discussed in this research paper the competitive factors of cost and delivery are closely related to the competitive factor quality. Hence when the SME organization receives such award or certificate from their customer like quality award or award for cost reduction or award for delivery performance it will imply that the organization is doing well on quality front due to which the performance on cost and delivery front are made possible.

6] SME Organizations which are supplying their auto components in the domestic as well as international markets are definitely having robust quality systems because the overseas customers are very careful about the quality and many of the suppliers are self certified suppliers. Self certified suppliers are the suppliers which supply their good/components with their own quality certification and there is no quality inspection carried out at the overseas customer end. Such supplies under the self certification category suppliers face stiff penalties as the customer/OEM organization faces higher risk from their customers. Hence the SME

organizations in the export markets are definitely performing well as compared to domestic suppliers.

7] Starting a new company due to demand from the customers.- When the performance of the SME organization is good the customer may give an entire assembly of some subassembly along with component manufacturing which are required in high volumes. This may require a entirely new set up thus prompting a new venture.

Thus the attempt here is to list down the various quality initiatives that are implemented in the organizations and the select indicators of performance and to find out whether there is any relationship between them.

Table 2: SELECT PERFORMANCE INDICATORS LISTED

SR. NO.	DESCRIPTION OF SELECT PERFORMANCE INDICATORS.
1.	Increase in turnover.
2.	Increase in number of employees.
3.	Increase in number of shifts.
4.	Acquisition of new customer.
5.	Acquisition of new component from existing customer.
6.	Joint development of subassembly/component with the customer.
7.	Starting of new company due to higher demand.
8.	Awards given by customers for Quality, productivity, cost reduction.
9.	Cost reduction in the organization by way of reduction in cost of poor quality/ inventory reduction etc.

CHAPTER-2 LITERATURE REVIEW

Literature review will essentially try to highlight following –

1. The happenings in the field in which research is being conducted.
2. The theoretical base of the topic.
3. The context of the research i.e. how the research is fitting in the overall environment of automotive manufacturing and outsourcing of components by the OEM companies.
4. The significance of the topic under research.

NEED OF THE STUDY

Due to National Manufacturing Policy initiative by the Central Government, the manufacturing SME's in general and Pune district in particular will be growing with a rapid pace. This policy has been formed mainly because the Government has understood the importance of SME sector as the engine of growth and that the contribution of the sector to the GDP and employment generation is much higher than the big companies.

The car manufacturing business in developed countries like USA and UK is a mature industry and has flourished there for more than a century. There were big car manufacturing industries like Ford motors, General motors, DaimlerChrysler and Chevrolet etc. employing tens of thousands of employees each and generating billions of dollars of revenues and supplying and exporting their cars to the entire world. But over the years their operations became uncompetitive due to cost structures and union activities and these car manufacturers could not compete cars coming from countries like Japan and Korea which were producing world class car with much lower costs. Hence they had to shift their manufacturing operations to developing countries like India setting up manufacturing plants in suitable locations like Pune.

These companies shifted their operations based on manufacturing costs but the quality requirements remained same in fact it increased given the increased competition from car manufacturers like Toyota from Japan which is number one car manufacturer in the world beating all the competition on Quality and lower costs.

The quality aspect of the manufacturing of these OEM companies should be prime concern for the SME components suppliers because this is the first requirement of the OEM companies.

Many of the SME organizations are owned by first generation of entrepreneurs in Pune who were not formally educated in engineering and business management and still continue to own the businesses. There could be lack of understanding on the part of such owners about the high technology nature of quality that is expected from the SME components manufacturing by the OEM companies. It requires new technology as well as new approaches to manufacturing and quality to come up to the expectations of OEM companies.

A detailed study as to whether such SME companies are really geared up to take up the challenge of manufacturing global quality standard components with lower cost of poor quality needs to be done and conclusions need to be drawn. The very existence of such SME organizations will depend on this understanding about the stringent quality and consistency requirements of the OEM. It is essential to study and collect data, analyze it and draw conclusions from these findings as to whether these SME suppliers are really geared up and really understood quality requirements of their respective OEM companies and have adopted quality initiatives in their manufacturing plants which will deliver world class quality components to OEM companies. These SME organizations from Pune district will be competing not only locally but also globally as the OEM organizations can source their components from anywhere in the world. Hence it is not surprising that the engine assembly in a world class car like Ford cars is done with the components sourced from at least ten countries.

Thus the major expectation from the automotive SME manufacturing suppliers in Pune district is the clear understanding about the quality and lower cost requirement of the OEM companies and the global nature of the competition they are facing and how this understanding is used to design their manufacturing facility and the quality system.

Such detailed analysis will be useful for the concerned SME companies in so far as understanding their present status of quality management and what improvement they need to bring about in their approach towards quality. The OEM companies also need to understand how well prepared are the various SME companies vis-à-vis their quality management requirements. The present status is that the OEM companies are still importing a large portion of their

component/subassembly requirements either from their own factories of overseas auto component manufacturers to meet their needs. It is essential to understand why these OEM companies are compelled to import costly products from outside India when we have a strong base of SME companies.

The auto supplier SME companies do have some quality related initiatives taken in their organizations but many times the effectiveness of such initiatives for the organization to gain results in reduction in cost of quality, reduction in customer complaints, reduction in customer returns and increase in business is not clearly understood by them. This understanding of the management team about the importance of Quality initiatives and their effectiveness is very importance in the progress of the organization in terms of customer satisfaction, lower cost of quality and growth.

Often the management teams of such auto SME companies have limited exposure and knowledge about what impact the various factors like Quality initiatives, the technology used in the organization, customers exact requirements, market conditions etc. have on the performance of the organization. Also the competence level of the employees working in the organization also has an impact on the performance of the organization. Hence the importance of Quality as a competitive tool to achieve the customer satisfaction and performance in turnover, quality rating, reduction in cost of quality, increase in employee number etc. is not fully understood. The implementation of such standards like ISO 9001 and TS16949 and/or other quality initiative are , many times, taken lightly by the management team ignoring the fact that it has a significant impact on performance of the organization. In fact, the Quality performance of the organization is a basis on which further process/business improvement strategies of the organization should be based. Hence this study will highlight various aspects of the Quality initiatives taken in select SME companies in automotive component manufacturing area in Pune district and these finding will be useful for the SME sector companies to understand the importance of Quality in new light and the OEM companies will be able to understand the status of the SME companies in Pune district about their preparedness to become their suppliers.

2.1 INTERNATIONAL LITERATURE REVIEW

The researcher has done literature review of some of the research studies done in international universities in subjects related to the suppliers of the automotive industry as well as the SME organizations as a whole. Various researchers have dealt with subjects varied in nature about the different aspects of manufacturing in big industries as well as the SME sector organizations. Also there are books regarding the SME suppliers highlighting their functioning example being the book by the Japanese writer about the Japanese experience.

Some of the findings are as follows-

1] The research was conducted by Mr. M.Mohd. Rosli in Malaysia which was conducted to determine the SME performance in auto parts industry from the standpoint of age of the firm and the foreign equity participation has clearly mentioned that there are various other factors for the performance of the SME sector such as customer satisfaction, competitive position and Quality of products and such factors need to be further explored for further studies.

[Determinants of small and medium enterprises

Performance in the Malaysian auto-parts industry

M. Mohd. Rosli

Faculty of Entrepreneurship and Business, University of Malaysia Kelantan, Malaysia.

E-mail: mrosli@umk.edu.my.

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This research has tried to find out how the age and the foreign equity participation have an effect on the performance of the firm in Malaysia. In these conclusions it clearly mentioned that the performance of the industry may depend upon other factors and they need to be researched.

Thus the above findings support the topic under the research that the select indicators of performance will be affected by the various quality related initiatives started by the organization and the relationship needs to be found out by research.

2] The book by Japanese author *Fukunari Kimura* (Medium Firms in Japan by *Fukunari Kimura*) has also highlighted certain trends as exhibited by the Japanese firms.
Here the author has highlighted various aspects of the Japanese firms as regards to the outsourcing of their components and subassemblies to the vendors.
There is a vast difference between the approach of Japanese firms and the Indian SME organizations towards the manufacturing and its management.

2.2 INDIAN LITERATURE REVIEW

The level of contribution of Industry in the GDP makes the country, in general, an industrialized one or otherwise. The industrialized counties like Germany and China have 28.1 % and 47% respectively of the GDP contributed by industry (iWATCH, February 2011). Present contribution of industry in Indian GDP is 15% which is far less compared to industrialized countries.

Boston Consulting Group has published a report “People Productivity- Key to Indian Manufacturing competitiveness-March 2013” which mentions various data regarding the manufacturing sector and their contribution to the GDP. They mention that the manufacturing industry will grow with a fast pace. But such high growth in industry and in particular in SME sector can only be possible when they are highly quality oriented and satisfy their customers with reference to quality products, customer satisfaction and lower cost of quality. Thus it is essential to understand the preparedness of SME companies particularly in Pune district towards becoming a supplier to highly quality conscious Global as well as local auto OEM companies.

The automotive sector manufacturing industry is being shifted to countries like India from developed countries like USA or UK due to cost factors. This aspect of cost needs to be taken into account by the SME auto ancillary companies so that they are globally cost competitive with excellence in Quality. The management of Quality is tricky in the sense that if the organization fails to manage the quality function with the focus on the "cost of quality" they end up in cost over runs and quality failures. Hence a detailed study needs to be done how the SME auto organizations view the Quality function and how quality affects the performance of the organization.

There are many surveys and reports published by CII, Boston Consulting Group, Deolitte consulting, Government authorities, magazines, researches etc. which will be thoroughly studied and relevant references will be used in this research. Various web sites of the OEM companies will also be visited and relevant study of the requirements posted by these companies for the vendors with reference to Quality management will be done to understand their requirements.

Various PhD theses were studied those were published under various university publications for reference (Research by Mr. Ubale Satish on Ahmednagar small scale industries).

Also many books have been studied in depth for the purpose of understanding the quality function and the performance of the organizations. The relevance of various methodologies and quality techniques to the automotive SME is left to the customer requirement of the respective OEM organization of the supplier.

The OEM cars manufacturers have mature manufacturing set up and have elaborated vendor selection process in place. The vendor/supplier selection teams usually after stringent scrutiny select the suppliers for the supplier of the components. Such selection is based on the supplier manufacturing set up, the manpower profile and their technical abilities, the quality system in the supplier organization, measuring systems, financial strength of the organization, present customers, past quality performance etc.

Some of the concepts which are vital for this research are highlighted here-

2.3 WHAT IS QUALITY?

Since the evolution of industry, there has been a discussion on what the "Quality" really is. There have been distinguished thinkers and gurus on Quality and they have highlighted various aspects of quality. Let us try to understand different views as we understand quality as well as views as expressed by these eminent management gurus.

The word Quality many times is used little vaguely. When we visit a restaurant we say that they serve "quality eatables" and what we mean by this is we as a customer are satisfied with the taste of food and the service. When a person purchases a branded shirt he says that the company sells "quality clothes" and here he means that he happy about shirt for its fit, texture, appearance and durability. When a customer of auto components of an SME company says the machined component is "meeting quality norms" what he is referring to is adherence of the component to quality norms as stated by the customer in the drawing which may contain hundreds of dimensional, metallurgical and appearance requirements.

Thus Quality, in general, is "meeting customer requirements". The same meaning is expressed in different ways by the gurus about what Quality is.

1. "Customer satisfaction and loyalty."-Gryna,Chua,DeFeo
2. "Quality should be aimed at the needs of consumer, present and future"-Deming.
3. "Quality is fitness for purpose or use."-Juran.
4. Quality has been defined as " the totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs"(ISO 8402: 1994,Quality management and quality assurance)
5. "The total composite product and service characteristics of marketing, engineering, manufacture and maintenance through which the product and service in use will meet the expectation by the customer"-Feigenbaum.
6. "The totality of features and characteristics of a product or service that bears on its ability to satisfy stated or implied needs"-BS 4778, 1987(ISO 8402, 1986) *Quality vocabulary*: Part 1, *International Terms*.
7. "Conformance to requirements"-Crosby.

The term Quality is, nowadays, applied to "products" of the organization. Here the products mean-

1] Goods-Automobiles, circuit boards, chemicals etc.

2] Software-A computer programme, a report, an instruction.

3] Service-banking, insurance, transportation, service.

(JURAN'S QUALITY PLANNING AND ANALYSIS by Frank M. Gryna, Richard C. H. Chua, Joseph A. DeFeo.

TOTAL QUALITY MANAGEMENT by John S. Oakland)

As the scope of this research is limited to Automobile sector SME companies in Pune district, here the "Product" means the manufactured component and the service involved, if any.

This research will try to find out the impact of such intangible factors like the increase in competitiveness, customer satisfaction and quality of products on the performance of the organization.

The concerned SME organization is competing with the other SME organization in India as well as other SME organizations in the world as the OEM companies source their components from the entire world wherever they get at lowest cost and highest quality and with delivery guarantee. The factors of competitive strategy are –Product Quality, Cost leadership and reliable delivery. Quality needs to be seen by the organization in light of the competitive perspective and the commitment to quality has to be a strategic decision of the management/ owner for the survival in the cut throat competition. The product quality needs to be strengthened first rather than concentrating on cost and delivery because in absence of quality focus the organization cannot maintain the cost and delivery focus. This is because when product quality fails the organization starts to bleed money in terms of internal rejections, failures at customers end and lost opportunities due to bad quality. Also the on time delivery can only be guaranteed through reliable product quality. Hence the organization or the business owner has to decide upon the relative emphasis on the competitive factors. Such emphasis on the prioritization of the competitive factors needs to be done as a part of the business strategy and the time horizon should be for a period of five years. Only such commitment to quality can give the organization a competitive edge to survive in the market and the organization can expect to grow.

In fact the Quality and NO Quality is the borderline between life and death of an organization as an SME component supplier. The quality decides whether the organization will survive in the market of component supply. This fact holds good for any product in the buyer's market. The automotive field being the buyer's market the customer decides the rules of the game and car makers have to follow what the customers want. Same is true for the component supplier and the OEM relationship. The SME automotive components suppliers must follow what the OEM companies want and the OEM companies need excellence in quality.

The present day car customers want excellent quality cars at a very competitive price. Due to the tremendous competition in the car market the car manufacturers have to comply with the customers demand. Hence the car makers naturally expect that their suppliers should supply them components at rock bottom prices with excellent quality. This has put tremendous pressure on the margins of the SME automotive suppliers. Also the suppliers have to comply to the OEM requirement about the quality management system in the organization.

The expectations of the OEM companies from the Tier 1, Tier 2 and Tier 3 companies have been derived from their web sites. The web sites of the companies give details about what they expect from their subcontracting companies. The common factors that these auto companies expect from their Tier 1 companies is comprehensive auto quality standard like TS 16949. The latest version of this standard is TS 16949-2009.

A] The biggest indigenous automotive OEM organization in Pune is Tata motors Ltd. and the expectations of Tata Motors Ltd. from the suppliers are as under-

2.4 Quality System Requirements from the suppliers-

A] TATA MOTORS LTD.

The supplier shall demonstrate the ability to establish, document and implement an effective quality system that complies with all applicable elements of ISO/TS16949-2002. The supplier's management shall ensure that the Supplier Quality Policy is thoroughly distributed, understood and maintained; and that adequate levels of authority have been established to ensure the continual improvement of the quality system.

It is a goal of Tata Motors to have all of our suppliers registered to a minimum of ISO 9001:2000 by 31st March 2004. Those who may not be in a position to be certified accordingly shall have to submit road map to become compliant with ISO 9001: 2000 with the aim of becoming TS16949.

B] FORD INDIA LTD.

The world class car manufacturing company ***Ford India Ltd.*** has mentioned on their web site-

OUR EXPECTATIONS OF OUR SUPPLIERS

Ford Motor Company works to develop long-term business relationships, in which all parties are committed to working together to achieve shared and customer-driven goals. Suppliers to Ford are expected to meet certain expectations to achieve our goals as the success of Ford Motor Company's final product depends largely on the contributions of our suppliers.

Quality

Quality is the key to customer satisfaction. The integrity of Ford Motor Company's products, as well as the Company's name, is rooted in a total commitment to quality. Global success is a team effort - a true partnership in the quest for excellence.

Ford Motor Company recognizes that it will not achieve and sustain high quality without the full support of our suppliers. In order to meet our high quality standards, we require that production

material suppliers' manufacturing sites achieve and maintain Q1 status which is the minimum acceptable performance level.

Ford motor company has directed all their suppliers to follow the Q1 quality norms which is a combination of requirements from the suppliers which consist of quality certification requirements like TS 16949 and some logistics norms. Ford, this means the suppliers must have highest requirements of quality, reliability and logistics. With Q1, Ford extends the standards of international quality standards such as ISO/TS certification, quality characteristic numbers (PPM) which means that the suppliers must not have any rejections at customers end not more than say 100 PPM (100 parts in ten lakh parts), logistics ratings and the specific requirements to the quality management system of potential-suppliers. It covers a full spectrum – as defined in the specially created rules – with fundamental quality and production standards, which are to guarantee that all suppliers, also in the future, will continue to operate successfully in the market and are constantly evolving. It is mandatory for the potential suppliers in order to be able to become a supplier at Ford; producers must achieve the so-called Q1 status. This status has clearly shown the emphasis that this MNC car company has on Quality.

These OEM company suppliers which are called Tier 1 companies, in turn, are expected to have all their Tier 2 suppliers with TS 16949 certification as per the TS standard. The TS 16949 standard expects that the TS certified company must have all its suppliers with at least ISO 9001 certified if not TS 16949 with the provision that subsequently these companies will get themselves TS16949 certified within a reasonable time limit like two to three years.

In this research the study of both the effects of INPUTS (Quality Management practices in the SME organization) and OUTPUTS (Various important indicators like perception of the customer organization about the quality of the SME supplier organization, business growth, employee

growth, customers acquired, new investments etc) will be studied through a schedule designed to capture the relevant data through the telephonic interview..

2.5 DIFFERENT QUALITY INITIATIVES

The various quality related initiatives that are preferred by OEM companies and the supplier companies are as follows.

1] ISO 9001 certification by third party.

2] TS 16949 certification by third party.

3] Other initiatives like six sigma techniques, TPM techniques implementation, TQM (Total Quality Management) implementation, TPS implementation etc.

4]. Written down quality objectives and review of the same at certain period. - It is very important to have a written down quality objectives for every function in the SME organization and there has to be monitoring of these quality objectives at a certain period. Generally the quality standards like ISO 9001 and TS16949 make it mandatory for the certified organization to conduct monthly review meetings (MRM) attended by the heads of department, employees in the supervisory capacity in the quality management hierarchy etc. and conducted by the management representative (MR). Such meeting is essentially cross functional one and hence every department participates in the meeting. The quality objectives are measurable indicators of the business like-

1. Reduction in internal rejection from 3% to 1.5 % by production.
2. Reduction of manufacturing defects on the final inspection station from 6% to 2% by quality department.
3. Bring the overall equipment break down time from 500 hours to 300 hours by maintenance department.
4. Acquiring two new components from our existing customer by marketing department.

5] Written down work instructions to the operators- The production shop in any manufacturing organization generally run in First shift (7 am to 3.30 pm), Second shift(3.30 pm to 12 am) and Third shift(12 am to 7 am). In such situation every manufacturing operation on the shop floor has to be precisely carried out by the operator again and again as per the control plan of the component. To do this there has to be a written down work instructions for the benefit of every operator working on that specific operation. This instruction sheet will give details of every action for the production, which gauge to use for checking, how to use certain instrument, what is the frequency of checking etc. In absence of such written down work instruction the operator may commit mistakes which may result into rejections/rework which is highly undesirable.

6] Customer related data collection, analysis and action taken- The SME organization needs to collect various data related to customer. Some of the data could be-

1. Customer returned goods.
2. Customer written complaints.
3. Customer informal complaints.
4. Customer satisfaction.
5. Customer levied penalties.

The SME organization must have internal system mechanism which collects this data on regular basis, analyses them and takes action to respond appropriately to the customer requirements and takes appropriate steps to prevent any such happening in the organization which is not desirable by the customer and the internal requirements of the organization.

The OEM organizations have to be very careful about the components supplied to them because many of the components are safety critical and any failure in the components in service may result into fatal accident. This may result into huge cost to the OEM car manufacturer in litigation.

7] Use of Quality tools like “7 QC tools” in day to day quality management of the products by the employees responsible for the quality–

1. Ishikawa diagram(Fishbone diagram)/Cause and effect diagram)
2. Check sheet.

3. Control charts.
4. Histogram.
5. Pareto charts.
6. Scatter diagram.
7. Flow charts

THE ISO9001-2008 STANDARD-

The ISO9001 standard is a generic standard and any engineering, auto, service organization as well as government office, private office etc. can be certified with this standard. The ISO is abbreviation for the "International Organization for standardization". Such service organizations like banks, hospitals, insurance companies etc. can also be certified with this standard. This standard is third party certified which means that some authorized third party after accessing the quality system documented manuals of the organization and auditing their entire quality system on the shop floor/work area will certify the quality system and the processes of the organization for adequacy of quality system for satisfying the customer for the intended products.

It contains 8 main clauses which include all the aspects of the functioning of an organization. They address all the functions and mention what all needs to be done to take care of customer requirements. As mentioned earlier this standard is generic in the sense that it can be used to certify any organization be it manufacturing or service or nongovernmental or governmental etc.

This standard aims at meeting the customer expectations consistently including the regulatory requirements. This standard requires that the QMS (Quality Management System) of the organization should be audited every 6 month and recertified every three year. This is required for the continued compliance to the standard.

There are certain benefits of the standard ISO9001 like-

- It acts like a common standard to qualify suppliers for global supply chains.
- It unifies base for the industry sectors.
- Due to the confidence generated in the minds of customers it generates sustainable business for the certified company.

- It creates positive image of the organization.
- This certification gives a competitive advantage over the rivals.
- It achieves customer satisfaction.
- The entire functioning of the organization is documented and it gives control over processes.

The ISO 9001 standard is based on certain principles like-

- It is customer focused- It is a well known fact that all the businesses depend on their customers for the business. Hence this standard is focused around the customer so that the internal processes are adjusted to customer requirements.
- Leadership of the organization given due importance- The leaders of the organization like the owner naturally provide administrative support to the system and give it a purpose and aim. They also provide objectives to the organization. It is the responsibility of the leadership of the organization to establish, maintain and run the Quality Management System (QMS) in the organization.
- It has process approach- It takes into account how the individual processes work as well as the interaction of the different processes in the organization. Thus it takes into account the effect/impact of the different processes on the overall objectives.
- Continual improvement of all the processes- This standard seeks focus of the management of the quality system on continual improvement of the all the processes and objectives as set by management.
- It aims at the system approach to the management- When all the interrelations of the processes and systems in the organization are managed as a system it gives better control over the outcomes.

THE TS16949-2009 STANDARD-

This technical standard (TS 16949 standard) is a comprehensive standard, applicable only to the auto sector. The automotive suppliers supplying auto components or subassemblies to the OEM can get TS 16949 certification from the third party certifying bodies.

This quality management standard (QMS) of TS16949 was initiated by three big passenger car manufacturers like Ford motors, DaimlerChrysler and General motors' along with the truck manufacturers association. This standard is based on ISO 9001 standard and in addition to that it takes into account the customer specific requirements along with the organizations own requirements. As the base of the TS16949 is ISO 9001 all the requirements of ISO9001 are covered in it. Hence any organization which is certified for the TS16949 standard is also certified for the ISO9001 automatically.

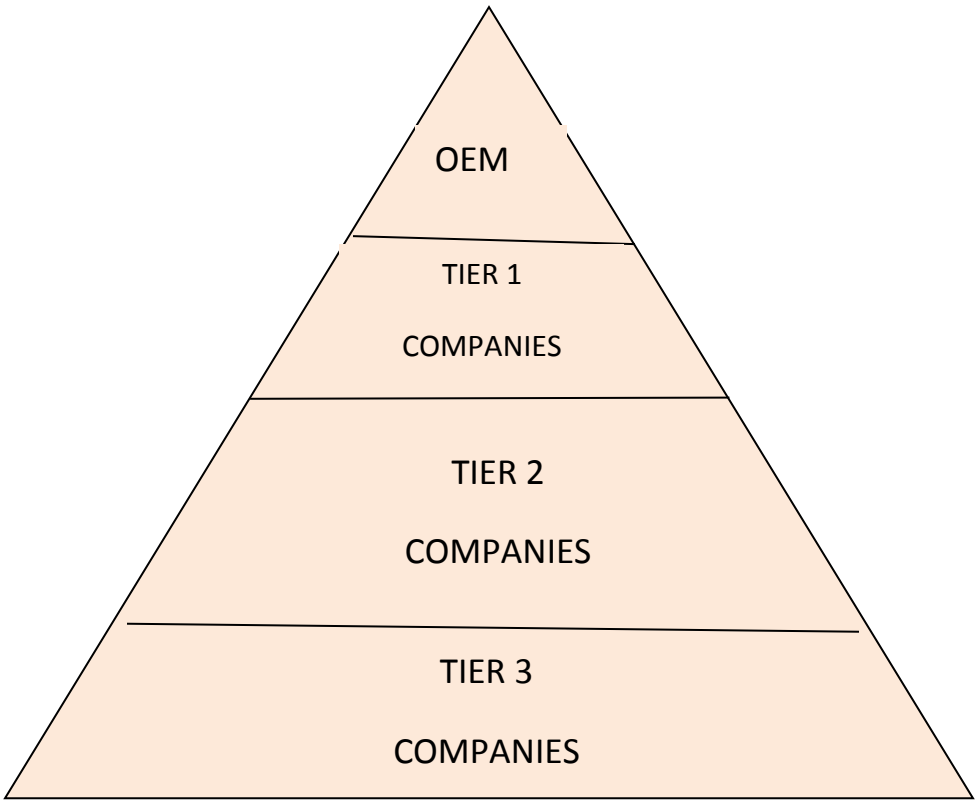


FIG 2- SUPPLIER HIERARCHY OF AUTO COMPONENT SUPPLIERS.

As is shown in the FIG 2 there are three categories of suppliers of the components in the automotive industry supplying to the OEM car manufacturers.

1] TIER 1 Suppliers - These are the organizations which directly supply the OEM organizations the automotive components in following conditions.

- Finished subassemblies ready to fit in the assembly- These are the subassemblies that are manufactured and tested with proper quality control norms by the Tier 1 organization and self certified. The status of self certification is given to such organization which has the TS16949 certification and has a proven reliability in maintaining the quality system and has passed many norms as required by the OEM Company. These subassemblies are directly fed to the assembly of the OEM Company without any inspection done to them. Depending upon the level of confidence in the supplier organization the OEM Company may give simpler subassemblies or complicated ones.
- Finished individual components- These are the finished components without any assembly involved in it. These components are ready to fit in the assembly line of the OEM Company. Depending upon the confidence in the supplier organization the OEM Company may give it a self certifying status. Such self certified components directly go into the assembly line of the OEM Company.
- Semi finished components- These are the automotive components that are supplied to the OEM Company in a semi finished state which means some of the finishing processes are done in the OEM Company after the receipt.

