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DIPLOMA THESIS



MASTER OF BUSINESS ADMINISTRATION

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TOTAL QUALITY MANAGEMENT IN AUTOMOTIVE INDUSTRY AND ITS APPLICATION

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STUDENT'S DECLARATION

I declare that this Diploma thesis is my own work, and the bibliography contains all the literature that I have referred to in writing of the thesis.

I am aware of the fact that this work will be published in accordance with the §47b of the Higher Education Act, and I agree with that publication, regardless of the result of the defended thesis.
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I declare that the information I used in the thesis come from legitimate sources, ie. in particular that it is not subject to state, professional or business secrets or other confidential sources, which I wouldn't have the rights to use or publish.
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Date and Place: 31.08.2018, Prague, Czech Republic
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SUMMARY

1. Main objective:

Main objective is to find out, evaluate the effect of total quality management in an automotive company, the factors effecting customer complaints and quality of a product, the effects of total quality management tools in customer complaints and total quality management tools that are applied in automotive company.

2. Research methods:

Customer relationship management, pareto analysis, cause & effect analysis, benchmarking, things gone wrong research.

3. Result of research:

According to customer satisfaction surveys, customers have complained about 124 of 1000 vehicles in high ceiling models and 52 of 1000 vehicles in low ceiling models due to door closing efforts. After the required changes and analysis, the customer complaints were solved and the requirements in the technical specifications were reached.

4. Conclusions and recommendation:

After the improvements made, the end-point measurements were taken and the values decreased to the expected levels. These studies have also been implemented in customer vehicles as a result of after-sale service and it has been seen that according to the feedbacks, the success has been achieved. Thanks to the total quality management implemented in Ford Otosan, the defects in the produced products are determined and the defects in the products are detected by the result of the studies made by the understanding of "Customer is always right" and "Customer satisfaction". The end result of Total Quality Management practices has been customer satisfaction of Ford Otosan. Thanks to the system applied, the problem has been solved by changing the design of the parts used in the production and it has been possible to prevent possible problems and complaints in the subsequent productions.

KEYWORDS

quality, total quality management, automotive, customer complaints

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1. Introduction

In this study, it is aimed to explain the total quality management which has almost the same importance by small or large companies and the benefit obtained by application of this management concept in a large automotive company which is corporate.

Firstly, the main components such as quality and total quality have been investigated and the understanding of Total Quality Management applied in the automotive sector has been examined.

The selected automotive firm has been evaluated on Total Quality Management concept and the studies on the problems identified in the direction of customer complaints and questionnaires and the customer satisfaction reflections and satisfied customer feedback of the Total Quality Management concept applied in line with these studies that have been targeted.

According to customer feedback, the success of the implemented Total Quality Management has been determined and the changes made in the production and management stages have been explained in order to ensure continuity of this system and continuity of customer satisfaction.

This precise topic was chosen in order to find out the effect of total quality management in an automotive company.

The main questions for the thesis are as follows:

- a) What are the factors effecting customer complaints and quality of a product?
- b) What are the effects of total quality management tools in customer complaints?
- c) Which total quality management tools are applied in automotive company?

The thesis proceed as follows: the first section provides definitions of total quality management and its factors. Then, information about TQM approaches and 6-sigma tools used. In addition, this paper discussed the effect importance of total quality management tools for product quality and customer. In order to make this section more understandable, the theoretical and methodological parts are included as well, where all the definitions and terms are described. In the practical part, a real TQM study will be analyzed and the effects will be shown.

2. Theoretical-Methodological Part

2.1 Total Quality Management

Total Quality Management is the improvement to the normal way of doing a business. To exist in competitive market, total quality management is a proven system. Organizational culture and actions can be changed by only the management. Total Quality Management is an approach to organizational management which aims to improve the product quality based on improvements on ongoing products based on customers continuous feedbacks. (Janakiraman, 2006).

Meanings of words:

Total: Whole product, service

Quality: Level of perfection of product or service

Management: Act of controlling and directing (Janakiraman, 2006)

Company-wide Quality Control make Japanese companies take actions in western markets which are dominated by western companies, which provides high quality and low price products. Western companies especially Americans, faced with a competition from Japanese and Asian competitors. This situation forced western companies to learn how Eastern companies managing quality, therefore they learned quality control management. Consequently, Total Quality Management was created and used by the companies all around the world. To gain the competitive advantage, Total Quality Management is a significant tool (Tauseef, 2012).

TQM main aim is to create a quality product or service for customers which increase the productivity and decrease the cost of the product or service. When companies provide high quality and low price, they can be sure that they will retain their competitive position in the market. In addition to all of these, they can be sure that they will keep their workforce and they satisfy the colleagues who work for the company (Rai Technology University TQM Book, 2010).

Today, total quality management approach has become the main topic to reach the desired quality level with the convenient prices. Total quality;

Prevention oriented approach: On the basis of total quality, there is a ‘no defects’ approach instead of ‘detecting the mistakes’.

Measurement and statistics: What cannot be measured is not developed. For this reason, the measurement and statistics heading is the indispensable element of total quality. The indispensable measure of statistical reasoning is due to the following reasons:

- There is variability throughout the natural incidents.
- Statistics is an important concept to measure or detect this variability.
- Variability has a large share in the emergence of errors.
- Statistical techniques that helps to analyze also contribute to communication.

Teamwork: The main tasks of the groups are to research and develop the method of how the work is done.

Management Model: There is a unique management model that the concept of Total Quality brings with it (Simsek, 2007)

2.2 Foundations of Total Quality Management

2.2.1 Total Quality Management Approach

Total quality management is an approach to improve effectiveness, competitiveness and flexibility through planning, organizing and involving each individual at each level. This approach is useful in all the types of organizations.

Total quality management ensures that management has a strategic overview of quality and focuses on prevention, not detection of problems.

It requires a mindset change to break all the barriers. Managements that doubt the applicability of total quality management should ask questions about the operation's standards, wastes, costs, errors, systems, training instructions (Oakland, 2003).

2.2.1.1 Commitment and Policy

Total quality management starts at top, where serious commitment to quality and leadership must be demonstrated. Middle management has also significant role to play in communicating the message.

Every chief executive should accept the responsibility for commitment to a quality policy that deals with the organization for quality, the ability of organization, the customer needs, education and training, supplied materials and services and review of the management systems for continuous improvement (Aized, 2012).

2.2.1.2 Excellence in Leadership

The vehicle for achieving excellence in leadership is total quality management. Using the construct of the new Oakland total quality management model, the four Ps and four Cs provide a framework for this:

- Planning
- Performance
- Processes
- People
- Customers
- Commitment
- Culture
- Communications

2.2.1.3 Effective Leadership

Effective leadership begins with chief executive's vision and turns into an implementation strategy.

Top management should develop following for effective leadership:

- PDCA cycle
- Clear and effective strategies and supporting plans
- Critical success factors and core processes
- Management structure
- Mission statement (Oakland, 2003)

2.2.1.4 Creating or Changing the Culture

The culture of the organization consists of behaviors, beliefs, norms, rules and climate in the organization. All the organizations need a vision framework, core values and beliefs, purpose

and a mission. The effectiveness of an organization depends on the extent to which people move towards the common goals and objectives and perform their roles. Total quality management is related with moving the focus of control from the outside to the inside of individuals, so that all the people in the organization is accountable for their own performance(Oakland, 2003).

Table 1. makes a comparison between previous state and total quality management state for typical quality elements. This change is substantial and will not be accomplished in a short period of time. Small organizations can make the transformation faster than large organizations.

New and Old Cultures of Quality Elements	Previous State	Total Quality Management
Definition	Product oriented	Customer oriented
Priorities	Second to service and cost	First among equals of service and cost
Decision	Short-term	Long-term
Emphasis	Detection	Prevention
Errors	Operations	System
Responsibility	Quality control	Everyone
Problem Solving	Managers	Teams
Procurement	Price	Life-cycle costs, partnership
Manager’s Role	Plan, assign, control and mentor	Delegate, coach facilitate and enforce

Table 1 Comparison between old culture and total quality management (Rai Technology University TQM Book,2010)

2.3 The Deming Philosophy

Deming’s philosophy is consist of 14 points. Most of these 14 points were given in a seminar for presidents of leading Japanese industries in 1950. Also some of the points were developed and the original ones modified afterwards.

The 14 points are intended to create strong management commitment to process design, quality, control through statistical tools and solutions for quality problems, and a policy that based on quality rathen than cost. This Deming’s model is created to remove all the barriers to employee participation and teamwork. It provides an effective communication between employees and managers, training and education, elimination of quotas for employees. Deming’s model also shows the importance of quality information systems and product design (Metri, 2006).

Create Constancy of Purpose for Continuous Improvement

Management should demonstrate their commitment to this statement.This point provides long-term need rather than short-term profits. Preventive maintance today can avoid major operational problems in the future. Quality and investments ensure that the existence and competitiveness of the company in the future. Product and process quality always results in less rework, less defects, reduced inspection and warranty costs and also customer satisfaction. On

the other hand, innovation guarantees the customers loyalty and companies reputation and market share.

To create constancy of purpose requires the development of a mission statement for the automotive company. The plan-do-check-act (PDCA) cycle allows the statement to evolve as customer expectation grows and changes. This flexibility allows innovation, putting resources into research, training, and improvements of quality in the company (Liker, 2004).

Long-term thinking provides a foundation for doing value added work. Short-term characteristically undermines value added work. Managers should explain the purpose of the organization, key aspects and insights about the industry, the significant values for the organization and how to demonstrate them during the daily work. Long-term thinking is quite important for managers because the employees will be more engaged, productive and enthusiastic.

Innovative investments, new skills and material investments, research and training investments, continuous improvement investments for the product or service can demonstrate constancy of purpose for survival, today and in the future. As Deming says, it is not enough to satisfy the customer. If the company does not want to lose the customer to a competitor, the company should completely delight the customer with its product or service, so that the customer can bring more customers (Liker, 2004).

