VEONEER STANDARD

Failure Mode and Effects Analysis

(FMEA)

VS104

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Introduction

Veoneer is a major global supplier to the world's automotive vehicle industry. This Veoneer Standard outlines Veoneer's requirements on Failure Modes and Effects Analysis (FMEA) management.

FMEA is a structured methodology to ensure that potential technical risks of failure modes and their effects are prevented or minimized during development and serial/service production of products and processes.
FMEA is an inductive analysis required for all automotive products and one of the core tools of IATF 16949.

FMEA management is an integral part of:

- VS108 New Product Development (Pre-VPDS),
- VS100 VPDS,
- VS160 VSDS,
- VS007 Change Management

1 Purpose

The purpose of this standard is:

- To define a global common method for building FMEAs within Veoneer,
- To define the interactions between the different types of FMEAs:
  - DFMEA (Function, Component, SW) and PFMEA (Line, Machine)
- To define the multiple levels of refinement and purposes of FMEAs
  - Production Line Level FMEA to Product Segment FMEA
  - Production Line Generation FMEA to Product Family FMEA
  - Machine-Station FMEA / Product Type FMEA

FMEA is an inductive analysis used as an input for Functional Safety but is also requested even for products that do not have to comply with functional safety standard.

2 Abbreviations and Terms

Term	Meaning
AIAG	Automotive Industry Action Group
AOI	Automated Optical Inspection
D	Detection
DFMEA	Design FMEA
F	Frequency
FMEA	Failure Mode Effect Analysis
M	Monitoring

MSR	Monitoring and System Response
O	Occurrence
PFMEA	Process FMEA
PLM	Product Life Cycle Management
RCS	Restraint Control System
RDR	Radar
S	Severity
SC2	Safety Controller Generation 2
SMT	Surface mount technology
SW	Software
VDA	Verband der Automobilindustrie

3 Scope

This standard is valid form its date of release for all projects with TG1 after January 2018.

4 Responsibility

Product Area Core/Platform Manager/Director is responsible for ensuring this standard is implemented for DFMEA and FMEA-MSR (FMEA for Monitoring and System Response) when applicable, during development of platform projects.

Product Area Engineering Manager/Director is responsible for ensuring this standard is implemented for DFMEA, FMEA-MSR during Product Development, and Serial Life.

The Manufacturing Plant Manager is responsible for ensuring this standard is implemented for PFMEA during Process Development and Serial/Service Production.

The Plant Quality Manager is responsible for ensuring that the requirements defined in this standard are implemented within the local Quality Management System.

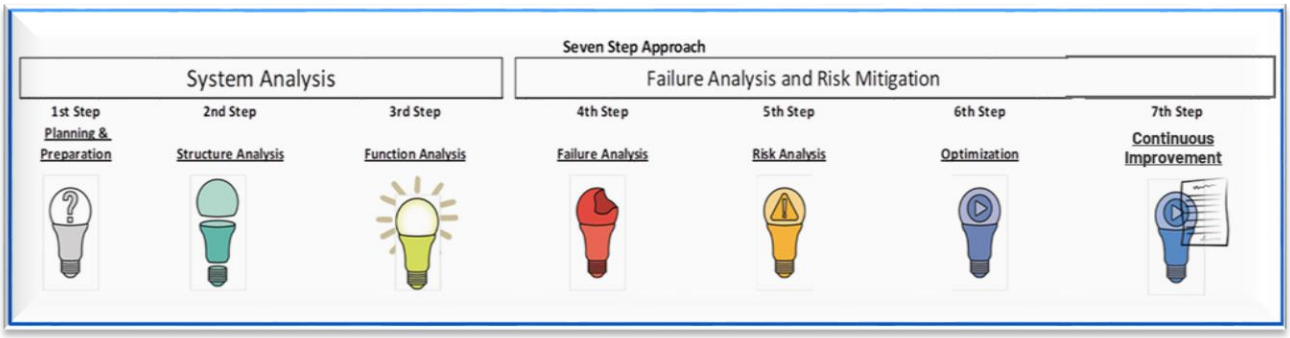
5 *Procedure*

All FMEAs shall be performed according to the '7 Steps FMEA'.

5.1 Methodology

The 7 Steps of FMEA are:

- Step 1: Planning and Preparation
- Step 2: Structure Analysis
- Step 3: Function Analysis
- Step 4: Failure Analysis
- Step 5: Risk Analysis
- Step 6: Optimization
- Step 7: Risk Communication & Continual Improvement



Picture 4.1: 7 steps of FMEA

The details of the methodology are described in the following Appendices:

- Appendix A: 7 Steps of DFMEA, 7 Steps of PFMEA, 7 Steps of FMEA-MSR
- Appendix B: FMEA IQ-RM Booklet

5.2 FMEA Team

All FMEA sessions shall be done with the participation of a facilitator.
A facilitator is an FMEA specialist or expert.

