AIAG – VDA Process FMEA: Striving for a Complete & Accurate Risk Analysis
Presentation Agenda

- Project Overview – Scott Gray
- Process FMEA Introduction – Dave Dalby
AIAG VDA FMEA - Project Objective

Provide consistent direction, guidance to all automotive suppliers

Update to include:
- Best Practices
- Improved Examples
- Functional Safety
## AIAG-VDA FMEA Project Team

<table>
<thead>
<tr>
<th></th>
<th>AIAG Work Group</th>
<th>VDA Work Group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OEMs</strong></td>
<td>FCA US LLC, Ford, GM, Honda N.A., Daimler Truck NA</td>
<td>Daimler AG, Ford Europe, Volkswagen AG, Adam Opel AG</td>
</tr>
<tr>
<td><strong>Suppliers</strong></td>
<td>Nexteer, Bendix, ZF/TRW, ON Semiconductor</td>
<td>Robert Bosch GmbH, Continental, Schaeffler AG, Knorr-Bremse, ZF Friedrichshafen AG</td>
</tr>
<tr>
<td><strong>Project Managers</strong></td>
<td>Scott Gray</td>
<td>Jochen Pfeufer</td>
</tr>
</tbody>
</table>
AIAG-VDA FMEA 7 Step Approach

<table>
<thead>
<tr>
<th>1st Step</th>
<th>2nd Step</th>
<th>3rd Step</th>
<th>4th Step</th>
<th>5th Step</th>
<th>6th Step</th>
<th>7th Step</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning &amp; Preparation</td>
<td>Structure Analysis</td>
<td>Function Analysis</td>
<td>Failure Analysis</td>
<td>Risk Analysis</td>
<td>Optimization</td>
<td>Results Documentation</td>
</tr>
</tbody>
</table>

System Analysis

Seven Step Approach

Failure Analysis and Risk Mitigation

Risk Communication

Alabama Automotive Manufacturers Association

AIAG Automotive Industry Action Group
Supplemental FMEA - MSR

• FMEA MSR = Monitoring and System Response
  – Addresses Risk Analysis of Mechatronic Systems
    • Not previously addressed in AIAG 4th Edition FMEA
  – Describes linkages between Design FMEA and Functional Safety concepts and analyses
  – Unique Frequency (F) and Monitoring (M) Rating Tables
The Team Work Continues
  – Final revisions and final reviews
  – Completion in March

Approvals by AIAG and VDA
  – Both required to approve the document
  – Scheduled in April and May, respectively

Release of Handbook, 1\textsuperscript{st} Edition, 2019
  – Targeted for release in June

Updated training
  – Expect global launches in Q3
1st Step: Planning and Preparation for Process FMEA

AIAG: “Define the Scope”

- Establishes Analysis Boundaries.
- Define what processes are to be included and excluded from the analysis.

AIAG - VDA - “1st Step – Planning and Preparation”

* In addition to the above-
* States the overall advantage of Planning and Preparation is to focus resources on processes with the highest priority i.e., must processes and highest level want processes.
* Direction from a high level of management so all processes that can impact product quality are considered:
  * Part receiving and delivery.
  * On-line and off-line detection controls.
  * Maintenance processes of critical equipment.
1st Step: Planning and Preparation – Process FMEA

Planning and Preparation: All Processes Level
- Receiving & Delivery
  - Root Cause
    - Outflow of Defective Product with Severity 9/10? No
- Assembly
  - New Processes? Yes
    - Electrical Motor Assembly Line OP 30
- Paint Shop
  - New Processes? No
- Maintenance
  - Outflow of Defective Product Severity Rank 9/10? Yes
    - OP 40 Work Instruction (Part Replacement)
- Weld
  - New Processes? No
- Test Lab
  - Outflow of Defective Product Impacting High Sort Costs? Yes
    - Hardness Tester: Set-up Procedure

