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EFFECTIVE EXECUTION OF FMECA

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INTRODUCTION

Failure Mode and Effect Criticality Analysis (FMECA) provides a disciplined procedure whereby engineers can assess products, systems, or processes to assure that all conceivable failure modes have been addressed. It is not a negative search for trouble. The goal of FMECA is to consistently turn out products with 100 percent probability of success -- without grossly overdesigning. Even though everybody understands it conceptually, it is executed very poorly. Instead of FMECA being helpful, it's execution becomes a defensive exercise by the designer. There are several issues that need to be addressed in order to increase the effectiveness of FMECA process and to derive meaningful results. The paper addresses these issues. The issues are: (1) Reducing the defensiveness of the designer in developing FMECA, (2) Generating realistic and unanticipated failure modes, and (3) Discussion of Degree of Detection column in FMECA which is often misinterpreted.

ISSUE 1: DEFENSIVENESS OF THE DESIGNER IN DEVELOPING FMECA

To execute FMECA successfully, we must ask the question of how design is created in the first place. Very first step in the design creation is the creativity applied by designer to generate an initial product configuration. He is the one who creates an initial configuration to serve the intended function.

Let us consider the creative process of arriving at an initial configuration. The process includes the use of designer's knowledge and experience. The designer couples this with customer requirements and customer constraints. Additionally, the designer has some idea of environmental harshness in which product must function. The synthesis of all the preceding items allows the designer to create the first design configuration. There is a high probability that the designer has considered 80% of all the possible failure modes and accounted for it in the design creation process. Any failure modes that are not part of the analysis are beyond his knowledge or experience.

The designer now needs to bring in other areas of expertise to see how initial design configuration can have additional failure modes. Thus to begin FMECA we need at least two things: (1) An initial design configuration and (2) a team that can contribute to the list of potential failure modes above and beyond what has already been considered.

Thus the FMECA execution can now be described in sequential steps as follows:

- Create an initial design configuration with the best knowledge of the designer.
- List all the failure modes that the designer considered in creating the design.
- Form a FMECA team to analyze additional potential problem areas.
- Brainstorm the potential failure modes with an objective of coming up with the list of failure modes that have not been considered.

- Provide short explanation for each failure mode that has already been considered.
- Analyze new failure modes in the FMECA format.

This scheme of executing design FMECA faces minimal resistance from the designer. It only talks about those failure modes that may have been skipped through the design process. This method of executing FMECA does not exhaust the energy of a creator in defending the failures he has already accounted for.

ISSUE 2: GENERATING REALISTIC AND UNANTICIPATED FAILURE MODES

Most critical step in executing FMECA is to generate a list of potential failure modes. It is helpful to know the likely sources to be able to identify failure modes and to invite appropriate participation on the team. Here are some ideas:

Previously know sources:

Customer usage complaints
Build complaints
Shipping complaints
Manufacturing related complaints
Known misuses
Field failures

Potential sources:

Examining the list of things that design is suppose to do
Examining the list of things that design is not suppose to do
Assembly related failures
Shipping related failures
Transit failures
Storage failures
Misapplication
Misuses

ISSUE 3: INTERPRETATION OF <u>DEGREE OF DETECTION</u> COLUMN IN FMECA

An objective of a good design is to be failure-free during the ownership of the product. The designer identifies this concern in the Frequency of failures FMECA column. Once he determines that it is not possible to design out all the conceivable failures, his next concern is identified under a degree of severity column. This column represents the variety of negative effects that can occur when failure is encountered. The negative effects can range from minor nuisance to a loss of human life. There are several ways in which the designer can address the issue of severity. The designer should warn the user about the hazard potential and provide safety precautions to prevent an accident. To the extent possible, he should design a soft failure mode with a provision to detect a degradation of performance. This allows the user to detect the malfunction before it can cause severe damage. The degree of detection column can be subjectively rated on 1 to 10 basis, where 1 indicates certain detection before

failure and 10 indicates no detection provision before failure.

SUMMARY

The paper has detailed the scheme to execute FMECA that is proven to offer minimal resistance by the designer. Furthermore. it has identified the sources of failure modes to help design creativity. By offering a different interpretation for *degree of detection* column, it has provided an added dimension for the designers to consider designing fail soft (degradation) as opposed to fail hard (catastrophic).