Learn and Adopt the New Philosophy

The implication is that management should actually adopt the new philosophy, rather than merely expect the workforce to do so. If the management looks forward instead of competitors, that will be the moment of major change in the organization (Gabay, 2008).

Top management and everyone should adopt the new philosophy. Organizations always should search for continuous improvement. Customer satisfaction should be the number one priority because dissatisfied customers do not purchase the products or services. The organization should focus on preventing defects rather than detecting them. All the employees in the organization should be involved and change their attitudes towards quality. The supplier should be helped to improve product quality by asking statistical evidences based on verification plan and by sharing customer expectation information.

Cease Dependence of Inspection

Quality does not come from inspection, mass inspection is not reliable and brings higher costs, unreliability. Management should understand that inspection purpose is to improve the process and cost reduction. The appropriate way is to replace this philosophy by continuous improvement using statistical tools.

According to Deming, routine 100% inspection and planning for defects are the same. It means that specifications do not mean anything and process can not function properly. It is needed to replace the mass inspection and defect detection practices with defect prevention and continuous improvement practices (Oakland, 2003).

Not Awarding a Business on Prices Alone

The organizations should stop awarding business based on prices alone since the low price without quality does not mean anything. The main purpose is to have single suppliers for each item to develop a long-term relationship between the supplier and manufacturer based on

loyalty and trust. Purchase team should be trained in statistical process control and require it from the suppliers. They should provide feedback to supplier based on customer expectations and quality (Liker, 2004).

In this approach total costs are more important than initial costs. Therefore, the objective is to reduce the total costs not only the initial costs. Managers should reduce the number of suppliers for the same item by eliminating the suppliers which does not qualify with the statistical quality evidence.

The main reason of reducing the number of suppliers is to reduce variation. Even the variation from one supplier is not good, therefore variation from multiple suppliers are considered as bad. Also the security of the long term relationship allows supplier to innovate.

Improve Constantly and Forever

Quality starts with the intent of management. Management is obligated to continuously search for ways to improve quality. Every employee and every department must commit to constant improvement. Quality circles and cross-functional teams work together to improve the product quality. The focus is to prevent problems before they happen. Variation is always expected, but there should be a continuous work for its reduction using control charts.

There is always a variability on every target, therefore there is always a reason for continuous improvement. If product meets the specification limits, it does not mean that there is nothing to worry about. The effects of uncontrollable factors in the customer's environment can easily cause the product that its components were too close to the limits in the specification to fail. The conformance to the specification can easily go outside the limits and customer dissatisfaction occurs. This is the reason why customer is the most important part of the process (Aized, 2012).

Institute Training on the Job

If people are inadequately trained, they will not all work the same way, and this will introduce variation. Management should use the resources to employee training to let them perform their jobs in the best possible way. All the employees should be trained in statistical methods and these methods will be used to find out the possible ways of further training (Davidson, 2002).

Training and on the job education provides consistency. Proper training investments for all new employees will ensure that the new employees will start working with their full capacity and also they will be aware of what is expected from them.

Training is mostly regarded as non productive by many managers. Mostly it is the first thing to be cut when budgets become tighter. Management should remove these barriers which restrains the effective implementation of lessons learned.

Institute Modern Methods of Leadership

Deming makes a distinction between leadership and mere supervision. All the managers, must be aware of the work they supervise. This will assist them to find out the difference between special and common cause of variation, also difference between a mere mistake and process weakness. The leaders should do the following:

- Encourage teamwork
- Use mistakes as lessons learned rather than blame
- Motivate and lead by example rather than fear

- Teach and counsel instead of supervise and judge
- Understand the difference between special and random variation
- Provide innovative methods to accomplish the improvement (Orsini, 2013)

Drive Out Fear

The best interests of a company are subordinated to the need to satisfy performance measures. If people make mistakes, they start hiding them for fear of the consequences. Fear of the effect on annual performance assessment can lead people to average performance, which means not making a decision can not be wrong and held to blame for a poor decision.

Deming sees management by fear as counter productive in the long term, because it prevents employees from acting in the organizations goals (Orsini, 2013).

Break Down Barriers Between Departments

The concept of the internal customer means that each department serves not the management, but the other departments that use its outputs. Management should optimize the efforts of teams, to reach the main goal of the organization. The competition within the same company should be replaced with cooperation. This point of view will solve individual problems (Liker, 2004).

The cooperation of many diverse organizations in the same company is significant for market success of a product. Different departments contributing to the development of a product can include following:

- Materials purchase
- Quality control and improvement
- Marketing and sales
- Product planning and design
- Market research

The employees in the organization should be aware of the importance of realizing the common goal of customer satisfaction.

Eliminate Slogans

This point is about eliminating slogans which demand zero defects without providing any methods. If there are low productivity problems, high defects, slogans such as do it right first time or increase productivity by 15% can not achieve anything. Most of the causes of low quality and productivity are not about workforce. It is because of the system and it can be solved by changing management practices. The management must support the employees by providing training and supervision and the continuous improvement opportunities (Orsini, 2013).

Eliminate Numerical Quotas

According to Deming, production targets as encouraging the delivery of poor-quality goods. Instead of quotas, managers should encourage employees for improvement. Quotas focus on quantity instead of quality. Quotas should be replaced with statistical methods of process control. An employee, in order to hold a job, will try to meet the quota in any circumstance, including doing damage to his/her company.

Numerical quotas will not help the employees do a better job. Instead of numerical quotas, hard work, service and growth and continuous improvement should be emphasized. But still, Deming does not tell to manage without number. Individuals should have goals, aims and

intentions. Only a statistical data can show what is achievable and what should be the next steps for continuous improvement (Liker, 2004).

Remove Barriers to Pride of Workmanship

Loss of pride exists in organizations because of reasons such as, they are being blamed for systems problems, not enough training is provided, employees do not understand the organizations mission, poor designs lead to poor production. Managements duty is to restore pride by long-term commitment.

If the employees are made to feel that their work are significant, they will want to come to work everyday. Management should understand the reasons of reduced workforce, with the corrective actions, the employees will respond immediately as they are enabled to achieve good work (Metri, 2006).

Encourage Education and Self-Improvement for Everyone

The strength of a company depends on its knowledge base, that is why the organization always needs good people who are improving continuously with continued education. Both management and employees must continuously gain knowledge. Employees should be educated with new methods, including teamwork and statistical tools. Training for a skill is finite, it ends when ability has reached a stable state. On the other hand, education is never ending (Metri, 2006).

Companies should search for the lists of courses available and encourage their employees to enroll. They should treat education as an investment not an expense.

Take Action to Accomplish Transformation

It will require a special top management team with a plan of action to carry out the quality mission. The critical mass of people should be included in the change. Workers cannot do it on their own, also the managers. Management should take action to understand the rest of 13 points and decide on the way to take the company to the future. Management should have the courage to adopt the new philosophy. Everybody should be encouraged to contribute to the process of innovation and continuous improvement of quality. Managers should promote the team spirit by eliminating the communication barriers and by providing the necessary trainings to employees (Liker, 2004).

2.4 Total Quality Management Approaches

2.4.1 Quality Control Circles

The Quality Circle was first introduced in Japan and started to be used. It was later accepted by the world as spreading from Japan. The Quality Circle is a system that can be used to see, discuss, and solve problems in an enterprise.

Quality Circle is a small, voluntary group of employees, supervisors, consist of 8 to 10 members from the same department that holds a regular meeting to solve problems related to their work. Quality circle works on the continuous and on going process in an organization.

Quality circles are useful because the team members work in the same workplace therefore face with similar problems. The benefits of quality control circles are quality control and quality improvements, effective company communication (Oakland, 2003).

2.4.1.1 Purpose of Quality Circles

The most important factors that need to be applied in Total Quality Management are team understanding. Being a team is the most important part of this system. In order to provide or increase quality, working teams should be formed with the employees who know their jobs and apply it well. The objectives of quality circles can be listed as:

- To improve the quality and to reduce the mistakes
- To improve motivation and participation of employees
- To improve internal communication
- To prepare the environment for the development of a more compatible executive employee relationship
- Ensure that employees are trained
- To give habit of preventing problems before they appear
- Contributing to the development of people's leadership and creativity skills
- Increase work dependency
- Lowering costs
- Increase the relevance to business security issues
- Contributing to the development of the company
- Making the workplace a meaningful environment worth living
- Increase human respect and ensure full utilization of the endless abilities of the workforce
- To improve the skills of the foreman in leadership and workshop management
- To raise the motivation of all employees involved in various stages of the production process and to make them more sensitive to the problems,
- To promote quality awareness in the whole organization from top management to the lowest level of employee. (Tasci, 2013)

2.4.2 Management by Objectives

Management by objectives, is a management style that gives responsibility to managers.

A manager,

- Prepares action plans
- Coordinates
- Supervises
- Determinates company targets
- Evaluates the results

The most important advantages of this management are as follows.

- It ensures that the communication between the working staff and the administrators in management is mature.
- It helps motivate managers and develop leadership skills to help set goals for the person.
- It ensures that the people who catch the success are more motivated in their work (Robbins, 2008).

Although individual approaches vary widely because they are defined as management by business planning and oversight according to objectives, most MBO programs carry the same content. According to the assumptions, there are four basic stages of management:

- Determination of Objectives,
- Business Planning,
- Self-Control,

- Periodic Evaluations.

2.4.3 Management by Exception

The expansion of the market, increase of competitive environment, increased technology every day, effected the market which has increased the responsibilities of managers and widened the areas of control.

In the face of changing economic conditions, the managers may need to decide in exceptional circumstances. However, it is necessary to consult to the managers in events that develop outside of normal situations. This system is meant to be governed by exceptions (Robbins, 2008).

It is expressed as problem determination and communication system. In other words, the management will certainly not be engaged when the management does not require intervention. The benefits of the exceptional administration are:

- Saving time
- The productivity and profitability of the business
- Decision making is simplified
- Upper level works with full efficiency
- Emergency issues identified
- Managers are objectively evaluated
- Management activities are concentrated on actual management tasks.

