Failure Mode and Effects Analysis - FMEA

By Issa Bass

When one is engaged in a New Product or Process Development, or a New System Implementation, no matter how well thought out and well conducted, his initiative is, uncertainty will always be present and it will always involve potential for failure. Being able to foresee the likely impediments to the initiative is a first step to reducing their occurrence and the cost attached to future repairs.
The techniques commonly used to forestall potential failures are the Fault Tree Analysis and the Failure Mode and Effect Analysis (FMEA). While a Fault Tree Analysis is an investigative tool that goes from the effects of a failure of a product or process to the root causes, an FMEA is a form of Brainstorming that generally follows a Cause and Effect Analysis or a Process mapping and it is usually followed by a Pareto Analysis. It is a granular analysis of a process, a system or a product design for the purpose of identifying possible deficiencies. It is generally conducted by a cross functional group with all the participants having a stake or knowledge about the process, system or product being assessed.

Although the methodology for conducting an FMEA is in general the same, there are very small differences of approach used to carry it out. The differences reside in the collection of the items to be evaluated for potential shortcomings.

When conducting a process or system FMEA, the first step should consist mapping the system or the process and then listing all the steps of the process to be implemented before brainstorming the potential problems that can cause undesired effects at every stage of the process.

When the FMEA is done in relation with a New Product Development, the listing of the items to be assessed will include all the critical parts of the product and their interactions. The next step will consist in determining the extent of the FMEA. What process, system or product is being studied and what are the critical components in that product or process and how do they interact?
An FMEA starts with the gathering of a team of very knowledgeable stakeholders who are involved in the designing, the development, the deployment or the marketing of the products or process to be evaluated. A graphical presentation of an FMEA is generally a representation of two combined matrices: The Failure Mode and Effect part which consist in developing the list all the causes of the potential failures and their effects on the overall process or product and then the Action Plan which determines what needs to be done to prevent the failures from happening.

Failure Mode Assessment

The first step will consist in the brainstorming and the listing of the critical parts or phases of the process or product at hand. Flow charts are generally used to map processes and interactions between different components of a product. Every element of the flow chart should be listed on the FMEA matrix for appraisal.

The next step will consist in listing all the potential failures that might occur to each part or phase. The probable causes of those failures will then be listed and their impact established.

A critical aspect of this methodology is the determination the severity (or criticality) of the failure, how often it is likely to happen and how easy it is to detect. In general, the levels of severity, occurrence and detection of each item in the FMEA are ranked between 1 and 9.

- **Severity**

The severity measures how critical, how serious a potential failure can be on the product or process. If the failure is so serious that it can stop production, it is graded 9 and if it is very easy to correct, it get a grade of 1.

- **Detection**

How easy is the failure to detect? If it is easy to detect, the grade should be low (1 for very easy to detect and 9 for very hard).

- **Occurrence**

The Occurrence measures of how often the failure is likely to happen.

- **Risk Priority Number (RPN)**

The Risk Priority Numbers help rank the failures and establish their precedence for consideration. The RPN is the product of the severity, detection and occurrence levels. For a failure with a severity of 6, a detection of 3 and an occurrence of 6, the RPN will be 108 (6 * 6 * 3 = 108). The higher the RPN, the more attention that particular step of the process or that characteristic of the product should get.

The templates used for FMEAs are not always the same but the items above (Severity, Detection, Occurrence and RPN) should always be present since they are the basis for corrective actions.

Action Plan
Since the purpose of an FMEA is to forestall failures, after determining the list of potential failures and their RPNs, the next step should be the planning of the actions to take to avert their occurrence. The strategic actions to take are above all based on the nature of the failures but their preseance is contingent upon the RPN. After finishing the first phase of the FMEA, preventive tasks are assigned to stakeholders according to their aptitude, but the priority of execution should be subject to the RPN ranking.

All FMEAs do not follow the same pattern of Action Plans but the following steps are usually considered.

- **Recommended actions:**

The recommended preventive actions are generally suggested by the FMEA team during a brainstorm session. It consists of all the suggested proceedings that need to be followed to prevent failures. The reasons for failures are multifaceted; every failure can have several causes, that is why recommended preventive actions are better generated by cross functional tea

- **Task owner and projected completion date**

The task owner is the person or people who have been assigned the task of mending the aspects of the product, process or design that is subject to failure. Even though the suggested preventive actions are the result of a collegial brainstorm, the task of executing the actions is performed at an individual or departmental level. A person or a group of people are selected and assigned the task of forestalling failures.

The projected completion date should also be determined to avoid procrastination and enforce accountability.

- **Severity**

If the actions are taken and conducted according to the suggestions made by the team, by how much are they expected to reduce the potential failure? How would they impact the criticality of the failure?

Here again the effects of the actions are ranked in general from 1 to 9.

- **Occurrence**

How often will the failures happen if the recommended actions are taken?

- **Detection**

Detection refers to the ability to detect failures. After improvement, potential failures should be easier to detect than they were before the recommended actions were taken.

- **RPN**

Here again, the Risk Priority Number will be the product of the Detection, the Occurrence and the Severity. After the improvements have been made, the RPN is expected to be significantly lower than it was before.

About the author

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