

Method

Failure Mode and Effect Analysis (FMEA)

Description

The Potential Failure Mode and Effects Analysis is a cross-industry established method to identify and eliminate potential failures, problems, errors and risks of a system, design or process before adverse consequences reach the internal/external customer. The basic idea of the FMEA is thus the preventive risk identification and error prevention instead of a subsequent correction. This method is therefore very suitable for risk management due to its holistic approach.

Basic procedure

The performance of an FMEA essentially depends on which type of FMEA is used. The following three types can be distinguished, whereby the selection depends on which phase of the product or process development cycle one is in:

- System-FMEA has the goal to provide a smooth interaction of system components along the pre-defined requirements.
- Design-FMEA aims at ensuring the functional fulfillment of components as well as the basic manufacturability of products and the feasibility of processes.
- Process-FMEA serves to ensure and control manufacturing and business processes..

However, the operational process of an FMEA is essentially the same and can be described as follows. A team consisting of representatives from all affected areas - the involvement of external parties such as customers and suppliers can also be useful - defines possible errors with- in the framework of brainstorming. Accordingly, an experienced moderator should be available to make the brainstorming session efficient.

This raises the following questions:

- Where can an error occur?
- How does the error manifest itself, i.e. how can it be detected/measured?
- What are the consequences of the mistake?
- Why can the error occur?

The possible consequences are then examined and the causes of the errors identified and evaluated. The causes of the errors are then assessed against three criteria: (1) A = probability of occurrence, (2) B = severity of the consequences, (3) E = probability of detection. Each dimension can have a value between one and ten. Finally, the risk priority figure RPN is determined from this, which results from multiplying the three variables described, i.e.: $RPN = A * B * E$

The significance of the rating numbers on the scale for the individual dimensions can easily be seen in the literature or on the Internet. On the basis of the RPN, it is then decided whether measures should be taken or not. Accordingly, communication with the responsible risk management team should be available in order to pass on identified risks directly.

Prerequisites/Aids

Since FMEA is a very complex method for identifying risks, a number of prerequisites should be met in order to justify the sometimes considerable effort involved. These include

- Support for this method by top management
- Provision of the necessary financial and human resources
- FMEA template

The composition of the team is essential for success. Therefore, each team member should meet specific requirements. Some of the things to mention are:

- Professional competence
- Experience with FMEA projects and existing FMEA
- High motivation and commitment

A large number of software products are available as aids for carrying out an FMEA.

Effort

The high expenditure of time and personnel is the biggest disadvantage of this method. Due to the duration of an FMEA and the size of the involved team, which usually consists of 5-10 members, a high effort is required. Due to the awareness of this method and with sufficient know-how, especially of the moderator/team leader, satisfactory results can be achieved in a short time (5-10 days).

Advantages	Disadvantages
<ul style="list-style-type: none"> • Enables early collaboration between different functional areas • Preventive quality assurance before adverse consequences are channeled through the supply chain • Combines the identification and evaluation phases and provides additional measures to reduce risks 	<ul style="list-style-type: none"> • Very high time and personnel expenditure • Team members need very high professional competence and experience • Little information available in early design phases

Related literature

Working Group 131 "FMEA", German Society for Quality e.V. (DGQ) (2012): FMEA - Failure Mode and Effect Analysis, Beuth, Berlin

Franke, W.D (1989): Failure Mode and Effect Analysis in Industrial Practice, Verl. Modern industry, Landsberg/Lech

Kamiske, Gerd F. /Brauer, Jörg-Peter (2011): Quality management from A to Z, Verlag 7. edition, Hanser, Munich

McDermott, Robin E./Mikulak, Raymond J./Beauregard, Michael R. (2009): The Basics of FMEA, 2. Aufl., Productivity Pr Inc, New York

Tietjen, Thorsten/Decker, André/Müller, Dieter H (2011): FMEA practice. The complete package for training and application, 3rd edition, Hanser, Munich