2] TIER 2 Suppliers- These are the suppliers which supply the automotive components to the Tier 1 suppliers. The Tier 2 suppliers are not supplying to the OEM Companies directly. As per the norms of the TS16949 and the OEM Company these suppliers also need to be TS16949 certified or at least ISO 9001 with a definite plan of getting the TS16949 certification within a short period. These organizations may supply components in the following conditions.

- Finished components which are used in the subassembly- It the responsibility of the Tier 1 supplier to ensure the quality of the components as received from the Tier 2 supplier.
- Semi finished automotive components will be supplied by them and the Tier 1 supplier will do finishing operations on components before supplying to OEM company.

3] TIER 3 Suppliers- These are the category of suppliers which supply automotive components to the Tier 2 suppliers. These Tier 3 suppliers are also required to have TS 16949 certification or at least ISO 9001 certification with a definite plan of acquiring the TS16949 certification within a short time frame. Generally Tier 3 suppliers do not supply finished components.

It is a standard which deals not only with all the matters of the functioning of the supplier which is dealing with/affecting Quality of the product but also all the activities and processes which may lead to Quality related issues. The TS 16949 standard has five main core tools viz. MSA (Measurement system analysis), APQP (Advance product quality planning), FMEA (Failure mode effect analysis), PPAP (Part production approval process) and SPC (Statistical process control) which states in detail about how these important processes are addressed in the supplier organization Quality System and what are the trends. Separate manuals are available as published by AIAG. Also there are customer related processes which are also taken into consideration extensively. All these processes and the customer centric approach leads to the ultimate Quality of the products. This standard is third party certified which means party other than the supplier and the customer will access and audit the TS 16949 Quality system of the supplier(in this case the SME company)and then certify with subsequent periodical surveillance audits e.g. UL Verification services India, Bureau Veritas India, TUV group India, LRQA India, DNV India etc. This guarantees the customer (the auto OEM) Quality and consistency of the product over a period and the reliability of the organization increases.

The main processes of TS16949 of which separate manuals are available are explained briefly as they are at the heart of the automotive standard. The customer/third party auditors look for the evidence of use of the methodology in the regular working of the quality system. All the manuals are published by the AIAG (Automotive industry action group).

- APQP (Advance product quality planning)- The TS16949 standard makes it mandatory for the suppliers to use a core tool like APQP to manage the development of any new automotive component in their organization. This methodology of developing the new component is very useful to the SME organization also as it ensures the timely

development of the component without quality problems. It is a structured way of defining and steps necessary so that the resultant product satisfies the customer. Such use of the tool requires the company's top management support and commitment. There are following phases of APQP-

1. Defining and planning of the component development programme.
2. The design and development of the product.
3. The design and development of the process.
4. Validation of the product and process.
5. Assessment of the feedback and the corrective actions if required.

- FMEA (Failure mode effect analysis)- The automotive industry being very careful and proactive in nature to the quality and safety features of the their product namely the passenger cars, the quality management system of the suppliers has to be very proactive to take care of the concerns of the OEM companies. There are many features in the TS16949 which are done in advance to the possible failure in quality in future. One of the tools to take care of the possible quality failure is the failure mode effect analysis tool. It take into account various ways of failure of given process. There are two types of FMEA.

  1] Design failure mode effect analysis.

  2] Process failure mode effect analysis.

  Out of these two ways the Design FMEA is generally not part of the suppliers like SME companies. The SME suppliers will have to use the FMEA tool to take care of the PFMEA in their quality management system. The FMEA takes into account an advanced approach to various ways how a process may fail thus leading to rejections and failure of the process. The format of the FMEA takes into account three ways how a process failure may be used to access the impact of it. The three ways being-

  1] Occurrence of the cause of failure.

  2] The Severity of the failure.

  3] The detection mechanism failure.

  All these three ways will be then allocated numbers depending upon the possibility of happening of the failure. The multiplication of the three numbers will result into the RPN (Risk priority numbers). The RPN numbers will then be studied in detail and various

ways to reduce the RPN numbers is devised. A comprehensive action plans are made to reduce the RPN numbers and the FMES format includes this part of the planning to reduce the RPN numbers and shows the new RPN numbers after reduction. Thus this tool is proactive failure mode detection as well as action oriented tool to reduce the risk of failures in processes.

- MSA (Measurement system analysis)- It is a well known fact that any process in manufacturing has an inherent variation. It is also true for the measurement system as a whole. Thus the entire system of the quality control measurement and the instruments used in it are subject to variation. This tool of MSA addresses this variation of the entire system and how to contain this variation within a norm so that the system becomes reliable within the statistical limits. There are variations like-

  1] Least count (Accuracy) and precision (repeatability) of the instrument.

  2] Tolerances on the functioning of the equipment.

  3] Manual variations in the reading and handling of the processes and equipment.

  4] Wear and tear of the instruments/equipment.

  All such variations add to the uncertainty of the measurement system. Such uncertainty needs to be contained within the statistical limits so that the entire measurement system is reliable.

  There are norms for the calibration of the laboratory equipment used in the manufacturing processes. Also there are norms for the laboratory which certifies the measurement equipment.

  One of the technique to track the variations in the gauging processes is GR and R (Gauge repeatability and reproducibility) which tracks these variations.

- PPAP (Production part approval process)- Whenever any supplier starts producing any new component in his organization there is a set of procedure that has be followed. All the sample parts produced in the organization along with the specific documents need to be submitted to the customer. This process or the check list of report is a guide line which details the specific reports and the documentation required to be submitted by the supplier to the customer for the production part approval in the auto motive industry. All the documentation required to be submitted by the supplier are mentioned in the PPAP

manual. Following are some of the documents that are required to be submitted. There are totally 18 such reports that are required to be submitted including a warrant. Depending upon the level of the organization the customer decides which documents need to be submitted with the samples.

1. Customer engineering approvals
2. Design FMEA(Failure mode effect analysis)
3. Process FMEA
4. Design records
5. Engineering change documents
6. Process flow diagram.
7. Control plan.
8. MSA (Measurement system analysis) records
9. Dimensional analysis of the component supplied.
10. Master sample
11. Material performance results.
12. The PSW(Part submission warrant)

    Depending upon the level of submission the documents to be submitted they vary. There are in all five levels. The level 1 will require only the PSW submission where as the level 5 will require to submit all the 18 documents.

- SPC (Statistical process control)- This is the very important aspect of the TS16949 standard where it is mandatory for the TS certified organization to have a clear methodologies to install and demonstrate operating of the different processes as mentioned in the five processes PPAP, FMEA, SPC, MSA and APQP.
  The SPC (Statistical process control) is very important tool in the hands of the manufacturer to have ongoing control over the manufacturing processes in the organization. It not only helps the decision makers to identify and pin point the various areas where the processes are behaving properly but it also helps the team to arrive at an action plan to correct the anomaly. Basically all the manufacturing processes need to be in the statistical limit to be able to reduce the number of defects have a predictable outcome. The processes when they are under the SPC limits the customer is also assured that the supplies coming them from this supplier will have predictable way of checking

and standard methods of checking these supplies with SPC tools will yield good results. This manual of SPC contains all the discussion right from how the SPC methodology can be effectively used by the suppliers to improve its internal processes and bring it under the SPC umbrella.

The figure shows the basic principal underlying the SPC technique.

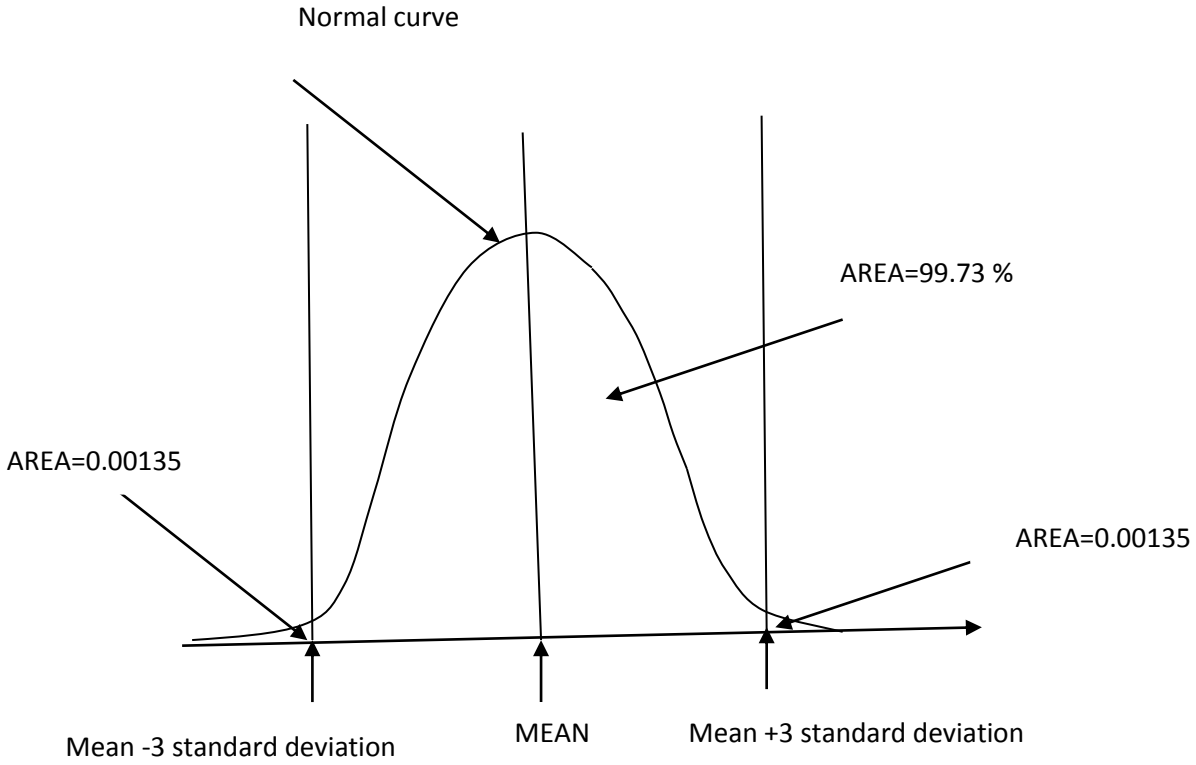


FIGURE 2A : NORMAL CURVE

This figure shows that when the process is under the statistical control the maximum defects that can be generated by the process are 27 parts per million. The use of 7 QC tools is extensively done in the SPC technique.

The OEM companies encourage/make it compulsory for the Tier 1 companies to get themselves TS 16949 certified it ensures a strong quality management system (QMS) at the supplier factory which strengthens the "supplier-customer" relationship because the customer develops a confidence about the manufacturing capability of the supplier with reference to quality. The TS 16949 certification is a must for exporting of auto components to overseas destinations. This clearly indicates that the SME organizations which are supplying to OEM companies must increase their quality orientation and get a third party quality certification like TS 16949.

Such auto sector specific standard like TS16949 is an assurance of the organization to the OEM Company that the quality of the products supplied to the OEM is guaranteed by the robust Quality Management System of the SME and also every function in the organization is prepared to deliver what it takes to deliver the quality goods as expected. In absence of such third party quality certification the OEM auditing teams needs to conduct extensive audits in the supplier organization to ensure the capability of the organization to deliver the quality components as required. Such audits by the customer with whatever care it is done may not be able to understand the true ability of the supplier organization to supply quality components over a long period. The frequent and extensive audits by the customer may not be desirable by the OEM because they require highly trained and experienced auditors and such audits are time consuming hence they prefer to have a third party audits and certification by professional bodies like the TS 16949 certifying organizations like Underwriters Laboratory. The third party certification of TS16949 is highly desirable by the car manufacturing OEM organizations in India as well as overseas companies as it has credibility and uniform standardized practice.

Also in comparison to ISO 9001, the TS16949 standard is very specific to automotive industry and it takes care of all the requirements of the OEM organizations as car manufacturer.

TS16949 has very extensive requirements from the SME auto component supplier along with the customer specific requirements which makes this standard very superior to ISO9001 as far as the automotive industry is concerned. SME companies certified with TS16949 will stand more chances of business from the OEM as compared to ISO 9001 and uncertified SME organizations due to following reasons.

1. TS16949 is auto industry specific whereas the ISO 9001 is generic standard.

2. TS16949 takes into account all the customer specific needs and the regulatory needs of the auto sector.
3. TS standard is stricter standard as it has more mandatory processes and clauses which have to be followed by TS certified SME organizations.
4. The level of the QMS (Quality Management Standard) of the TS16949 will have to be very high to get the certificate.
5. The staff of the TS certified organization managing the quality and also all other significant staff affecting the quality has to be qualified and well trained.

Thus these facts make the TS 16949 certified SME organization more competitive as compared to the ISO 9001 certified organization and those organizations which are not third party certified.

The ISO 9001 certified SME organizations will obviously be more competitive compared to uncertified organization as the OEM organizations will have fewer guarantees of quality products from uncertified companies. Hence the OEM organizations always prefer the TS 16949 certified organizations or at least the ISO 9001 certified organizations.

In fact, all the international standards like ISO 9001, TS16949 and initiatives like TQM, TPM and Six Sigma believe in standardization and system improvement in every function in the organization. Thus the emphasis is on not only physical Quality of the end product of the company but also on every action that leads to customer satisfaction and quality. Hence the implementation of such standards and initiatives leads to overall improvements in the organization in every function and process thus leading to customer satisfaction and higher performance.

The entire system of the TS16949 along with the five manuals as mentioned before, if really implemented in the organization with the right spirit of the standard, will definitely yield good results for the organization in terms of consistent quality products and achieve customer satisfaction and thus lead to the growth of the organization.

These standards have not only intending to have good processes in place but also improving the internal processes continually by observing and analyzing the results of the process output and how far these results satisfy the external and internal customers. Hence bellow is the famous P-

D-C-A cycle as adopted by ISO 9001 and TS16949 to improve every process in the organization (Please refer to FIG 1). This concept of P-D-C-A (Plan-Do-Check-Act) which is an iterative cycle of improving of processes and/or products of the organization was first introduced by the management guru Deming. This states that all the processes as well as the products can be continually improved by using this cycle.

This cyclic improvement concept states that the management of the organization has the final responsibility of understanding the requirements of the customers and uses these requirements of customers in processes and decisions regarding the use of the resources of the organization to convert the inputs as received from the customers into the output (product). This is also called as product realization process. Further the management has to continually interact with the customer about the customer satisfaction measurement and use this data to analyze internal process trends to further improve the internal processes to achieve the product improvements and process improvements.

This fundamental cycle of improvement of the processes and products is the basis of both the ISO 9001 and TS16949 standards. These two standards have a basic concept of "Process" which is used in the entire text of the standards.

SIX SIGMA INITIATIVES

There are many approaches to improvement of the functioning of the organization and Six Sigma is one of the very important of all the approaches. This approach not only aims to improve the Quality function and product quality but also has comprehensive methodology to improve the entire organization and make it customer centric.

The Six Sigma approach is a collection of statistical and managerial methods, concepts and techniques that focus on reducing the variation in processes and prevent deficiencies in the product.

This particular technique of Six Sigma can be applied to any kind of organization be it a manufacturing, an auto, a service or a governmental organization.

The variation in a process is denoted by the sign of SIGMA (σ) in statistical analysis of the variation of the processes. The Sigma (σ) denotes the standard deviation of the measurements around the process mean.

When the process achieves the Six Sigma status the variation in the process is very small compared to a process without Six Sigma status. In other words the process becomes very reliable and the output of the process is very predictable and the customer will be very satisfied.

The *statistical process control* is application of statistical methods to the measurement and analysis of variation in a process. This technique is applicable to in process as well end products of the process.

The key focus area in Six Sigma is the relationship between the input variables and the outputs of a process.

$Y = f(X1,X2……..Xn)$

Here *Y*= Product results and (f)is a function of many process variables like X1…Xn. This means that Y is an output of many inputs is in effect a dependent variable. Here the X are inputs or causes or dependent variable.

Thus the Six Sigma approach identifies the process variables that cause variations in product results.

Six Sigma has five steps as under-

1.Define- This step defines or identifies the potential projects suitable for the Six Sigma, selects and defines the relevant projects and sets up the project team.

The steps are-

A. Identify potential projects.

B. Evaluate the project.
C. Select the project.
D. Prepare the problem and mission statement for the project.
E. Select and launch the project team.

2. Measure- This step measures i.e. documents the process in detail and measures the current process capability.

Steps are-

A. Verification of the project need *Y* [in Y=f(X)]
B. Documentation of the process.
C. Data collection plan making.
D. Validate the measurement system.
E. Measure the baseline performance of *Y*.
F. Measure the process capability.

3. Analyze- This step analyzes i.e. collects and analyzes data to determine the critical process variables in the selected process.

Steps are-

A. Plan for data collection.
B. Collect and analyze the data collected.
C. Testing the theories or the hypotheses on source of variation and cause- effect relationship which is also called as identification of the determinants of process performance.

4. Improves- This step aims at improvement of the process by way of formally conducting experiments when necessary to focus on the most important process variables and this determines the process settings for optimizing the final results i.e. product results.

Steps are-

A. Evaluate alternative remedies or solutions.
B. Design a formal experiment to optimize process performance.

C. Design a remedy.
D. Prove that the remedy is effective.
E. Deal with the resistance of the concerned people for the new remedy.
F. Transfer the new remedy to the actual operation.

5. Control- This step measures how the new process stands with respect to process capability and documenting the new improved process and installs controls to maintain the gains of new process.

Steps are-

A. Design controls and document the improved process.
B. Validate the measurement system for the new process.
C. Determine the final process capability.
D. Implement and monitor the process control measures.

TPM (TOTAL PRODUCTIVE MAINTENANCE)

The two gurus of Quality Juran and W. Edwards Deming have played a tremendous part in the manufacturing sector management particularly in management of Quality.

Juran's efforts in Japan have resulted in a big movement in Quality improvement and evolution of TPM in Japan.

Japan Institute of Plant Maintenance (JIPM) is a leading institute in TPM related activities and promotional movement.

The JIPM approach towards TPM is as under with the definition of TPM.

T = Total. Here it implies that all the employees of the organization at all levels must be involved in the TPM.

P = Productive. It means that all the resources must be utilized effectively.

M = Maintenance. Maintaining the man-machine-material-methods system in optimum condition by using various techniques of TPM.

The TPM methodology tries to achieve following goals by using the techniques of TPM.

1. Zero breakdowns.
2. Zero accidents.
3. Zero defects.

Generally before any of TPM initiatives are implemented in the factory the extensive implementation of 5 ‘S’ is recommended to make the technique effective.

There are eight pillars of the TPM system.

1. Focused improvements.
2. Autonomous maintenance.
3. Planned maintenance.
4. Training and education.
5. Early management.
6. Quality maintenance.
7. Office TPM.
8. Safety, health and environment.

TQM Methodology

The TQM is one of the important initiatives which are being used by all of the types of organizations and the manufacturing industry in particular to improve the processes of the organization in general and Quality in particular.

It is a comprehensive approach to improve-

- Competitiveness.
- Effectiveness.
- Flexibility

This is achieved through planning, organizing and understanding each activity with involvement of each individual in the organization.

This initiative requires that a strategic view must be taken of the quality aspect of the business and prevention of defects should be the policy rather than the detection of defects or problems.

To adopt such type of philosophy in the organization requires a mindset change which is often difficult for the employees. Hence it is very important that the organization involves all the employees in the process of TQM implementation.

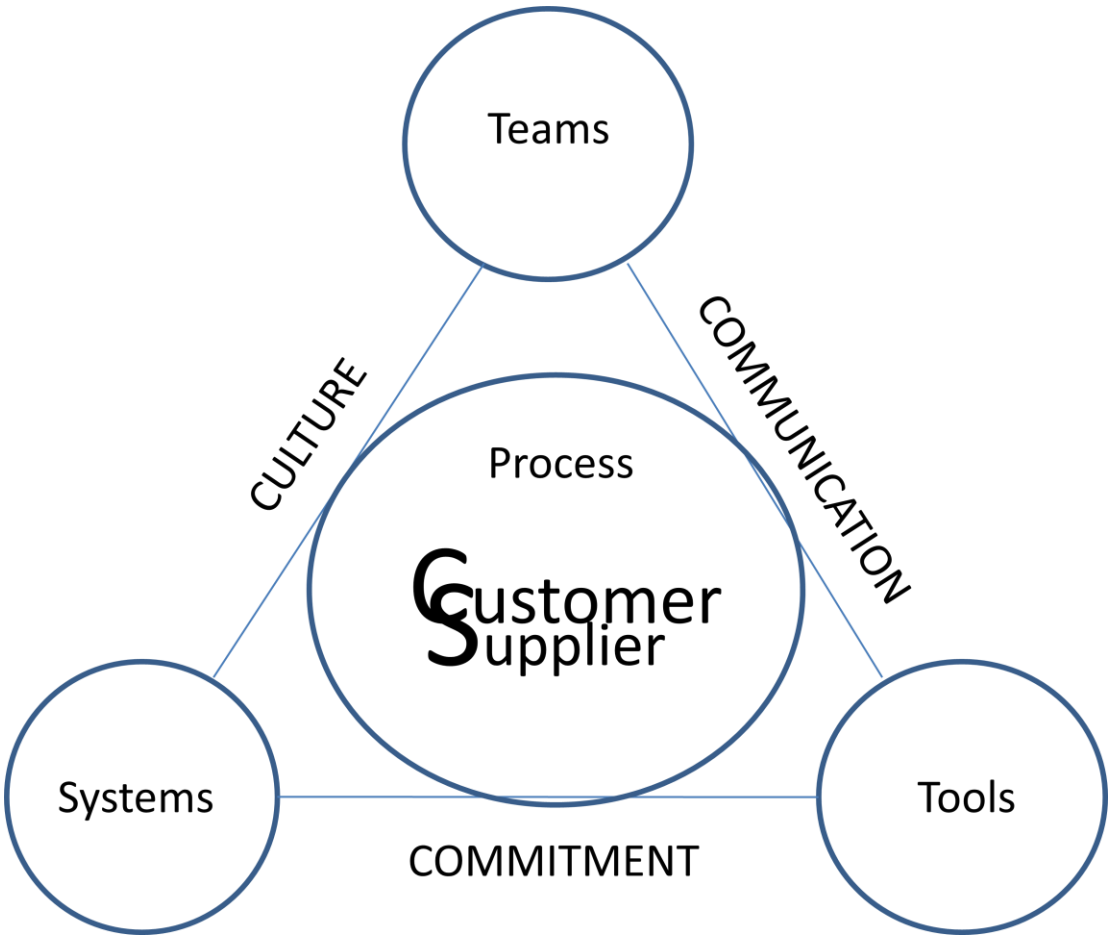


FIG3- THE TQM MODEL

(By John S. Oakland)

The following points need to be adopted by the top management team for the effective implementation of the TQM model.

1. A long term commitment on constant improvement in the organization.
2. The philosophy of zero error/defects needs to be the aim of culture building efforts.
3. The employees need to understand the "customer-supplier" relationships of the organization.
4. The "Total cost" of the product/service needs to be taken into account rather than the price alone.
5. Recognize that improvement of the "systems" needs to be managed.
6. The modern methods of the "supervision" and "training" need to be adopted with elimination of fear in the minds of employees.
7. The "processes" of the organization should be such managed that it improves the "communication" and "team working" amongst the employees.
8. Following needs to be eliminated.
    i. Arbitrary goals without methods.
    ii. All standards based on only numbers.
    iii. Barriers to pride of workmanship.
    iv. Fiction. Get the facts by using correct tools.

9. Constantly educate and retrain- develop the "Experts" in the field.
10. Develop a systematic approach to manage the implementation of TQM in the organization.

TOYOTA WAY OF PRODUCTION

In the days when the biggest company like Ford was leading the car segment in the world, the Japanese car manufacturer Toyota revolutionized the car manufacturing by supplying cars with excellent quality at lower cost and with wide variety and became the leader in the world. This was possible for Toyota because of Toyota Production System (TPS).

There are certain basic concepts of TPS as follows which makes it possible.

1. Maintain smooth Flow manufacturing and produce to "Takt Time".

$$\text{Takt Time} = \frac{\text{(TIME AVAILABLE)}}{\text{(PRODUCT DEMAND)}}$$

   The TPS only produces as per the takt time and the "single piece flow" is maintained. Also "Just in time" is followed in production in the entire supply chain.
2. Produce to order.
   The TPS manufacturing system does not believe in producing to stock but only in producing to order which means only against the order of the customer.
3. Make the systems "observable" and immediately correct the problems/errors as they occur. Example is the kanban system of production.
4. Integrate worker skills with the manufacturing systems.
5. Institutionalize the change that has been brought about by the above actions.
   The TPS is a very difficult management tool to improve the functioning of the organization. This initiative takes into account not only the organization which implements this initiative but also the entire supply chain that is up processes and down processes. The famous Just In Tine (JIT) technique which is heart of the TPS system is very effective technique. This technique cannot be used in isolation but it needs to be implemented in tandem with other technique like TPM.

THE 7 QC TOOLS

ISHIKAWA DIAGRAM-

This tool is called Ishikawa diagram after the inventor of this concept Kaoru Ishikawa. It is also called "Cause-and-effect diagram".

This tool helps to identify and sort and display graphically possible causes of a certain problem. This tool graphically illustrates the relationship between all the factors that influence the problem and the problematic outcome. Generally a cross functional team can use this tool to find out the various factors that may affect the Quality defect in the given manufacturing process.

This tool is used to construct the diagram when the team needs to

- Identify the possible root causes with reasons behind them which will lead to a specific condition or problem.
- Sort out and relate some of the factors and the interactions among them which will affect the final outcome of the process.
- Facilitate corrective actions on the existing problems after detailed analysis.

For a given Quality problem, some of the factors of production like man, machine, methods and material cause some problem to occur. And this is graphically represented as follows as a general case. Any specific case will have very specific causes and outcome.