The manager may sometimes fall into the following traps.

- The manager may not have the success to see the problems before exceptions have come through.
- The manager can spend a lot of time on subordinates who have made no progress
- The manager can cause morale low. The other successful staff thinks that there is no difference with the unsuccessful, because the executive manager put his hand to the problem of joining and assuming the failure of subordinates.
- The manager may fall into a situation that prevents the subordinates creativity. In this respect, the manager should not extend this practice beyond a certain crisis (Robbins, 2008).

As a result, managers sometimes use the exceptional management model as a solution to the downtime of the business because of the intensity of the business. However, the most important factor to note here is that this application is implemented only in times of crisis and that the application is terminated after the crisis has passed.

2.4.4 Self Improvement

Self-awareness, knowing what talent is, and analyzing and analyzing himself/herself is known as self-improvement. Employees must be educated and skilled in order for Total Quality Management to be successful. The skills of the employees must be trained and trained so that the quality can be sustainable. Everyone thinks that education is only about learning in school. However, education is with us at every point in our lives. As long as employees do not turn themselves into learning, they can always train and improve themselves (Goetsch, 2009).

2.4.5 Volunteering

At the beginning of the biggest problems of the present generation that live and continue to live is the problem of self-confidence. Without being told what to do to them they do not take action,

and when they are forced to do their jobs, they create risks for both their own and the firm's future. People are not machines. It is the ability to think about the most important feature that separates people from machinery and animals. People should use their own thoughts and wills. People must decide freely and play an active role in the quality circle. If staff feel that they can not use their will in the company, they can not be productive and can not achieve the success that is lacking in productivity. The Movement of Quality Management is a movement based on human respect. If you do not insist on volunteering, you can not respect human (Aized, 2012).

2.4.6 Participation of All Employees

Employees working in the business also play an active role in all the decisions related to themselves in the enterprise and they are expected to be consulted and their ideas about the issue. Therefore, the management of the reward system should be established to ensure the participation of employees, the transfer of authorities, the understanding of organizational and personal systems, quality and sustainability, and the management of benefiting from them by determining the strengths and abilities of employees. Keeping the motivation of the staff at the top level and developing the methods that will help them succeed is the first goal of the management systems. Full involvement of employees is crucial for business. Employees in businesses that have a healthy communication environment that can comfortably present their own ideas, discuss and predict decisions to be made within the business will feel comfortable and improve the quality of their work. In order for managers to provide motivation for employees in the working environment, it is necessary to establish the following conditions (Goetsch, 2009).

- The award system should be established and the success of the employees should be appreciated.
- Employees should be given advice about the business they are doing.
- Employees are happy about what they do if they feel important.
- Success brings quality.
- Employees and their ideas should be valued.
- Communication should be provided between employees.

In order for a system to achieve success, it is necessary for the people who are the basis of the system to be motivated, to believe in the system they are in and to work in this direction. Motivation should always be nurtured and educated, as an important factor for the employee. Manager's education should always be considered as one of the most important factors of the system. The appreciation and rewarding of the accomplishments achieved by the executives motivates the staff to provide further development. This is because Total Quality Management prevents the employees from being afraid of the managers thanks to the cooperation with the spirit of teamwork within the enterprise. Providing employees with job security and ensuring stability in their jobs will bring quality in a short time and increase the efficiency of the employer (Oakland, 2003).

As a result, managers must provide a business environment that allows them to be recognized within the quality management system, work within the team and demonstrate their skills and motivate them by recognizing and rewarding the successes of the workforce. Thus they can increase the success of their businesses and bring them to a better future.

2.4.7 Mutual Development

Employees who have a global perspective and a wide perspective have always been useful for companies in their own right. Personnel are more inclined to grow up in the circles they spend their time with and to develop themselves in this direction. This narrows their perspective.

Employees' perspectives should be broadened and interpreted as a whole by assessing the events that they have experienced and experienced from the perspective of the company, not from their own perspective. Employees should only exchange opinions with firms in the same sector, not even within the company in which they operate, even with companies in different industries. Quality circle is mostly preferred and used by companies in the automotive sector (Tasci, 2013).

2.4.8 Just In Time

As it is in the name of just in time, it depends on the time factor. It is also called as the production of timely production, zero inventory, production without stocks, Japanese Kanban system. The main objective of just in time is to make production processes continuous without any stop. Just in time production, the goal is to reduce costs through prevention of waste at all stages of production.

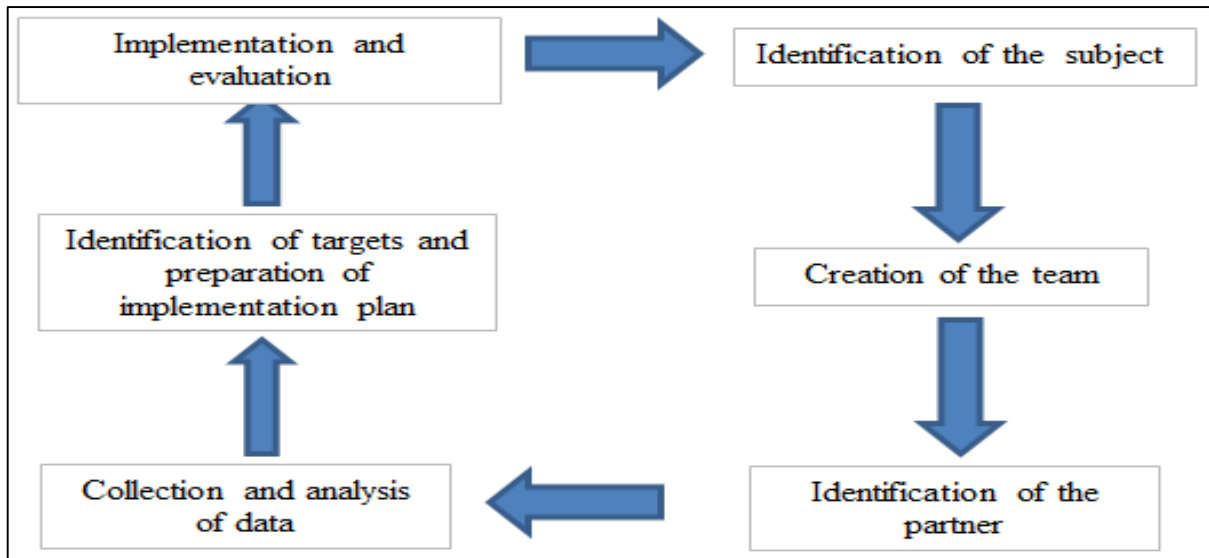
Every element that does not add value to the value of a production is referred to as "waste". In this context, inventories at every stage of production (raw materials, semi-finished goods and stocks of goods) and poor quality (defects in purchased or manufactured parts and products) have been identified as the main waste factors. The aims of production in just in time are expressed as follows (Oakland, 2003).

- To reduce intermediate stock levels in production to minimum level,
- To facilitate inventory control by reducing the changes in intermediate stock levels to the minimum,
- To streamline production flow by reducing demand fluctuations in production,
- To provide effective control,
- Reduce the rate of turnover

If the employee works in small parties instead of large parties, it will be easier for them to detect and recognize their mistakes. Particularly if the employees are separated according to their area of expertise and their abilities, it will increase the possibility of detecting and interfering with the material which has reached to itself before production. This will result in a significant change in the rate of defects in production.

2.4.9 Benchmarking

In this system, the reference point is determined. That is to say, the enterprises, the ones that are successful in the sector compares the reference points by themselves. The benchmark results in applying the data obtained in its own operation. This system provides competitive advantage to businesses by increasing their competitive power (Garavelli, 2004).



Picture 1 Benchmarking Process (Pekdemir, 2013)

Benchmarking can also be briefly described by the following definitions.

- One of the best practices is to do research to ensure learning.
- It is a systematic process developed to ensure organizational development and to evaluate the products, services and processes of organizations in their own fields.
- Benchmarking is a research study that determines who is the best, who is improving the standards, and what is more important (Pekdemir, 2013).

Benchmarking is the process that it has developed by evaluating its products and services in any given field by comparing it with the competitors in the sector or the products and services produced by the leading companies in the market.

Xerox's Benchmarking Partners	Benchmarking Process
American Express	Billing and Collection
American Hospital Supply	Inventory Control
Florida Light and Power	Quality Assurance Process
Ford Motor Company	Manufacturing Line Design
General Electric	Robot System
Cummins Engine Company	Daily Production Planning
Westinghouse	Warehouse Control

Table 2 Xerox's Benchmark Process Example (Pekdemir, 2013)

As mentioned above, the firm that performs the benchmarking application compares its products and services with the products and services produced by its competitors quality. The goals that are aimed at in comparison can be listed as follows.

- Determination of company goals and objectives

- At the rate of reaching the specified objectives and goals
- Keeping the goals and objectives continuous
- Changing or strengthening the culture adopted within the company
- Identify best practices for the company
- Lowering costs
- Providing motivation
- Increasing staff performance
- Strategically managed by the company

Benchmarking is about processes and practices. It is also a tool to identify processes that require major changes. Benchmarking is done in situations where mutual benefits can be created between firms that may or may not be competitors (Garavelli, 2004).

2.4.10 Codetermination

It is a systematic participation in management that enables staff and managers to collaborate together, aiming to work on solving common problems encountered in a bounded area. To put it more broadly, it is clear that the employees in the business have a say in decisions about the business.

Where do employees participate in management in business? In an opinion, employees should only participate in decisions that concern themselves. Another view; every decision taken is directly or indirectly related to the employee. As such, employees in the business should participate in the decisions taken (Kocaman, 2013).

2.5 6-Sigma

Six Sigma is considered as a methodology of implementing TQM. Six Sigma is an innovative approach to continuous process improvement and a TQM methodology. Since quality improvement is the prime ingredient of TQM, adding a Six Sigma program to the company's current business system covers almost all the elements of TQM. Six Sigma has become a much broader umbrella compared to TQM (Desai, 2008).

