PURPOSE OF DFMEA
(DESIGN FAILURE MODE EFFECTS ANALYSIS)

- Define and guide a logical design process
- Identify, quantify, and reduce design risk
- Provide a traceable document for design and development
- Justify design activities
- Provide a means for continuous product improvement

RESPONSIBILITY AND SCOPE OF THE DFMEA

- The DFMEA is a **team** function
  - All team members must participate
  - Multi-disciplinary expertise and input is beneficial
    - Input from all engineering fields is desirable
    - Representatives from all areas (not just technical disciplines) are generally included as team members
- The DFMEA is **not** a one meeting activity
  - The DFMEA will be refined and evolve with the product
  - **Numerous** revisions are required to obtain the full benefit of the DFMEA
- The DFMEA should include all systems, sub-systems, and components in the product design

DFMEA INPUTS

- Product Design Requirements
  - Design requirement document (if available from customer)
  - Legal and technical regulations
- Bill of Materials (BOM) and Specific Hardware
  - List of components
  - Components and/or samples as supplied by the customer
- Product Definition
  - Drawings, sketches, animations, and simulations
  - Description of systems and components
    - What are the functions of the components listed on the BOM?
- Previous Experience (Lessons Learned from Others)
  - Experience with similar concepts, designs, and DFMEA
  - Customer and supplier inputs
  - Design guides and design standards (for example ASME codes)

DFMEA OUTPUTS

- RPN: Risk Assessment Number
  - RPN = (Severity) x (Occurrence) x (Detection)
  - Identification of both systems and components with high RPN values represents a summary of high risk items.
  - Ranking of RPN to provide guidance on critical design issues
    - Address the highest RPN items first!
- Identification of Critical and Significant Characteristics
  - This is also normally required by a customer
- ***The DFMEA is An Output to Your Customer***
  - Be aware that your customer may be internal or external
    - Internal customers may include other engineering groups or non-technical groups such as procurement, manufacturing, safety, etc.

DFMEA METHODOLOGY

- (1.) Complete the top of the form
  - Project, year, team members, date, and DFMEA iteration
- (2.) List items and functions
  - Start with the system, then subsystems, and finally components
- (3.) Document potential failure modes
  - How could the design potentially fail to meet the design intent
  - **Note: this might be the cause of failure at a higher level (i.e. component to subsystem) or the effect of a failure at a lower level.**
  - Consider all types of failure
- (4.) Document the potential effects of failure
  - How would the design potentially fail to meet the design intent.

DFMEA METHODOLOGY: (CONTINUED)

- (5.) Rate the severity of the failure effect
  - See attached page for ranking guidelines
  - Severity ranking is linked to the effect of the failure
- (6.) Document potential causes and mechanisms of failure
  - Failure causes and mechanisms are an indication of design weaknesses
  - **Potential failure modes** are the *consequences* of the **failure causes**
  - A single failure mode may have multiple failure mechanisms
  - Use group brainstorming sessions to identify possible failure mechanisms
  - Don't be afraid to identify as many potential causes as you can
    - This section of the DFMEA will help guide you in necessary design changes
    - The output of the DFMEA will indicate on which item to focus design efforts

DFMEA METHODOLOGY: (CONTINUED)

- (7.) Rate the occurrence
  - See attached page for ranking guidelines
  - Things that may help you rate the occurrence
    - Are any elements of the design related to a previous device or design?
    - How significant are the changes from a previous design?
- (8.) List the design controls
  - Design controls are intended to:
    - Prevent the cause of the failure mode (1st choice solution)
    - Detect the cause of the failure mode (2nd choice solution)
    - Detect the failure mode directly (3rd choice solution)
  - Applicable design controls include
    - Predictive code analysis, simulation, and modeling
    - Tolerance “stack-up” studies
    - Prototype test results (acceptance tests, DOE’s, limit tests)
    - Proven designs, parts, and materials

DFMEA METHODOLOGY: (CONTINUED)

- (9.) List any critical or special characteristics
  - Critical characteristics: Severity > 8 and Occurrence >1
  - Special characteristics: Severity > 6 and Occurrence >2
- (10.) Detection rate
  - See ranking guidelines (**consider making your own**)
- (11.) Calculate the RPN of each potential failure effect
  - RPN = (Severity) x (Occurrence) x (Detection)
  - What are the highest RPN items?
- (12.) Define recommended actions
  - What tests and/or analysis can be used to better understand the problem to guide necessary design changes ?