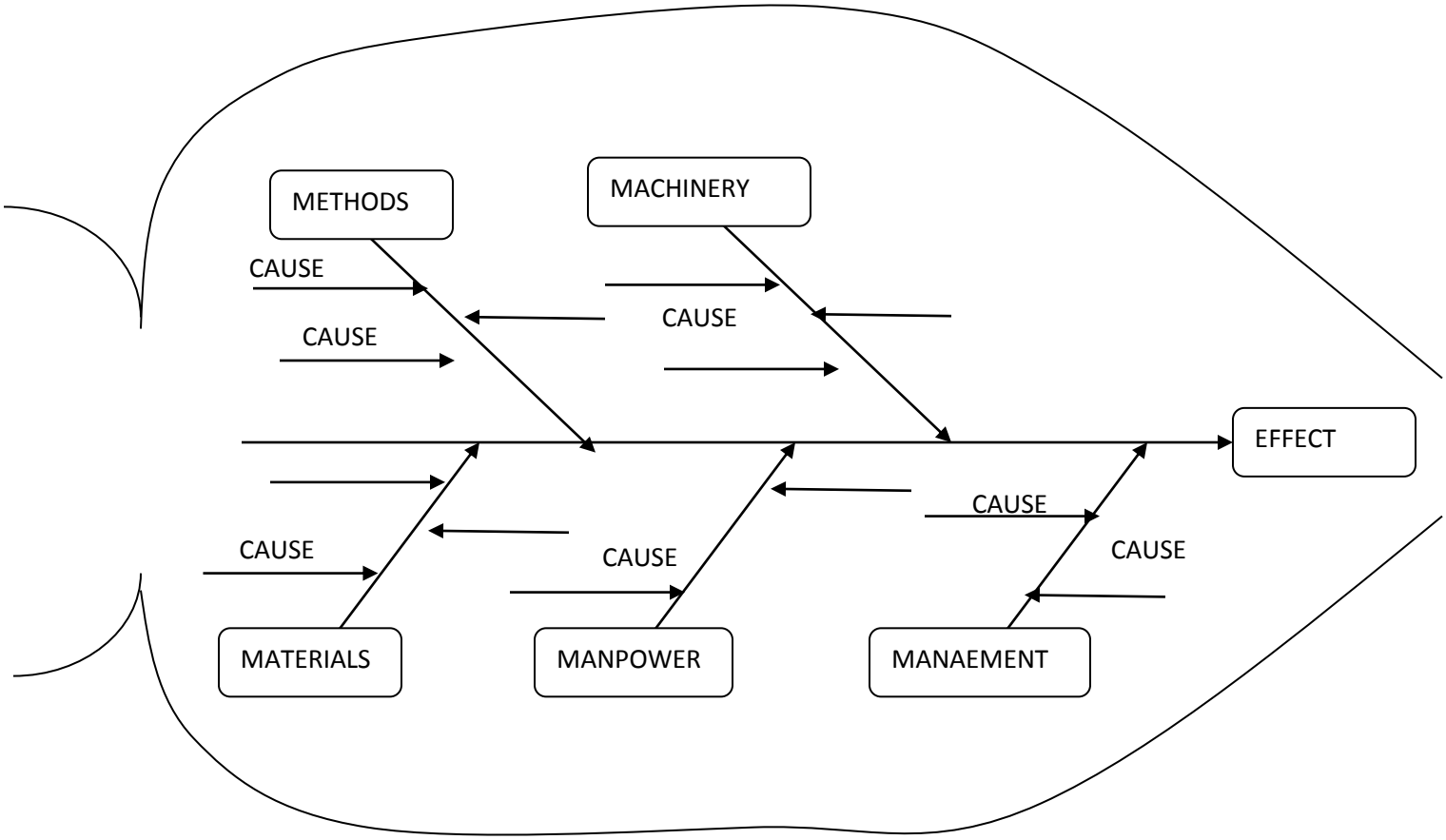


FIG4- THE ISHIKAWA DIAGRAM

2 CHECK SHEETS

Check sheet is also called as “defect concentration diagram”.

This is a tool that is a structured approach to collecting and analyzing data and is used for wide variety of purposes.

The check sheet approach is used in following situations-

- When data is observable and can be collected by the same person or at the same location.
- While collecting data on frequency/pattern of events or defect causes or defects etc.
- While gathering production process data.

Procedures of Check Sheet making-

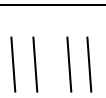
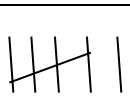
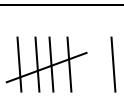
- Decide the problem to be observed.
- Decide what data is required to collected and over what time limit.
- Design the form for tabulation.
- Test the table for few readings and make sure that it collects the appropriate data.
- When each time the targeted event occurs record it in the table with tally mark.

  Example of check sheet-

  How the check sheet is to be used for various defects on the production line of a shaft being ground on machine.

DIAMETER OF A SHAFT (Φ50.00+-0.012) - Day wise defect data.

Table3: CHECK SHEETS EXEMPLE

REASON	DAY						
	MON	TUES	WED	THUS	FRI	SAT	TOTAL
Dia. undersize							25
Dia. oversize							22
Dia. oval							23
Total	13	15	13	12	9	8	70

3 CONTROL CHARTS

All the manufacturing processes in Industry have inherent variability and this is inherent in nature. These variations may be due to-

- Chance causes/random causes(This is unpreventable)
- Assignable causes (These are preventable).

The concept of control charts was developed by Dr. Shewhart in Bell laboratory. These charts separate the assignable causes from the random causes. These charts help the diagnosis and corrections of production problems and bring about improvements in the Quality and reduce the rejections.

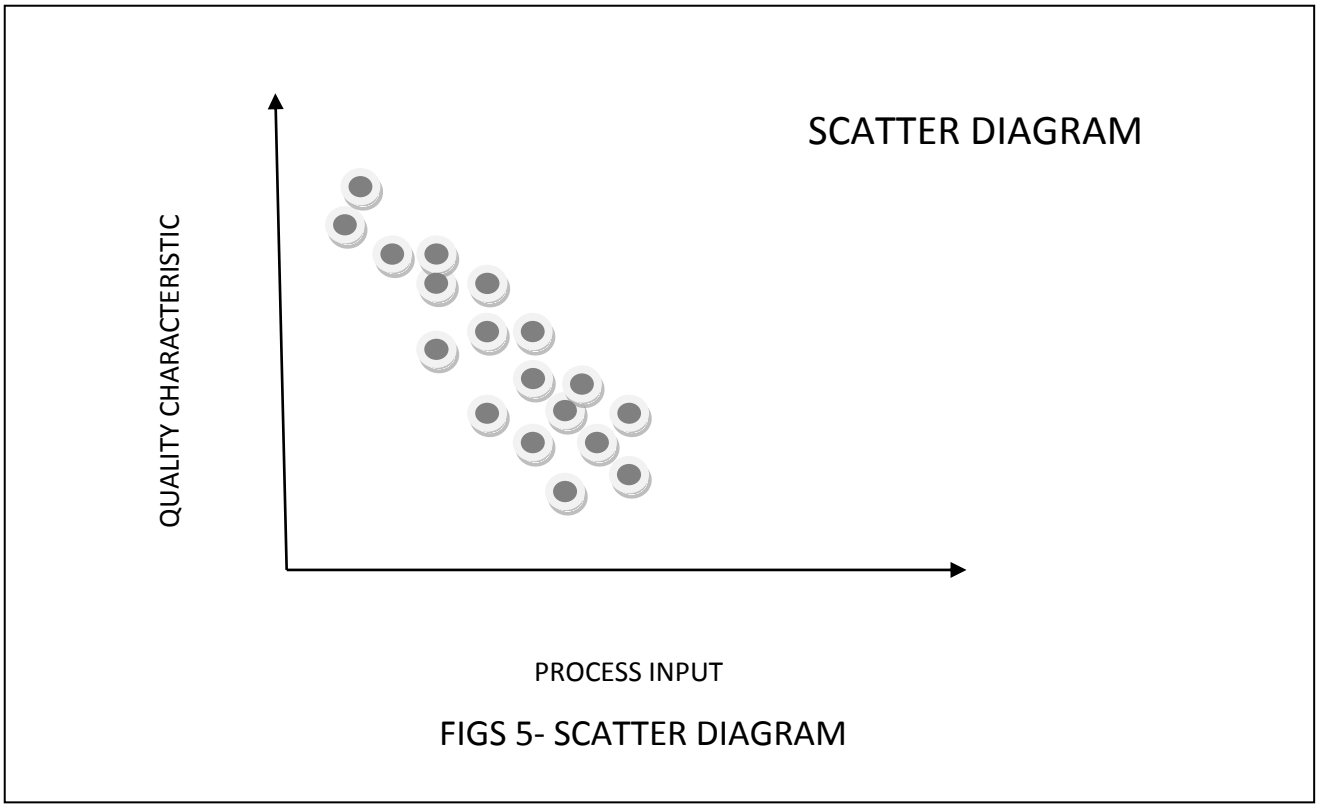
There are two types of charts.

- Control charts for the variables- These charts are used for the variable data.
- Control charts for Attributes- These are useful for the attribute data.

Control charts are extensively used in controlling the manufacturing processes in Statistical Process Control.

4 SCATTER DIAGRAMS

Sometimes it is essential to understand the relationship between two variables during the problem solving process. A relationship may or may not exist between the variables. The relationship could be weak or strong, positive or negative, simple or complex. Scatter diagram helps to study the relationship between the variables. It was first used by Francis Galton.



FIGS 5- SCATTER DIAGRAM

5 PARETO CHART

Wilfred Pareto invented this chart which contains the bar as well as line graph. Here the individual values are represented in descending order by bars and the cumulative total is represented by line graph.

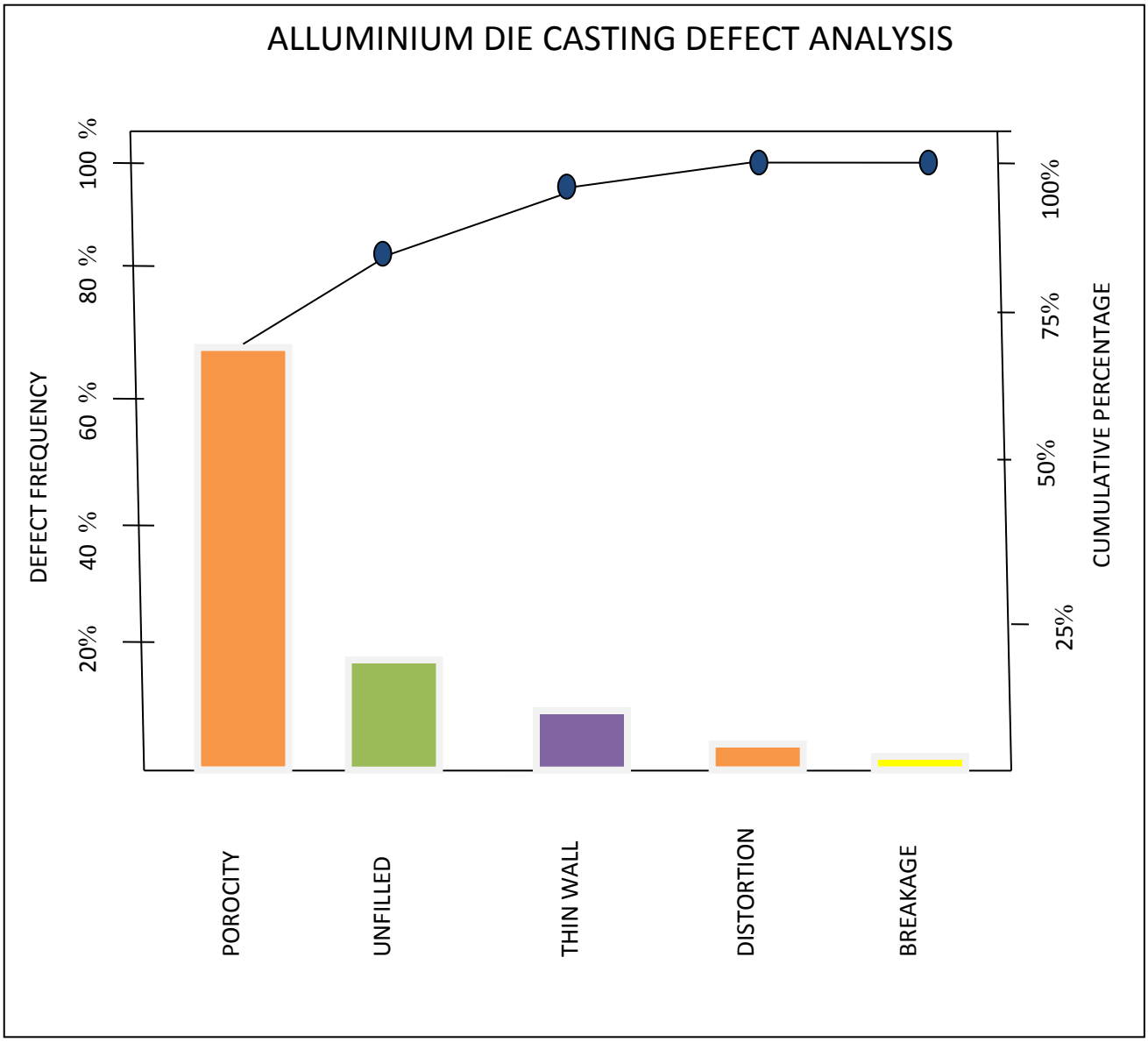


FIG 6- PARETO CHART

The Pareto chart was effectively used by Dr. Juran for the defect analysis. He clearly showed with this chart how the 80/20 rule can be used for the actions to prevent the defects in the components. He showed that by taking actions on 20 % of defects you can achieve 80 % control on the defects. It is also known as “vital few” and “trivial many” rule.

6 HISTOGRAM

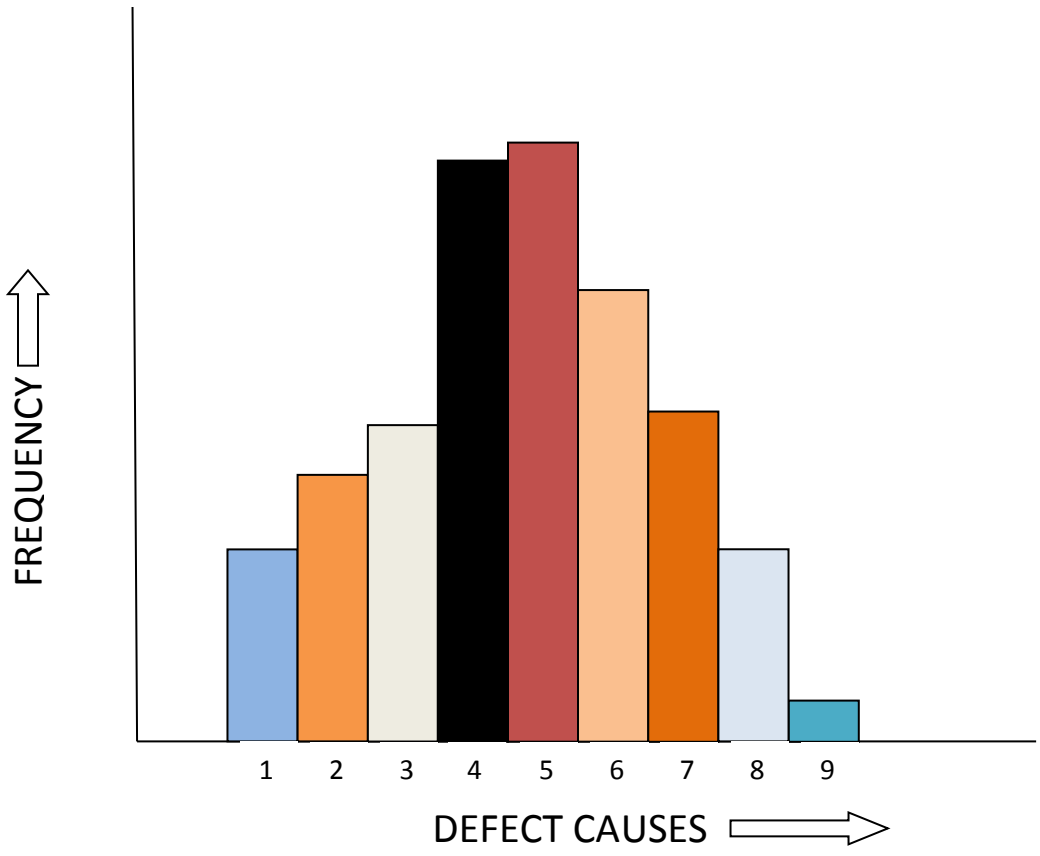


FIG 7- HISTOGRAM

Histograms are used in analyzing the patterns in data collected. The data is arranged in frequency intervals and then arranged as shown in Histogram. The Histograms are useful in studying the patterns in the different categories so arranged. These patterns help in drawing conclusions about the process under study.

7 FLOW CHARTS

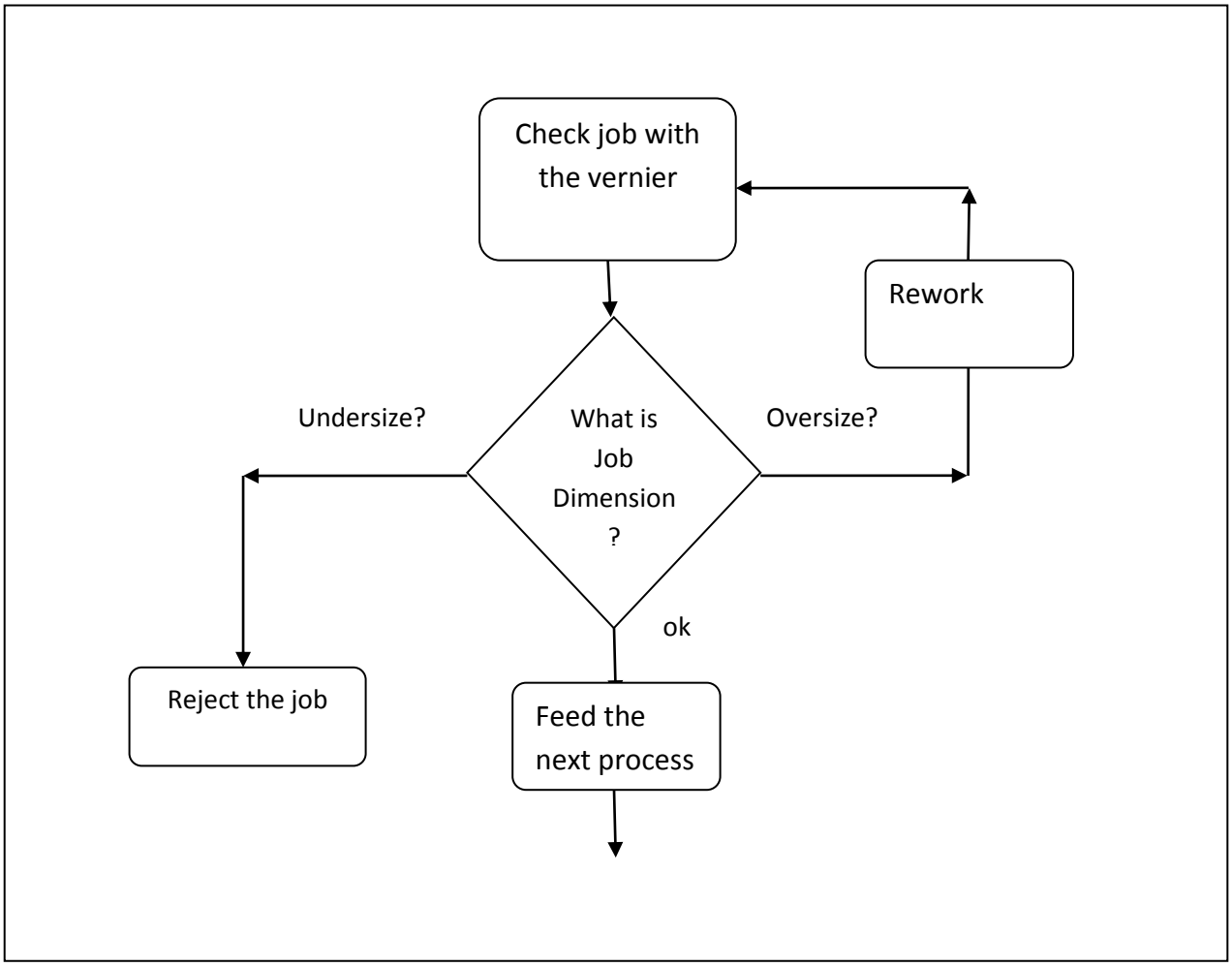


FIG 8- FLOW CHARTS

Flow charts are used to design and document processes and programmes. They help in understanding the process and the analyzer can map the process in small steps. The different flaws, problems, bottlenecks etc. can be understood by studying the flow chart. In the flow chart following are the conventions that are used to chart a process.

- The decision stage like making some choice is denoted by a diamond.
- The processing stage is also called as activity is denoted by a rectangle.

The flow chart drawing is generally done by a cross functional team drawn from different functional groups. The flow chart diagram shows a simple process of checking one dimension with the help of vernier caliper and finding out OK or NOT OKS jobs.

Here we need to understand the different concepts and terms that are used throughout this research thesis while explaining the Quality management of the organization.

1] A process-The concept of a process-

The entire gamut of manufacturing or even the service sector consists of different events that take place in sequence in response to a certain input received and the output given.

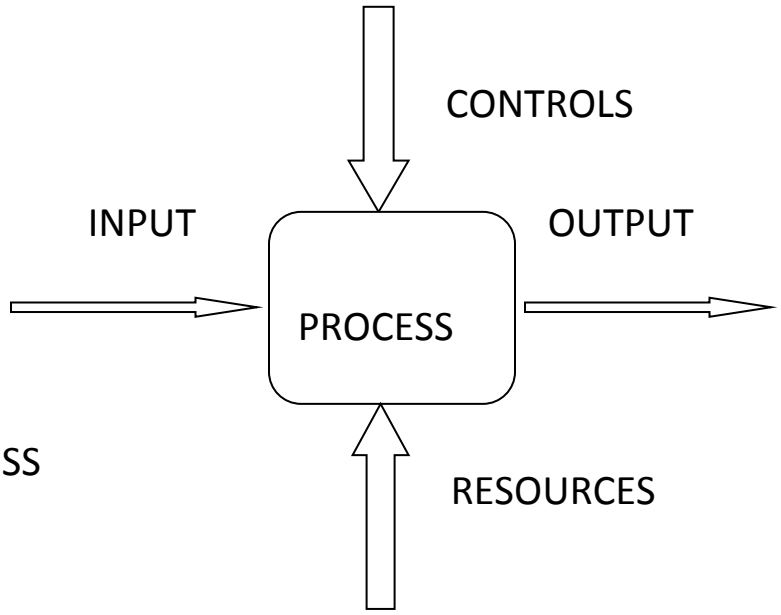


FIG 9- A PROCESS

Thus the process, with the help of the controls provided, converts the input into output. For the effective functioning of the organization, such numerous processes need to be identified and managed as linked processes. Linked processes are those processes which happen in sequential manner thus giving the final output of the larger process.

An activity using resources, and managed in order to enable the transformation of inputs into output with the help of controls can be considered as a “Process”. Many times, in a large process, the output from one process forms the input to the next proves. In fact the “process” is a unique combination of methods, machines, tools used for the process, materials and the people who run the processes like manufacturing goods, software, service like a computer programme, or answering a call on phone.

Such application of “system of linked processes” within the organization, together with the identification and interactions of these processes and their management is referred to as “process approach” towards the management of the organization. Such approach when used within the Quality management process and system puts a lot of importance on (Please also refer to the FIG-9)-

A] The understanding the customer requirements and the efforts required to meet the same.

B] Consider the different processes in the organization in terms of added value. The different processes while giving output add value to the final goal of the organization to meet the customer requirements.

C] Obtaining results of processes and effectiveness through the analysis and actions taken.

D] Continual improvement of processes based on objective measurement of various parameters of the processes.

2] Cost of poor Quality-

The customer satisfaction, no doubt, is the main aim of any organization but, particularly for the manufacturing organization, the "cost of Quality" (COQ) is a very important factor. In fact this concept is more focused when it is called as the "Cost of Poor Quality". Cost of achieving this goal of customer satisfaction is also very important as if the competitive factor "cost/price" is ignored then this will have a serious impact on the competitiveness of the organization. The profit margins of the OEM car manufacturing companies are really under pressure due to "Price conscious" car users (customers) and hence to keep their costs under control the OEM companies always try to squeeze the profit margins of their suppliers. Due to this cost cutting pressure on the entire supply chain of the car business the profit margins of the component suppliers are low generally in the range of 10 %.

Now if the cost of quality (COQ) is high then obviously the SME organization will tend to lose heavily in the profit margin thus making the business unviable.

It has been observed that many manufacturing organizations have a "cost of poor quality" in the range of 20% of the sales to 40% of the sales in case of organizations which have inefficient manufacturing systems.. This is huge cost and any auto component manufacturing SME organization cannot survive in the market with such cost. Hence there has to be a formal mechanism in the organization to find out what is the cost of poor quality every month, analyze the findings, and take corrective measures to ensure that the costs are under control. Such approach will ensure that the SME organization is not bleeding heavily due to unnecessary losses.

Thus the goal of the management should be a balance between the Quality and the cost factors. The management has the responsibility to build the manufacturing system such that the cost of quality will be as low as possible. In fact the Japanese system believes that all the efforts taken by the organization to correct the defective Quality is a "waste".

The management guru Philip B. Crosby has stated that "Quality is free" meaning that the culture of "doing the things right at the first time" should be encouraged rather than making defects and then spend money in correcting the defects.

The analysis and cost control on the Quality related costs is a very important management tool. It gives following two very important ways of doing it.

- Assessment tool to assess the effectiveness of management of Quality in the organization.
- A tool to determine the problem areas, opportunities, and savings in avoiding the quality related wastes and various action priorities throughout the manufacturing processes.

The COQ consists of various factors.

- Prevention costs.
- Appraisal costs.
- Internal failure costs.
- External failure costs.

A diagrammatic representation of the COQ is as under.

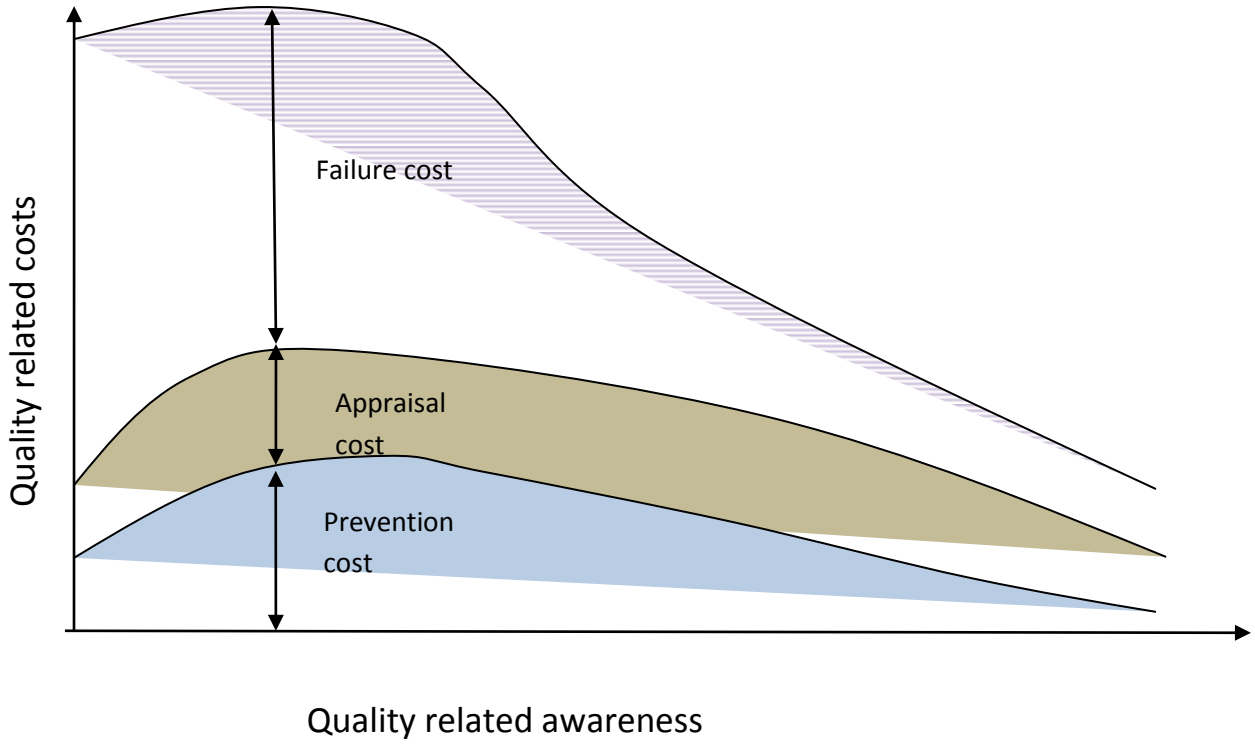


FIG 10- THE COST OF QUALITY

The concept of COPQ is diagrammatically represented in FIG 10 A.

