CHAPTER II

THEORETICAL CONCEPTS

In this chapter, the theoretical concept related to Automotive Seat Production Improvement, which will be discussed as Total Quality Management Concept, Problem Solving Method, Cause and Effect Diagram and FMEA.

2.1 Total Quality Management Concept

Before starting product improvement, to better understanding thus we should know the concept of "Total Quality Management (TQM)".

Today, TQC has come to be known as total quality management (TQM), the roots of which are in Japan. The United States attempted to import some of these "secrets," such as quality circles or just in time, in the 1970s and 1980s. Not until the mid-1980s was the label TQM extensively used to emphasize the crucial role of management in the quality process.

Total quality management utilizes a combination of methods, theories, techniques, and quality guru strategies for achieving world-class quality. It is management process or system that emphasizes continuous quality improvement and demands that top management (leadership) be committed to continuous involvement. Total means that everyone participates and that it is integrated into all business functions. Quality means meeting or exceeding customer (internal or external) expectation. Management means improving and maintaining business system and their related processes or activities.

Total Quality Management calls for a cultural transformation that requires employee involvement at all levels and a spirit of teamwork among customers, suppliers, employees, and managers. Employee involvement, participation, and empowerment form the cornerstones of TQM.

The five basic elements to a basic understanding of TQM are:

- Communications
- Cultural Transformation
- Participative Management
- Customer Focus
- Continuous Improvement

2.2 Problem Solving Method

The plan-do-check-act (PDCA) cycle is a four-step, never ending process for solving problems, planning, making decisions, and process improvement. It has also been called plan-do-study-act (PDSA) cycle and it is commonly called the Deming cycle or wheel. The PDCA cycle provides a model or process for teams. It can be applied to any process including a budget, vacation, company goals.

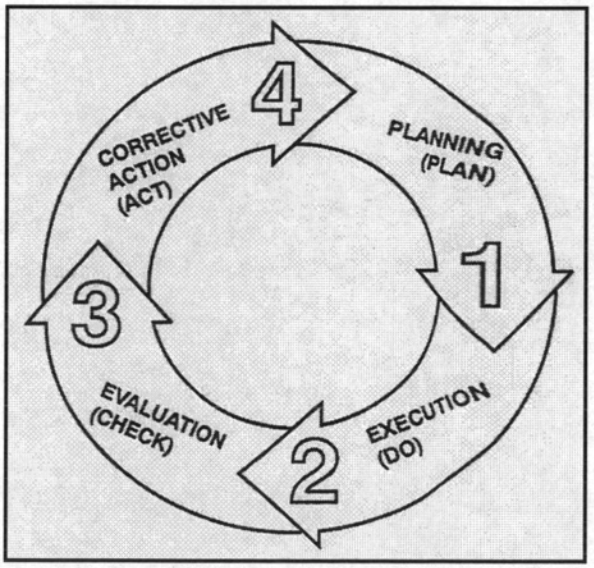

Figure 2.1 P-D-C-A Cycles

2.2.1 Plan

During the planning step, we have developed a problem statement and determine which data are needed. Brainstorming is commonly used to identify what we already know, identify what we still need to learn, and identify potential improvement ideas or plan which our plan also be based on facts and data.

2.2.2 Do

Do is a second step. The plan must be implemented to see how it works. The proposed improvement is generally attempted on a small scale and preferably in a controlled environment. Our data are carefully collected during this stage.

2.2.3 Check

The third step is to check the effects of the plan. Our Data gathered during the doing stage are analyzed to determine the proposed improvements result whether it work or not.

2.2.4 Action

In this step, we could know countermeasure and correction method to prevent problem recurrence.

2.3 Cause-and-Effect-Diagram

The cause-and-effect diagram is a tool used to help illustrate the relationships between an effect and its possible causes. It is also known as a fishbone diagram (because of its resemblance to a fish skeleton) or Ishikawa diagram (after Kaoru Ichigawa, the creator of this tool as a problem-solving technique). Some have referred this tool as the brainstorming diagram. While individuals can develop cause-and-effect diagrams, team use is most effective.

The diagram is used to highlight the main causes, minor causes, and subcauses leading to an effect (problem, symptom, or the like). This is an important tool in the early stages of problem solving. It can also be used to clarify problem areas and establish corrective actions.