Six Sigma is a formal methodology for measuring, analysing, improving, and then controlling or locking-in processes. This statistical approach reduces the occurrence of defects from a three sigma level or 66 800 defects per million to a Six Sigma level or less than four defects per million (Bolze, 1998).

The statistical focus of various Six Sigma definitions reflects its basic philosophy. Six Sigma is an operating philosophy that can be shared beneficially by everyone, including customers, shareholders, employees, and suppliers. Fundamentally, it is also a customer-focused methodology that drives out waste, raises levels of quality, and improves the financial performance of organizations to breakthrough levels (Tauseef, 2012).

Design for Six sigma is a common project methodology used for design. These methodology replaces DMAIC methodology for design to prevent defects in design phase. There are five stages such as, Define design goals, Measure and Identify critical characteristics, Analyze to develop and design alternatives. And then last of all Verify the design. This methodology is not the same with ISO 9001, but it can be used as a method for design improvement, which would comply the design change requirements of ISO 9001 (Hammar, 2015).

2.5.1 Method

- DMAIC (Define, Measure, Analyze, Improve, Control) These five steps will be explainen in 2.4.1. Defining of the problem, measuring the data, analyzing the

collected data, improving the product or service, and controlling it just to make sure problems will not happen again.

DMAIC focuses on improving existing designs to increase the quality and customer satisfaction.

2.5.1.1 DMAIC (Define, Measure, Analyze, Improve, Control)

DMAIC methodology is similar in solving defects in manufacturing like plan, do, check, act and the seven why method. DMAIC is a routine for changing established methods for designing new ones (Schroeder et al., 2008).

DMAIC is a problem solving method and improvement method in practice. It is a part of improvement methodology of Six Sigma (Chakravoty, 2009).

Define	The goals of the improvement activity
Measure	The existing system
Analyse	The system to identify ways to eliminate the gap between the current performance of the system or process and the desired goal
Improve	Design and implementation of adjustments to the process to improve the performance of the CTQ's
Control	Verification of the project results and control system in order that improvements are sustainable. The new system

Table 3 Rational Reconstruction of the DMAIC procedure (Six Sigma's Breakthrough Cookbook, De Koning and De Mast, 2006, Pp. 773)

2.5.1.2 Define

Applying the define, measure, analyze, improve, and control (DMAIC) approach, the team begins by defining project stakeholders using a suppliers, inputs, process, outputs, customers (SIPOC) analysis. This analysis led to three groups— internal, external, and a mixed group that contained both internal and external customers. The mixed group includes customers and process owners and quality control group (Jacobsen, 2011).

At Ford each Six Sigma Black Belt projects start with a standard project charter, which includes a rating and impact estimation of project targets. The Six Sigma project team calculates the impact for each aim by measuring benefits against company goals and measures. They determined to find the real brake factor value according to the customer complaints (Jacobsen, 2011).

2.5.1.3 Characterize

The Six Sigma project team chooses design alternatives for the DCOV (Define, Characterise, Optimise, Verify) project. In Characterize phase, customer expectations and system concept. is created. The main plan is to avoid defects by using FMEA (Failure Mode and Effect Analysis) and developing P-Diagram to manage initial noise factor strategy. The Sig Sigma project team develops a system transfer function $Y=f(x)$. After this phase, the project team continues with Optimize phase (6-Sigma, DMAIC & DCOV Reference Guide).

Critical to Quality must be identified after the Define phase, but it should be based on the voice of the customer. Critical to Quality is operationally defined in Characterize phase. It means that the team finds specific metrics for each Critical to Quality, and creates new internal requirement based on this information. Also data sources should be identified. When using existing data, data range and quality issues must be taken into account (Pyzdek, 2014).

2.5.1.4 Optimise

The DCOV project team aims for robust performance and manufacturability. The team must find the transfer function, create a scorecard and create a verification plan. The product is designed to be reliable and robust by eliminating the noise factors during the optimize phase. In verify phase, product robustness and reliability is confirmed. The validation testing includes the effect of the noise factors. The DCOV project team must decide the testing to be conducted in verify phase and develop a testing plan (6-Sigma, DMAIC&DCOV Reference Guide Fundamentals, 2012).

The project team designs the product to be reliable and robust by minimizing the effect of critical noise factors. The project team:

- Validates transfer function with measured data
- Identifies the effects of critical noises
- Conducts experiments to optimize the system
- Develops a design verification plan that included tests to verify the absence of important failure modes (6-Sigma, DMAIC & DCOV Reference Guide Fundamentals, 2012).

2.5.1.5 Verify

After the optimum product design and the work in the previous phases, project team moves to finalize the project. They also share the knowledge that they gained during the project with others. The main purpose of the verify phase is to confirm the functionality of the product which leads to higher customer satisfaction and replicate and note the improvements on product. Actions taken, deliverables, tools table links the components of the verify phase. During the verification testing, analytical models are used because of the time saving and high cost of hardware based testing. The transfer function is the ideal model that can be used in testing (6-Sigma, DMAIC&DCOV Reference Guide Fundamentals, 2012).

2.5.1.6 Cause & Effect (Fishbone) Diagram

Fishbone diagram is mostly used as a tool in improvement projects. The diagram is also known as Ishikawa diagram which named after the founder. The cause & effect diagram helps the team for creating new ideas, brainstorming with a certain way. This diagram is used as an input to DOE (Design of Experiment). Cause & effect diagram has an input of x variables, and also noise factors, control variables (Boby, Lutfi, 2013).

The main shape of the diagram looks like a skeleton of a fish. In the diagram, distribution of the multiple causes and sub-causes for those can be found. Characterization of the causes and sub-causes are also done in fishbone diagram. For the risk evaluation, the cause&effect diagram can also be used to determine the risks for all the causes and sub-causes of the effects (Ciocoiu, 2008).

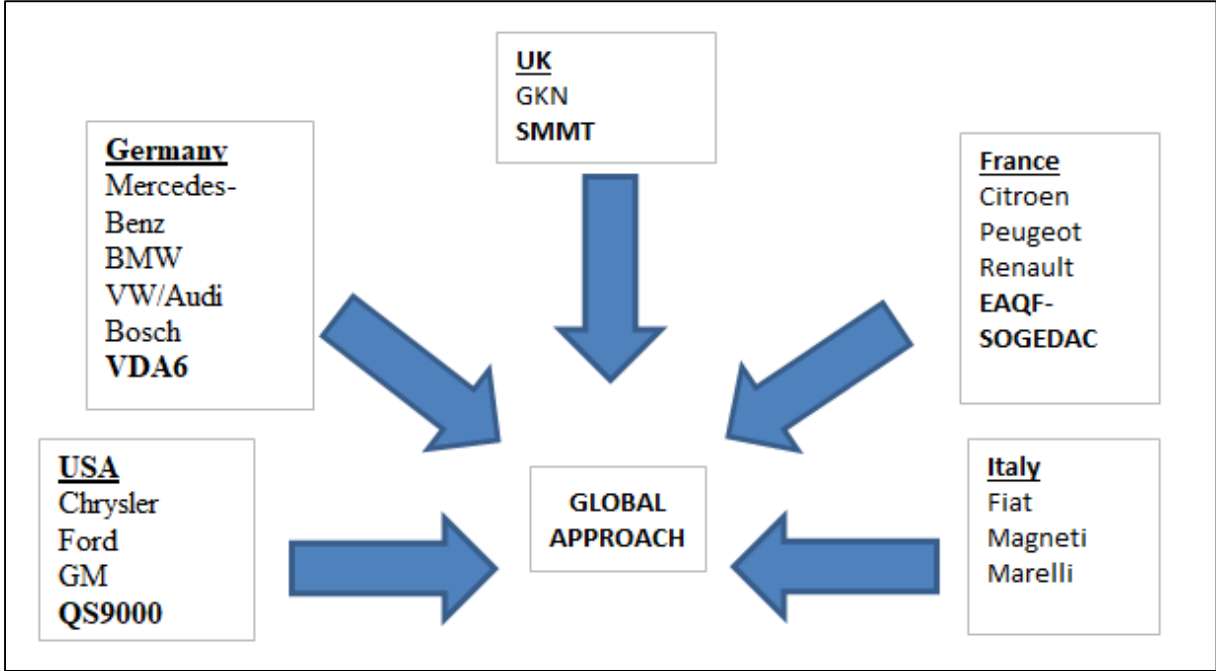
2.6 Total Quality Management in Automotive

2.6.1 ISO 16949 Quality Management System

The concepts of Quality Assurance and Quality Management have gained international quality with ISO 9000 series standards. When automotive companies accepted the ISO 9000 Quality Management System, they found this standard very general and developed new standards / technical specifications by detailing them according to the needs of their own sectors. The QS 9000 is a special adaptation of the ISO 9000 Quality Management System for the automotive industry and is a standard developed by Chrysler, Ford Motor and General Motor companies, taking industry requirements into account. ISO/TS 16949 is a technical specification designed to address the quality system requirements existing in the automotive sector on a universal basis and to avoid miscellaneous documentation investigations. ISO 16949: 2002 has been revised to ISO/TS 16949: 2009 in parallel with the revision of the latest ISO 9001: 2008, following the

revision of the ISO 9000 series of standards in 2000 in parallel with the requirements of the day (Naveh, 2007).

Providing customer specific requests for certification of production (semi-finished, finished parts, complex production, heat treatment, paint, coating or surface treatment) areas of all the manufacturers in the ISO / TS 16949 automotive supply chain, it is not used to certify components or indirect services (such as engineering) that are not included in the vehicle during the OEM manufacturing process (Naveh, 2007).



Picture 2 Member Automobile Manufacturers and Authorized Organizations of Countries (own elaboration)

2.6.2 ISO/TS 16949 Historical Development

The search for quality is based on very old histories in the automotive sector. In the automotive field, Ford, Chrysler and General Motors are known as the three biggest companies. The historical development of ISO / TS 16949 standard is as follows.