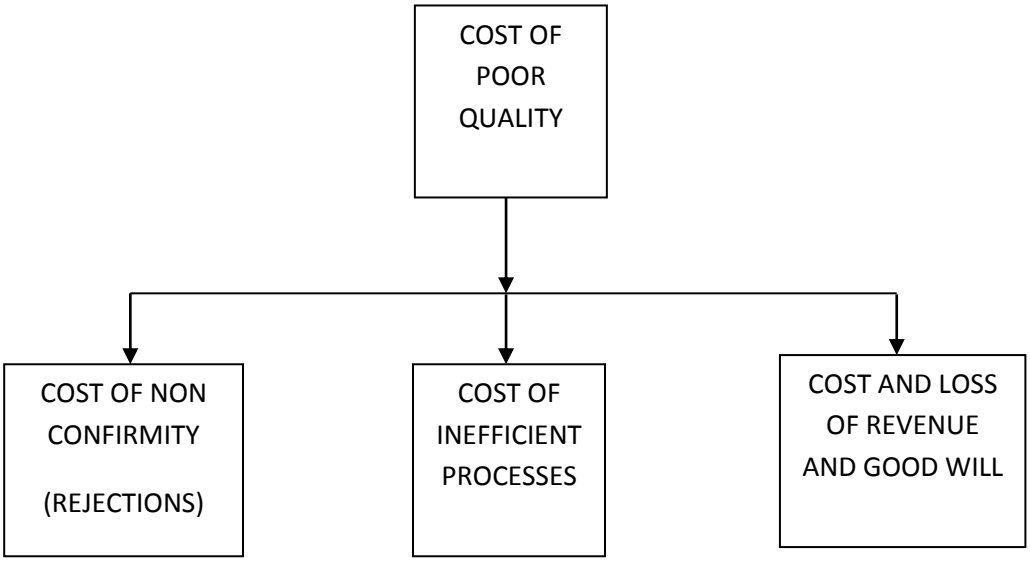


FIG-10 A- COMPONENTS OF COPQ

Let us consider these factors in detail as the concept of COQ is central to the efforts of organization to survive in the tough and competitive market.

- Prevention cost- Such costs are related to the efforts taken to prevent occurrence of Quality related issues. It includes the design, implementation and maintenance of Quality management system. The prevention costs are planned costs. The various preventive actions include such things as Quality planning, Quality assurance, inspection equipment, training of employees and service requirement etc.

- Appraisal costs-Such costs are associated with suppliers and customers costs related to evaluation of purchased material, processes, intermediates, products and services to assure conformance to specified requirements. Such costs include verification, quality audits, inspection equipment required for the verification and vendor rating etc.
- Internal failure costs- Such costs occur when the quality of product fail to achieve the required quality norms/standard. It could be because of errors, faulty processes, poor organization and faulty communication or faulty material etc. and such defects are detected before product reaches to the customer. Such costs include waste, scrap, rework and rectification, re-inspection, downgrading and costs for failure analysis.
- External failure costs- Such costs occur when the product is transferred to customer and then the defect is detected. These include repair and servicing, customer returns, warranty claims, customer complaints, liability claims and loss of goodwill etc.

The cost of poor quality is also very important term Please refer to FIG10A. In fact the COPQ (cost of poor quality) is required to be understood by the concerned organization owners to fully utilize the benefits of COPQ analysis and the actions that are taken based on the analysis.

It contains the costs that are associated with the internal and external rejections, the rework that has been done at various places to make the products confirm to quality like final assembly, the defective components and assemblies at the ware house, services after the sales and the customer dissatisfaction resulting out of the bad components.

It has been mentioned in many quality forums that the COPQ of many organizations (including organizations like the SME automotive organizations under study) is between 10-40 % of the revenue of the organization.

Relation between Quality and Competitiveness of the organization-

- For the concerned auto SME or for that matter any organization, the reputation that it enjoys with the customer or people at large, is built on Quality, reliability, delivery and

price which also called the factors of competitiveness. Of all these factors the Quality is the most important of all the competitive factors.

- Good or bad reputation for Quality can last for a long period in the minds of the customers and it is very difficult to correct the bad reputation for Quality.
- Quality is not merely meeting the functional characteristics of the product or service but it is meeting the customer requirements.
- Reliability is the ability of the product/service to continue to meet the customer requirements over time.
- The organizations can delight the customers by continuing to meet the customer requirements in Quality consistently and achieve the reputation for "Excellence".

The strategic decision of the organization to start, maintain and have consistency in robust Quality management system will lead to distinctive competency for the organization. A robust quality management system of an organization is often difficult to be duplicated by its rival competitors in short term and it often requires a long range efforts and qualified, trained and experienced employees to reap the benefits of good quality systems. This is a unique capability of the organization that gives it an advantage over its competitors. Also it must also be noted by the concerned SME that the Quality initiatives are critical success factor for the organization which means that such initiatives are what organizations has to do right to succeed in the competition.

Many organizations in the manufacturing have the direct internal rejection rate due to Quality related issues in the range of 2% to even up to 10% with many customer complaints and customer goods returns. Such kind of status of quality naturally will result in loss of revenues up to 2% to 10% thus leading to failure in competitiveness on each counts, Quality as well as costs.

QUALITY MODEL STUDY

Study of TS 16949 quality model as given in the TS16949 standard.-

As has been discussed in the foregoing chapters this standard is comprehensive quality standard and has been developed specifically for the automotive supply chain organizations with addition of customer specific requirements.

This model clearly shows that the requirements of the customer need to be studied in detail and the internal quality system should be designed in such a way as to satisfy the customer.

It also takes into account various important factors of manufacturing like resource management and how the product realization should be done.

This quality management as developed by the ISO/TS16949 standard is a comprehensive one which takes into account the responsibility of the management of the organization to manage the internal resources of the organization in such a way as to meet the ultimate goal of achieving the customer satisfaction.

It also takes into account the product realization process of the organization (which is also known as the production process) and how this process needs to be measured, analyzed and continually improved.

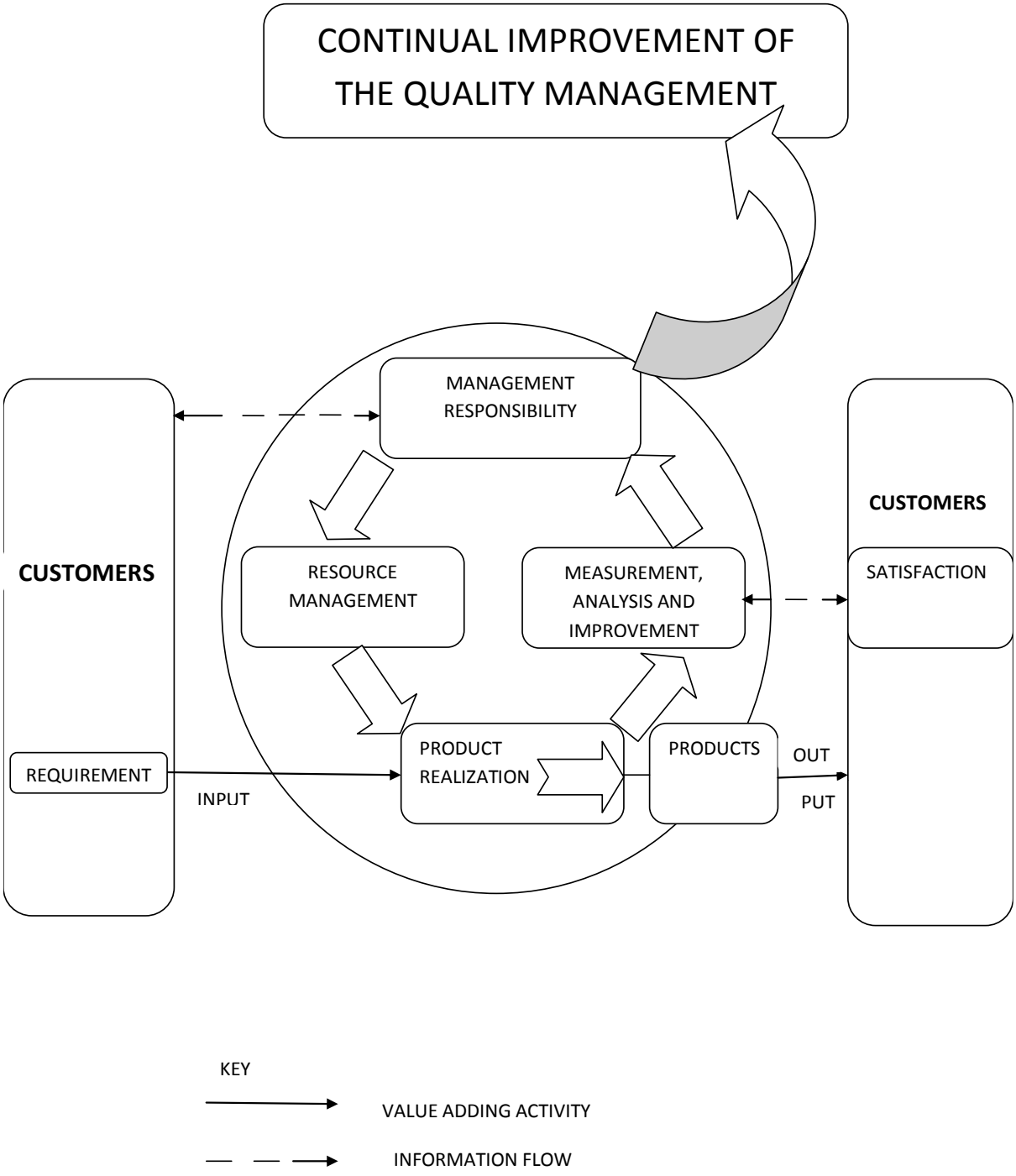
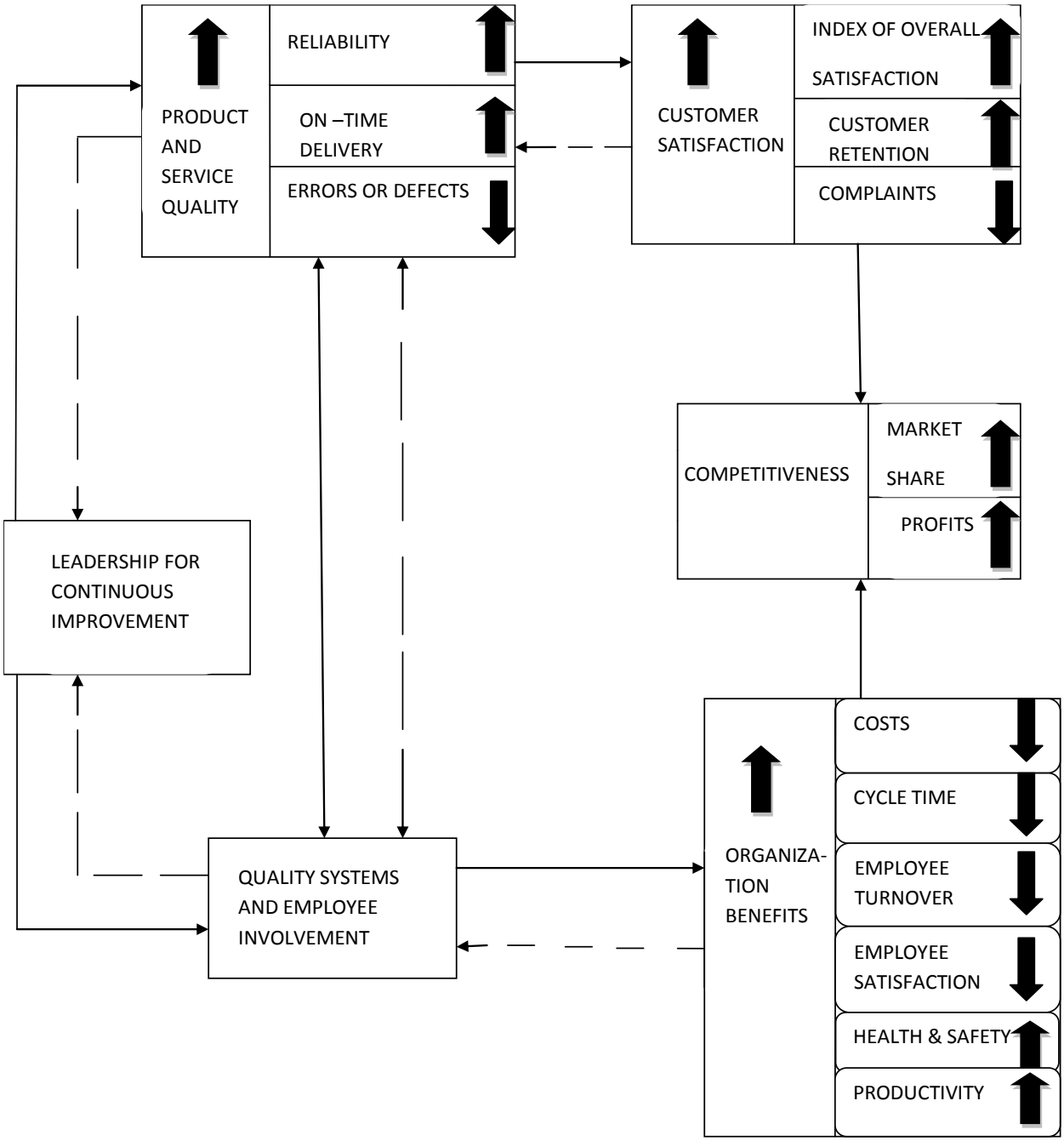


FIG2- MODEL OF A PROCESS- BASED QUALITY MANAGEMENT SYSTEM.

FIG 11- QUALITY MANAGEMENT SYSTEM

(QMS TS16949 STANDARD)



QUALITY MANAGEMENT MODEL

[GAO/NSIAD-91-190 MANAGEMENT PRACTICES (PAGE 14)]

FIG 12- ANOTHER QUALITY MODEL

The Quality management model as suggested in the FIG 12 is a model which considers various factors in management of the organization like leadership, quality, productivity, delivery, employee satisfaction etc. and discusses their interrelationship between them.

Any model of quality such as this will always have a very important goal as the customer satisfaction. These models give a very logical way of looking at the interrelationship between the variables and factors and help understand how at a glance the reader can grasp the complex system of various factors. Also the various ways the factors lead to each other is also important to note. The model gives a snap shot of the work of the researcher and what he means by the research he has conducted.

CHAPTER-3: THOUGHTS OF QUALITY GURUS

The discussion about quality is not complete without the detailed discussion about the "QUALITY GURUS".

1] Dr. Edward Deming

Dr. Edward Deming was an American statistician and professor and consultant. He is best known for his work in America during cold war and best known for his role in Japan. He changed the perspective of manufacturing and quality in Japan and pioneered a Quality Movement.

In Japan, 1950 onwards, he taught top management how to improve design, product quality, testing and sales through various methods including the application of statistical methods.

He has taught the operators and the senior management alike what approach to have towards quality and management. Deming advocated that all the managers need to have what he called System of Profound Knowledge which consists of four parts.

1. Appreciation of system- Must understand overall processes i.e. suppliers, producers, customers of goods and services. A thorough understanding of the different processes is a must.

2. Knowledge of variation-The range and causes of variation in Quality and use of statistical sampling in measurement. How and why of the variation that are caused in the manufacturing processes must be thoroughly understood by the managers.

3. Theory of knowledge- The concepts of knowledge and the limits of what can be known. A theoretical and practical knowledge is must management of processes.

4. Knowledge of psychology- The concepts of human nature to be understood. Since human beings operate and manage the different processes how behave and their psychology needs to be understood properly.

DR. DEMING'S 14 PRINCIPLES

Through his long term work in management of quality and manufacturing activities and his interactions with the people in manufacturing, he put forth 14 principles.

1. Create constancy of purpose with a plan-

   All concerned with quality must work together with a clear plan and must have clear objectives.

2. Adopt the new philosophy of Quality-

   He insisted on adoption of new methods like statistical process controls to improve the processes.

3. Cease dependence on mass inspection to achieve quality-

   He insisted on stopping the traditional method of mass inspection and switch over to reliable processes with SPC like technique.

4. End the practice of choosing suppliers on price alone-

   Previously the suppliers who were supplying components/subassemblies to the organizations were chosen on cost alone without much focus on quality. Thus there were inefficiencies and lack of quality focus. Usually huge costs were incurred due to rejections and mass inspections. He insisted on ending such practices.

5. Identify problem and work continuously to improve the system-

   He insisted on solutions of problems on a permanent basis and further improving the processes and the system continuously.

6. . Adopt modern methods for training on the job-

   As the focus of manufacturing was shifted from "checking quality" to "producing quality" the operators needed to be given new and modern training to make them suitable for the change.

7. Change focus from “Quantity” to “Quality”-

   The manufacturing organizations then were more worried about pushing the produced goods out of factory by mass inspection. Hence the focus was always more quantity rather than quality. It resulted in lot of quality failures and huge losses. Hence he insisted upon changing the focus from “Quantity” to “Quality”.

8. Drive out fear from organization so that everyone can work effectively for the company-

   He realized that the open communication between the work force and managers is a must for the quality revolution. Also the operators know much more about the processes on which they work. The fear in the minds of employees about speaking out openly about the work related issues is very important for the continuous improvement of the work place and processes.

9. Break down barriers between the departments- As the manufacturing processes and organizations are complex in nature they are divided in sections or departments. Specialized skills of the employees in those departments make that function effective. But such departmentalization of functions leads to individual goals being set for the departments. Such goals could lead to problems for the organization due to clashes between the departments. Hence Dr. Deming insisted on removing the barriers between the departments work as one unit for the well being of the organization.

10. Eliminate slogans, and targets for the workforce- (Ask for productivity only after providing the methods)- Dr. Deming believed in eliminating catch slogans like “Productivity first” and setting targets to operators. He said that first provide effective method of operation which is capable to produce the required results. He insisted on asking the productivity improvements only after proper provision of methods.

11. Eliminate numerical quotas for the workforce and numerical goals for the management-

He believed in putting full day work rather than giving the operators numerical targets. He also insisted that even the management should not be given any of the numerical targets but do their best in their work after careful planning.

12. Remove barriers that rob people of pride in their work, and eliminate the annual

ratings. There are many administrative measures that are taken to evaluate an employee and according to him such things rob people of their pride about their work and they do not participate in continuous improvements. The exercise of annual ratings is also such measure which discourages the full participation of employee in work.

13. Institute a vigorous program for education and self improvement for everyone- According to him educating and training employees and their self improvement only can improve the organization rather than administrative measures.

14. Create support of Top Management for all above points-

He believed in importance of top management in implementing the various points he has suggested. Hence the top management of the organization must believe in what Dr. Deming is saying and they need to support the implementation of the same.

PHILIP CROSBY

Philip Crosby started his consultancy in 1979 regarding education in Quality. During that period the American manufacturers were losing their market share to Japan due their superior quality. Philip Crosby proposed four principles-

- The definition of quality is conformance to requirements- According to Crosby the definition of quality is not restricted to dimensional but it includes every aspect of it including reliability.
- The system of Quality is prevention- He believed that the quality system in any organization should be such oriented that it prevents defects from occurring rather that checking and correcting it.

- The performance standard is zero defects- He says the standard of performance of any quality system in an organization must be Zero Defects rather than piece meal kind of targets.
- The measurement of quality is the price of non conformance- According to him quality is measured in monetary terms and it is the price of non conformance.

He promoted the phrases-

- Quality is free- Mr. Phillip Crosby argues that when a company that established robust quality programme, will see savings returns in terms of savings in cost of poor quality that more than pays off the cost of the quality programme. This is his ides of "Quality is free".

- Zero defects- He believes in having a quality system built with the intension of zero defects with prevention at its heart rather than detection.

- Right first time- He also believed that the quality system must assure processes that produce quality right at the first instance rather that reworking.

SHIGEO SHINGO

He was great guru from Japan and had a huge contribution in manufacturing and quality in Japan. Two aspects of his thinking got great attention-

1. SMED- How to accomplish drastic cut in set up time by single minute exchange of dies procedures.

   The technique of SMED is very important in case of manufacturing lines where the set up time of the individual machines or the entire line is large. Many organizations which make use of large machines like large press tools often require eight to ten hours to change the set up on the machine and start new die. Such delays were making the change over from one die to another die very time consuming and costly.

   This SMED technique as developed by Shigeo Shingo makes use of analysis of the set up time required. The set up consists of internal set up time and external set up time. The external set up time required are due to activities external to the set up, meaning they can

be performed without stopping the machine. The internal set up time is required due to internal reasons, meaning the machine has to be stopped to do it. The SMED technique converts the internal set up requirements into external one thus reducing the machine stop time. As the machine stop time is reduced drastically over a period all the necessary set up activities is done externally without stopping the machine. Due to this technique the organization can do set up change overs quickly thus giving better service to customer by way of more product variety as well as reduce internal set up costs.

2. Use of source inspection and the poka-yoke system to achieve zero defect.

   It has been found many times in the manufacturing scenario that mistakes done by the operators lead to internal rejections. If these rejected components escape to customers then major customer complaint can occur. To avoid such mistakes on the part of the operators this technique of poka-yoke (mistake proofing or fool proofing) is used. In this technique a detailed study and analysis of the set up and the production process under study is done. In such a study all concerned members of the manufacturing like operators, engineering staff, industrial engineering person, production in charge etc. come together and based on the analysis of the previous rejections/complaints a mistake proofing idea is used and relevant change is done in the process/fixture. Because of such change in fixture the operator can not commit the mistake again. The poka-yoke idea could be electrical/electronic/mechanical in nature.

KAORU ISHIKAWA

Ishikawa worked with Dr. Deming.

He advocated the use of “cause and effect diagram” in root cause analysis and made significant and specific advancement in quality improvement.

He also showed the use of seven quality tools to improve quality. He himself used these seven QC tools in his work extensively and advocated the use of them in day to day manufacturing environment.

1. Control chart.
2. Run chart.
3. Histogram.
4. Scatter diagram.
5. Pareto chart.
6. Flow chart.
7. Cause and effect diagram.
8. He improved the PDCA cycle to six stage cycle.

MICHAEL PORTER

Competitive strategy defined.

He is a leading authority in competitive strategy, the competitiveness and economic development of nations, states and regions and the application of these principles to health care etc. Some of his popular theories are-

1. Competitive advantage- Competitive advantage occurs when an organization acquires or develops an attribute or combination of attribute that allows it to outperform its competition.

   According to him the organizations should pursue systems and policies that create high quality goods which can be sold at high prices in the market.

1. Porter's five forces- This was developed during 1979 by him. This concept developed by him applies to organizations as well as nations. He has considered the different forces acting on the organization like the competitive forces of competitors as well as the forces as exerted by the suppliers and the customers. This is done in conjunction with SWOT analysis. The SWOT analysis (Strength, Weakness, Opportunity, strengths) of the organization focuses on the internal strengths and the weak areas of the organizations to focus on the external threats coming from market forces as well as the opportunities available.

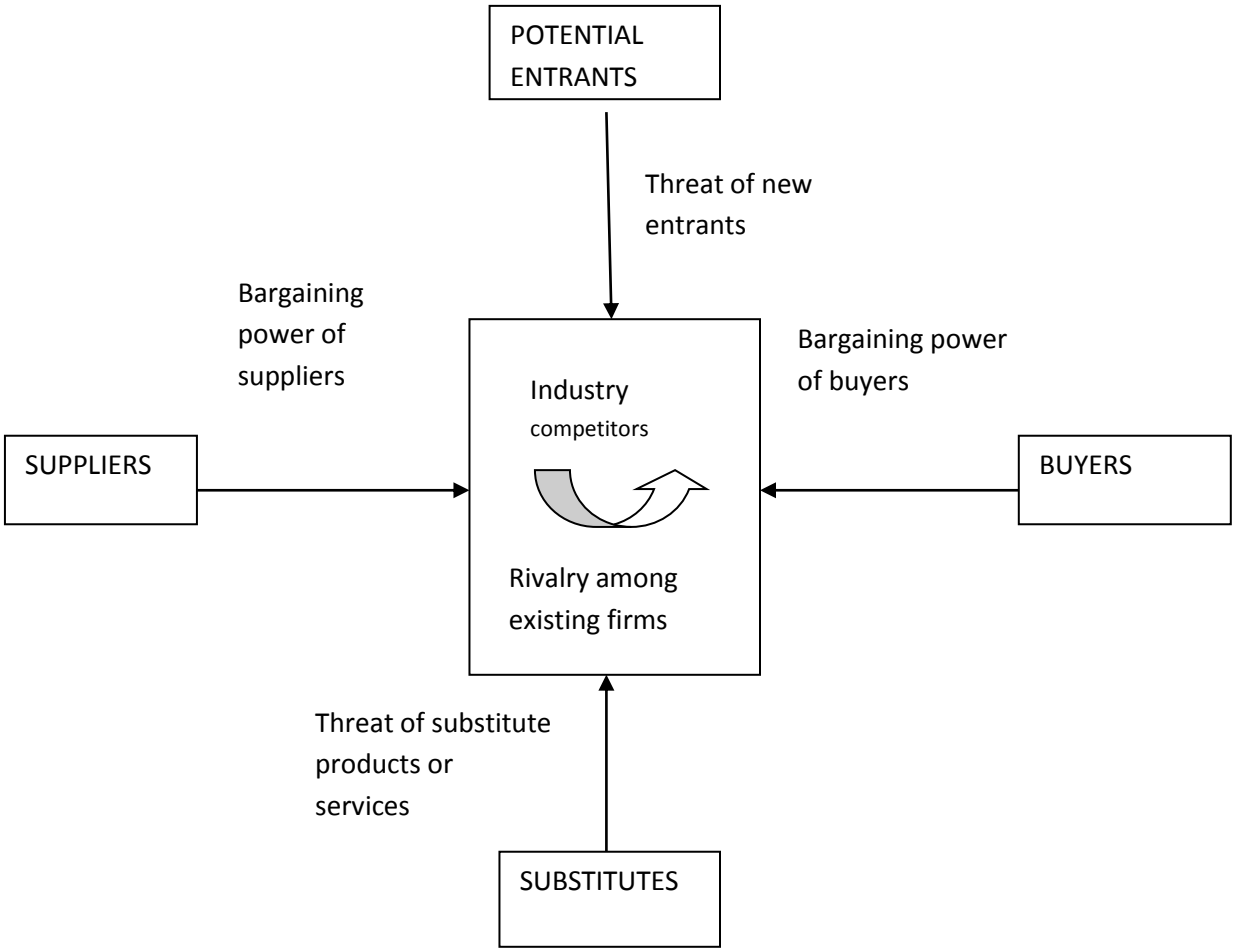


FIG 12 A- MICHEL PORTER – FIVE FORCES OF COMPETITION.

The five forces include-

- Three forces from the horizontal competition

1. Threat from substitute products- There are products in the market which can be a substitute to the products made by the organization. Such substitute products pose threat to the organization.

2. The threat of established rivals- The established rivals(competitors) in the market are obvious threat to the organization because they try to improve their processes, technology to gain competitive advantage.