The left side of the diagram represents the main or root causes; the right side shows the effect. Each of these categories is divided into minor causes, which may be further divided into numerous sub causes and then further subdivide.

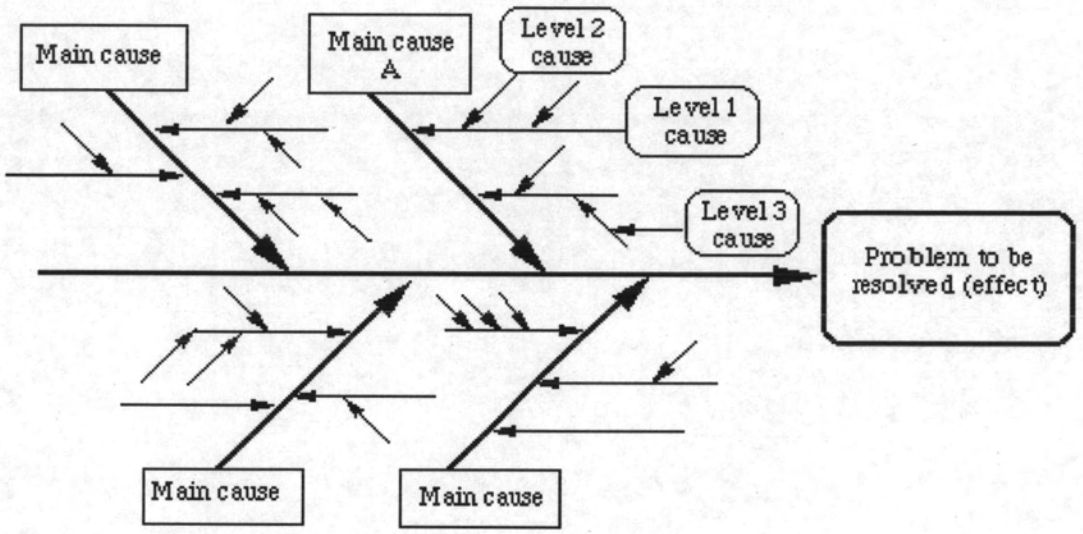

Figure 2.2 Ichigawa Diagram

2.4 FMEA: Failure Modes and Effects Analysis

2.4.1 Definition of FMEA

FMEA is a systematic approach used to examine potential failures and prevent their occurrence. It enhances an engineer's ability to predict problems and provides a system of ranking, or prioritization, so the most likely failure modes can be addressed.

It is generally applied during the initial stages of a process or product design. Brainstorming is used to determine potential failure modes, their causes, their severity, and their likelihood of occurring. FMEA is also a valuable tool for managing tasks during defect/failure reduction projects.

FMEA is a systematic design evaluation procedure whose purpose is to:

1. Recognize and evaluate the potential failure modes and causes associated with the designing and manufacturing of a new product or a change to an existing product,
2. Identify actions which could eliminate or reduce the chance of the potential failure occurring,
3. Document the process.

2.4.2 Types of FMEA

Generally, FMEA can classify into 2 types which are shown in table 2.1. The two types of FMEA are

1) Design FMEA - is used to analyze products before they are released to production

The Design FMEA is a living document and should:

- Be initiated before or at design concept finalization.
- Be continually updated as changes occur or additional information is obtained throughout the phases of product development, and
- Be fundamentally completed before the production drawings are released for tooling.

2) Process FMEA - is used to analyze manufacturing, assembly and administrative processes

- Before or at the feasibility stage,
- Prior to tooling for production, and
- Take into account all manufacturing operations, from individual components to assemble.

	START	COMPLETE
DESIGN	After product functions and design concepts are defined but before the design is complete	When final drawings are released
PROCESS	When preliminary drawings are available but before tooling design is completed	When the product reaches end of life or is removed from production

Figure 2.3 Types of FMEA

2.4.3 When to Start FMEA

- When new products and processes are being designed.
- When existing designs and processes are being changed.
- When carry-over designs or processes will be used in new applications or environments.
- After completing a Problem Solving Study, to prevent recurrence of a problem.

2.4.4 The Process of Conducting an FMEA

To approach FMEA effectively, there was eight-step method that facilitates the design and process FMEA.