QS 9000 Quality Management System has not emerged as an international standard. Nonetheless, today, General Motors operates globally and the automobile segment has gained an international dimension due to its impact on the company that provides the materials and services, and even some European automobile companies have begun to accept this document from the suppliers. The QS 9000 standard which is recognized by the 22 accreditation institution has been multiplied by 800,000 copies, translated into 9 languages and used in 63 countries since its publication (Seddon, 2000).

Year	Progress
1963	MIL-Q 9858A (US Military)
1965	GM General Quality Assurance Standard (GQS)
1969	DEF Standards (UK MOD)
1974	AQAP Defence Standards

1979	BS 5750
1981	Ford Q101
1983	Chrysler Quality Assurance
1987	ISO 9000 Series
1994	July - ISO 9000 Revision
1994	August - QS-9000
1995	QS-9000 Second Edition
1998	QS-9000 Third Edition
2000	ISO 9000: 2000 series published
2002	TS 16949: 2002

Table 4 ISO/TS 16949 Historical Development (own elaboration)

The fact that QS 9000 is a certification process that meets all quality requirements and is based on cost effectiveness is a factor that increases the confidence of customers as well as commercial importance for certified companies. It also aims to reduce waste in every way. Daimler Chrysler, Ford Motor Company and General Motors, Supplier Quality Requirements Task Force (SQRTF) are responsible for writing the QS 9000 quality management system, its content and for setting policies and procedures for QS 9000 programs worldwide. AIAG is involved in the distribution of these documents, in trainings and in the management of these transactions (Hoyle, 1998).

QS 9000 requirements basically aim to guarantee customer satisfaction. The main goal is to ensure continuous improvement of the process and product and to limit product differences. QS 9000 quality plans focus on methods to eliminate them before problems arise.

2.6.3 Purpose of ISO/TS 16949

The purpose of this standard is; Automotive Sub-Industries Quality management systems are evaluated according to common criteria accepted all over the world. This standard also aims to meet different customer demands and eliminate different auditing and documentation requirements. The object of the ISO / TS 16949 standard is as follows;

- To gather the knowledge of the automotive industry together,
- To improve product quality, to provide more reliable products to consumers,
- To develop the supplier chain,
- Reducing costs, increasing productivity,
- To ensure that all sectors meet in the same quality system,
- To prevent the parent company from implementing different types of control,
- To increase the quality level of the sector (Kymal, 2004)

ISO / TS 16949 Quality Management Standard is accepted and supported by all automotive industry (OEM) companies in the world. The major organizations are Ford, Chrysler, Peugeot, Audi, GME Opel, Bosch, Volkswagen GM, BMW, Citroen, Mercedes Benz, Fiat and Renault.

2.6.4 Benefits of ISO/TS 16949

ISO / TS 16949 standard to meet the specific needs of the automotive industry. ISO / TS 16949 was published in August 1994 by three major engine manufacturers Chrysler, Ford and General Motors to standardize their quality assurance requirements for suppliers. Today it is a

mandatory standard engine manufacturer suppliers. It will reduce the possible changes in the supply chain. Main benefits of ISO/TS 16949 can be listed as follows.

- Increasing competitive edge in the market,
- Employee motivation increases,
- Provides continuous improvement of the company's system,
- Wastes are reduced,
- To increase productivity and profitability,
- Enabling business processes with a consistent structure that meets customer expectations in product / service delivery,
- Production and final controls can be done effectively,
- To make things work right at the first time,
- Reducing costs due to malfunctions and poor quality work,
- Provide the memory needed to reach the sources of error,
- To create permanent in-house information with ISO 9001: 2000,
- Encouraging employees to participate
- To be able to benefit from the commercial advantages of obtaining a quality certificate with international validity for the automobile industry (proof of quality for export) (Kymal,2004).

According to ISO / TS 16949, only automotive suppliers can be certified. The system is based on ISO 9001: 2000 and introduces a different perspective on the establishment and supervision of management systems.

3. Application Part

3.1 Ford Otosan's Total Quality Approach

Ford Otosan has been working with green and black belt quality directors since 2001 which brings the Kocaeli factory to the Europe's top factory award for four consecutive years. With "6 Sigma", a systematic total quality management system targeting 3.4 errors in the million, Ford Otosan has increased both the number of projects it has developed and substantial savings. The number of green and black generation managers who control the 6 Sigma system increased from 33 to 628 in 2001. The number of projects developed through this method has increased from 4 to 92. These projects only saved \$ 26 million in 2005. Ford Otosan started to teach this system to other Ford executives at the Ford Motor Europe Germany center, although 6 Sigma started to apply after 6 months of "Ford Motor Europe".

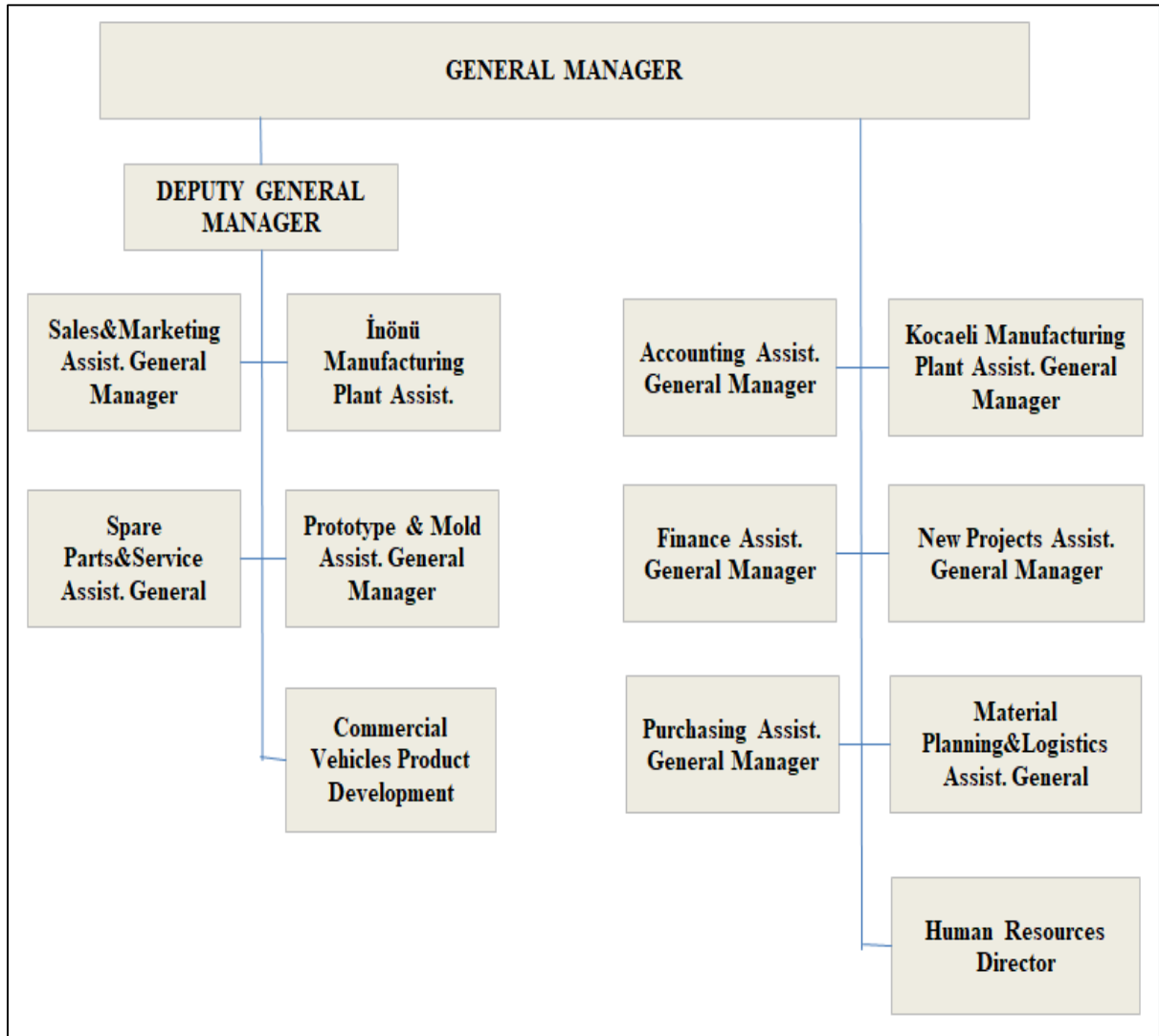
Excellence in Total Quality has been adopted by the Ford management. This principle can be expressed as " Whatever you do, it will be the most perfect". The quality level is determined by the customer. The shortest way to reach perfect Total Quality is to find solutions to the problems all work done by all employees, suppliers and vendors of the company is part of the product or service process for the customer. In order to achieve the excellent Total Quality, all the processes (not only the production processes, but also all the sales processes and processes that supports just in time) must be constantly monitored and improved, and in order to realize these improvements, employees must generate ideas and act in a planned manner. We are all customers of each other and every customer has the right to expect the most perfect.

3.2 Company Description

Ford Otomotiv Sanayi A.Ş. which was established in Turkey, focusing on commercial vehicles, production of motor vehicles, including installation and sales, import of passenger car, sales

and production of spare parts of these vehicles. The company was established in 1959 and is currently operating as a partnership between Ford Motor Company and Koç Group companies. 17,92% of the shares of the publicly traded company are traded on the Istanbul Stock Exchange.

The company has two separate factories in Kocaeli and Eskişehir, spare parts distribution warehouse in Istanbul Kartal, and a workplace branch in Tübitak Marmara Research Center and Gebze Campus Technology Free Zone (TEKSEB). In the Kocaeli plant, light commercial vehicle "Transit Connect", other commercial Transit brand vehicles (minibus, pick-up, van) and Transit Custom, which was started to be produced in 2012, and Ford Cargo trucks and engines of these vehicles are produced in Eskişehir factory. TEKSEB, established in 2007, conducts research and development activities which are also subject to export of services.