3. The threat of new entrants- If there are no significant entry barriers then there could be an entry of a new competitor in the market thus threatening the organization and its products.

- Two forces from vertical competition.

1. The bargaining power of suppliers- If the products that are supplied by the supplier of the organization are specialized he will have a lot of bargaining power and thus may succeed in getting higher prices from the organization.

   Bargaining power of customers- Many times the customer is in a dominant position to negotiate due to multiple suppliers and big size of customer. In such situation the customer will try to reduce the margins of the organization

GENERIC COMPETITIVE STRATEGIES

As has been mentioned there are five competitive forces acting on the manufacturing firms like the SME organizations in this research. To cope up with these forces the organizations can use three generic strategic approaches like-

1. Overall cost leadership.
2. Differentiation.
3. Focus.

The overall cost leadership is a strategy whereby the organization keeps very close control over the internal costs and supplies the customer products with lower costs as compared to the competitors.

The differentiation strategy enables the organization to differentiate itself from the competition with some unique feature like excellent quality, brand image etc. This enables the organization to get higher margins and become more viable. Hence a differentiation strategy is best suited to the SME automotive organizations as only the cost leadership approach will not be viable in the long run because there will be many more organizations which ready to supply at lower costs. The differentiation like excellent quality is difficult to achieve in short run but with a sustained efforts the organization can definitely achieve this status and become competitive.

In the Focus strategy the organization concentrates on a particular segment or group of customers and has a focus only on supplying to them.

CHAPTER-4: CHARACTERISTICS OF AUTO SME ORGANIZATIONS IN PUNE DISTRICT.

The auto SME organizations in Pune district are a mix of first generation SME companies started by the owners around 20-25 years back and new generation SME organizations started by experienced and qualified engineers and managers. Most of them were started as engineering companies and later on converted into automotive SME organizations. Many of them are still managed by the founder owners. Some of the characteristics of such automotive SME companies from the perspective of this research could be listed as-

1. Many of the companies are managed by owners with little support from professionally trained quality professionals.
2. The limited revenues that are generated by the business, probably, do not allow the owner to employ highly qualified managers. At the same time those SME organizations that have good business employ professional quality managers.
3. The importance of Quality as competitive factor is not understood by the owners fully.
4. Even if they know that quality remains singularly important issue with the customers, SME owners do not have the required manufacturing background and education to manage the Quality function to its required level.
5. The profit margins of SME organizations are being squeezed by the OEM organizations because they themselves are under pressure to reduce the prices of the cars to remain competitive. Hence the availability of funds for the running of the organization is a problem thus leading to less allocation of funds for quality initiatives and equipments.
6. The ever changing quality norms and requirements of the highly technology oriented and demanding business like automotive components manufacturing requires extensive exposure to quality norms and manufacturing practices of the OEM organizations. Also to absorb such technology requires engineering and manufacturing talent which very few SME organizations possess.
7. The new entrant organizations in the auto SME sector are generally promoted by experienced qualified engineers. Some of them have good experience in manufacturing in reputed organizations thus enabling them to understand the requirements of the OEM companies in a better way and plan and operate their manufacturing set up accordingly.

8. The experienced and trained machine operators demand more wages and hence only the good profit making auto SME organizations can afford them and this makes such profit making organizations more competitive than other rival SME organizations that cannot afford them.

4.1 QUALITY FOCUS AS AUTO SME BUSINESS STRATEGY

It has been discussed in this research paper that the competitive factors are quality, price and delivery. These factors enable the automotive SME organizations to compete successfully with other rival competing organizations.

The definition of business strategy is a long term plan of action designed to achieve a particular goal or set of goals or objectives.

The SME organizations have limitations like lack of trained and well qualified business managers (Owners or professional managers) hence a formal exercise of strategy formation for the organization in view of the changing markets is not very common. Only SME organizations having robust revenue and profitability and a professional team can only think of such elaborate process of strategy formation.

The business strategy is a long term view taken by the SME based on the strengths and weaknesses of the organization. This enables the organization to take measures and redirect their resources like money, machines, equipment and manpower towards the competitive factors which can help the organization succeed in the competition with other SME organization.

Thus the quality being the most important requirement of the customers that is the OEM organization the focus of the automotive SME organizations must be on quality management and how the quality function can be strengthened to gain the customer loyalty.

Such Quality related business strategy should achieve one or more of following-

- Create customer loyalty and more demand for their products.
- Increased business volume.
- Ability to expect higher prices and hence become more profitable.
- Customer retention and repeat business from existing customers.
- Reduce their manufacturing costs as COPQ (cost of poor quality) has gone down thus resulting in lower operational costs.

CHAPTER-5 **RESEARCH METHODOLOGY**

5.1 INTRODUCTION

Research Design

"Research design is the plan and structure of investigation so conceived as to obtain answers to research questions. The plan is the overall scheme or program of the research. It includes an outline of what the investigator will do from writing hypotheses and their operational implications to the final analysis of data."(Business Research methods- By Donald R. Cooper and Pamela S. Schindler).

At this stage of the research the decisions regarding various enquires like what, where, when, how much and by what means need to be addressed by the researcher.

It is now clear from the definition of the Research Design is the conceptual structure within which the research will be conducted.

It will have details like the data base of the study, the collection, analysis and analysis of data.

In this research CAUSE AND EFFECT RELATIONSHIP between the various quality related initiatives in the automotive SME organization and the select indicators of performance will be focused for the purpose of study and it will be understood as to what type of relationship exists between them.

"Research Methodology" methods and techniques (By C.R. Kothari) has mentioned the features of "Research Design" as follows-

A. It is a plan that specifies sources and types of information relevant to the research problem.
B. It is a strategy specifying which approach will be used for the gathering of data and analyzing the data.
C. It also includes the time and cost budgets these being the constraints.

5.2 **RESEARCH TOPIC**

STATEMENT OF THE RESEARCH PROBLEM

"A study on impact of Quality initiatives on select indicators of performance in respect of selected SME manufacturing industrial units with special reference to automotive sector during the period of 2011 to 2014 in Pune district."

To survive in the global competition, sustainable performance is the need of manufacturing SME (Small and medium scale enterprises) in automotive sector. In order to achieve that envisaged performance certain Quality initiatives need to be implemented and parameters of quality need to be fixed.

Here Quality initiative implementation means Initiation (understanding of concepts and principles), Adoption (Preparing and planning), Adaptation (Monitoring, adjusting manufacturing processes and continually improving).

However there is gap between envisaged performance and actual performance vis-a-vis quality which is due to improper implementation or absence of tools and techniques of Quality management and lack of employee understanding. Such quality initiatives will result into performance of the organization like increase in turnover etc. The researcher will attempt to find what select indicators of quality related initiatives have been implemented in the organization and what are select indicators of the growth of the organization and whether there is any relationship of any kind that exists in the level of quality initiatives and the level of select indicators of performance.

The scope of this thesis will be automotive sector SME manufacturing industries in Pune district during 2011 to 2015.

Let us now list down the factors which will indicate the performance of the organization.

5.3 OBJECTIVES OF RESEARCH

The main objectives of study are-

A. To study different universally accepted quality initiatives and techniques that are implemented in automotive vendor SME companies in Pune district and the gap between the expectations of the OEM companies from the vendors and the actual practices in automotive SME industrial units.
B. To study how and what internal benefits these SME companies are getting out of such quality initiatives like data collection, analysis and action taken for lowering of their cost of quality, data collection, analysis and action taken for reduction in customer complaints and customer returns etc. which will lead to customer satisfaction and hence more business.
C. To study the results of how such quality initiatives help the SME sector companies in gaining advantage externally like competitive advantage through Quality, customer satisfaction through awards like Quality awards, best supplier awards, Production related award, logistics (delivery) related awards etc. and whether they are achieving further growth.

5.4 SCOPE AND LIMITATIONS OF STUDY

The present study will focus mainly on impact of quality initiatives (and related practices) by target SME industrial units which are suppliers to automotive supply chain companies in automotive sector in Pune district on select indicators of performance during 2011 to 2015. This study will take into account the various quality related initiatives undertaken by the automotive sector suppliers of manufactured components companies to the automotive supply chain

especially to the OEM companies and the select indicators of performance. The OEM car manufacturing companies have a clear requirement for their suppliers that they should be TS16949 certified companies. Also it is expected that their II tier suppliers and the III tier suppliers should also be TS 16949 certified companies.

Limitations of the study

1. Data collected may not be sufficient / exact as some of the target SME industrial units may not be ready to disclose data which is confidential to them.
2. Few of SME owners / senior management people may not be aware of the latest development in the quality requirements of the product/components and the modern techniques and tools in the Quality practices.

5.5 HYPOTHESIS

RESEARCH HYPOTHESIS

Ho (Null hypothesis)- Implementation of Quality initiatives and techniques by automotive manufacturing SME industrial units may not result in achieving performance of organization.

HA (Alternate hypothesis)- There is a gap between the expectations about Quality initiatives from SME and actual fulfillment of such Quality related customer requirements due to ineffective implementation of Quality initiatives by SME industrial unit management/owners.

5.6 SAMPLE DESIGN

The different aspects of the sample design are explained as bellow-

1. Population- The Automotive industries in Pune district in the automotive manufacturing SME sector will be studied for the research study. The Industrial Directory (Eighth edition published in 2012-13) of Pune as published by the Mahratta Chamber of Commerce, Industries and Agriculture (MCCIA) has been taken as the reference directory for finding out the population and relevant samples. As is clear from referring the directory there are many

industries that are listed under the Automotive sector but the eligibility of the enterprise to be included in the population is subject to following criteria-

A] The SME organization is a manufacturing unit.

B] The manufacturing SME unit is in Pune district. C] The unit is in the category of engineering manufacturing SME (small and medium enterprise) and does not fall into other category like micro or big size company.

D] The enterprise is automotive component manufacturing Vendor Company and is from one of the categories of vendors like First Tier automotive vendor (Supplying directly to OEM car manufacturing Company), Second Tire automotive vendor (supplying to the First Tire Company) or Third Tire automotive vendor (Supplying to the Second Tire Company). The SME organizations which are supplying to automotive as well as engineering companies are included in the population. The companies which are engineering SME companies and supplying solely to engineering goods manufacturing companies and are not supplying to automotive sector supply chain are not included in the survey.

E] SME organizations which are automotive related but are not manufacturing companies like auto component stockiest, automotive garages, automotive servicing organizations etc. are excluded from the list.

2. Sample- Appropriate number of SME automotive organizations in auto component manufacturing will be selected for the purpose of survey. The Quality heads, Plant heads, in charge person or owner of the selected SME industrial units will be interviewed by telephone by the researcher with the help of Schedule designed.
3. Sample frame (Source list)- The research will be carried out with reference list prepared from the institutional data as available from MCCIA automotive industry data (Industrial Directory of Pune Auto/Auto ancillary sector). The list is attached herewith which contains data of all the automotive SME organizations contained in the publication. There are around 211 SME organizations eligible to be included in the list. There are many organizations registered in the publication but many of them are automotive garage, service organizations, battery suppliers etc. and they are excluded from the list.
4. Sample size- A sample size of **40** automotive SME manufacturing industrial units will be taken for present study and data collection through telephonic interviews will be carried out

on their Quality related initiatives implementation in the organization and select indicators of performance.

5. Sampling Technique- The samples from the source list will be selected by purposive sampling method for different locations of the Pune district. Within the given location the different SME organizations have been selected randomly.

5.6.1 SOURCES AND METHODS OF DATA COLLECTION

Sources and Methods of data collection- This research study will contain both primary as well as secondary data for the research study.

The *primary data* are those which are collected afresh and for the first time and thus happen to be original in character

(*Research Methodology*, Methods and techniques by C.R.Kothari).

In this case of research the primary data is being collected by telephonic interviews with the help of a detailed schedule (Please refer to the annexure for the schedule).

All the detailed discussion with the respondents (which happen to be the authority that is responsible to achieve the quality in the automotive SME organization) is immediately entered into the schedule paper. All the documents thus generated are preserved for further references. These sets of records of all respondents are used to prepare the tabulation for the statistical data analysis to test the hypothesis and interpret the other aspects of findings.

The *secondary data* are those which have already been collected by someone else and which have already been passed through the statistical process. (*Research Methodology*, Methods and techniques by C.R.Kothari).

5.6.2 PRIMARY DATA COLLECTION

In this research the primary data collection is done through telephonic interview with the respondents. The advantages of data collection through telephonic interviews are-

- It is more flexible compared to mailing method.
- It is faster than other methods.
- It is cheaper than personal interview method. Here cost per response is relatively low.
- Recall is easy.
- There is higher rate of response.
- Replies can be recorded without causing embarrassment to respondents.
- Interviewer can explain the requirements more easily.
- Sometimes access can be gained to respondents who otherwise cannot be contacted for some reason.
- NO field staff is required.
- Representative and wider distribution of sample is possible.

However there are some disadvantages of this method of data collection. One important shortcoming is that the questions have to be short and to the point. Extensive probes are difficult to handle.

Here the researcher has taken this aspect into consideration and the questionnaire schedule is so designed that the questions are short and to the point.

The important features of this schedule are as under-

A. A combo model of dichotomous questions (Yes or No), open and closed ended(alternative answers listed) questionnaire schedule has been framed which will collect details about the quality initiatives and the select indicators of performance of the organization over last few years i.e. 2011 to 2014.
B. Detailed objective telephonic interviews of the management person/directors/Quality related senior employee/owner etc. who are responsible for the achievement of Quality has been conducted.
C. Relevant information/data published by various OEM car manufacturing authorities through publication/websites has been considered.

The main requirement of the OEM organizations in automotive sector is that their suppliers must be TS16949 certified as well as their tier II and tier III suppliers also should be Ts 16949 certified or at least ISO9001 certified.

D. The questions have been designed to be short and to the point so that answers do not require too much thinking or deliberations. As the respondents are senior management persons in the SME organization they are really busy hence this approach has helped to complete the interview in a reasonable time.
E. The size of the schedule has been kept optimum that is it covers the research requirements in detail at the same time it is not too lengthy. The questions are logically arranged so that the respondents find it easy to answer. Some difficult questions are asked at the end of the schedule. The wording of the questions is so chosen that there is clarity of meaning and technical jargon is avoided.
F. Sufficient space has been provided on the interview schedule for recording the answers of the respondents.

5.6.3 SECONDARY DATA COLLECTION

Secondary data-

Articles from various sources about this subject e.g. books, periodicals, journals, dissertations; thesis, working papers, expert opinions, and websites of various organizations and reputed OEM companies will be the source of secondary data.

5.6.4 METHOD OF ANALYSIS AND STATISTICAL TOOLS

Method of Analysis and statistical Tools used in data Analysis and Hypothesis testing-

This study involves collection, editing, coding, classification and tabulation of collected data so that they are amenable to analysis. Then the analysis of data which refers to computation of certain measures along with searching for patterns of relationship that exists among the data groups.

Various statistical tools like Levene's Test for Equality of variances, t-test for equality of means, ANOVA test etc. are used to test the relationship between the variables. Also the frequency distribution and the various percentages of the respondent data are also used in this analysis.

CHAPTER-6 ANALYSIS AND INTERPRETATION OF DATA

6.1 INTRODUCTION

In this research analysis following topics are discussed.

- Summarizing the data collected.
- Identifying the various relationships between the variables.
- Compare the variables.

6.2 TABULATION

The questionnaire schedule for the collection of the data is attached in the annexature. The tabulation of the data is presented in a spreadsheet for the interpretation. The spreadsheet is a large one and cannot be fitted in the A4 format hence is available separately filed in a folder.

Analysis of data is a process of transforming and modeling data with the aim of discovering useful information. This analysis will help in suggesting conclusions ans the decision making as per the goals decided in the beginning of the research.

6.3 STATISTICAL ANALYSIS

The statistical analysis here includes the Reliability of the questionnaire as well as the data analysis of the data as collected from the senior management of the automotive SME organizations in Pune district. Here data is collected and analyzed to answer questions, test the relevant hypothesis as decided.

6.3.1 RELIABILITY OF QUESTIONNAIRE

Reliability of the questionnaire:

The questionnaire for pilot study includes 6 demographic questions, 22 questions related to study.

The reliability of the questionnaire using 22 questions is calculated as follows.

Table4: Reliability of questionnaire analysis

Item-Total Statistics			
Questions	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Cronbach Alpha if Item Deleted
Q7	14.4000	54.267	.964
Q8	14.6000	49.156	.955
Q9	14.7000	46.678	.951
Q10	14.5000	51.611	.957
Q11	14.8000	45.067	.949
Q12	14.7000	46.678	.951
Q13	14.7000	46.678	.951
Q14	15.1000	47.433	.955
Q15	14.8000	45.067	.949
Q16	14.8000	45.067	.949
Q17	14.8000	45.067	.949
Q18	14.8000	45.067	.949
Q19	14.8000	45.067	.949
Q20	14.8000	45.067	.949
Q21	14.7000	46.678	.951
Q22	14.8000	45.067	.949
Q23	15.0000	46.444	.953
Q24	14.9000	45.433	.951
Q25	14.8000	45.067	.949
Q26	14.8000	45.067	.949
Q27	15.0000	46.444	.953
Q28	15.2000	58.622	.972

Table5: Reliability statistics

Reliability Statistics	
Cronbach's Alpha	N of Items
.955	22

The reliability of the questionnaire i.e. the Cronbach alpha = 0.955

Hence the Cronbach alpha & reliability of the questionnaire is good.

If the reliability alpha (if the question deleted) is less than 0.955, then the corresponding question is important (must be kept in questionnaire). If the reliability alpha (if the question deleted) is greater than 0.955, then the corresponding question is unnecessary (must be removed from questionnaire).

Since there is no high variation of the reliability alpha (if the question deleted) from the Cronbach alpha, which is 0.955; all the questions are equally important & kept in the questionnaire for main study.

6.3.2 -ANALYSIS -A

Table1: Frequency distribution of responses according to Age of Organization

The frequency distribution of responses according to Age of Organization is given below along with its bar graph.

Table6 : Age of organization

Age of Organization	Frequency	%
Below 5 Years	1	2.50
5 to 10 years	7	17.50
10 to 15 years	13	32.50
15 to 20 years	3	7.50
20 to 25 years	9	22.50
25 to 30 years	4	10.00
30 to 35 years	3	7.50
Total	40	100.00

FIG 13- AGE OF ORGANIZATION

Summary:

There are 2.5% & 17.5% organizations with age ‘Below 5 Years’ & ‘5 to 10 years’.

There are 32.5% & 7.5% organizations with age ‘10 to 15 years’ & ‘15 to 20 years’

There are 22.5% & 10% organizations with age ‘20 to 25 years’ & ‘25 to 30 years’

There are 7.5% organizations with age ‘30 to 35 years’.

Table2: Frequency distribution of responses according to Category of Organization

The frequency distribution of responses according to Category of Organization is given below along with its bar graph.

Table7 : Category of organization

CATEGORY	Frequency	%
PARTNERSHIP	7	17.50
PROPRIETARY	16	40.00
PVT.LTD.	17	42.50
Total	40	100.00

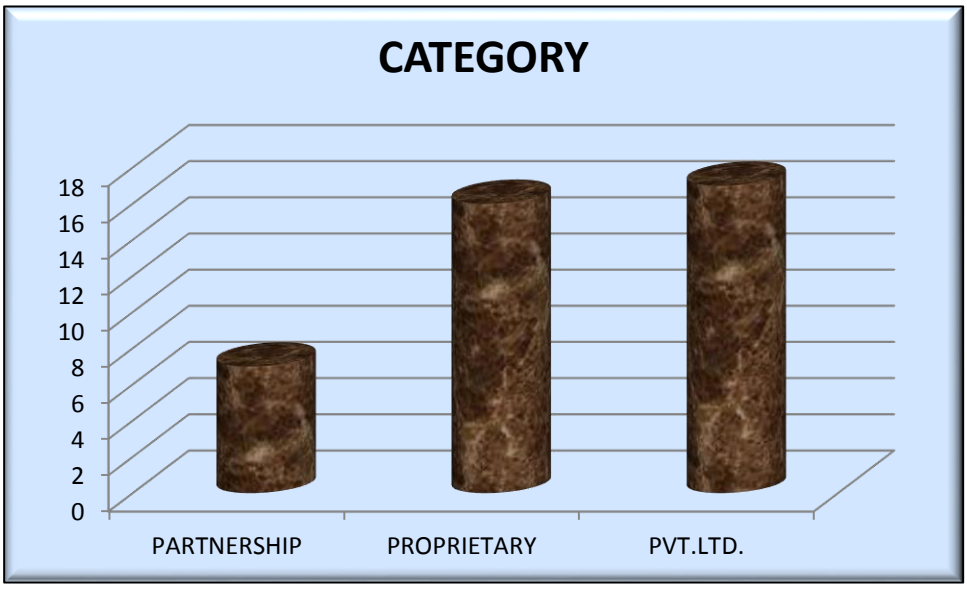


FIG 14- CATEGORY

Summary:

There are 17.5% organizations of category ‘Partnership’.

There are 40% organizations of category ‘Proprietary’.

There are 42.5% organizations of category ‘Private Limited’.

Table3: Frequency distribution of responses according to Designation

The frequency distribution of respondents according to Designation is given below along with its bar graph.

Table8 : Designation of respondents

DESIGNATION	Frequency	%
DIRECTOR	3	7.50
FACTORY INCHARGE	1	2.50
HOD(Production)	1	2.50
HOD(QUALITY)	16	40.00

OWNER	16	40.00
PLANT HEAD	1	2.50
SR. QA.	1	2.50
UNIT HEAD	1	2.50
Total	40	100.00

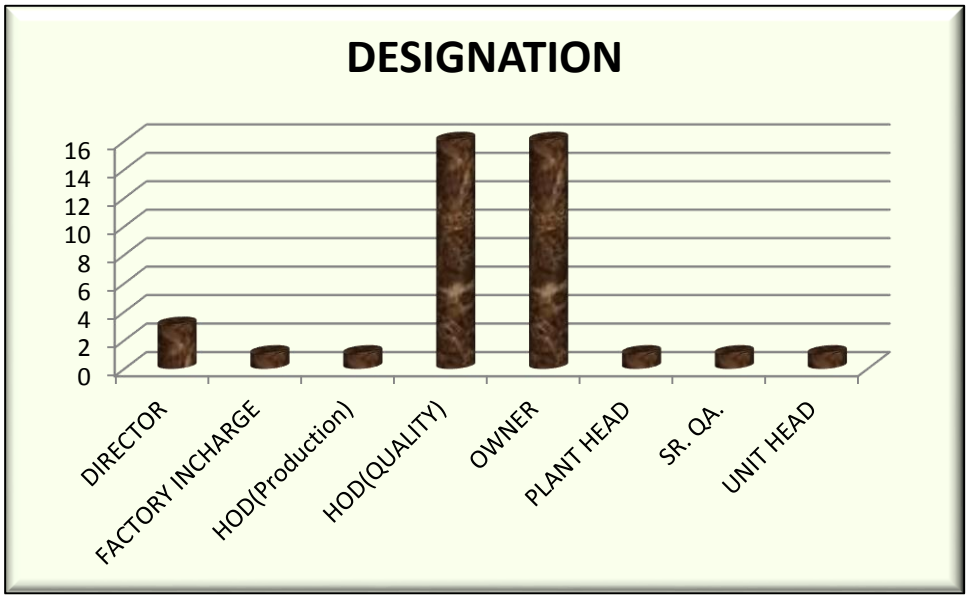


FIG 15- DESIGNATION

Summary:

There are 7.5% respondents of designation ‘Director’.

There are 2.5% respondents of designation ‘Factory In charge’.

There are 2.5% respondents of designation ‘HOD (Production)’.

There are 40% respondents of designation ‘HOD (Quality)’.

There are 40% respondents of designation ‘Owner’.

There are 2.5% respondents of designation ‘Plant Head’.

There are 2.5% respondents of designation ‘SR. QA.’.

There are 2.5% respondents of designation ‘Unit Head’.

Table4: Frequency distribution of responses according to Type of Organization

The frequency distribution of responses according to Type of Organization

is given below along with its bar graph.

Table9: Type of organization

Domestic/export	Frequency	%
DOMESTIC	28	70.00
DOMESTIC+EXPORT	12	30.00
Total	40	100.00

FIG 16- DOMESTIC/EXPORT

Summary:

There are 70% organizations of type ‘Domestic’ & 30% organizations of type ‘Domestic + Export’.

Table5: Frequency distribution of responses for ‘Q7: What importance do you assign to Quality in your organization?’

The frequency distribution of responses for ‘Q7: What importance do you assign to Quality in your organization?’ is given below along with its bar graph.

Table10 : Importance to quality

Importance to The Quality	Frequency	%
Very important	37	92.50
Important	3	7.50
Somewhat important	0	0.00
Not important	0	0.00
Total	40	100.00

FIG 17- IMPORTANCE TO QUALITY

Summary:

There are 92.5% organizations assigning quality as ‘Very Important’ & 7.5% organizations assigning quality as ‘Important’.

There are none organization assigning quality as ‘Somewhat Important’ & ‘Not Important’.

Table6: Frequency distribution of responses for ‘Q8: Do you have a documented Quality System?’

The frequency distribution of responses for ‘Q8: Do you have a documented Quality System?’ is given below along with it’s bar graph.

Table11 : Documented quality system

Documented Quality System	Frequency	%
No	4	10.00
Yes	36	90.00

Total	40	100.00

FIG 18- DOCUMENTED QUALITY SYSTEM

Summary:

There are 10% organizations not having documented quality system & 90% organizations having documented quality system. This clearly indicates that 10 % organizations do not have even a basic quality system in existence in their company.

Table7: Frequency distribution of responses for ‘Q9: Does the Quality system include Quality Assurance Manual?’

The frequency distribution of responses for ‘Q9: Does the Quality system include Quality Assurance Manual? It is given below along with its bar graph.

Table12 : Quality assurance manual

Quality Assurance Manual	Frequency	%
No	6	15.00
Yes	34	85.00
Total	40	100.00

FIG 19- QUALITY ASSURANCE MANUAL

Summary:

There are 15% organizations not having quality assurance manual & 85% organizations having quality assurance manual. It clearly shows that 15 % SME organizations even do not have a quality assurance manual in place meaning that most basic requirements of the customer are ignored.

Table8: Frequency distribution of responses for ‘Q10: Are there written Work Instructions?’

The frequency distribution of responses for ‘Q10: Are there written Work Instructions? It is given below along with its bar graph.