1. Select team and brainstorm

   The team must be cross functional and multidiscipline and the team members must be willing to contribute.
2. Functional block diagram and/or process flow chart

   For design FMEA the functional block diagram is applicable. For the process FMEA the process flowchart is applicable.
3. Prioritize

   After the team understands the problem, the actual analysis begins in order to know where the team should begin and what part is important.
4. Data collection

   To collect the data of the failures and categorizes them appropriately.
5. Analysis

   Utilize data for a resolution. The analysis may be qualitative or quantitative. The method may be brainstorming, cause-and-effect analysis and anything else which is suitable.
6. Results

   Use the information to quantify the severity, occurrence, detection, and RPN.

7. Confirm/evaluation/measure

   To confirm, evaluate, and measure the success or failure. The information from this step will be used to recommend actions and to see the result of action.

8. Follow up

   Follow up the result after taken correction in order to prevent recurrence of problem.

2.5 Advantages and Disadvantages of FMEA

2.5.1 Advantages of FMEA

There are many studies and literatures supporting FMEA as the useful and effective techniques. Examples of these studies are:

Debbie Vermillion (2002) explained that service companies who frequently conduct FMEA's and evaluate their success typically experience:

- Minimize customer defection/increased customer satisfaction
- Increased consistency in service quality
- Reduction of costly design changes
- Reduced transaction costs/increased profits
- Reduced liability

FMEA is differentiated over other types of failure analysis methods in that it is particularly adept at:

- Identifying cause and effect of known and potential failures before they occur
- Providing documentation of failures which can be tracked over
- Making accountability easier to pinpoint
- Facilitating continuous improvement
- Creating a common language that can be easily understood by both technical and non-technical people in the organization

Hayet Mouss, Djamel Mouss, Nadia Mouss and Samia Chebira (2000) explained that the FMEA is a method of critical analysis which consists of identifying an inductive and systematic way the risks of abnormal operations of a system then to seek the origins and their consequences. More generally, it allows:

- Identification of the failure modes of all the components of a system.
- The possible investigation into the failure causes, for each mode of failure.
- The evaluation of the effects on the system and the user for each combination cause-mode of failure
- The search of possible detections, for each combination cause-mode of failure

FMEA was always used for the studies of the diagnosis prepared within the framework of the plant maintenance. The diagnosis uses the links between the effects of a failure, perceived like an addition of detection test (visual or sound alarms, measurement of signals, etc.) allotted to each combination cause-mode of failure

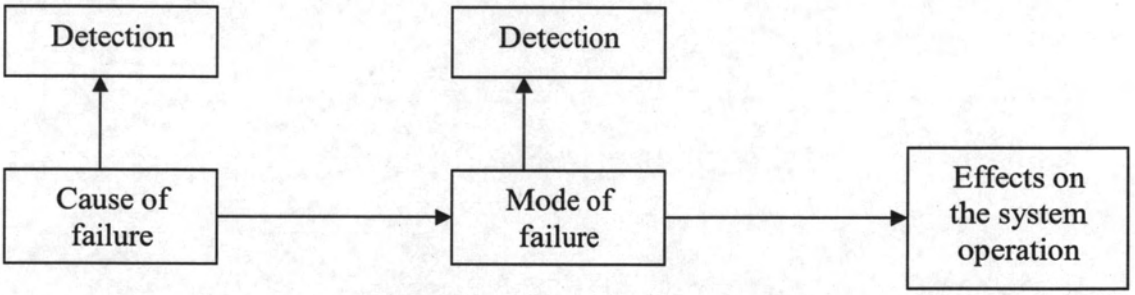

Figure 2.4: Failure Mechanism

The realization of an FMEA first of all requires the determination of the level of decomposition. A system could be the subject of a hierarchical decomposition in as much of level of decomposition must be compatible with the knowledge of all the modes of failure and their effects. The results of these analyzed are then presented in the form of a table with columns gathering the main analyzed criteria.

2.5.2 Disadvantages of FMEA

Hayet Mouss, Djamel Mouss, Nadia Mouss and Samia Chebira (2000) explained about FMEA that the problem of the diagnosis is the deductive step which consists in analyzing the table and to determine all the possible causes of an observed failure. The disadvantage is its extreme heaviness of use. For complex industrial systems, and FMEA can lead to the realization of thousand of tables. Under these conditions, the use of the FMEA diagnosis imposes the use of a deductive procedure which makes it possible to automatically generate knowledge necessary to the design of a diagnostic tool.