Picture 3 Ford Otosan Organizational Chart (Ford Otosan HR, 2013)

Name	Share amount	Percentage
Koç Holding A.Ş.	144.126.893	41.07%
Ford Motor Company	143.997.037	41.04%
Public Shares	62.786.070	17.89%

Total Rated Stock (TL)	350.910.000	100%
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Table 5 Ford Otosan Partnership Structure (Ford Otosan Annual Report, 2017)

As of 31 March 2018, the Company has a total of 11,133 employees, 2,619 employees and 8,514 employees (31 December 2017: 2,654 civil servants and 8,847 workers, a total of 11,501 employees). Ford Otosan continued to have the highest employment in the Turkish automotive sector. The company's vision is to be a leading automotive product and services company with a customer-focus. The mission is to be the leader of Turkey's automotive market and become Ford of Europe's production center while providing best automotive products and services which suits with customers needs and expectations (Ford Otosan Annual Report, 2017).

3.3 Company History

Otosan is a Turkish company that has been operating in 1959. The first production started in 1996-1984 by producing Anadol brand cars. In 1997, company changed its name to Ford Otosan by increasing his shares. Ford Otosan is located in;

Istanbul Sancaktepe Product Development Center,

Gölcük Factory,

İnönü Plant,

Kartal Spare Parts Center,

A total of 11.501 employees are employed in these operations.

Ford Otosan achieved an important success in 2011 with a total of 50 million engineering exports. 1200 engineers are employed in the Product Development Center located in Sancaktepe. The short history of the company is shown in Table 6.

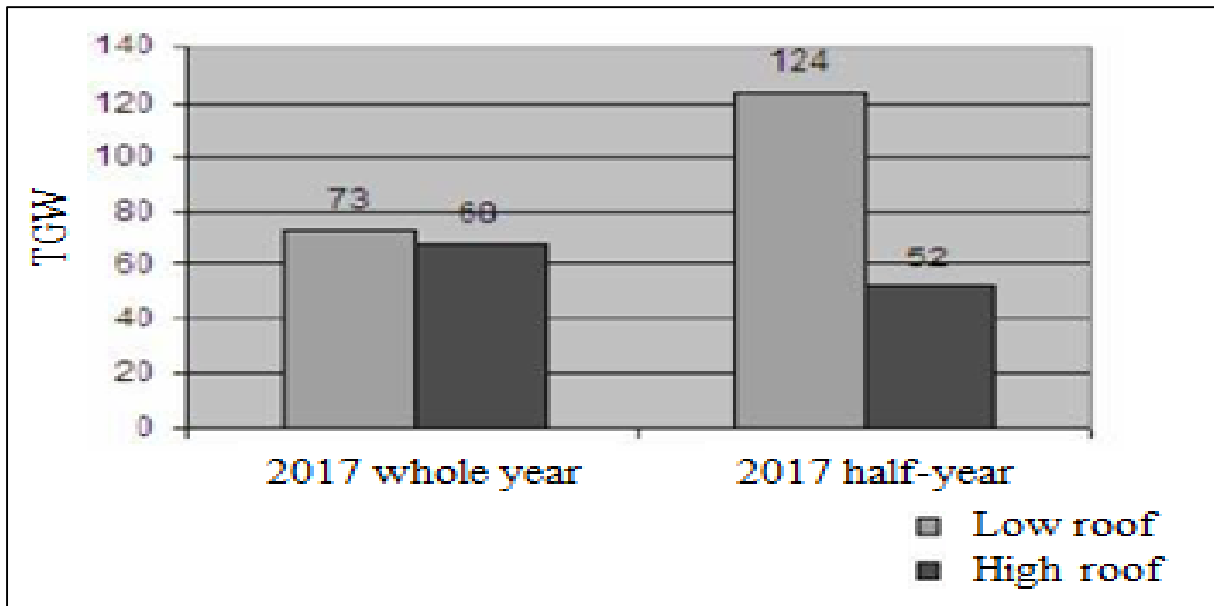
1928	The first Ford dealership
1956	The first dealership in the world with rights of assembly
1959	The first assembly factory founded by Ford-Otosan partnership
1960	Production started at the Istanbul factory
1961	The first minibus rolls of the assembly line
1983	30% of Otosan's shares acquired by Ford
1997	Changeover from Otosan to Ford Otosan
1998	Spare Parts Distribution Center is established
2001	Opening of the Kocaeli Plant
2002	Production of the Transit Connect
2003	The Connect Selected as International Van of the year
2005	One millionth vehicle produced

2007	The Ford Transit is selected International Van of the year
2007	Gebze Technology Center Opens
2015	Opening of Turkey's Biggest R&D Center

Table 6 Ford Otosan History (Ford Otosan website, 2018)

3.4 Ford Otosan Total Quality Management Practice

Full and continuous customer satisfaction is essential in Total Quality Management. Therefore, in the studies conducted from the customer satisfaction, it is frequently mentioned by the customers that the effort to close the rear covers of the vehicles in the high ceiling models of Ford Otosan vehicles is high.



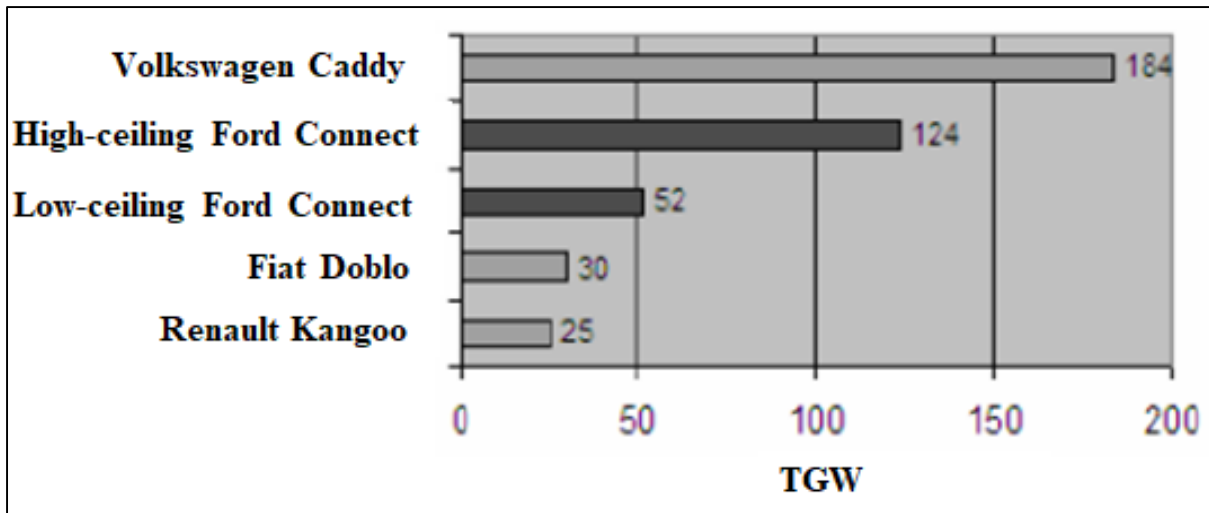
Graph 1 Rear door closing effort (TGW/1000) (Cargo TGW Report, 2017)

Problems expressed as "ThingsGoneWrong" (TGW) are expressed in terms of the TGW / 1000 metric according to the frequency of encounter in every 1000 rounds.

In customer satisfaction surveys, complaints about the high closing power of rear doors in Transit Connect's high-ceiling models are at the top. As seen in Graph 1, this problem has been identified as the second major complaint in vehicles with low ceilings.

3.4.1 Analysis of the problem

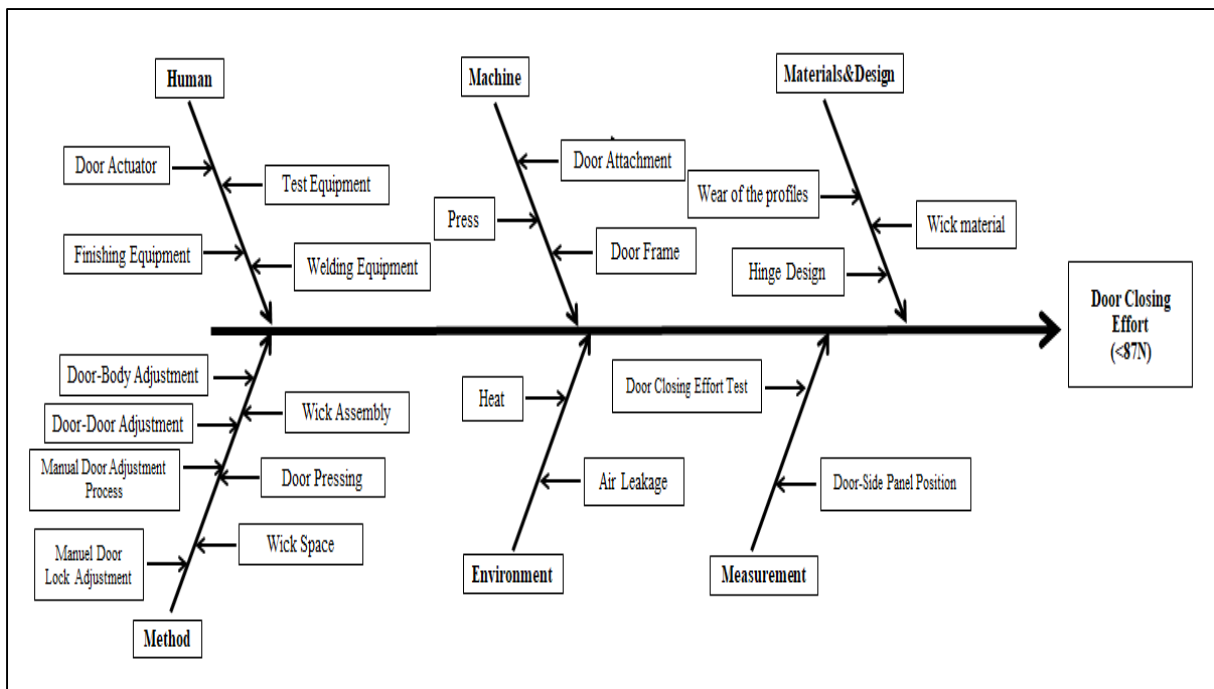
According to customer satisfaction surveys, customers have complained about 124 of 1000 vehicles in high ceiling models and 52 of 1000 vehicles in low ceiling models due to door closing efforts. Due to the serious complaints, the door effort measurements were made on some of the models presented in the market and Transit Connect high and low ceilings were among the worst vehicles and their competitors in their segment.



