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OISM470W- Tutorial

In 1960 the aerospace industry created **Failure Modes and Effects Analysis**, a quality tool designed to improve the process of discovering how systems fail. Since its invention, this tool has been adopted by many diverse industries and its scope of application had broadened to include elements of failure prevention relating to areas such as design, service, and equipment.

Failure Modes and Effects Analysis (FMEA) is an analysis tool that works from the bottom up. It systematically considers the failure of each component of a system, and how those individual failures relate to the failure of the system as a whole. To operate, the system under analysis is dissected into components according to the smallest level of detail to which the system is designed. FMEA works upward through the system components and in its consideration of the failure mode of each component, this process identifies, analyzes, and documents these failures to better understand their effect on the rest of the system. The result of a FMEA is an improved understanding of how failures influence the performance of the entire system, and how that understanding in itself relates to product and personnel safety.

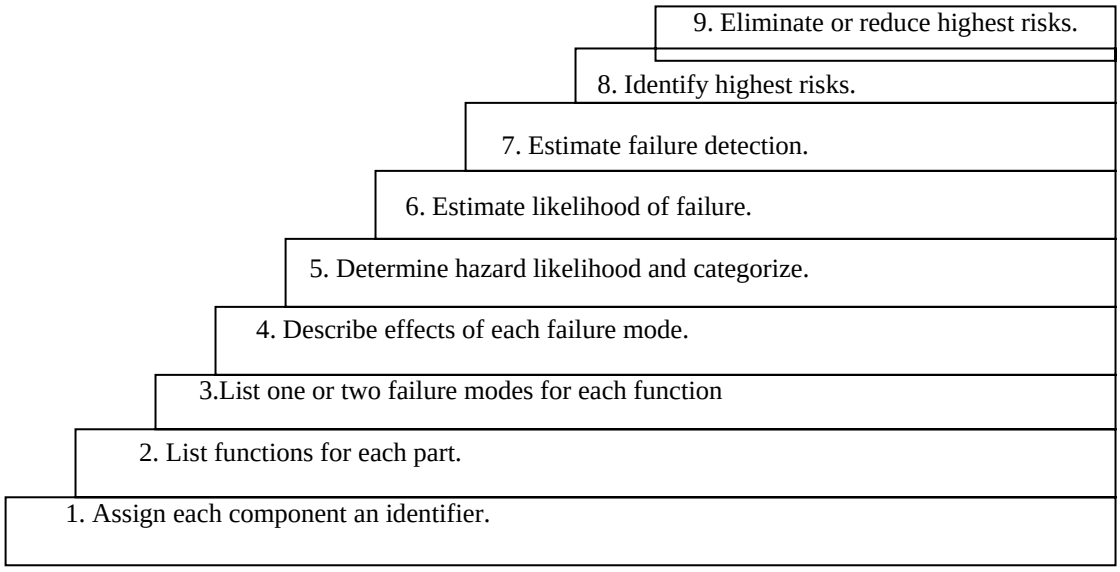
The implementation of FMEA has many potential benefits to its users. By analyzing the failure modes of components in a system, a company can better modify their processes to prevent any defects and safety problems. Therefore the product produced by those adhering to the use of FMEA will be of improved quality, reliability, and safety. This in turn will lead to increased customer satisfaction, as well as creating a good name for the producer's themselves. The decreased occurrence of defects and safety problems lowers the producer's risk and also reduces the product development costs, re-work costs, warranty costs.

The use of Failure Modes and Effects Analysis isn't strictly reserved for any one area in a company's system design. It can be used to analyze the potential failure of five distinct areas:

Concept, Process, Design, Service, and Equipment. FMEA can be used in the analysis of a design **concept** in order to consider its required systems and subsystems. FMEA is also used to evaluate which **processes** should be undertaken to bring a concept to life through the use of manufacturing and assembly. The **design** processes are analyzed using FMEA to prevent possible defects prior to the mass production of the product ensues. **Service** industry processes can likewise be analyzed by FMEA before they are released to customers to prevent any failure or loss of business. Lastly, the use of FMEA to test the potential failure of prospective **equipment** is a valuable process businesses use prior to making a final purchase.

As mentioned earlier, FMEA works upward through the system components in its consideration of the failure modes of the entire system. This process is composed of 9 steps as provided by **S. Thomas Foster** as seen in **Figure 1** and **Definition 1**.

Figure 1



Definition 1:

1. The first FMEA step is to give each component in the system a unique identifier; this is so none of the parts will be overlooked in the analysis.
2. In the second step, list all the functions each part of the system performs. This step requires you to develop a block diagram for the description of your design.
3. List the one or two failure modes for each function from the second step. The best description of a failure mode is a short statement of how a function may fail to be performed. What a product does or does not do when it fails describes the failure mode.

4. The fourth step describes what effects each failure mode of the component will have, especially the effects perceived by the user or operator. Analysis of the effects should follow a hierarchical order as any effect should be fairly detailed so the severity of each effect can be judged. Some of these effects measure the consequence of failures on a component or part of a device, the whole system, the user, and/or the public.
5. Determine whether the failure will result in a potential hazard to personnel or the system. Then categorize how severe each hazard will be. There are four basic categories hazards that fall into: catastrophic, critical, marginal, and negligible.
6. Estimate the relative likelihood of occurrence for each failure. The likelihood of occurrences is estimated using a 10-point scale and described in steps 4 and 5, ranging from highly unlikely (1) to very likely (10).
7. Estimate the ease with which the failure may be detected. If the failure takes so long to be detected that it becomes too late to replace of repair, the magnitude of the problem is likely to be much greater than if the failure can be easily detected.
8. Use the estimates in steps 5,6 and 7 to identify the highest risks related to the system.
9. Decide what action will be taken to eliminate of reduce the highest risks in the system. The most common decision made is to alter the design to reduce the likelihood of occurrence and failure severity or simply to bring about easy failure detection.

One area where the use FMEA analysis has been exhibited is in the marine industry. Obviously safety is immensely important and is the utmost concern when developing the designs and processes used to construct submarines, vessels, and boats. Traditionally marine design regulation has accepted a certain probability of risk and failure associated with the processes. Although the complete elimination of risk is impossible, the marine industry is recognizing the powerful techniques provided by FMEA that can be used to perform risk analysis of their systems. In fact, regulations have been passed on the design, construction, and operation of U.S. flagged ships mandating the use of a qualitative failure analysis technique. Although these regulations don't specifically require the use of FMEA, it is the most frequently used technique applied.

The use of FMEA analysis has been increasing in many industries. Its function of identifying the possible failure modes within a system is an integral part in maintaining successful processes within a business structure. While revealing to its users how a system may fail, it provides grounds for continuous improvement and prevention of future failure. For more information related to Failure Modes and Effects Analysis consult the following sources:

FMEA.COM: http://www.fmeca.com

The Basics of FMEA : http://www.reseng.com/fmeabscs.htm
Failure Modes and Effects Analysis Advice: http://www.datakel.com.au/fmea.htm