Planning and Preparation: Department Levels
- Assembly
  - New Processes? Yes
    - Electrical Motor Assembly Line OP 30
- Maintenance
  - Outflow of Defective Product Severity Rank 9/10? Yes
    - OP 40 Work Instruction (Part Replacement)
- Test Lab
  - Outflow of Defective Product Impacting High Sort Costs? Yes
    - Hardness Tester: Set-up Procedure

Planning and Preparation: Assembly Line Level

Structure Analysis: Process Structure
- Electrical Motor Assembly Line
  - OP 70 Gear Cover Assembly Process
  - OP 40 Gear Cover Assembly Process
  - OP 30 Sintered Bearing Press-in Process
  - MAN ( Operator )
    - Machine ( Press Machine )
    - Material ( Grease )
    - Environment
  - MAN ( Operator )
    - Machine ( Greasing Device )
    - Material ( Grease )
    - Environment

Figure only shows Assembly taken to Process Structure level.
* AIAG Severity 9 & 10 - Are applied for safe operation and / or noncompliance of government regulation defects. The difference between the two rating are **With Warning** (9) and **Without Warning** (10).
  * With and Without Warning not defined in the manual.
  * Each user could define what these terms meant.

* AIAG - VDA Severity -
  * Severity 10 – Applied to safe operation defects.
  * Severity 9 – Applied to noncompliance of government regulations.
**PFMEA Severity**

* AIAG – Considers two categories
  * Effect on Manufacturing – Verbiage implies to your manufacturing plant
  * Effect on Customer (End User)

* AIAG - VDA – Considers three categories
  * Impact to Manufacturing – Divided into two categories
    * Impact to Your Plant
    * Impact to the Ship-to-Plant (when known)
      * Eliminate or reduce –
        * Charge-back for customer containment activity.
        * Manpower sent to support customer on-site sorts & repairs.
        * 3rd party charges for sorts and repairs.
      * Management involvement for high impact items to customer manufacturing.
        * In automotive production – Number of units to repair / Line downtime
  * Effect on Customer – End User
# PFMEA Severity

## Process General Evaluation Criteria Severity (S)

Potential Failure Effects rated according to the criteria below.

<table>
<thead>
<tr>
<th>S</th>
<th>Effect</th>
<th>Impact to Your Plant</th>
<th>Impact to Ship-to Plant (when known)</th>
<th>Impact to End User (when known)</th>
<th>Corporate or Product Line Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>High</td>
<td>Failure may result in an acute health and/or safety risk for the manufacturing or assembly worker</td>
<td>Failure may result in an acute health and/or safety risk for the manufacturing or assembly worker</td>
<td>Affects safe operation of the vehicle and/or other vehicles, the health of driver or passenger(s) or road users or pedestrians.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Failure may result in implant regulatory noncompliance</td>
<td>Failure may result in implant regulatory noncompliance</td>
<td>Noncompliance with regulations.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Moderately high</td>
<td>100% of production run affected may have to be scrapped. Failure may result in implant regulatory noncompliance or may have a chronic health and/or safety risk for the manufacturing or assembly worker</td>
<td>Line shutdown greater than full production shift; stop shipment possible; field repair or replacement required (Assembly to End User) other than for regulatory noncompliance. Failure may result in implant regulatory noncompliance or may have a chronic health and/or safety risk for the manufacturing or assembly worker</td>
<td>Loss of primary vehicle function necessary for normal driving during expected service life.</td>
<td></td>
</tr>
</tbody>
</table>

[Image of logos: AAMA and AIAG]
PFMEA Occurrence & Detection

AIAG Occurrence vs AIAG - VDA Occurrence
* AIAG Occurrence - Based on defects per thousand, set for automotive production rates.
* AIAG - VDA Occurrence - Based on robustness of Prevention Controls.
  * Can be applied to any production rate.

AIAG Detection vs AIAG - VDA Detection
* AIAG Detection - Based on:
  * “Opportunity for Detection” (4 ~ 5 word summary)
  * “Likelihood of Detection” by Process Control (overview of controls and where applied)
* AIAG - VDA Detection – Based on:
  * Maturity of Detection Method (experience with controls)
  * Opportunity of Detection (overview of controls and where applied)
• Rating of 3 & 4 made more stringent – Requires control of rejected product...by robust system to prevent outflow.
Risk Priority Number (RPN) and Action Priority (AP)

* AIAG RPN Based on:
  * Severity x Opportunity x Detection = RPN
  * S, O and D weighted equally.