DFMEA METHODOLOGY: (CONTINUED)

- (13.) Assign action items
  - Assemble team
  - Partition work among different team members
  - Assign completion dates for action items
  - Agree on next team meeting date
- (14.) Complete "Action Results" Section of DFMEA
  - Note any work not accomplished (**justify** incomplete work)
  - Change ratings if action results justify adjustment, but the **rules** are:
    - Severity: May only be reduced through elimination of the failure effect
    - Occurrence: May only be reduced through a design change
    - Detection: My only be reduced through improvement and additions in design control (i.e. a new detection method, better test methodology, better codes)
  - Include test and analysis results with with DFMEA to validate changes!!

DFMEA METHODLOGY: (CONTINUED)

- (15.) Repeat: undertake the next revision of the DFMEA

Your DFMEA is an evolving document!

Revise your DFMEA frequently!

Diligence will eliminate design risk!

Include documentation of your results!

SEVERITY CRITERIA

Score	Rank	Comments
1	None	No Effect
2	Very Minor	Fit/Finnish Do Not Conform. Defect Noticed By Discriminating Customer. Performance Nominal.
3	Minor	Fit/Finnish Do Not Conform. Defect Noticed By Average Customer. Performance Nominal.
4	Very Low	Fit/Finnish Do Not Conform. Defect Noticed By Most Customers. Performance Nominal.
5	Low	Device Operable, But Convenience Options Operate At Reduced Performance Levels. Customer Experiences Some Dissatisfaction.
6	Moderate	Device Operable, But Convenience Options Inoperable. Customer Experiences Some Dissatisfaction.
7	High	Device Operable, But At Reduced Performance Levels. Customer Dissatisfied.
8	Very High	Device Inoperable With Loss Of Primary Function
9	Hazardous (With Warning)	A Potential Failure Mode Makes Operation Unsafe To Operator And/Or Involves Non-Compliance With Government Regulations With Warning
10	Hazardous (Without Warning)	A Potential Failure Mode Makes Operation Unsafe To Operator And/Or Involves Non-Compliance With Government Regulations With Warning