Table13 : Written work instructions

Written Work Instructions	Frequency	%
No	4	10.00
Yes	36	90.00
Total	40	100.00

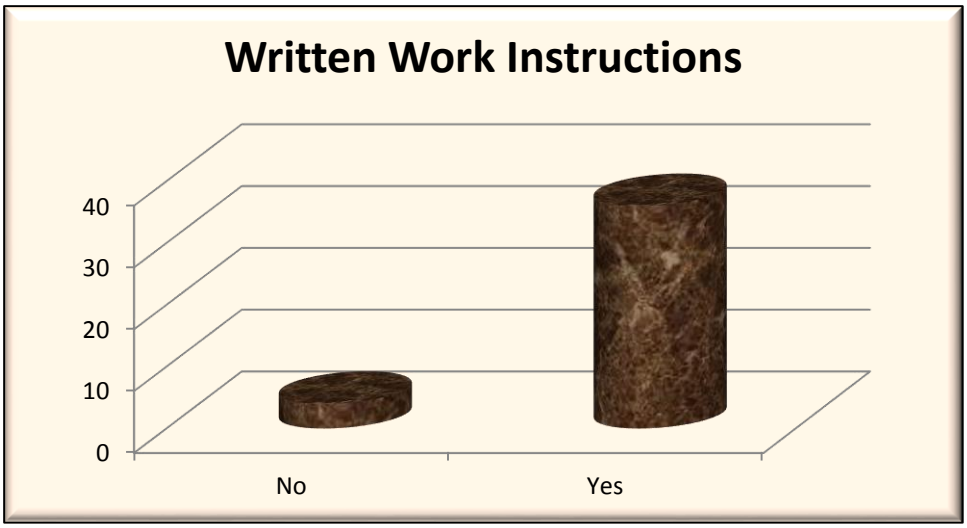


FIG 20: WRITTEN WORK INSTRUCTIONS.

Summary:

There are 10% organizations not having written work instruction & 90% organizations having written work instruction. It means that 10 % SME organizations operate their processes without written work instructions which is again the most basic requirement of a supplier to a OEM company.

Table9: Frequency distribution of responses for ‘Q11: Is quality function deployed in departments in company like production, purchase, stores, HR?’

The frequency distribution of responses for ‘Q11: Is quality function deployed in departments in company like production, purchase, stores, HR?’ It is given below along with its bar graph.

Table 14 : Quality function deployment in Production, purchase, stores.

Quality Function deployed in departments in company like production, purchase, stores, HR	Frequency	%
No	10	25.00
Yes	30	75.00
Total	40	100.00

FIG 21- QUALITY FUNCTION DEPLOYMENT

Summary:

There are 25% organizations not having Quality Function deployed in departments in company like production, purchase, stores, HR & 75% organizations having Quality Function deployed in departments in company like production, purchase, stores, HR.

It means that 25 % SME organizations do not follow the mandatory requirement of the OEM organization to deploy the quality system in the entire organization and to have a cross functional approach.

Table10: Frequency distribution of responses for ‘Q12: Is cost of poor quality related data identified, collected, analyzed and actions taken?’

The frequency distribution of responses for ‘Q12: Is cost of poor quality related data identified, collected, analyzed and actions taken?’It is given below along with its bar graph.

Table15 : COPQ data analysis

Cost of poor quality related data identified, collected, analyzed and actions taken	Frequency	%
No	9	22.50
Yes	31	77.50
Total	40	100.00

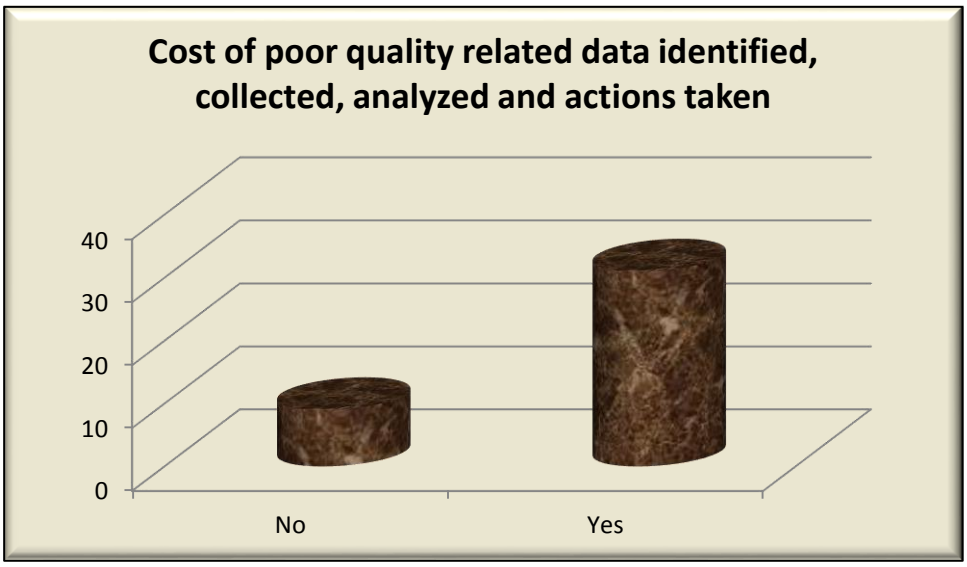


FIG 22- COPQ DATA ANALYSIS

Summary:

There are 22.5% organizations not having Cost of poor quality related data identified, collected, analyzed and actions taken & 77.5% organizations having Cost of poor quality related data identified, collected, analyzed and actions taken.

It means that 22.5 % do not use the analysis of COPQ (cost of poor quality) in the management of the quality in their organization. This lack of use of such powerful method to analyze the COPQ means that the SME organization will lose heavily in rejections thus lose lot of revenue.

Table11: Frequency distribution of responses for 'Q13: Are customer related data like customer satisfaction, customer complaints and customer goods returned are identified, collected, analyzed and actions taken on them?'

The frequency distribution of responses for 'Q13: Are customer related data like customer satisfaction, customer complaints and customer goods returned are identified, collected, analyzed and actions taken on them?'It is given below along with its bar graph.

Table16 : Customer related data analysis.

Customer related data like customer satisfaction, customer complaints and customer goods returned are identified, collected, analyzed and actions taken on them	Frequency	%
No	9	22.50
Yes	31	77.50

Total	40	100.00

FIG 23- CUSTOMER REALATED DATA ANALYSIS

Summary:

There are 22.5% organizations not having Customer related data like customer satisfaction, customer complaints and customer goods returned are identified, collected, analyzed and actions taken on them & 77.5% organizations having Customer related data like customer satisfaction, customer complaints and customer goods returned are identified, collected, analyzed and actions taken on them.

It clearly means that the 22.5 % SME organizations do not care about the customer related data. This will result in failure in customer satisfaction and loss of business.

Table12: Frequency distribution of responses for ‘Q14: Is your company TS 16949 certified? If yes since when?’

The frequency distribution of responses for ‘Q14: Is your company TS 16949 certified? If yes since when?’ It is given below along with its bar graph.

Table17 : TS16949 certification

TS 16949 certification	Frequency	%
No	26	65.00
Yes	14	35.00
Total	40	100.00

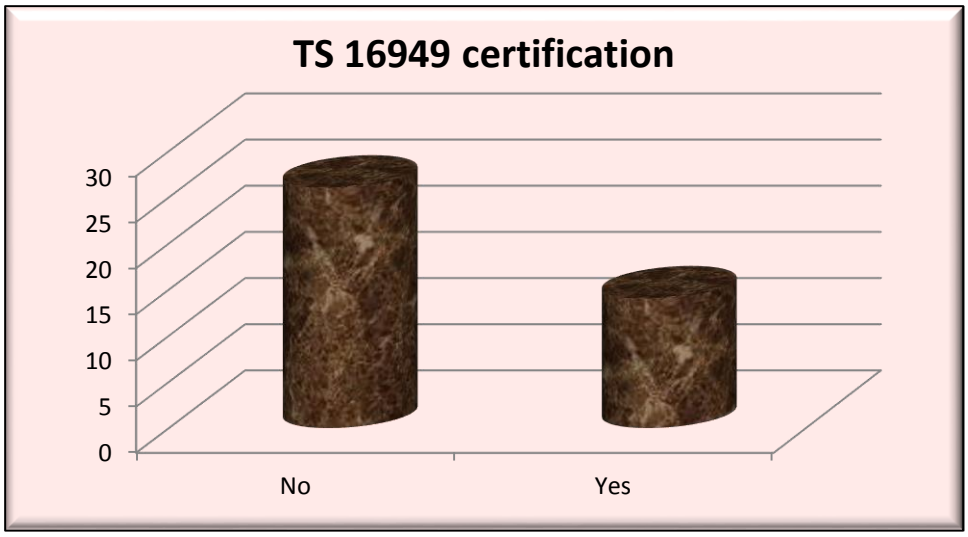


FIG 24- TS 16949 CERTIFICATION

Summary:

There are 65% organizations not having TS 16949 certification & 35% organizations having TS 16949 certification.

This means that only 35 % of the SME organizations have the TS16949 certification and satisfy the OEM requirement. But 65 % of the auto SME organizations have no TS16949 certification and these SME organizations do not fit in the OEM requirements.

Table 18: Number of years the organizations are TS16949 certified.

Years of TS 16949 certification	Frequency	%
Below 5 Years	5	35.71
5 to 10 years	5	35.71
10 to 15 years	4	28.57
Total	14	100.00

FIG 25- AGE OF TS 16949 CERTIFICATION

This means that trend of organizations are going in for the TS 16949 certification for the last many years is more or less constant where as the trend should have been increasing trend. This is a worrying finding for the auto SME category.

Summary:

Out of 35% organizations having TS 16949 certification; 35.71% organizations having years of TS 16949 certification ‘Below 5 Years’; 35.71% organizations having years of TS 16949 certification ‘5 to 10 years’ & 58.57% organizations having years of TS 16949 certification ’10 to 15 years’.

6.3.3- ANALYSIS B

Table13: Frequency distribution of responses for ‘Q15: your company ISO 9001 certified? If yes since when?’

The frequency distribution of responses for ‘Q15: your company ISO 9001 certified? If yes since when?’ is given below along with it’s bar graph.

Table19 : ISO9001 certification

ISO 9001 certification	Frequency	%
No	7	17.50
Yes	33	82.50
Total	40	100.00

FIG 26- ISO 9001 CERTIFICATION

Summary:

There are 17.5% organizations not having ISO 9001 certification & 82.5% organizations having ISO 9001 certification.

Years of ISO certification-

Table20 : Years of ISO 9001 certification.

Years of ISO 9001 certification	Frequency	%
Below 5 Years	9	27.27
5 to 10 years	10	30.30
10 to 15	14	42.42

years		
Total	33	100.00

FIG 27- YEARS OF ISO 9001 CERTIFICATION

Summary:

Out of 82.5% organizations having ISO 9001 certification; 27.27% organizations having years of ISO 9001 certification 'Below 5 Years'; 30.30% organizations having years of ISO 9001 certification '5 to 10 years' & 42.42% organizations having years of ISO 9001 certification '10 to 15 years'.

Frequency distribution of responses for 'Q16: Do you use such methodologies like TPM/six sigma/TQM/TPS for the work place management?'

The frequency distribution of responses for ‘Q16: Do you use such methodologies like TPM/six sigma/TQM/TPS for the work place management?’ is given below along with its bar graph.

Table21 : Methodologies like TPM/Six Sigma/TQM/TPS

Methodologies like TPM/six sigma/TQM/TPS for the work place management	Frequency	%
No	14	35.00
Yes	26	65.00
Total	40	100.00

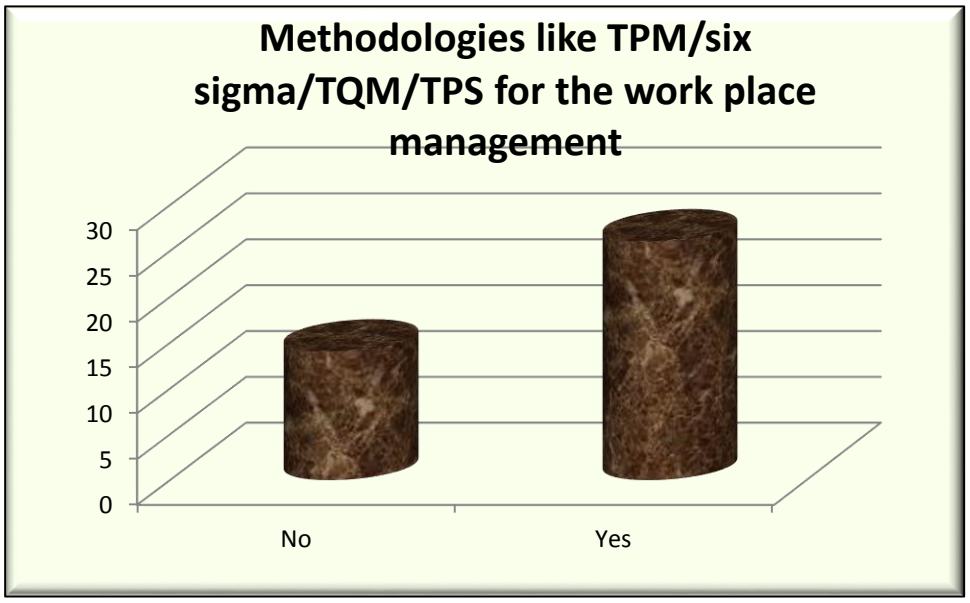


FIG 28- METHODOLOGIES LIKE TPM ETC.

Summary:

There are 35% organizations not having Methodologies like TPM/six sigma/TQM/TPS for the work place management & 65% organizations having Methodologies like TPM/six sigma/TQM/TPS for the work place management.

Table15: Frequency distribution of responses for ‘Q17: Do you have a continuous improvement process in place in manufacturing?’

The frequency distribution of responses for ‘Q17: Do you have a continuous improvement process in place in manufacturing?’ is given below along with its bar graph.

Table22 : Continuous improvement process

Continuous improvement process in place in	Frequency	%

manufacturing		
No	9	22.50
Yes	31	77.50
Total	40	100.00

FIG 29- CONTINUAL IMPROVEMENT

Summary:

There are 22.5% organizations not having Continuous improvement process in place in manufacturing & 77.5% organizations having Continuous improvement process in place in manufacturing.

Table16: Frequency distribution of responses for ‘Q18: Are Quality objectives written down and regular meetings are taken to monitor them?’

The frequency distribution of responses for ‘Q18: Are Quality objectives written down and regular meetings are taken to monitor them?’ is given below along with it’s bar graph.

Table 23 : Written quality objectives

Quality objectives written down and regular meetings are taken to monitor them	Frequency	%
No	10	25.00
Yes	30	75.00
Total	40	100.00

FIG 30- QUALITY OBJECTIVES

Summary:

There are 25% organizations not having Quality objectives written down and regular meetings are taken to monitor them & 75% having Quality objectives written down and regular meetings are taken to monitor them.

Table17: Frequency distribution of responses for ‘Q19: Do you give regular training to your operators and staff for Quality improvement?’

The frequency distribution of responses for ‘Q19: Do you give regular training to your operators and staff for Quality improvement?’ is given below along with its bar graph.

Table 24 : Training given to staff for quality.

Regular training to your operators and staff for Quality improvement	Frequency	%
No	7	17.50
Yes	33	82.50
Total	40	100.00

FIG 31- OPERATOR TRAINING

Summary:

There are 17.5% organizations not having Regular training to your operators and staff for Quality improvement & 82.5% having Regular training to your operators and staff for Quality improvement.

Table18: Frequency distribution of responses for ‘Q20: Do you have written down Quality records of finished products supplied to customers?’

The frequency distribution of responses for ‘Q20: Do you have written down Quality records of finished products supplied to customers?’ is given below along with it’s bar graph.

Table 25 : Finish product quality records

Written Quality records of finished products supplied to customers	Frequency	%
No	7	17.50
Yes	33	82.50
Total	40	100.00

FIGS 32- FINISH PRODUCT QUALITY RECORDS

Summary:

There are 17.5% organizations not having Written Quality records of finished products supplied to customers & 82.5% having Written Quality records of finished products supplied to customers.

Table19: Frequency distribution of responses for ‘Q21: Do you use the 7 QC tools (Ishikawa diagram, check sheets, control charts, histograms, Pareto charts, Scatter diagrams, flow charts) in your quality related activities?’

The frequency distribution of responses for ‘Q21: Do you use the 7 QC tools (Ishikawa diagram, check sheets, control charts, histograms, Pareto charts, Scatter diagrams, flow charts) in your quality related activities?’ is given below along with it’s bar graph.

Table 26 : Usage of 7 QC tools.

Usage of the 7 QC tools	Frequency	%
No	6	15.00
Yes	34	85.00
Total	40	100.00

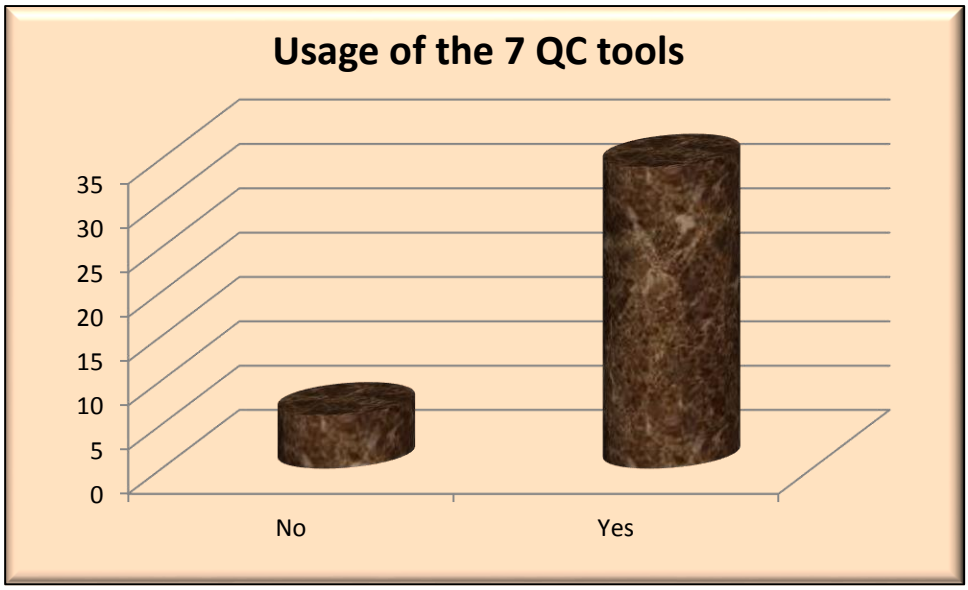


FIG 33- USAGE OF 7 QC TOOLS

Summary:

There are 15% organizations not having Usage of the 7 QC tools & 85% having Usage of the 7 QC tools.

Table20: Frequency distribution of responses for ‘Q22: How many employees working in the organization and how many shifts?’

The frequency distribution of responses for ‘Q22: How many employees working in the organization and how many shifts?’ is given below along with it’s bar graph.

Table 27 : Employees working in organization.

Growth	Frequency	%
No	11	27.50
Yes	29	72.50
Total	40	100.00

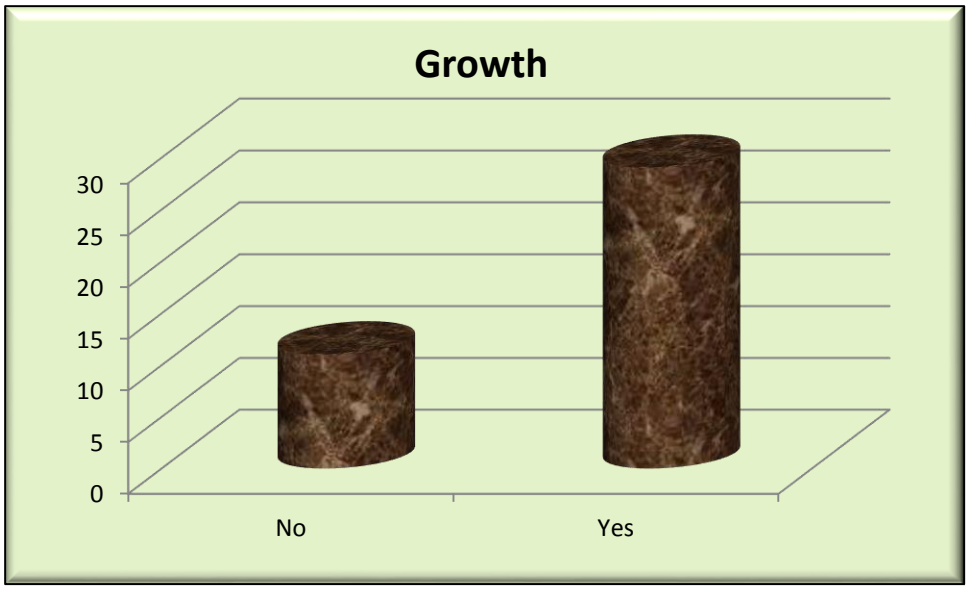


FIG 34- ORGANIZATION GROWTH

Summary:

There are 27.5% organizations not having Growth & 72.5% having Growth.

Table21: Frequency distribution of responses for ‘Q23: Have you received any customer given award for performance in Quality, production, logistics? If yes when-’

The frequency distribution of responses for ‘Q23: Have you received any customer given award for performance in Quality, production, logistics? If yes when-’ is given below along with it’s bar graph.

Table 28 : Customer given awards

Received any customer given award for performance in Quality, production, logistics Award for performance in Quality, production, logistics	Frequency	%
No	20	50.00
Yes	20	50.00
Total	40	100.00

FIG 35- CUSTOMER AWARDS

Summary:

There are 50% organizations not having Received any customer given award for performance in Quality, production, logistics Award for performance in Quality, production, logistics & 50% having Received any customer given award for performance in Quality, production, logistics Award for performance in Quality, production, logistics.

Table22: Frequency distribution of responses for 'Q24: Was there a business growth during 2011-12? If yes what type of growth?'

The frequency distribution of responses for 'Q24: Was there a business growth during 2011-12? If yes what type of growth?' is given below along with it's bar graph.

Table 29 : Business growth during 2011-2012

Business Growth during 2011-12	Frequency	%
No	14	35.00
Yes	26	65.00
Total	40	100.00

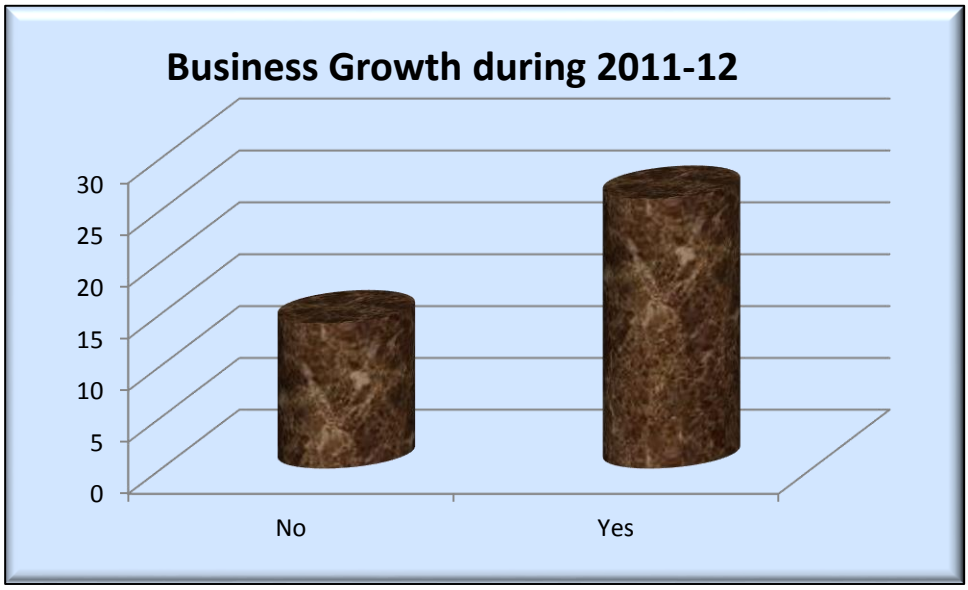


FIG 36- BUSINESS GROWTH 2011-12

Summary:

There are 35% organizations not having Business Growth during 2011-12 & 65% having Business Growth during 2011-12.

Table23: Frequency distribution of responses for ‘Q25: Was there a business growth during 2012-13? If yes what type of growth?’

The frequency distribution of responses for ‘Q25: Was there a business growth during 2012-13? If yes what type of growth?’ is given below along with it’s bar graph.

Table 30 : Business growth during 2012-2013

Business Growth during 2012-13	Frequency	%
No	12	30.00
Yes	28	70.00
Total	40	100.00

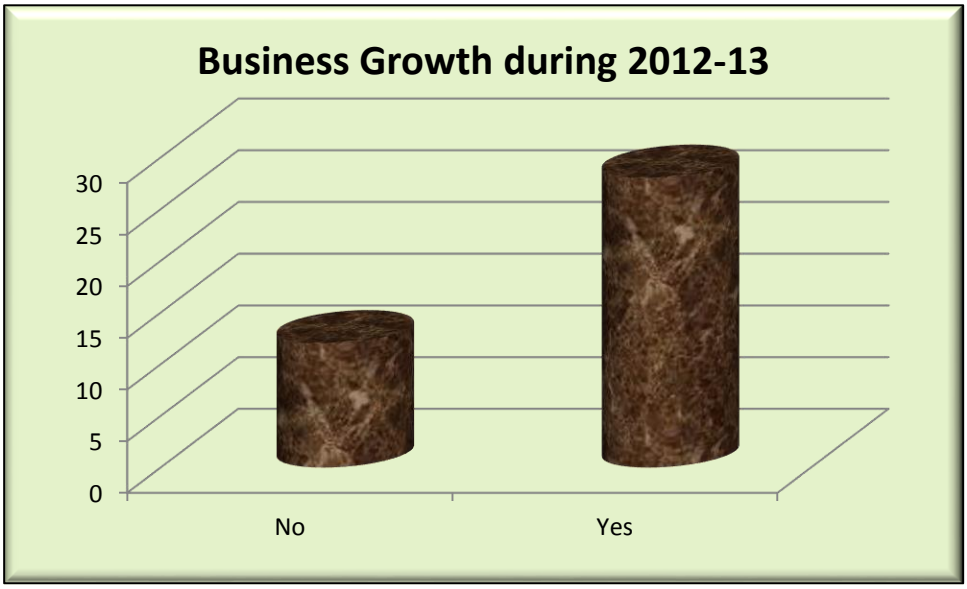


FIG 37- BUSINESS GROWTH 2012-13

Summary:

There are 30% organizations not having Business Growth during 2012-13 & 70% having Business Growth during 2012-13.

Table24: Frequency distribution of responses for ‘Q26: Was there a business growth during 2013-14? If yes what type of growth?’

The frequency distribution of responses for ‘Q26: Was there a business growth during 2013-14? If yes what type of growth?’ is given below along with it’s bar graph.

Table 31 : Business growth during 2013-2014

Business growth during 2013-14	Frequency	%
No	10	25.00
Yes	30	75.00
Total	40	100.00

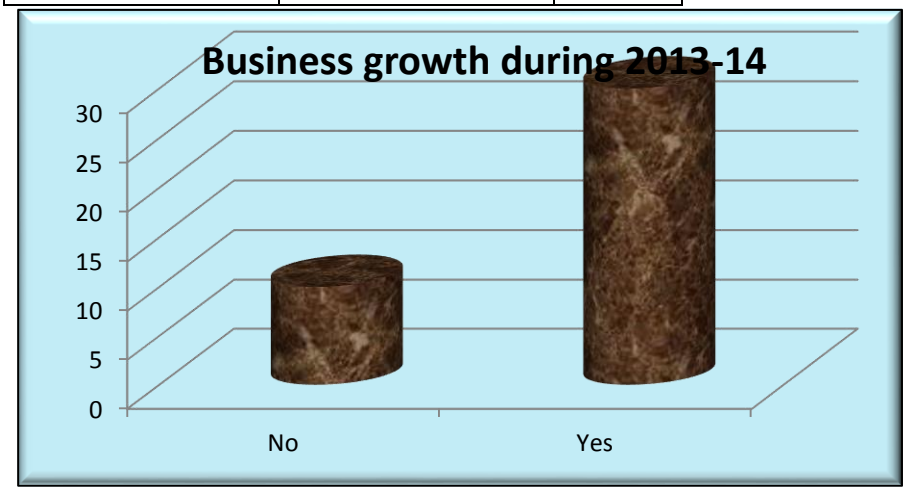


FIG 38- BUSINESS GROWTH 2013-14

Summary:

There are 25% organizations not having Business Growth during 2013-14 & 75% having Business Growth during 2013-14.