* AIAG - VDA Action Priority Table Based on:
  * S, O and D considered at the same time while weighting Severity highest, then Occurrence, then Detection, to determine priority of action.
  * High, Medium, or Low.

<table>
<thead>
<tr>
<th>Effect</th>
<th>Prediction of Failure Cause Occurring</th>
<th>S</th>
<th>O</th>
<th>Ability to Detect</th>
<th>D</th>
<th>ACTION PRIORITY (AP)</th>
<th>Comments</th>
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<tr>
<td>Product or Plant Effect Very high</td>
<td>9-10</td>
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<td></td>
<td></td>
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<tr>
<td>Very high</td>
<td>8-10</td>
<td>Very high</td>
<td>8-10</td>
<td>Low - Very low</td>
<td>7-10</td>
<td>H</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Moderate</td>
<td>5-6</td>
<td>H</td>
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<td></td>
<td></td>
<td></td>
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<td>2-4</td>
<td>H</td>
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<td></td>
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<td></td>
<td></td>
<td>Very high</td>
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<td>High</td>
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<td>Low - Very low</td>
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<td>2-4</td>
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<td>Very high</td>
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<tr>
<td>Moderate</td>
<td>4-5</td>
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<td>Low - Very low</td>
<td>7-10</td>
<td>H</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Moderate</td>
<td>5-6</td>
<td>H</td>
<td></td>
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</table>

Blank until filled in by user.
## Risk Priority Number (RPN) and Action Priority (AP)

<table>
<thead>
<tr>
<th>Actual Sev.</th>
<th>AP Sev</th>
<th>Actual Occ.</th>
<th>AP Occ</th>
<th>Actual Det.</th>
<th>AP Det</th>
<th>Action Priority</th>
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<tbody>
<tr>
<td>1</td>
<td>9</td>
<td>9 ~ 10</td>
<td>8</td>
<td>8 ~ 10</td>
<td>5</td>
<td>H</td>
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<tr>
<td>2</td>
<td>9</td>
<td>9 ~ 10</td>
<td>6</td>
<td>6 ~ 7</td>
<td>5</td>
<td>H</td>
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<tr>
<td>3</td>
<td>9</td>
<td>9 ~ 10</td>
<td>4</td>
<td>4 ~ 5</td>
<td>5</td>
<td>H</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>9 ~ 10</td>
<td>3</td>
<td>2 ~ 3</td>
<td>5</td>
<td>M</td>
</tr>
<tr>
<td>5</td>
<td>9</td>
<td>9 ~ 10</td>
<td>3</td>
<td>2 ~ 3</td>
<td>4</td>
<td>L</td>
</tr>
</tbody>
</table>

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**Notes:**
- RPN = Actual Sev. x Actual Occ. x Actual Det.
- AP = Action Priority
- H: High, M: Medium, L: Low
AIAG - VDA Failure Cause Identification: Add 4M Categories

To aid the users to identify Failure Causes, the 4M approach has been added in this step.

For each Failure Mode, the users are asked to consider the 4M Categories as a source for a Failure Cause.

4M Categories;

- **Man**
- **Machine**
- **Material (indirect)**
- **Milieu**

Milieu is a term coined in mid-18th century France meaning: “A person’s social environment”

- As in - “He grew up in a very strict milieu”

Word was adopted by the English and used to represent - Background, Backdrop, Setting, Context, Scene, Atmosphere, and Environment.

- **Milieu (Environment)**
Potential rollout path and timing:

* AIAG - VDA FMEA Handbook to be published by end of Q2 2019
* 2 -3 months for training to be developed.
* 6 ~ 9 months for training to be completed by supplier / company.
* Recommend to apply at start of next “major model” development cycle, i.e., business awarded for new drawings.
* Discretion of company/supplier to retroactively apply to existing processes.
Any Questions?