AEROSPACE INFORMATION REPORT

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The FMECA Process in the Concurrent Engineering (CE) Environment

RATIONALE

It is recommended that this document be stabilized due to the release of the new SAE J1739 FMEA Standard. This document will address all content within AIR4845. Once this document has accepted in the industry, there is a need to keep AIR4845 available for current customer use.

STABILIZED NOTICE

This document has been declared “Stabilized” by the SAE G-41 Reliability Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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FOREWORD

This SAE Aerospace Information Report (AIR) by the G-11AT (Automation and Tools) subcommittee of the SAE G-11 RMS Committee, examines in detail the failure mode, effects and criticality analysis (FMECA) and how it relates to concurrent engineering. FMECA is probably the most labor intensive analysis performed by any of the RMS disciplines. The report outlines the FMECA process and the users of the FMECA as it is currently performed and indicates the various requirements which the analysis satisfies. Suggestions are made on which parts of the current process could be automated and how this may be accomplished. Finally a set of recommendations are given for integrating FMECA automation into the concurrent engineering process.

TABLE OF CONTENTS

1. SCOPE 3

2. REFERENCES 3

2.1 SAE Publications 3
2.2 Military Publications 3
2.3 Other Publications 4
2.4 List of Acronyms 4

3. TECHNICAL REQUIREMENTS 5

3.1 FMECA Overview 5
3.2 The Current FMECA Process 6
3.2.1 FMECA Needs 6
3.2.2 FMECA Requirements 10
3.2.3 FMECA in the Current Design Process 12
3.2.4 Initiating the FMECA 23
3.2.5 FMECA Control/FMECA Control to a Hardware Configuration 24
3.2.6 Generation of the FMECA Report 26
3.2.7 Current Difficulties (With Generating FMECAs) 26
3.3 FMECA in the Concurrent Engineering Environment 27
3.3.1 Relevant Aspects of the CE Environment 29
3.3.2 The Role of the FMECA in the CE Environment 31
3.3.3 Timing 31
3.3.4 Users of the FMECA Data in a CE Environment 32
3.3.5 Benefits of FMECA in the CE Environment 32
3.4 Automation of FMECA Within CE 33
3.4.1 Information Gathering 33
3.4.2 Analyses 34
3.4.3 Report Generation 34
3.4.4 Today's Capabilities 35
3.4.5 Needed Automation Capabilities 37
3.4.6 Technology Needs (to Automate FMECA) 48
3.5 Priority for FMECA Automation 49

4. SUMMARY AND RECOMMENDATIONS 49

APPENDIX A EXAMPLES OF DIFFERENT TYPES OF FMECA 51

1. SCOPE:

This AIR by the G-11AT (Automation and Tools) subcommittee, examines the failure mode, effects and criticality analysis (FMECA) requirements and procedures as performed on current and earlier vintage engineering programs. The subcommittee has focused on these procedures in relation to the concurrent engineering (CE) environment to determine where it may be beneficial, to both FMECA analysts and users, to automate some or all of the FMECA processes.

Its purpose is to inform the reader about FMECAs and how the FMECA process could be automated in a concurrent engineering environment. There is no intent on the part of the authors that the material presented should become requirements or specifications imposed as part of any future contract.

The report is structured to include the following subjects:

a. A FMECA overview
b. The current FMECA process
c. FMECA in the concurrent engineering environment
d. FMECA automation
e. The benefits of automation

2. REFERENCES:

The following publications form a part of this specification to the extent specified herein. The latest issue of all SAE Technical Reports shall apply.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

2.1.1 Reliability, Maintainability & Supportability Guidebook (Ref. ISBN 1-56091-039-9). By SAE G-11 RMS Committee.

2.1.2 ARP926 Fault/Failure Analysis Procedure, (SAE Aerospace Recommended Practice) Revised 11-15-79. By: SAE S-18 Ad Hoc Committee to update ARP926.

2.2 Military Publications:

Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

2.2.1 Procedures for Performing a Failure Mode, Effects and Criticality Analysis (Ref. Mil-Std-1629A). By Department of Defense.

2.2.2 Reliability Program for Systems and Equipment Development and Production (Ref. Mil-Std-785B). By Department of Defense.