OCCURRENCE CRITERIA

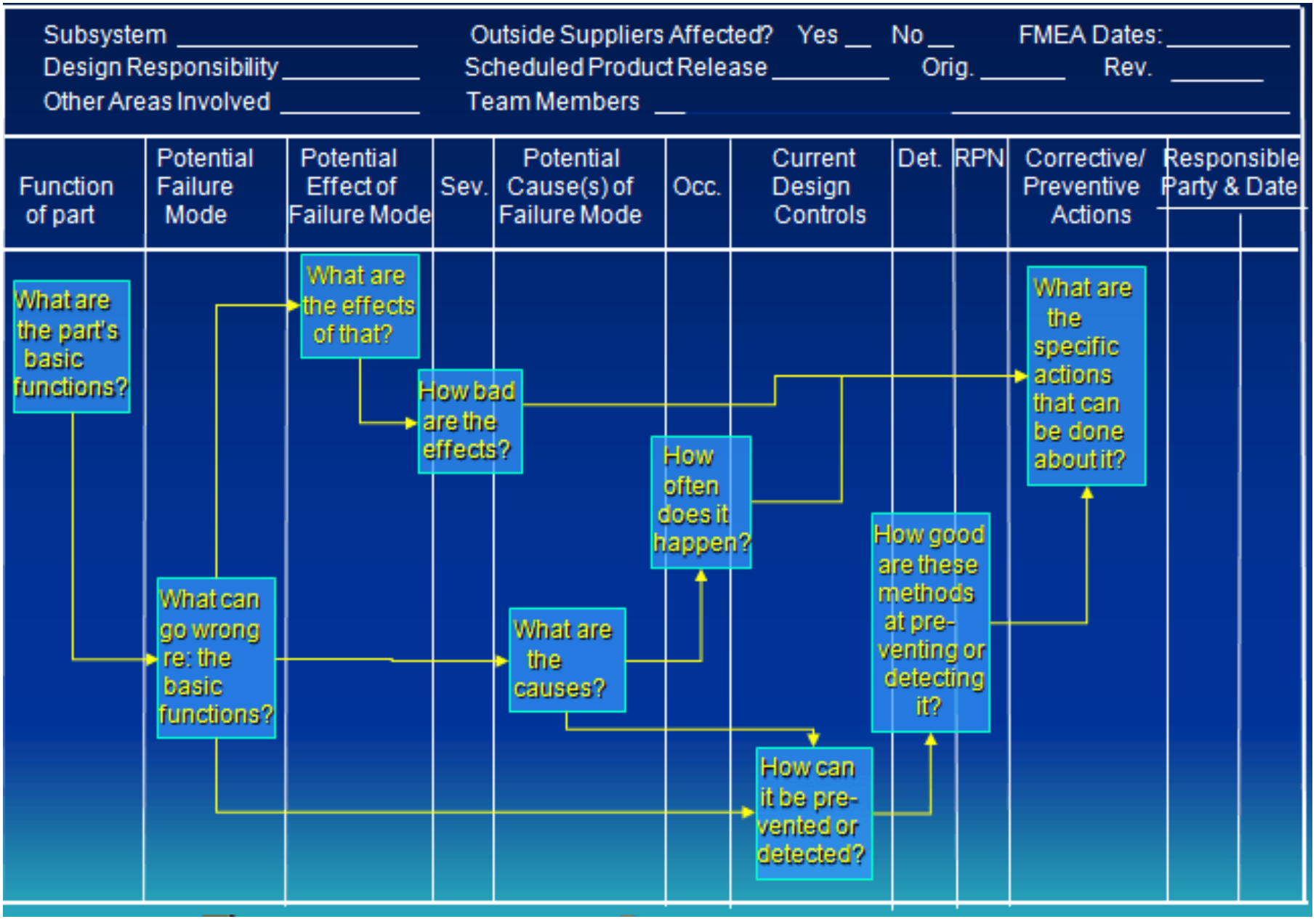
Score	Rank	Comments	Failure Rate
1	Remote	Failure Is Unlikely	<1 in 1,000,000
2	Very Low	Relatively Few Failures	1 in 150,000
3	Low	Not Uncommon	1 in 15,000
4	Moderate	Occasional Failures	1 in 2,000
5	Moderate	Frequent Failures	1 in 500
6	Likely	Frequent Failures	1 in 100
7	High	Failure Is Typical	1 in 25
8	Very High	Repeated Failures	1 in 10
9	Severe	Failure Is Almost Inevitable	1 in 5
10	Extreme	Failure Is Normal	> 1 in 2

DETECTION CRITERIA

Score	Rank	Comments
1	Almost Certain	Design controls will almost certainly detect a potential cause/mechanism and subsequent failure mode.
2	Very High	Very high chance the design control will detect a potential cause/mechanism and subsequent failure mode.
3	High	High chance the design controls will detect a potential cause/mechanism and subsequent failure mode.
4	Moderately High	Moderately high chance the design controls will detect a potential cause/mechanism and subsequent failure mode.
5	Moderate	Moderate chance the design controls will detect a potential cause/mechanism and subsequent failure mode.
6	Low	Low chance the design controls will detect a potential cause/mechanism and subsequent failure mode.
7	Very Low	Very low chance the design controls will detect a potential cause/mechanism and subsequent failure mode.
8	Remote	Remote chance the design controls will detect a potential cause/mechanism and subsequent failure mode.
9	Very Remote	Very remote chance the design controls will detect a potential cause/mechanism and subsequent failure mode.
10	Absolute Uncertainty	No Control. Design control will not and/or can not detect a potential cause/mechanism and subsequent failure mode.

- Links de interes

http://quality-one.com/fmea/


Subsystem
Outside Suppliers Affected? Yes No
FMEA Dates:
Design Responsibility
Scheduled Product Release
Orig.
Rev.
Other Areas Involved
Team Members
Function of part
Potential Failure Mode
Potential Effect of Failure Mode
Sev.
Potential Cause(s) of Failure Mode
Occ.
Current Design Controls
Det.
RPN
Corrective/ Preventive Actions
Responsible Party & Date
What are the part's basic functions?
What can go wrong re: the basic functions?
What are the effects of that?
How bad are the effects?
What are the causes?
How often does it happen?
How can it be pre-vented or detected?
How good are these methods at pre-venting or detecting it?
What are the specific actions that can be done about it?