Top “Action Plan” Methods for DFMEA

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The 10-Step DFMEA Process

A DFMEA (Design Failure Mode and Effects Analysis) is a method for evaluating a design for robustness against potential failures and is part of the Advanced Product Quality Planning (APQP) process which is an integral part of new product development process required by many companies. There are typically ten (10) steps in the process for developing a DFMEA:

Step 1: Review the design
Step 2: Brainstorming failure modes
Step 3: List potential effects of failures
Step 4: Assign severity rankings
Step 5: Assign occurrence rankings
Step 6: Assign detection rankings
Step 7: Calculate the RPN (Risk Priority Number)

Step 8: Develop action plan

Step 9: Take action
Step 10: Calculate the resulting RPN

“Step 8-Develop Action Plan” is the focus of this White Paper. The Action Plan is a way to reduce the relative risk of failure modes that require action. There are several tools/methods that can be used to achieve this.

1) Design of Experiments (DOE)

DOE can be used at the point of greatest leverage to reduce design costs by speeding up the design process, reducing late engineering design changes, and reducing product material and labor complexity. DOE’s are also powerful tools to achieve manufacturing cost savings by minimizing process variation and reducing rework, scrap, and the need for inspection. The DOE can be used to identify potential failure modes and verify the failure mechanisms to assist in assigning severity rankings as well as assigning the detection rankings.
One tool that can be used for this is an accelerated test using singular or multiple stresses. Some accelerated test methods include: Highly Accelerated Life Test (HALT), Highly Accelerated Stress Screening (HASS) and Failure Mode Verification Testing (FMVT®).

2) Mistake Proofing (Poka Yoke)

Poka Yoke is a Japanese term that means “Fail-Safing” or “Mistake-Proofing”. A poka-yoke is any mechanism in a lean manufacturing process that helps an equipment operator avoid (yokeru) mistakes (poka). Its purpose is to eliminate product defects by preventing, correcting, or drawing attention to human errors as they occur. Some examples of this would be the inability to remove the key from the ignition of a vehicle without the transmission being in park thereby making a person unable to leave the car in an unsafe state; high security padlocks in which you can not remove the key without the door being latched and locked. Security mistakes are much less likely to occur, especially if the key is kept on a person’s belt.

Poka Yoke can be implemented in any part of the manufacturing process where the process errors or human error can occur. Some types of manufacturing implementation are: a) the contact method which identifies product defects by measuring size, shape, color or anything that would indicate a defect. b) Constant Number method to indicate to the operator if the prescribed number of movements in the step has not been completed. c) Sequence method to indicate to the operator if the prescribed number of steps in the process has not been made.

3) Design for Assembly and Design for Manufacturing (DFA/DFM)

Design for Assembly (DFA) techniques aim to reduce the cost and time of assembly by simplifying the product and process through such means as reducing the number of parts, combining two or more parts into one, reducing or eliminating adjustments, simplifying assembly operations, designing for parts handling and presentation, selecting fasteners for ease of assembly, minimizing parts tangling, and ensuring that products are easy to test. There are a variety of guidelines and checklists that can be used to check for: Identifying the limit(s) of sub-assemblies to ensure it is near the limits of the overall assembly and communization of screws used in the assembly where possible. There are also computer programs available that assign a score to the product as a function of assembly, as well as estimated assembly cost and time.

Design for Manufacture (DFM) techniques are closely linked to Design for Assembly techniques, but are oriented primarily to individual parts and components rather than to DFA's. sub-assemblies, assemblies, and products. DFM aims to eliminate the often expensive and unnecessary features of a part that make it difficult to manufacture. It helps prevent the smooth surface and radius that are unnecessarily small, and the tolerances that are unnecessarily high.
4) Simulations

Simulation approaches include pre-production prototypes, computer models, accelerated life test simulations. Pre-production prototypes will verify the design is correct dimensionally, and potentially give insight into any obvious changes required. There are several tools available for computer modeling and some are specific to a technique/discipline, for example: Contemporary Engineering, Physical, Chemical & Biological Sciences; Systems Integration through Computations; Advanced Communications and Information Processing Technologies. Some Computer software can be used to load or stress a design to verify the robustness thereby performing virtual and accelerated testing.

Utilizing some or all of these methods should result in a reduction of the Risk Priority Number value. Whether it’s to obtain an initial design RPN, or to reduce the RPN with cost savings, each improvement to reduce or eliminate any failure mode and/or failure mechanism is an opportunity to recalculate the RPN until it is within the acceptable range set by the company.

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