Table25: Frequency distribution of responses for ‘Q27: Any growth/expansion plan in near future 2015-16? If yes what type of growth?’

The frequency distribution of responses for ‘Q27: Any growth/expansion plan in near future 2015-16? If yes what type of growth?’ is given below along with it’s bar graph.

Table 32 : Any growth/expansion plan in future

Any growth/expansion plan in near future 2015-16	Frequency	%
No	25	62.50
Yes	15	37.50
Total	40	100.00

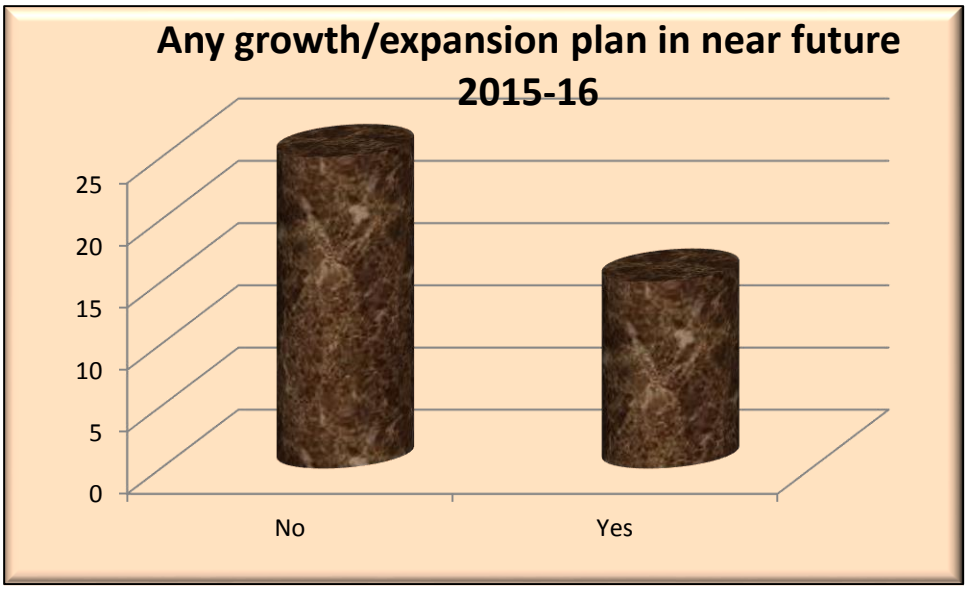


FIG 39- GROWTH/EXPANSION PLAN

Summary:

There are 62.5% organizations not having Any growth/expansion plan in near future 2015-16 during 2013-14 & 37.5% having Any growth/expansion plan in near future 2015-16.

Table26: Frequency distribution of responses for ‘Q28: Has any old customer stopped business with the company?’

The frequency distribution of responses for ‘Q28: Has any old customer stopped business with the company?’ is given below along with it’s bar graph.

Table 33 : Old customer stopping business

Any old customer stopped business with the company	Frequency	%
No	35	87.50
Yes	5	12.50
Total	40	100.00

FIG 40- CUSTOMER BUSINESS STOPPED

Summary:

There are 87.5% organizations not having any old customer who stopped business with the company & 12.5% having any old customer who stopped business with the company.

6.3.4- ANALYSIS C

The questions considered to assess quality score for each organization are as follows.

7] What importance do you assign to Quality in your organization?

8] Do you have a documented Quality System?

9] Does the Quality system include Quality Assurance Manual?

10] Are there written Work Instructions?

11] Is quality function deployed in departments in company like production, purchase, stores, HR?

12] Is cost of poor quality related data identified, collected, analyzed and actions taken?

13] Are customer related data like customer satisfaction, customer complaints and customer goods returned are identified, collected, analyzed and actions taken on them?

14] Is your company TS 16949 certified? If yes since when ?

15] Is your company ISO 9001 certified? If yes since when?

16] Do you use such methodologies like TPM/six sigma/TQM/TPS for the work place management?

17] Do you have a continuous improvement process in place in manufacturing?

18] Are Quality objectives written down and regular meetings are taken to monitor them?

19] Do you give regular training to your operators and staff for Quality improvement?

20] Do you have written down Quality records of finished products supplied to customers?

21] Do you use the 7 QC tools (Ishikawa diagram, check sheets, control charts, histograms, Pareto charts, Scatter diagrams, flow charts) in your quality related activities?

The answers to above questions are noted down for each organization & the count of response 'Yes' is considered as the quality score of that organization.

This quality score is tested further for various purposes.

Q 22 How many employees working in the organization and how many shifts?

To test the hypothesis the quality score is higher for the organizations having response 'Yes' to above question than for those having response 'No' to above question.

To test the hypotheses,

The null hypothesis, H_0:

The quality score is same for the organizations having response 'Yes' to above question & for those having response 'No' to above question on an average.

Vs.

The alternative hypothesis, H_a:

The quality score is higher for the organizations having response 'Yes' to above question than for those having response 'No' to above question on an average.

The test used is t test for two independent samples.

Table 34 : Quality score statistics for Q.22

Group Statistics					
	Q22	N	Mean	Std. Deviation	Std. Error Mean
Quality Score	No	11	9.1818	5.94673	1.79301
	Yes	29	16.8276	1.83359	.34049

Independent Samples Test						
		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	P value (2-tailed)
Quality Score	Equal variances assumed	51.369	.000	-6.290	38	.000
	Equal variances not assumed			-4.189	10.729	.002

Since p value < 0.05, the level of significance; there is strong evidence to reject the null hypothesis.

The graph showing mean values is given below.

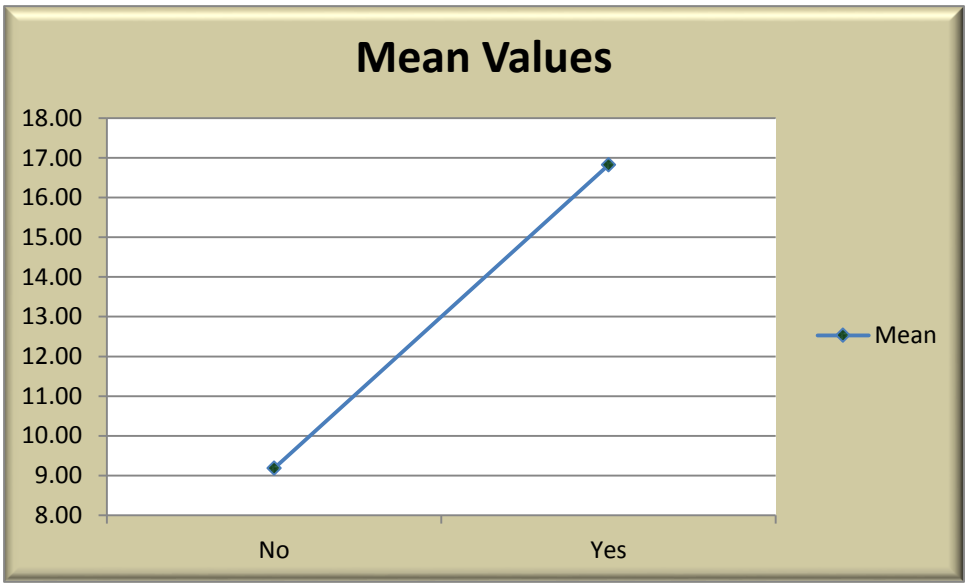


FIGURE 41: Quality score mean value graph.

Conclusion:

The graph & the p value both suggest that the quality score is significantly higher for the organizations having response 'Yes' to above question than for those having response 'No' to above question on an average.

Q 23- Have you received any customer given award for performance in Quality, production, logistics ? If yes when-

To test the hypothesis the quality score is higher for the organizations having response 'Yes' to above question than for those having response 'No' to above question.

To test the hypotheses,

The null hypothesis, H_0:

The quality score is same for the organizations having response 'Yes' to above question & for those having response 'No' to above question on an average.

Vs.

The alternative hypothesis, H_a:

The quality score is higher for the organizations having response ‘Yes’ to above question than for those having response ‘No’ to above question on an average.

The test used is t test for two independent samples.

Table 35 : Quality score statistics for Q.23

Group Statistics					
	Q23	N	Mean	Std. Deviation	Std. Error Mean
Quality Score	No	20	12.1500	5.70572	1.27584
	Yes	20	17.3000	1.26074	.28191

Independent Samples Test						
		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	P value (2-tailed)
Quality Score	Equal variances assumed	52.402	.000	-3.941	38	.000
	Equal variances not assumed			-3.941	20.851	.001

Since p value < 0.05, the level of significance; there is strong evidence to reject the null hypothesis.

The graph showing mean values is given below.

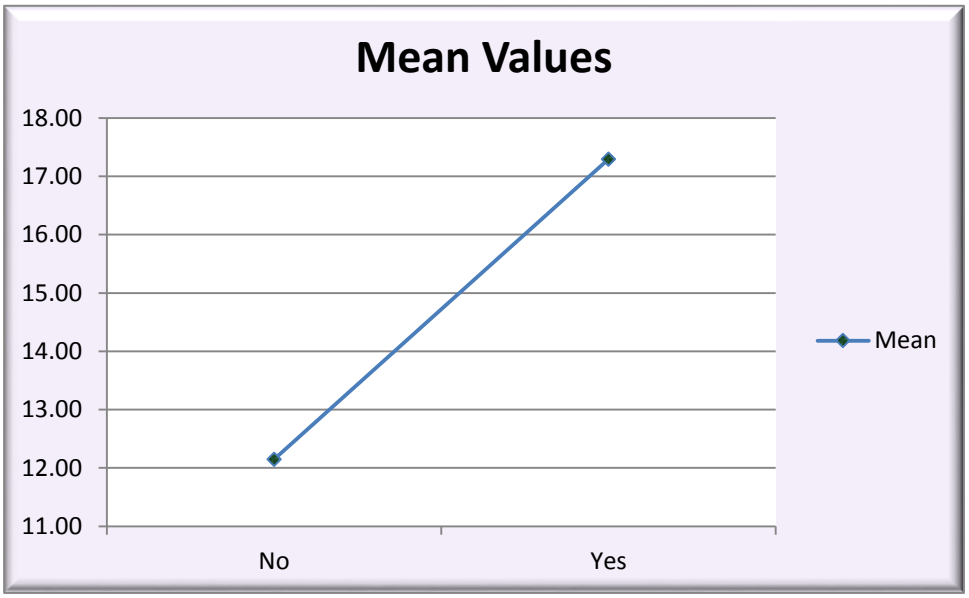


FIGURE 42 : Quality score statistics for Q23.

Conclusion:

The graph & the p value both suggest that the quality score is significantly higher for the organizations having response 'Yes' to above question than for those having response 'No' to above question on an average.

Q 24 Was there a business growth during 2011-12? If yes what type of growth?

To test the hypothesis the quality score is higher for the organizations having response 'Yes' to above question than for those having response 'No' to above question.

To test the hypotheses,

The null hypothesis, H_0:

The quality score is same for the organizations having response 'Yes' to above question & for those having response 'No' to above question on an average.

Vs.

The alternative hypothesis, H_a:

The quality score is higher for the organizations having response ‘Yes’ to above question than for those having response ‘No’ to above question on an average.

The test used is t test for two independent samples.

Table 36 : Quality score statistics for Q24

Group Statistics					
	Q24	N	Mean	Std. Deviation	Std. Error Mean
Quality Score	No	14	10.0714	5.64956	1.50991
	Yes	26	17.2308	1.14220	.22400

Independent Samples Test						
		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	P value (2-tailed)
Quality Score	Equal variances assumed	64.964	.000	-6.293	38	.000
	Equal variances not assumed			-4.690	13.575	.000

Since p value < 0.05, the level of significance; there is strong evidence to reject the null hypothesis.

The graph showing mean values is given below.

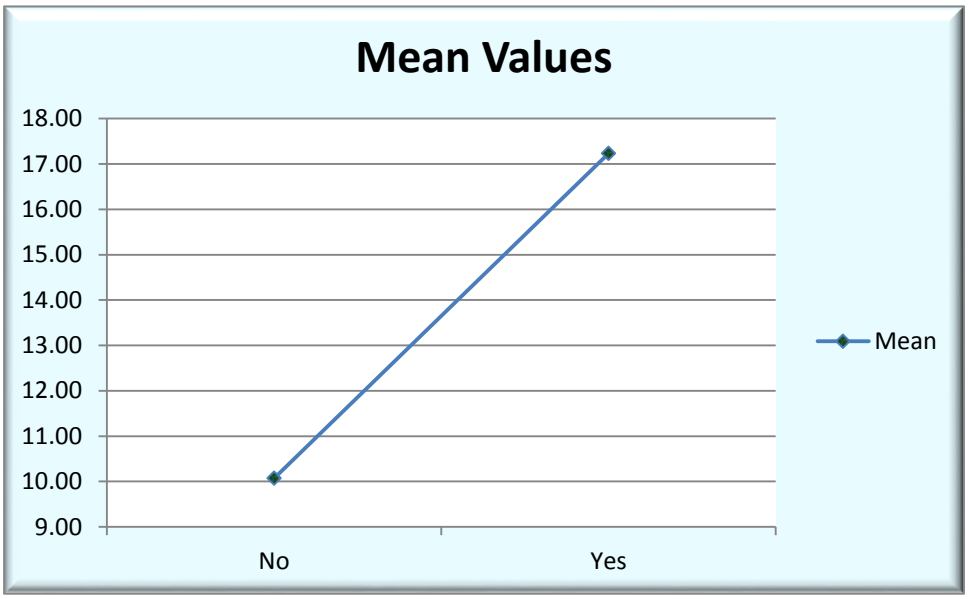


FIGURE 43 : Quality score mean value for Q24

Conclusion:

The graph & the p value both suggest that the quality score is significantly higher for the organizations having response ‘Yes’ to above question than for those having response ‘No’ to above question on an average.

Q 25 Was there a business growth during 2012-13? If yes what type of growth?

To test the hypothesis the quality score is higher for the organizations having response ‘Yes’ to above question than for those having response ‘No’ to above question.

To test the hypotheses,

The null hypothesis, H_0:

The quality score is same for the organizations having response ‘Yes’ to above question & for those having response ‘No’ to above question on an average.

Vs.

The alternative hypothesis, H_a:

The quality score is higher for the organizations having response ‘Yes’ to above question than for those having response ‘No’ to above question on an average.

The test used is t test for two independent samples.

Table 37: Quality score statistics for Q.25

Group Statistics					
	Q25	N	Mean	Std. Deviation	Std. Error Mean
Quality Score	No	12	9.3333	5.69423	1.64378
	Yes	28	17.0357	1.47779	.27928

Independent Samples Test					
	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df	P value (2-tailed)

Quality Score	Equal variances assumed	57.713	.000	-6.750	38	.000
	Equal variances not assumed			-4.620	11.640	.001

Since p value < 0.05, the level of significance; there is strong evidence to reject the null hypothesis.

The graph showing mean values is given below.

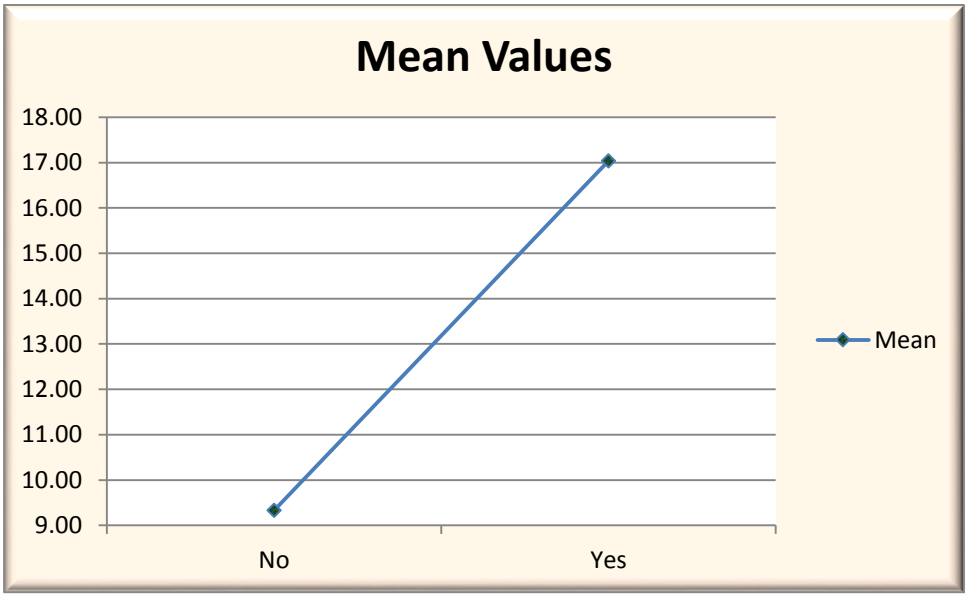


FIGURE 44: Quality score mean value for Q.25

Conclusion:

The graph & the p value both suggest that the quality score is significantly higher for the organizations having response ‘Yes’ to above question than for those having response ‘No’ to above question on an average.

Q 26 Was there a business growth during 2013-14? If yes what type of growth?

To test the hypothesis the quality score is higher for the organizations having response 'Yes' to above question than for those having response 'No' to above question.

To test the hypotheses,

The null hypothesis, H_0:

The quality score is same for the organizations having response 'Yes' to above question & for those having response 'No' to above question on an average.

Vs.

The alternative hypothesis, H_a:

The quality score is higher for the organizations having response 'Yes' to above question than for those having response 'No' to above question on an average.

The test used is t test for two independent samples.

Table 38: Quality score statistics for Q.26

Group Statistics					
	Q26	N	Mean	Std. Deviation	Std. Error Mean
Quality Score	No	10	8.4000	5.64112	1.78388
	Yes	30	16.8333	1.80198	.32899

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	P value (2-tailed)
Quality Score	Equal variances assumed	38.563	.000	-7.298	38	.000
	Equal variances not assumed			-4.649	9.619	.001

Since p value < 0.05, the level of significance; there is strong evidence to reject the null hypothesis.

The graph showing mean values is given below.

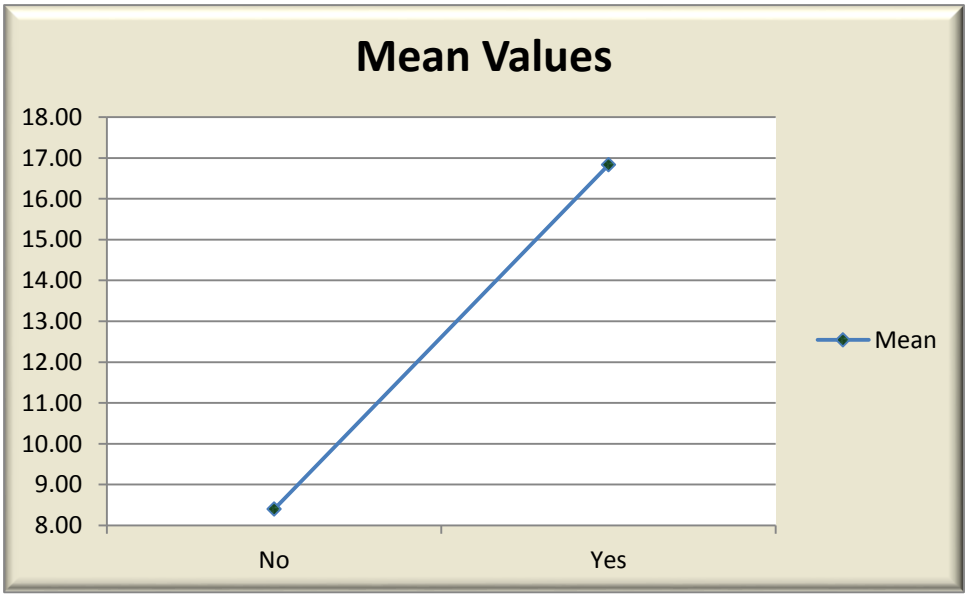


FIGURE 45 : Quality score mean value for Q.26

Conclusion:

The graph & the p value both suggest that the quality score is significantly higher for the organizations having response ‘Yes’ to above question than for those having response ‘No’ to above question on an average.

Q 27 Any growth/expansion plan in near future 2015-16? If yes what type of growth?

To test the hypothesis the quality score is higher for the organizations having response ‘Yes’ to above question than for those having response ‘No’ to above question.

To test the hypotheses,

The null hypothesis, H_0:

The quality score is same for the organizations having response ‘Yes’ to above question & for those having response ‘No’ to above question on an average.

Vs.

The alternative hypothesis, H_a:

The quality score is higher for the organizations having response ‘Yes’ to above question than for those having response ‘No’ to above question on an average.

The test used is t test for two independent samples.

Table 40 : Quality score statistics for Q. 27

Group Statistics					
	Q27	N	Mean	Std. Deviation	Std. Error Mean
Quality Score	No	25	13.0400	5.45802	1.09160
	Yes	15	17.5333	.83381	.21529

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	P value (2-tailed)
Quality Score	Equal variances assumed	33.735	.000	-3.150	38	.003
	Equal variances not assumed			-4.038	25.836	.000

Since p value < 0.05, the level of significance; there is strong evidence to reject the null hypothesis.

The graph showing mean values is given below.

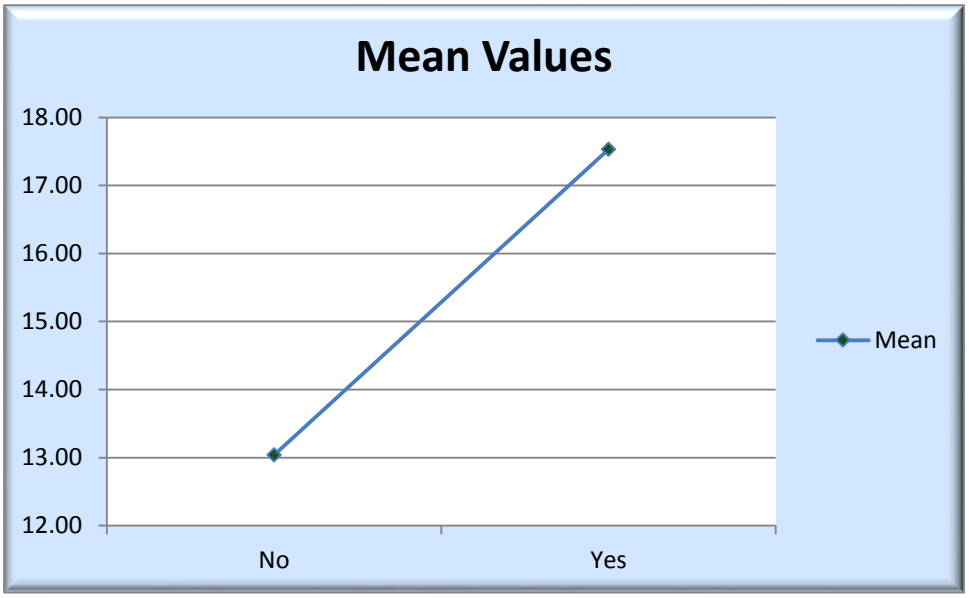


FIGURE 46 : Quality score mean value for Q27

Conclusion:

The graph & the p value both suggest that the quality score is significantly higher for the organizations having response ‘Yes’ to above question than for those having response ‘No’ to above question on an average.

Q 28 Has any old customer stopped business with the company?

To test the hypothesis the quality score is higher for the organizations having response ‘No’ to above question than for those having response ‘Yes’ to above question.

To test the hypotheses,

The null hypothesis, H_0:

The quality score is same for the organizations having response ‘No’ to above question & for those having response ‘Yes’ to above question on an average.

Vs.

The alternative hypothesis, H_a:

The quality score is higher for the organizations having response ‘No’ to above question than for those having response ‘Yes’ to above question on an average.

The test used is t test for two independent samples.

Table 40 : Quality score statistics for Q. 28

Group Statistics					
	Q28	N	Mean	Std. Deviation	Std. Error Mean
Quality	No	35	16.0286	3.46822	.58624

Score	Yes	5	5.6000	2.70185	1.20830

Independent Samples Test						
		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	P value (2-tailed)
Quality Score	Equal variances assumed	.071	.792	6.424	38	.000
	Equal variances not assumed			7.765	6.065	.000

Since p value < 0.05, the level of significance; there is strong evidence to reject the null hypothesis.

The graph showing mean values is given below.

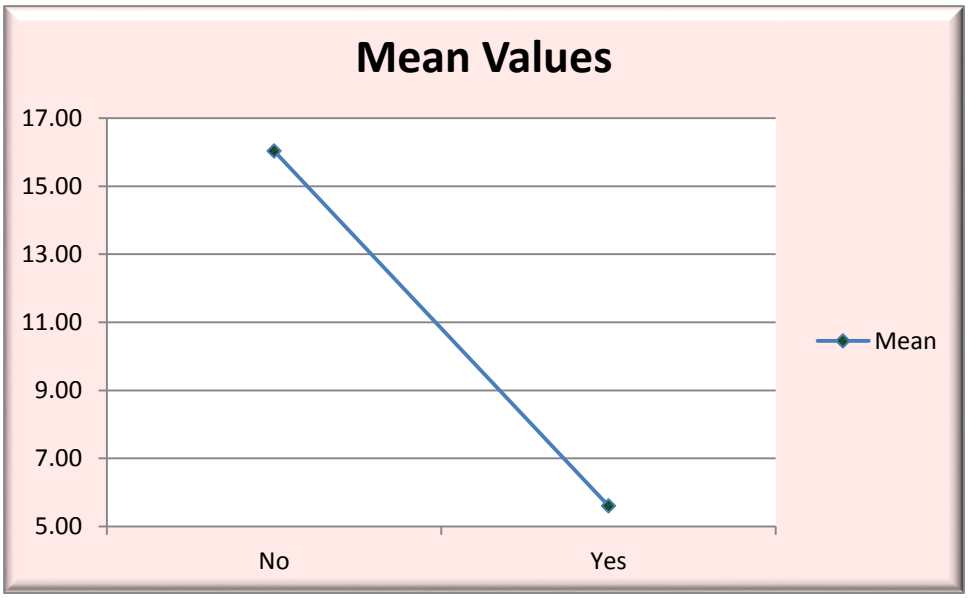


FIGURE 47 : Quality score mean value for Q. 28

Conclusion:

The graph & the p value both suggest that the quality score is significantly higher for the organizations having response 'No' to above question than for those having response 'Yes' to above question on an average.

To test the hypothesis the quality score is higher for the Domestic & Export organizations than only Domestic organizations.

To test the hypotheses,

The null hypothesis, H_0:

The quality score is same for the Domestic & Export organizations and only Domestic organizations.

Vs.

The alternative hypothesis, H_a:

The quality score is higher for the Domestic & Export organizations than only Domestic organizations.

The test used is t test for two independent samples.