2.2.3 Military Standard System Safety Program Requirements (Ref. Mil-Std-882B). By Department of Defense.

2.2.4 Potential Failure Mode and Effects Analysis in Design (Design FMEA) and for Manufacturing and Assembly Processes (Process FMEA) Instruction Manual by Ford Motor Company, September 1988.

2.3 Other Publications:

2.3.1 Memorandum for Secretaries of the Military Departments-- Subject: Concurrent Engineering - A Total Quality Management Process. By: Dr. R. Costello, OSD/USD(A), 9 March 1989.

2.3.2 Results of the Aeronautical Systems Division Critical Process Team on Integrated Product Development. By: Lavern J. Menker, Deputy Chief of Staff, Integrated Engineering & Technical Management, November 1990.

2.3.3 Nonelectronic Parts Reliability Data 1991 (NPRD-91). By Reliability Analysis Center, Rome Laboratory, Griffiss AFB, NY 13441-5700, 1 May 1991.

2.4 List of Acronyms:

AI	Artificial Intelligence
AFSC	Air Force Systems Command
BIT	Built-in Test
CAA	Civil Aviation Authority
CAD	Computer Aided Design
CAE	Computer Aided Engineering
CALS	Computer-aided Acquisition and Logistics Support
CDR	Critical Design Review
CE	Concurrent Engineering
CID	Change in Design
DOD	Department of Defense (U.S.)
FAA	Federal Aviation Administration (U.S.)
FMEA	Failure Mode and Effects Analysis
FMECA	Failure Mode, Effects and Criticality Analysis
G-11	SAE RMS Committee
G-11CR	SAE G-11 Computerization of RMS Subcommittee
ILS	Integrated Logistics Support
IPD	Integrated Product Development
IPT	Integrated Product Teams
JAA	Joint Airworthiness Approval
LCC	Life Cycle Cost
LCN	Logistic Support Analysis Control Number
LSA	Logistic Support Analysis
LSAR	Logistic Support Analysis Record
M	Maintainability
MIL-HDBK	U.S. Military Handbook
MIL-STD	U.S. Military Standard
MTBF	Mean Time between Failures
NASA	National Aeronautics and Space Administration
OODB	Object Oriented Data Base
PC	Personal Computer
PDR	Preliminary Design Review
PHS&T	Packaging, Handling, Storage and Transportation
QA	Quality Assurance

2.4 (Continued):

R	Reliability
RCM	Reliability Centered Maintenance
RLA	Repair Level Analysis
R&M	Reliability and Maintainability
RMS	Reliability, Maintainability and Supportability
RPN	Risk Priority Number
S	Supportability
SAE	Society of Automotive Engineers
STEP	STandard for the Exchange of Product data
US	United States
USAF	United States Air Force
USN	United States Navy
WUC	Work Unit Code

3. TECHNICAL REQUIREMENTS:

3.1 FMECA Overview:

Failure mode and effects analysis (FMEA) is a logical, structured analysis of a system, subsystem, piece part, or function. Identified in the analysis are potential failure modes, their causes and the effects associated with the failure mode's occurrence at the piece part, subsystem and system levels and its severity rating. FMECA is an extension of the FMEA task, where each failure mode is evaluated for its "criticality", i.e. an assessment of the severity of the event at the "system" level and the probability of its occurrence.

A FMECA provides a basis for the recognition of failure modes developed from historical "lessons learned" data bases of similar equipment and the unacceptable effects which limit the achievement of design requirements. FMECA is best performed as early as possible in the design process in order to verify adequacy of the design, change the design if not adequate, and/or incorporate appropriate controls. Problems discovered during the design phase are much easier and less costly to correct than if they are identified after hardware has been produced. In addition, FMECA also provides:

a. A common communication tool between product designers, manufacturing engineers, test engineers, reliability and maintainability (R&M) engineers, and logistic support analysts.

b. A means of identifying potential single point failure modes.

c. A means for identifying the types of test and testing environments needed to certify whether a design or process is suitable.

d. The basis for the evaluation and/or certification of changes in design, process, or materials.

e. A means of identifying Reliability Critical Items.