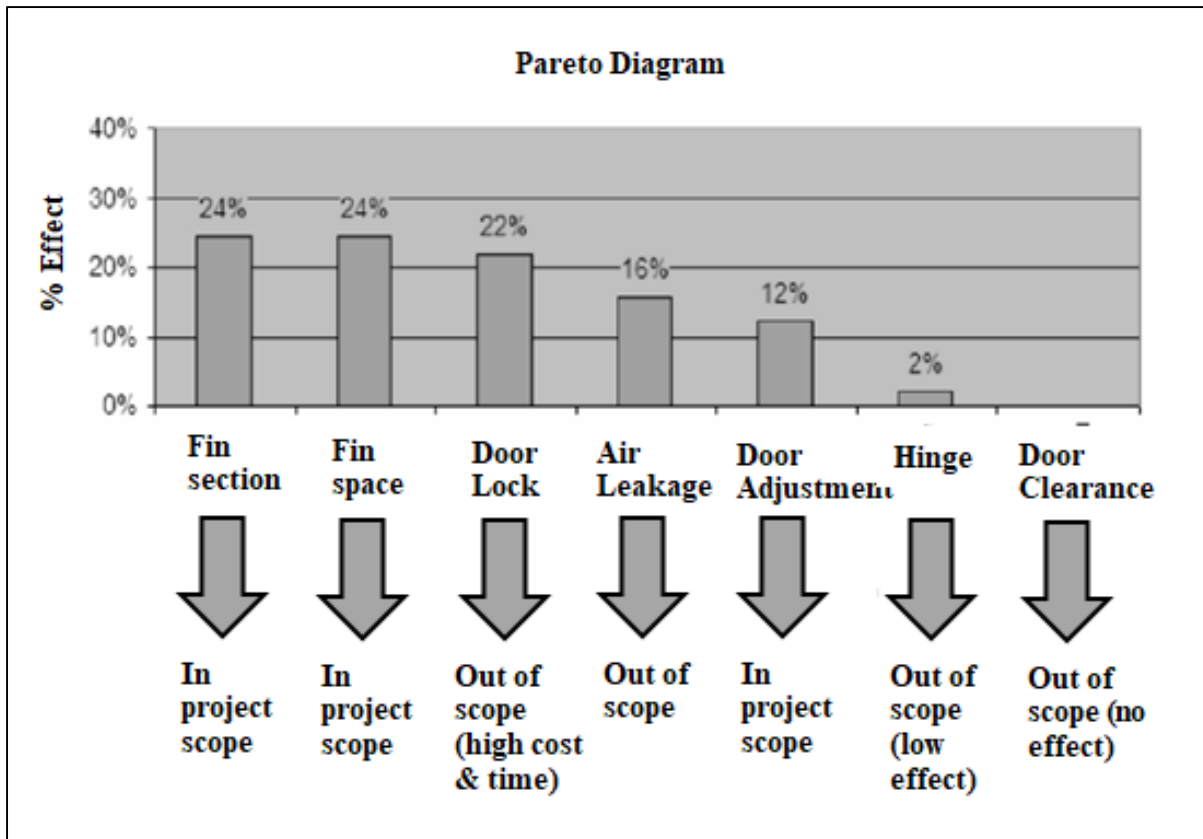
Graph 2 Customer complaints, things gone wrong (TGW) benchmark (Cargo Benchmark Presentation, 2017)

After this determination, cause analysis results have been made in order to determine the source of the excessive effort problem in the back cover of the vehicles. The cause and effect diagram for decreasing the closing effort below the expected value of 87 Newtons is shown in Picture 4 below.

During the measurement phase, the team decides what and how to measure each effect in each transfer function, and prepares a data collection plan. In addition, a Design of Experiment (DOE) study is planned. Within the scope of this data collection plan and Experimental Design study, total of 55 vehicles were measured with three dimensional measuring device at 7 selected critical points in the welding hull line. In addition, the sealing working gaps were measured from these 25 different points. The ability analysis of the pre-measurement metering system has been determined to be capable of Gauge R & R.



Picture 4 Cause and effect diagram for door closing effort (own elaboration)



Graph 3 Pareto Analysis (own elaboration)

The values measured in the analysis stage and the results of the Experimental Design study were analyzed with the Minitab program. The effect of each measuring point on door closing effort was tried to be determined by performing regression tests. According to the assessment of the measurement points and the determined specific values, the results of the line tests made with the manufactured bodies were calculated, and the intensity of each of the influences affecting the closing effort was calculated and reported by a Pareto Analysis as shown in Graph 3 above.

Analysis made shows that there are three most important factors affecting back closure effort;

- Fin (sealing) sections
- Fin (sealing) space
- Door lock.

Project team aimed to reach this goal and continue to the project. The analysis completion settings (door gaps) and seal gap operations have been made more convenient by the respective teams. In addition, the arrangement of the sections of the backfill fins.

According to the Pareto Diagram, the "Fin (sealing) Sections" and "Fin (sealing) Space", which take the first and second order, will be subjected to a variability reduction process in welding and assembly workshops. For the third factor that appears in the diagram, the reaction forces were measured in comparison with competitor's vehicles and it was decided that the Transit Connect seals were much harder than their competitors and therefore the design variability was needed. An optimal setting position for the door setting process in the assembly line has been established and a pass-through gauge has been activated so that this optimal setting can be

relieved from the working operator dependency. Variations that occur in the door operation space are another important issue that increases effort. Dimensional errors in the body parts are the causes of the variability.

Mold modifications were made in the panel molds of the Ford Otosan Press Area Directorate and in the parts of the supplier industry in order to make the mistakes detected on the parts-based measurements.

Process documentation and control plans in welding and assembly workshops have been updated to ensure the continuity of the proposed improvement in the process. Important features have been defined for measurement points specified in the supplier's parts.

3.4.2 Application and Evaluation

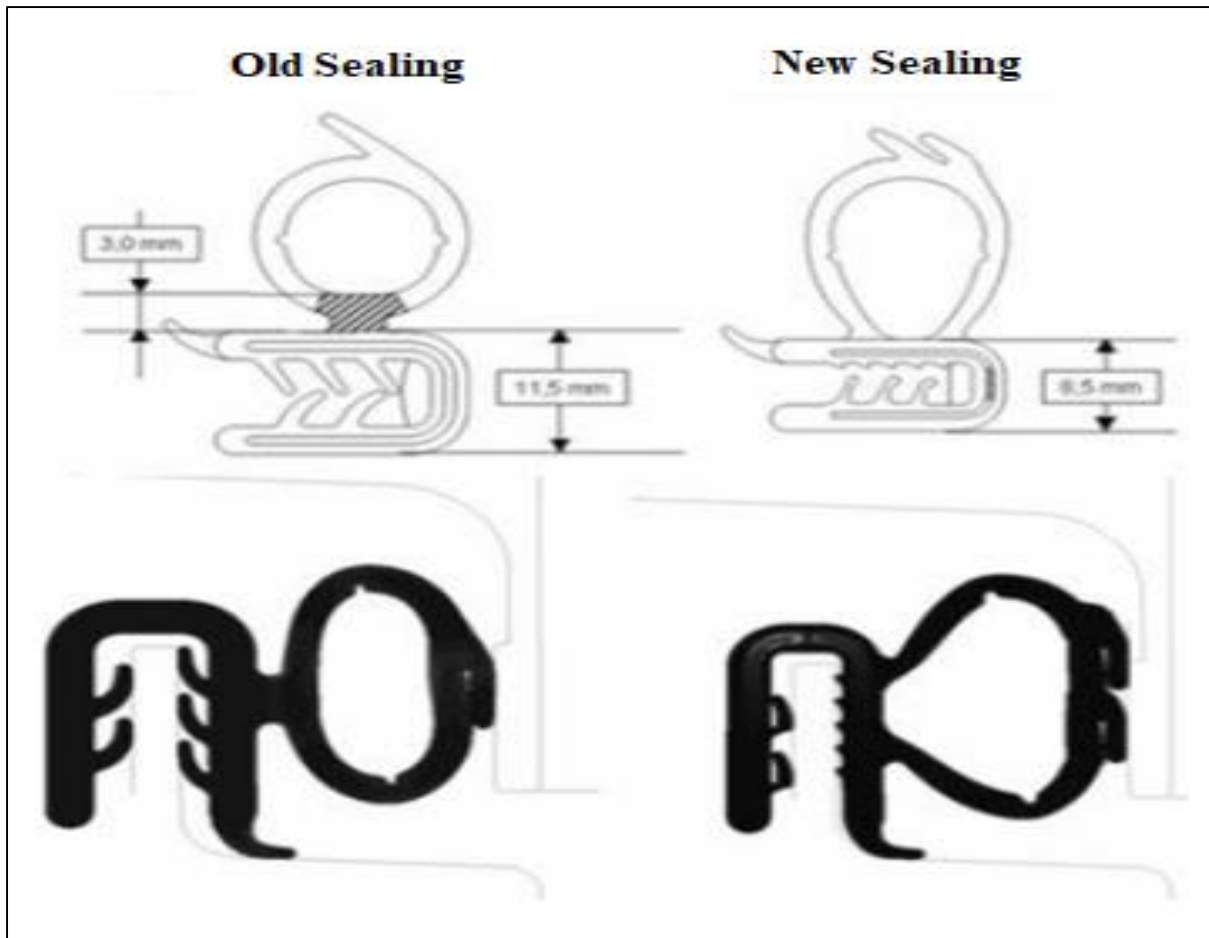
The rear door closing effort of 122 Newtons is reduced to 94 Newtons, gap of 6 mm between the two doors, set as a minimum of 5 mm and a maximum of 9 mm for the door adjustment effect, which affects the door closing effort.