All FMEA teams shall consist of multi-disciplinary members, i.e., members from all relevant disciplines.

All participants of any FMEA session shall be trained to the Veoneer FMEA methodology and Appendix Training Modules (see Appendix A and B).

5.3 Tool

All FMEAs shall be performed within Veoneer selected system (see Appendix B).

5.4 Language

All FMEAs shall be performed in English.

Note: to help local team to understand correctly the FMEA, translation in local languages should be done by the local team.

5.5 General FMEA Flow

FMEA are structured in 3 levels of refinement for both DFMEA and PFMEA.

The DFMEA starts with the Product Line (i.e., RCS, Radar, Vision, …), go down to Product Generation (i.e., platform RCS SC2, RDR 77 Ghz Gen 1.2, …) and the Customer Application Project (SC2 PSA, SC2 VW, RDR DAI Gen5, …).

The PFMEA has an equivalent structure in 3 levels from the line level, which describes the high-level process flow chart (SMT, Clean Room, Assembly, Test), down to the line generation of the technology used (AOI 2D, AOI 3D) and the machine stations (Printing, Screwing, …).

If the platform doesn't exist for a product generation, then the first application shall consider the line generation constraints.

5.6 Special Characteristics

The purpose of the special characteristics is to provide information and focus regarding design characteristics which require attention to process controls. The team uses DFMEA to highlight when process controls are required to ensure conformance to specifications.

The special characteristics management is described within the VS052.

5.7 Risk Matrix and Action Priority

Priorities for risk mitigation shall be defined after assessment of Product or Process Risks using the Action Priority methodology.

Actions shall be prioritized by high, medium, and low priorities according to Severity (S), Occurrence (O), Detection (D), Monitoring (M), Frequency (F) as below:

- FMEA: SxOxD (Refer to Matrix below. S, O and D are weighted differently to help identify prioritization of action and mitigate risk)
- FMEA-MSR: SxFxM

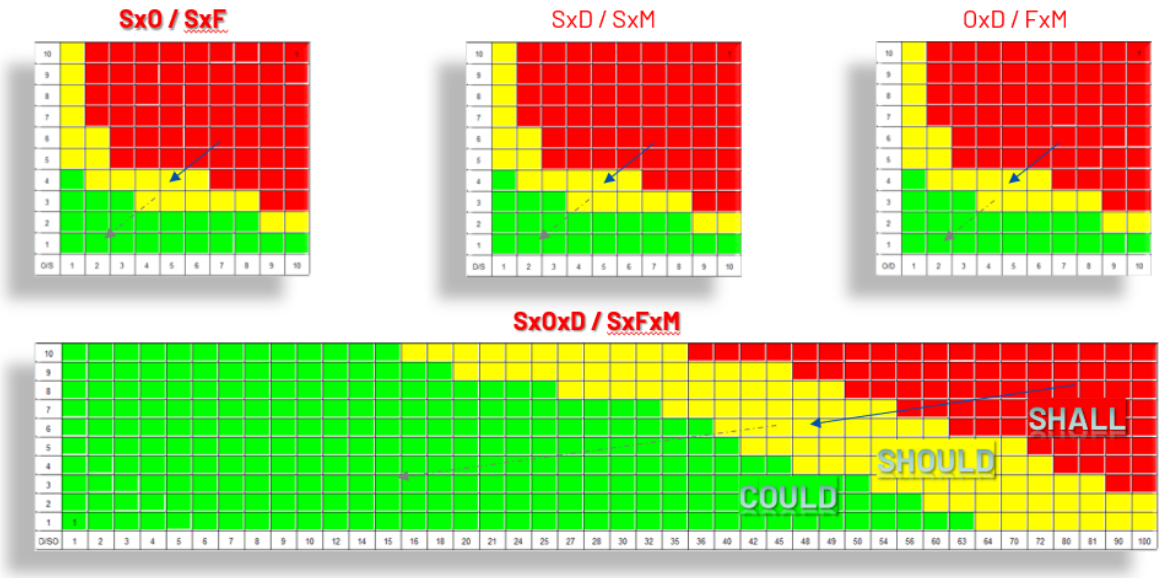
In addition, the complementary following Action Priority can be used:

- FMEA:
  - SxO and/or
  - SxD and/or
  - OxD
- FMEA-MSR:
  - SxF and/or
  - SxM and/or
  - FxM

The reduction of Risks shall be part of the Veoneer continual improvement process.

The long-term targets are:

- Risk is reduced until
  - FMEA: SxOxD = Severity (means that both Detection=1 and Occurrence=1),
  - FMEA-MSR: SxFxM = Severity (means that both Frequency=1 and Monitoring=1),
- The Severity level could also be considered to reduce the risk. In general, for application projects the severity should be defined by the customer. Evaluate high severity items to look for opportunities to reduce risk (for example by design improvements, optimization of prevention and/or detection actions).
- The picture 4.9 shows examples of various matrices that can be used in complement of the SxOxD main matrix.
- This could reveal potential hidden levels that can be used to mitigate the risks.