R.R. Mohr (1994) explain about limitations and abuses of FMEA that

- Frequently, human errors and hostile environments are overlooked
- Because the technique examines individual faults of system elements taken singly, the combined effects of coexisting failures are not considered.
- If the system is at all complex and if the analysis extends to the assembly level or lower, the process can be extraordinarily tedious and time consuming.
- Failure probabilities can be hard to obtain; obtaining, interpreting, and applying those data to unique or high-stress systems introduces uncertainty which itself may be hard to evaluate.

2.6 Literature Review

Regarding to literature survey, these books and research are supported to write up thesis. Most details are concerned in quality improvement in order to use quality improvement tools with high efficiency and wisely.

1) Somnuk Liabma, The author has applied the use of statistical process control and Gage P&R study to control and review supplier process variation, identified the potential product related process failure modes by using the process FMEA (failure mode and effect analysis). After implementation, about 85% of all machines meet with Cpk of 1.33 in June 1996 and increase to 100% in July. The corrective actions, taken on the major defect, can improve the quality more than 50%.

2) Mali Sae-ung, used cause-and-effect diagrams to define the potential factors that effect to plating thickness in electro-plating process. From the diagrams, six factors are considered to have major contribution. These factors are compromised of tin, additive and electrolyse concentration, shield height, plating time, and current density.

3) Sayom Surijamongkol studied on a quality assurance for the distributed control system project. He used failure mode and effect analysis and fault tree analysis as a quality tools for analyse the potential failure modes and effect analysis technique have leaded to establish the quality assurance system for the project.

4) Suchin Samathiwat used the failure mode and effect analysis (FMEA) as a quality tool for analyzing the potential failure mode and their effects in engineering work for electrical substation in a systematic way. The result of the analysis by using FMEA techniques have led to the establishment of the quality assurance for design control of electrical substation with include standard procedure, design check lists and working manual.

5) Tawichart Dechwitayaporn. This research is to develop a quality assurance system for brake drum manufacturing process. The quality assurance system used in the brake drum manufacturing process includes quality planning, quality control, quality audit, and preventive procedures. The author also established the quality tools for the quality assurance system such as check sheets, statistical method, and control chart. The established system can be guideline for quality assurance system in the same area of manufacturing.

6) Dechakom Boonma used Pareto analysis to identify the priority of problems and then used cause-and-effect diagrams to analysis the potential problem in a case study of steel manufacturing, design of a customer complaint management. Finally, he used 3M (Muri, Mura, Muda) technique to eliminate the waste in the system. After implementation, the company could reduce the process time from 69.3 days to 39.7 days.

7) Chalermphol Leelapatikul, The author has used failure mode and effect analysis (FMEA) to analyze and control automotive tire production. He also used cause and effect diagram, relation diagram as a quality tools for evaluate possible factors which could affect production process. The result of the analysis by using FMEA techniques have led to the reduction of tire defects.

8) Kittisak Anuraksakul used failure mode and effect analysis technique (FMEA) to analyze defect occurred in DRAW, TRIM/PIERCE and SEPARATE processes in automotive industry. After using FMEA techniques, the defects has been reduced from 2.02% to 0.22% in DRAW process, 2.20% to 0.22% in TRIM/PIERCE process and 2.25% to 0.18% in SEPARATE process.

9) Jakrapong Karnjanasomwong, This research study and develop the appropriate process quality assurance for the model factory and also find the way to reduce defective products which have been generated during manufacturing process. Model factory is the recording magnetic head factory.

10) Rungrudee Nonceeya, The objective of this research is to search for the management that will lead to the Zero Complaint. The author has divided the research into 2 parts. First, he used PDCA cycle to investigate cause and plan for corrective action. Second, he used failure mode and effect analysis (FMEA) to find preventive action which the result of FMEA will lead to process improvement.

11) Paisit Tangkitsiri, This research study about supplier quality improvement which is a key part of continuous improvement plans to achieve customer satisfaction. It is important to understand and exceed the requirements and expectations of all customers as well.