It was discussed with the supplier companies about the fin (sealing) space which affected the rear door closing effort from the second grade and it was asked to suppliers to research and study again about the subject.

According to the researches made by the supplier companies, it has been determined that the sealing front panel and the protruding edge angle are outside of the standards and developments related to these problems have been made.

Ford Transit Connect has the highest fin pressure force based on the comparisons between competitive companies (benchmark) with the same segment vehicles. It has also been found that the door systems of competitive vehicles are made up of a single piece and that there are at most two or three roving ducts to prevent water leakage. In this context, an alternative sealing section design was made based on the collected data.

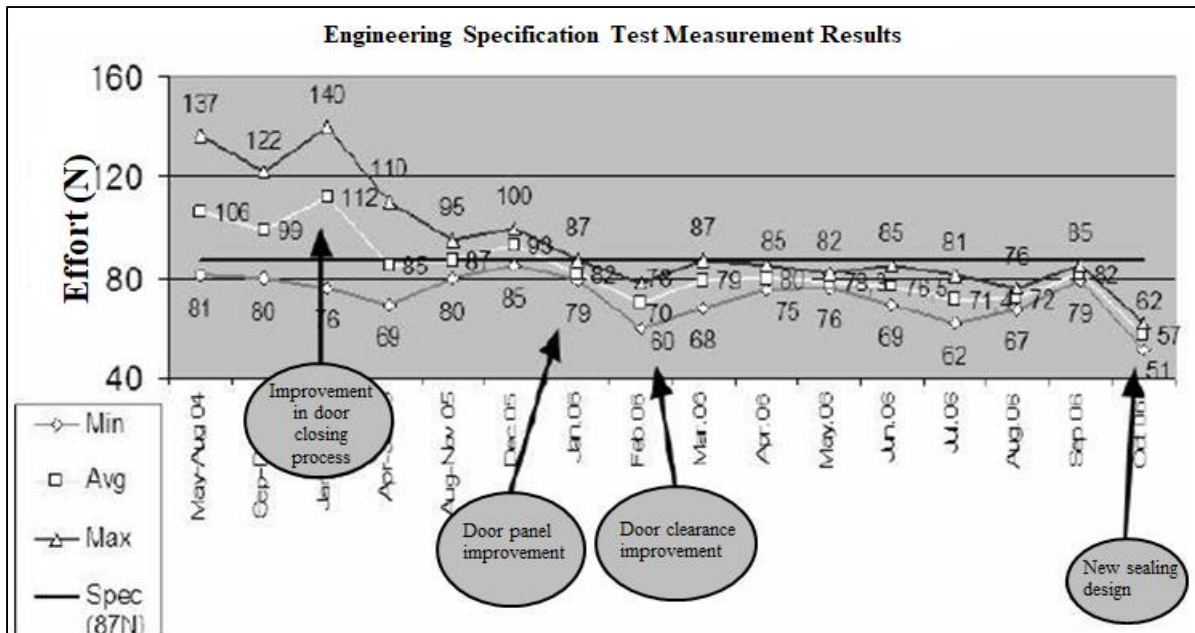
In Picture 5 there are differences between the old seal and the new seal. After this work, the amount of door closing effort decreased by 15 Newtons, and the amount of water leakage decreased compared to the old one and the creeping durability increased.



Picture 5 Old and new sealing designs (own elaboration)

At the beginning of the project, the door closure effort, which caused customer complaints in 124 of the 1000 vehicles, and door closing effort which was very high compared to its competitors as 140 Newton was reduced to around 60 Newtons thanks to total quality management. As a result, thanks to this project, the TGW value of Ford Connect, which is the worst door-closing effort among its competitors, now is the best among the competitors. The effort graph in Picture 6 below shows the success of the project.

Thanks to the outputs that started with customer complaints and successfully completed Total Quality Management process, customer satisfaction was ensured and superiority was gained over competitors who were constantly faced in the competitive environment.



Picture 6 Effort Time Graph (Door Closing Effort Test Report)

Total quality management places a great deal of responsibility on all workers. If employees are to identify and correct quality problems, they need proper training. They need to understand how to assess quality by using a variety of quality control tools, how to interpret findings, and how to correct problems. These are sometimes called the seven means for quality control (cause and effect diagrams, Scatter diagram, flowcharts, Pareto chart, Histogram, Control charts, checklist). They are easy to understand and at the same time extremely useful in the quality problems identification and analysis. Sometimes, the employees use one mean, but often, the use of a combination of means is of greater help. As it can be seen in Picture 6, by using total quality management tools, specifically, gage r&r, cause&effect diagram, pareto chart, the customer satisfaction is ensured and the new design is now the best among all the competitors.

Total quality management extends the concept of quality to the suppliers. In this study, supplier quality management provided a flexibility and speed while making the required design change according to customer needs and updated technical specifications. The company needs to ensure that the suppliers engage in the same quality practices. If suppliers meet quality standards, the products do not have to be inspected upon arrival. This situation will make the company save time and lower the costs. Therefore it is always better to have a representative residing at the supplier's location, from product design to final production to reach the higher quality as big automotive companies do.

- The optimisation of costs
- Customer satisfaction
- Continuous quality improvements
- Solution for quality problems
- The identification and selection of key suppliers
- Detailed analysis of the quality problems
- Information and analysis of competitors performances
- Thanks to the pareto chart usage, the team focus on the inputs that will have the greatest impact

- Thanks to the cause&effect diagram usage, the team can easily find out the many causes that contribute to an effect.
- By creating a core engineering team, the company can develop technical specifications, lessons learned documents based on customers feedbacks, and make a failure mode and effect analysis for design and processes.

As it is a team work rather than individual performance, it is significant to participate for all the employees and functions.

After the successful application of total quality management tools, total customer complaints for Ford Connect were eliminated, and the expected quality level in technical specifications were achieved.

Total Quality Management must investigate whether the personnel and managers are in compliance with the system before starting the application. If the personnel and managers are not suitable for the system, the personnel and managers who will be part of the system should be brought in.

The system and the parts of the system must be designed from the beginning and applied until the last. In other words, it is called Total Quality Management that personnel at every level can freely express their ideas and offer suggestions freely, and participate in decisions about the company.

Total Quality Management covers the period from production to after-sales of the product or service. Therefore, the system has not been completed after the product or service has been provided.

4. Conclusion

Large or small sized enterprises can only survive as long as they respond to customer requests and expectations. Total quality management is a system that focuses on quality at all stages of a product or service from production to consumption.

Total quality management never brings individual success. This system should be adopted and implemented by everyone, from a worker to a manager, with a team work.

Quality Management is just like a puzzle. In order to be able to see all of the pieces, it is very important that all parts are in the right place and at the right time. When one of the pieces is missing, that is, if the person does not fit in the system, the yield will be very low and the whole visuality will not be achieved.

It is very important for after-sales service that positive feedback from customers can be taken into account when considering the qualitative customer determination philosophy.

In this research in the automotive sector I have found that customer complaints coming to technical service departments which continue their after sales services are inevitably part of Total Quality Management philosophy.

Considering the customer complaints that have been received by the technical services and the user survey researches that have been done, the problems experienced by the customers have been determined. In the light of this information obtained, the measures of the rear doors which caused the complaints of the customers were investigated. Later, these measurements were expanded and measurements were taken on all models with high and low ceilings.

In studies using benchmarking with different brands in the same segment as the data obtained after taking the measurements, Ford Connect was found to be the model with the worst rear door closing effort in low and high ceiling models in its class. In this respect, it has been seen what the customers are justified in their complaints.

The cause and effect diagram has been created to achieve the required effort value. After this, measurement and experiment studies were carried out and the reasons were reported with the Pareto analyzer.

Three factors have been identified that will cause the end result of the analysis to be overloaded. These three factors were examined one by one, independent of each other and related to each other, and the impact rates of the rear door closing effort were extracted. In the following period, improvement studies were carried out for the three factors taking into consideration the impact rates.

The most important effect for rear door closing effort has been the design of the new door for the first-door door. The new sealing was designed by comparing the sealings of the vehicles in the same class on different marks.

After the improvements made, the end-point measurements were taken and the values decreased to the expected levels. These studies have also been implemented in customer vehicles as a result of after-sale service and it has been seen that according to the feedbacks, the success has been achieved.

Thanks to the total quality management implemented in Ford Otosan, the defects in the produced products are determined and the defects in the products are detected by the result of the studies made by the understanding of "Customer is always right" and "Customer satisfaction".

The end result of Total Quality Management practices has been customer satisfaction of Ford Otosan. Thanks to the system applied, the problem has been solved by changing the design of the parts used in the production and it has been possible to prevent possible problems and complaints in the subsequent productions.

Total quality management extends the concept of quality to the suppliers. In this study, supplier quality management provided a flexibility and speed while making the required design change according to customer needs and updated technical specifications.

The company needs to ensure that the suppliers engage in the same quality practices. If suppliers meet quality standards, the products do not have to be inspected upon arrival. This situation will make the company save time and lower the costs. Therefore it is always better to have a representative residing at the supplier's location, from product design to final production to reach the higher quality as big automotive companies do.

Abstract

This document provides an analysis and evaluation of the effect of Total Quality Management tools on specific customer complaints in automotive research and development organisation.

The analysis was performed through the real TGW (Things Gone Wrong), customer complaint data and TQM tools used through real project. The usage of fishbone diagram, pareto chart, cause and effect diagram has seen. The selected automotive firm has been evaluated on Total Quality Management concept and the studies on the problems identified in the direction of customer complaints and questionnaires and the customer satisfaction reflections and satisfied customer feedback of the Total Quality Management concept applied in line with these studies that have been targeted. According to customer feedback, the success of the implemented Total Quality Management has been determined and the changes made in the production and management stages have been explained in order to ensure continuity of this system and continuity of customer satisfaction.

Key words: quality, total quality management, automotive, customer complaints

JEL classification: L15, O32

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