Table 41 : Quality score statistics for Q.6

Group Statistics					
	Type	N	Mean	Std. Deviation	Std. Error Mean
Quality Score	DOMESTIC+EXPORT	12	17.6667	.49237	.14213
	DOMESTIC	28	13.4643	5.31582	1.00460

Independent Samples Test						
		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	P value (2-tailed)
Quality Score	Equal variances assumed	25.579	.000	2.713	38	.010
	Equal variances not assumed			4.142	28.064	.000

Since p value < 0.05, the level of significance; there is strong evidence to reject the null hypothesis.

The graph showing mean values is given below.

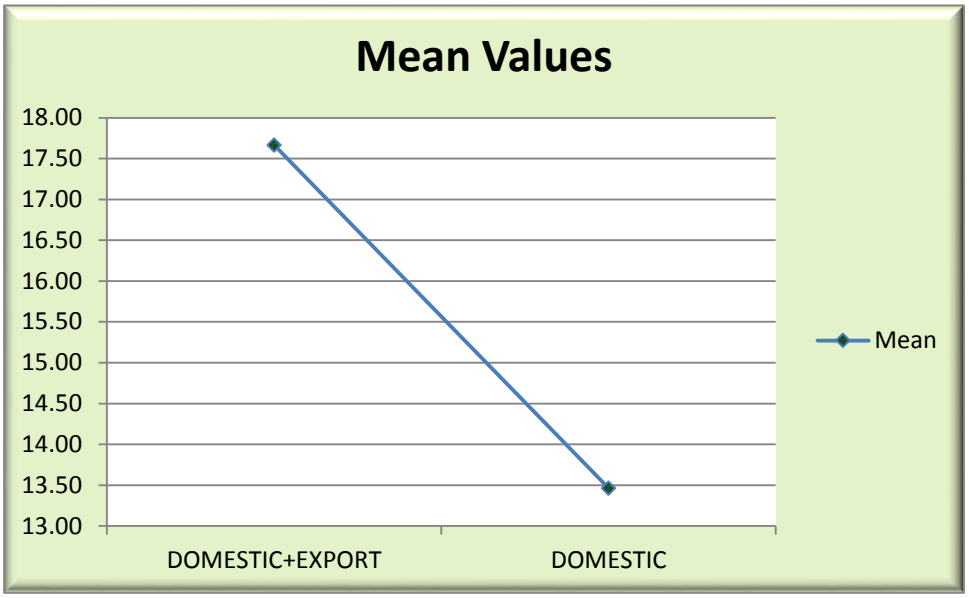


FIGURE 48 : Quality score mean value for Q.6

Conclusion:

The graph & the p value both suggest that the quality score is higher for the Domestic & Export organizations than only Domestic organizations.

To test the hypothesis the quality score is highest for the organizations with TS 16949 certification & ISO 9001 certification both than the organizations with ISO 9001 certification & the organizations with no such certification.

To test the hypotheses,

The null hypothesis, H_0:

The quality score is same for the organizations with TS 16949 certification & ISO 9001 certification both; the organizations with ISO 9001 certification & the organizations with no such certification.

Vs.

The alternative hypothesis, H_a:

The quality score is different for the organizations with TS 16949 certification & ISO 9001 certification both; the organizations with ISO 9001 certification & the organizations with no such certification.

The test used is one way ANOVA.

Table 42 : Quality score statistics for Q 15 and Q16

Quality Score				
	N	Mean	Std. Deviation	Std. Error
None	7	5.1429	2.34013	.88448
ISO 9001	19	15.8947	1.94064	.44521
ISO 9001 & TS 16949	14	17.9286	.26726	.07143
Total	40	14.7250	4.84100	.76543

ANOVA					
	Sum of Squares	df	Mean Square	F	P value
Between Groups	812.400	2	406.200	147.963	.000
Within Groups	101.575	37	2.745		
Total	913.975	39			

Since p value < 0.05, the level of significance; there is strong evidence to reject the null hypothesis.

The graph showing mean values is given below.

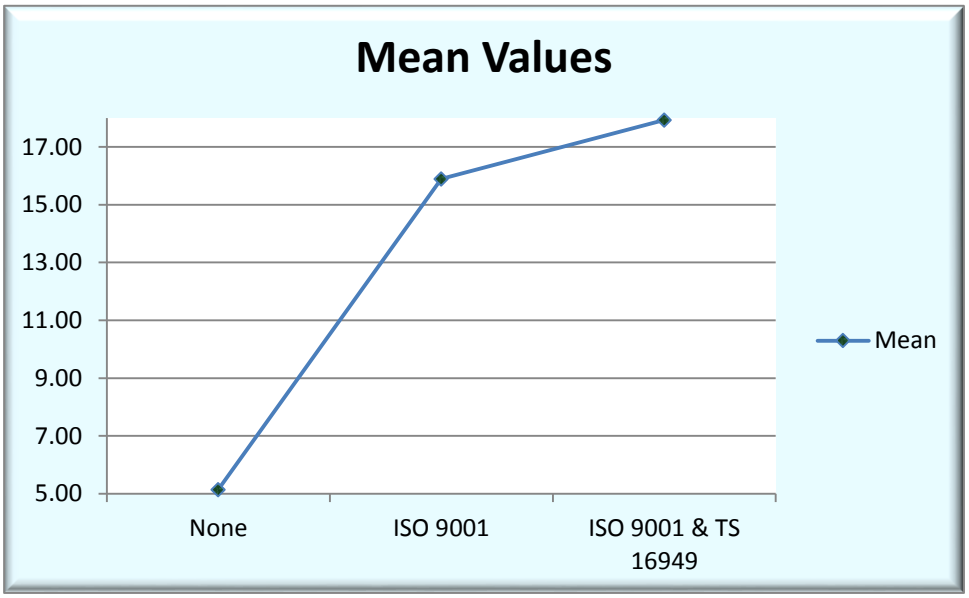


FIGURE 49 : Quality score mean value for Q.15 and Q16

Conclusion:

The graph & the p value both suggest that the quality score is highest for the organizations with TS 16949 certification & ISO 9001 certification both than the organizations with ISO 9001 certification & it is least for the organizations with no such certification.

CHAPTER-7 CONCLUSIONS AND FINDINGS

7.1 INTRODUCTION

As has been mentioned in the foregoing chapters the researcher was curious to understand how the automotive SME suppliers to the OEM car makers in Pune district are meeting their customer requirements with respect to quality initiatives and the third party quality certification. The growth of GDP of India is heavily depending on industrial sector particularly the SME sector. The contribution of SME industry in GDP is presently 15 % and it is planned to be 25 % in the coming years. Thus the main driving engine in GDP growth will be SME organizations.

The automotive industry in India is one of the high growth sector and large number of employees work with automotive related industries. The question here is whether the automotive SME organizations really meet the quality related requirements of the OEM organizations to be able to meet all the requirements of them i.e. indigenous components supply as well as the import substitution of high technology and high quality subassemblies? Can the SME organizations give enough confidence to the OEM car makers that they fully meet their quality related requirements and supply whatever is expected of the local automotive SME suppliers?

In this research project an attempt has been made to study and understand the various quality related initiatives of the automotive SME suppliers in the Pune district and their various select growth indicators.

The idea is to study their quality related practices in the organizations and what are their select growth related indicators and whether there is causal relationship between them.

7.2 GENERAL CONCLUSIONS

Data was collected from 40 SME automotive suppliers with the help of a questionnaire. The researcher himself has conducted telephonic interviews of the respondents who are responsible for the quality of the organization.

The age of the SME automotive organization varies from 1 year to more than 30 years.

The SME suppliers consisted of three categories namely “partnership”, “proprietorship” and “private limited”.

There are 17.5% organizations of category ‘Partnership’.

There are 40% organizations of category ‘Proprietary’.

There are 42.5% organizations of category ‘Private Limited’.

Depending upon the internal management structure of the SME organization the person responsible for the quality management could be any one from following categories stated in percentages.

There are 7.5% respondents of designation ‘Director’.

There are 2.5% respondents of designation ‘Factory In charge’.

There are 2.5% respondents of designation ‘HOD (Production)’.

There are 40% respondents of designation ‘HOD (Quality)’.

There are 40% respondents of designation ‘Owner’.

There are 2.5% respondents of designation ‘Plant Head’.

There are 2.5% respondents of designation ‘SR. QA.’.

There are 2.5% respondents of designation ‘Unit Head’

Here one thing seems interesting that the respondents Directors and the Owners are really the promoters of the organizations and they are totally 19(16+3=19) in numbers out of 40 respondents which is 47.5 %. This shows that the promoters of the organization still manage the quality function themselves and do not employ professionally qualified experienced managers to manage it. All other remaining 52.5 % respondents are professional managers. This happens as the professionally qualified managers in Quality management function may demand more salaries which, in many cases, are not possible for many SME organizations given the pressures on the margins. But it is a worthwhile decision to employ professional quality professions to head the quality function as these results in the overall performance and leads to higher performance. This itself will take care of the salary of the quality professional. Hence rather than

a limited vision of the quality function a broader outlook of the overall performance will lead to better functioning of the SME automotive suppliers.

There are two important categories of Domestic suppliers and Domestic + Export suppliers.

There are 70% organizations of type ‘Domestic’ & 30% organizations of type ‘Domestic + Export’.

To be able to supply components to overseas OEM organizations requires a very robust quality system in the organization compared to the domestic suppliers. It is interesting to note here that out of 12 organizations who supply to overseas companies(export) 10 are TS16949 certified and remaining two are ISO9001 certified. It clearly shows how important it is for the SME organization to have a robust quality system in place. Thus only 30 % suppliers are able to export to global markets clearly showing that there is vast scope for the SME industry to improve and compete in the global markets.

As far as the importance given to the quality function is concerned there are still 7.5 % companies which are not treating the quality function as the “very important” function. It naturally results in failures in quality and the SME organization will not be able to compete even in the local market let alone the global market.

There are still 10 % organizations which do not have a clearly written down quality system in the manufacturing of components. Such a mistake of not having written down quality policy is a fatal mistake and no OEM organization will make such SME organizations their suppliers. Even the Tier I and Tier II organizations will not be giving any work to such SME suppliers.

There are 15 % SME organizations who do not have written down quality assurance manual. Such a QA manual is a must requirement and any automotive supplier organization which is manufacturing components without QA manual is doomed to commit serious mistakes and cannot be trusted by the OEM companies for quality.

There are 10 % organization working as suppliers of components which are not having the written down work instructions to the operators. It means the work procedures are not

standardized and there are chances of errors and mistakes. This may result into large scale rejections.

There are 25 % organization which have not deployed the quality function in other function of the company like the purchasing, HR, Production etc. The concept of quality is required to be deployed in the entire organization and every function of the organization so that there is synchronization of the entire company towards the one goal of the quality. All the functions of the organization contribute to the achievement of the goal of quality and this understanding is vital to the automotive supplier.

The discussion on why the COPQ analysis and actions are required in the organizations clearly shows that unless the internal costs particularly the cost of rejections of the company are kept low the organization cannot survive. In many forums which deal with the cost of poor quality it has been mentioned that the cost of poor quality of many organizations may be in the range of 10 % to 40 %. This is a huge cost. The margins of the SME organization as given by the OEM organizations are in the range of 10-12 %. Thus any SME automotive supplier will earn around 10 % profit with tight control on quality and internal cost. If the supplier starts losing money in range of 10 -40 % of the revenue the results will be obvious that the organization will be of out of business very soon. The question related to COPQ which is asking the details of identification, collection, analysis and action taken has 22.5 % respondents not understanding the concept and hence not doing it. This must be naturally leading to high rejections and high internal costs. Such organization will find survival difficult.

The SME automotive organization supplying components to the OEM companies need to be very careful about customer related processes like customer complaints; customer returned material, customer satisfaction etc. and all the data related to customer has to be processed under extreme care and actions taken on them with a feed back to customer wherever necessary. But still about 22.5 % SME organizations do not take customer related processes seriously. The car selling market is buyers market. What it means is the buyer decisions rule the market or in other words the “Customer is the king”. This means that the cars need to be sold in the market by the OEM companies as per the customer requirements and not as per the seller (OEM companies)

requirements. This makes the car market price sensitive meaning the change in the price has a significant impact on the sales volume. Hence the suppliers to the OEM have to be very careful about the material they supply to OEM companies because any problem at car user end will result into major problem for the OEM. Hence the customer processes are important to SME automotive suppliers.

It has been stated in the customer expectations that the automotive component supplier has to be TS16949 Company. Even the Tier II and Tier III suppliers are required to be TS16949 certified. The question 14 related to TS16949 shows that there are only 35 % (14 numbers) SME automotive companies which are Ts16949 certified and remaining 65% (26 numbers) are not TS16949 certified. This means that these 26 SME organizations which not TS16949 certified cannot become Tier I supplier to any of the OEM Company. This shows that even if there are number of automotive component related SME organizations which are registered in various bodies there are few organizations which actually qualify to become the OEM supplier. This also shows why many of the OEM organizations have to import their critical assemblies/components from other countries. It also shows that there are younger organizations having started just before 5 years are having TS certification. It makes sense to acquire the certification as early as possible.

The question relating to acquisition of ISO9001 certification shows that 82.5% (33 organizations) have acquired this certification whereas 17.5 % (7 organizations) have no quality certification at all. Such organizations having no certification will stand no chance to get any of the automotive business. Even the Tier II and Tier III suppliers are required to have TS16949 certification as per the OEM requirement.

The question relating to techniques like TPM/TPS/6 Sigma/TQM etc. shows that 65 %(26 organizations) use such technique to improve their work place and the quality of their products and 35 %(14 organizations) do not use these techniques for the work place improvement.

The continuous improvement process is central to both the international certifications ISO9001 as well as the TS16949. According to both these Quality Management Systems (QMS) all the processes in the quality management has to be managed such that they are continually improved.

There are 22.5 %(9 organizations) which are not continually improving their processes and 77.5 % (31 organizations) which are continually improving their processes.

According to TS16949 and ISO9001 the quality management systems mandates that the monthly review meetings (MRM) must be conducted in which all facts related to happening in the organizations related to quality along with the quality objectives set by the management of organization has to be discussed every month. It shows that 25 % (10 organizations) do not conduct such meetings whereas 75 % (30 organizations) conduct such meetings.

The operator and staff training in the automotive supplier organization is a must to update them about the latest happenings in the manufacturing and the customer requirements and this has to be done on regular basis. It shows that 17.5 %(7 organizations) do not give regular training to operators and the staff whereas 82.5 %(33 organizations) give regular training to them.

It is mandatory under the TS16949 and the ISO 9001 quality systems that the supplier has keep documented record of any finished goods supplied to customer. It shows that 17.5 %(7 organizations) do not have documented records of finished products supplied to customer whereas 82.5 %(33 organizations) have the documented records.

To manage the quality in manufacturing environment any kind of organization must make use of such technique as 7 QC tools. This is most essential for the automotive sector suppliers because without the use of such technique it is not possible to collect, analyze and inference drawn on any of the manufacturing data collected in the manufacturing environment. It shows that 15 %(6 organizations) do not use this technique whereas 85 %(34 organizations) use this technique.

The Q22 shows a table where data of the organizations for the last 4 years is collected. It gives an indication whether the organization is growing or not in terms of the manpower it employs. The organizations which have the same manpower or reduced manpower during this period are categorized as NO GROWTH organizations whereas the organizations which show increase in manpower during this period is categorized as YES GROWTH organization. There are 27.5 % (11 organizations) having NO GROWTH whereas there are 72.5 %(29 organizations) which are having YES GROWTH.

The Q23 is concerned with the awars the organizations have received in quality,Production.

7.3 STATISTICAL CONCLUSIONS

For the sake of discussion the hypothesis is reproduced here.

Hypothesis-

Ho (Null hypothesis)- Implementation of Quality initiatives and techniques by automotive manufacturing SME industrial units may not result in achieving performance of organization.

HA (Alternate hypothesis)- There is a gap between the expectations about Quality initiatives from SME and actual fulfillment of such Quality related customer requirements due to ineffective implementation of Quality initiatives by SME industrial unit management/owners.

As has been mentioned in the analysis section about how the analysis has been done. There are 6(Q1 to Q6) questions related to demographic data of the organizations. There are in all 15(Q7 to Q21) questions which are related to the quality initiatives assessment of the SME organizations. There are 7(Q22 to Q28) questions which are related to various select indicators of performance assessment related to the SME organizations.

The data analysis of Quality scores is done in depth in the analysis section and every question has been subjected to analysis. The quality score of the SME organizations is used to test the main hypothesis which says that the quality initiatives may not result into performance of the organization. Here the individual performance indicator in the questionnaire is tested with the help of the quality score. This testing clearly showed that the quality score of the organizations is significantly higher for the organizations that have response “YES” to the questions related to performance indicators seven questions (Q22 to Q28).

Thus the various quality related questions (Q7 To Q21) which are grouped to make the quality score of the statistical analysis is used to relate with the performance indicator group of questions (Q22 to Q28) and each question in the performance group is subjected to analysis.

The OEM car manufacturing industries have clearly stated their requirement about the quality from the suppliers. Not all of the automotive SME organizations have understood this fully hence some of them have not got themselves certified with TS16949 certification.

suppliers who clearly understood this requirement and who had the ability to implement this in their manufacturing set up have done so by obtaining the TS16949 certification. Some of them have obtained the ISO 9001 certification partially fulfilling the OEM requirement.

Also the discussion done previously clearly states that the SME automotive suppliers who have obtained the TS16949 certification or ISO 9001 certification are showing clear trend of higher performance through various indicators of performance as captured in this survey.

This fact clearly prove that the null hypothesis (Ho) "Implementation of Quality initiatives and techniques by automotive manufacturing SME industrial units may not result in achieving performance of organization." Is rejected and the alternative hypothesis(Ha) "There is a gap between the expectations about Quality initiatives from SME and actual fulfillment of such Quality related customer requirements due to ineffective implementation of Quality initiatives by SME industrial unit management/owners." is accepted.

The analysis has also shown that there are in all 14 organizations out of 40 which are TS16949 and ISO 9001 certified. It means that these 14 organizations are very careful about the customer requirements, understood it and their quality system are oriented towards highest level of quality consciousness. All these organizations show high quality scores and high indicators of performance. Also the analysis shows that the SME organizations which score least on the quality scores also show least on the growth indicators. It shows that there is significant impact of quality initiatives on the select indicators of the performance.

Thus the ***causal*** relationship between the high level of quality initiatives and the high level of score on the performance of the organizations is seen here.

CHAPTER-8 RECOMMENDATIONS

Based on this research and the analysis that followed it is evident that there is a ***causal*** relationship between the quality initiatives and the select indicators of performance. This clearly indicates that for the SME organizations to be able to outperform the competition they need to take into account what the customer expects from them about the product quality and how this knowledge about the expectations can be translated into the quality system of the organization. There are 14 organizations in this survey which show that they have complied fully with the customer requirement of TS16949 certification and they show a very good score on the quality management and select indicators of performance.

Hence based on the findings of this research following are the recommendations of the researcher.

1] To be able to sustain and survive in the automotive components supply business and the global competition the SME organizations must have robust quality system in the organization. The OEM car manufacturers expect them to have minimum of ISO 9001 certification and TS16949. This requirement is for all the Tier I, Tier II and Tier III categories of suppliers. The direct components (Tier I) suppliers must be TS16949 certified. It is also recommended that the SME organizations must go in for the TS16949 certification as early as possible in their life cycle.

2] The organizations which do not have any of the certification like ISO9001 or TS16949 and hence weak in quality system will find it very difficult to survive in the global competition. Such organizations need to wake up immediately and make efforts towards establishing and sustaining a robust quality system. It must be understood here that robust quality system building is a long term commitment and it cannot be done overnight.

The promoters of the organizations must give attention to this aspect before they take any other measure to survive.

3] The SME organizations which export their products have professional managers for the quality function except one organization (SPS automotive components). It shows that well

trained quality professionals can give better results. It also gives confidence to the customers that the organization is really committed to quality. Hence well trained and highly qualified managers need to be heading the quality function of the organization. The organizations which have TS16949 certification and have qualified quality professionals heading their quality department are showing good results.

4] All the export oriented units have TS16949/ISO9001 certification. It clearly indicates that higher level progress of the organization like exporting of products is possible only through the clear focus on the quality management system of the organization. Also the organizations which want to enter the global supply chain of the OEM organizations must have clear focus on quality with a certification like the TS16949 certification.

5] The clear causal relationship between the quality initiatives and the business growth indicators show that all the automotive supplier SME organizations need to get themselves TS16949 certified in their own interest.

6] The OEM organizations like Toyota motors ltd. take lot of pains to develop their suppliers (Tier I suppliers). The suppliers are given the inputs like training of their personnel in Toyota factory, transfer of the knowledge of Toyota way of manufacturing, sharing of expertise of Toyota manufacturing experts to the supplier etc. Such development of the suppliers will naturally lead to betterment of the supplier's quality and manufacturing system. It is recommended that the Tier I suppliers should also take pains to develop the Tier II and Tier III suppliers so that the manufacturing and quality related knowledge is passed on to them thus making them more competitive. The various governmental and nongovernmental organizations which are working in the developing of the SME sector should also have a clear guideline as to how to develop the SME sector.

7] The researcher has arrived at the following model which takes into account various facts that have been discussed in the research paper. Please refer to FIG 41.

Following are the steps that need to be taken to build and use such a model in any organization.

- It starts with the quality requirement identification of the customer about the quality system. In this case the SME organization must understand the OEM quality requirements first before designing their quality system.
- Such identification of customer requirements should lead to proper implementation of the quality system in the organization and this in turn leads to customer satisfaction through various measures taken as a part of the quality system. Thus as the automotive car OEM organizations clearly say that TS16949 certification is a must, that is the first goal of the concerned SME automotive supplier.
- The QMS (Quality management system) of the organization when properly established and maintained will lead to better product quality thus leading to customer satisfaction. This will also enhance the quality image of the organization in the eyes of the customer.
- It has been reported in many forums that the cost of poor quality of manufacturing organizations may range from 10 % to 40 % of their annual revenues. This is a whooping cost due to poor quality and this high level of cost may close down the industry by itself. The loss of revenue of the organization can be controlled by proper implementation of COPQ (Cost of poor quality) analysis and action thus making the organization more competitive from cost perspective. Also the better product quality leads to more competitiveness on quality front. Both these factors of competitiveness will naturally lead to business growth.
- As shown in the diagram as the competitive advantage of better quality and competitive advantage of lower cost along with the customer satisfaction is achieved the business growth will naturally follow and the organizational performance will be better and better.
- Thus this model clearly shows the various relationships of the organizational performance with other factors which govern the manufacturing quality.

FIG - A SUGGESTED BUSINESS PERFORMANCE MODEL LINKED TO QUAILITY INITIATIVES.

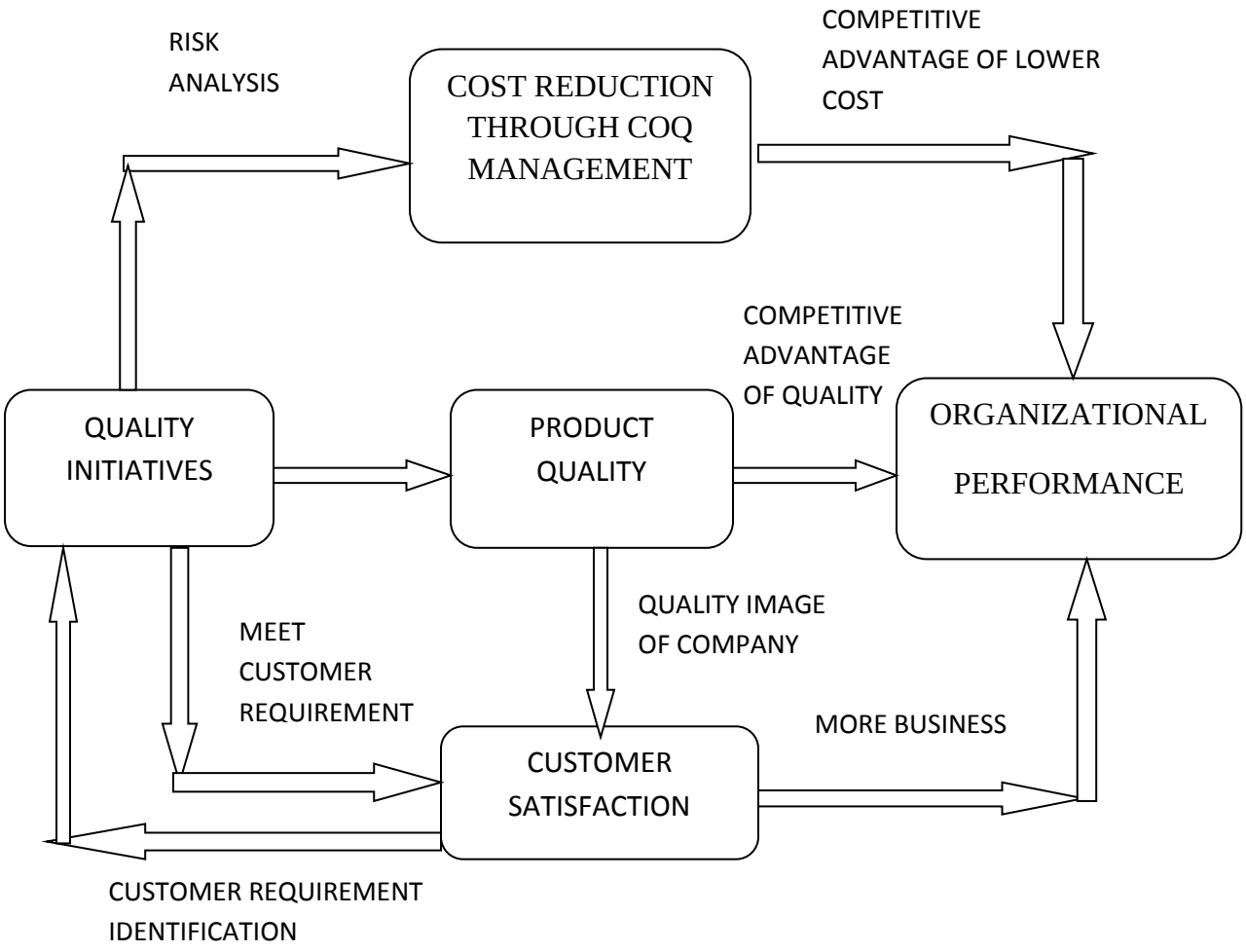


FIG 41- SUGGESTED QUALITY MODEL OF RESEARCHER

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9.4.1 **Abbreviations**

NO	ABBREVIATION	MEANING
1.	GDP	Gross domestic product
2.	BCG	Boston consulting group
3.	SME	Small and medium enterprises
4.	MCCIA	Mahratta Chamber of commerce, Industries and Agriculture.
5.	CII	Confederation of Industries
6.	OEM	Original equipment manufacturer
7.	CAGR	Compounded annual growth rate
8.	ACMA	Automotive component manufacturers association
9.	COPQ	Cost of poor quality
10.	OEM	Original Equipment Manufacturer
11.	AIAG	Automotive industry action group
12.	APQP	Advanced product quality planning
13.	MSA	Measurement system analysis
14.	PPAP	Production part approval process
15.	FMEA	Failure mode effect analysis
16.	SPC	Statistical process control