Picture 4.9 (Risk Matrices Examples)

5.8 Optimization

The assessment of the FMEA actions effectiveness shall be done on a regular basis. The intent of this assessment is to confirm (or not) the initial ranking of the Occurrence (O) and Detection (D).

Note: The action effectiveness management could be managed via the VS106.

5.9 Connection between DFMEA & PFMEA

The connection between DFMEA and PFMEA is described in Appendix F.

5.10 FMEA Changes

The Change Management is described in the VS007.

A review of the impact of the change shall be performed on the DFMEA, FMEA-MSR, and PFMEA for any modification on the product and/or the process.

A review and/or update of the DFMEA shall be performed for every modification made to the product after start of production (SOP).

NOTE: Design modifications may be initiated after SOP due to issues related to yield, quality, safety, or reliability.

5.11 Control Plan

The Control Plan Management is described in the VS105.

A review of the PFMEA shall be performed for every modification to the Control Plan and vice versa.

5.12 Storage & Retention

FMEA shall be stored in Veoneer Product Life Cycle Management tool.

Retention shall be done according to the VS303.

5.13 FMEA Communication Summary Report

A communication summary report of the FMEA shall be built as part of the FMEA steps 6 and 7. This report shall be updated, for each change, as part of the FMEA step 7. This report is meant to be a communication tool and can be supplied to the customers (or suppliers) upon request (See Appendix D).

FMEAs are considered confidential and proprietary to Veoneer. Distribution of any FMEA contents outside of Veoneer is strictly prohibited.

6 References

VS007	Veoneer Standard	Change Management
VS052	Veoneer Standard	Special Characteristics
VS100	Veoneer Standard	VPDS
VS105	Veoneer Standard	Control Plan
VS106	Veoneer Standard	PFMEA Go, See and Fix
VS108	Veoneer Standard	New Product Development (Pre-VPDS)
VS160	Veoneer Standard	Veoneer System Development System
VS303	Veoneer Standard	Records and Information Management

AIAG&VDA FMEA Handbook
IATF16949 Automotive Quality Management Systems Standard
Customer Specific Requirements (see IATF portal
https://www.iatfglobaloversight.org/ and Customer portals).
Global Master IQ-RM PFMEA File PLM E#: E2753165

7 Appendices

NOTE- Appendices and additional supporting documents (e.g., best practices, examples) are stored in ***PLM Project 211984 Coll. Space VS104 COLLABORATION***

7.1 Appendix A1 Training Modules - FMEA Introduction

7.2 Appendix A2 Training Modules - 7 Steps of a DFMEA

7.3 Appendix A3 Training Modules - 7 Steps of a PFMEA

7.4 Appendix A4 Training Modules - 7 Steps of a FMEA-MSR

7.5 Appendix B1 – DFMEA IQ-RM Booklets

7.6 Appendix B2 – PFMEA IQ-RM Booklets

7.7 Appendix C1 – FMEA Milestone Guideline

7.8 Appendix C2 – PFMEA Checklist Guideline

7.9 Appendix D1 – Communication Summary Reports – DFMEA Guideline

7.10 Appendix D2 – Communication Summary Reports – PFMEA Guideline

7.11 Appendix E1 - DFMEA Process

7.12 Appendix E2 – SYS-FMEA

7.13 Appendix E3 – CFMEA Methodology

7.14 Appendix E4 – Risk Analysis Guideline

8 Modification Index

Version #	Date / Author	Modification	Purpose
1.0	01-Apr-2018 / Williams Billiotte	First edition	
2.0	3-JAN-2019 / Williams Billiotte	Completely revised version.	
3.0	16-Feb-2021 / N. Grasselli, T. Kirpalaney	-Standard updated to include AIAG & VDA Handbook 1st Edition 2019 guidelines. -Additional Training Modules and Guideline Appendices included.	-Incorporate AIAG & VDA Handbook into the VS104 Standard. -Updated training and guidelines for FMEA Methodology and IQ-RM Tool clarity.
3.1	30-Nov-2021 / N. Grasselli, T. Kirpalaney	- "Scope" replaced, "This standard is applicable to all FMEAs for all Veoneer products." to "This standard is valid from its date of release for all projects with TG1 after January 2018. " -Created a separate section for "Optimization" - FMEA applicable to serial and service (not only for development), updates made to include serial and service. -"Responsible" section titles updated	-Clarity that pre-Jan 2018 TG1 projects can remain in the existing FMEA format. Post Jan 2018 TG1 should be using this standard. -Optimization section created for clarity (previously it tagged along with Risk Matrix and Action Priority). - Responsible section titles updated to reflect current organization structure