An overview of AIAG – VDA alignment of FMEA Methodology

Currently, those supplying products to both German and North American OEMs need to follow VDA and AIAG manuals of FMEA to assess their products' failure modes and effects. This is due to differences in Severity, Occurrence, and Detection rating tables in the VDA and AIAG FMEA Manuals. This causes confusion and adds complexity to the product development and product improvement activities. Thus an alignment between these two manuals was felt necessary to enable suppliers to have a single FMEA methodology to meet the expectations of any customer globally.

The talks in this regard between AIAG (Automotive Industry Action Group) and VDA (Verband Der Automobilindustries meaning Association of Automobile Industries) started soon after the second edition of AIAG FMEA Manual. The effort has taken a shape now and the manual is expected to come for implementation soon. The AIAG-VDA alignment also takes in to account the standard SAE J1739.

The common FMEA approach involves some key changes as follows:

1. Six Step FMEA Process

The revised FMEA process is now represented in six steps against the normal ten step approach.

Step 1: Scope, Definition and Project Planning

Step 2: Structure Analysis

Step 3: Function Analysis

Step 4: Feature Analysis

Step 5: Risk Analysis

Step 6: Optimization

2. FMEA-MSR

A new method FMEA-MSR (FMEA for Monitoring and System Response) has been added. The FMEA-MSR is a supplement to DFMEA to maintain Safety and Regulatory requirements during customer operation. This is explained in detail at the end.

3. Two Types of Recommended Action

"Recommended Action" has been changed to two columns: "Preventive Action: and "Detection Action." Evidence of these actions is also to be documented.

4. Special Characteristics

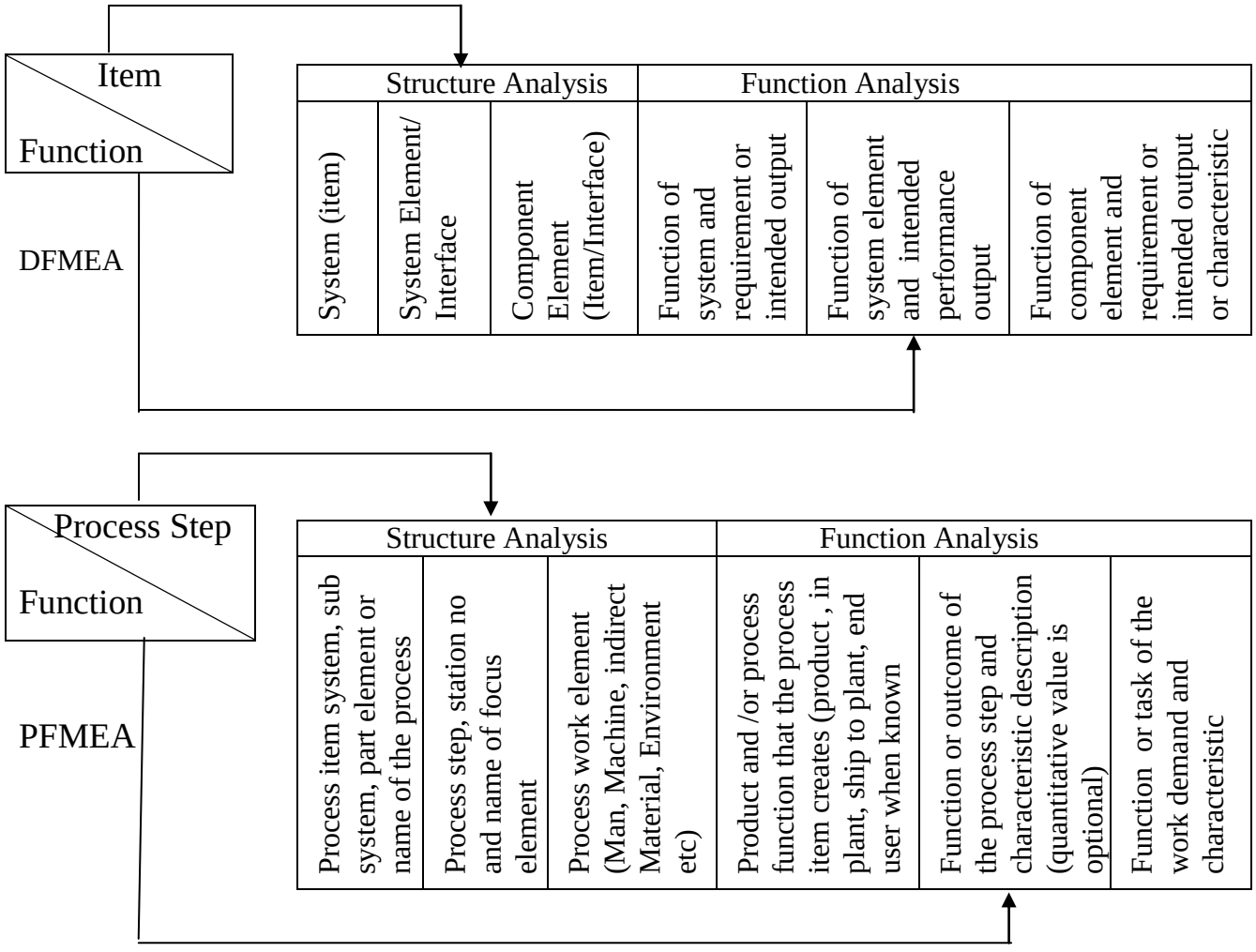
No special characteristics column in DFMEA

The FMEA format undergoes revision as follows:

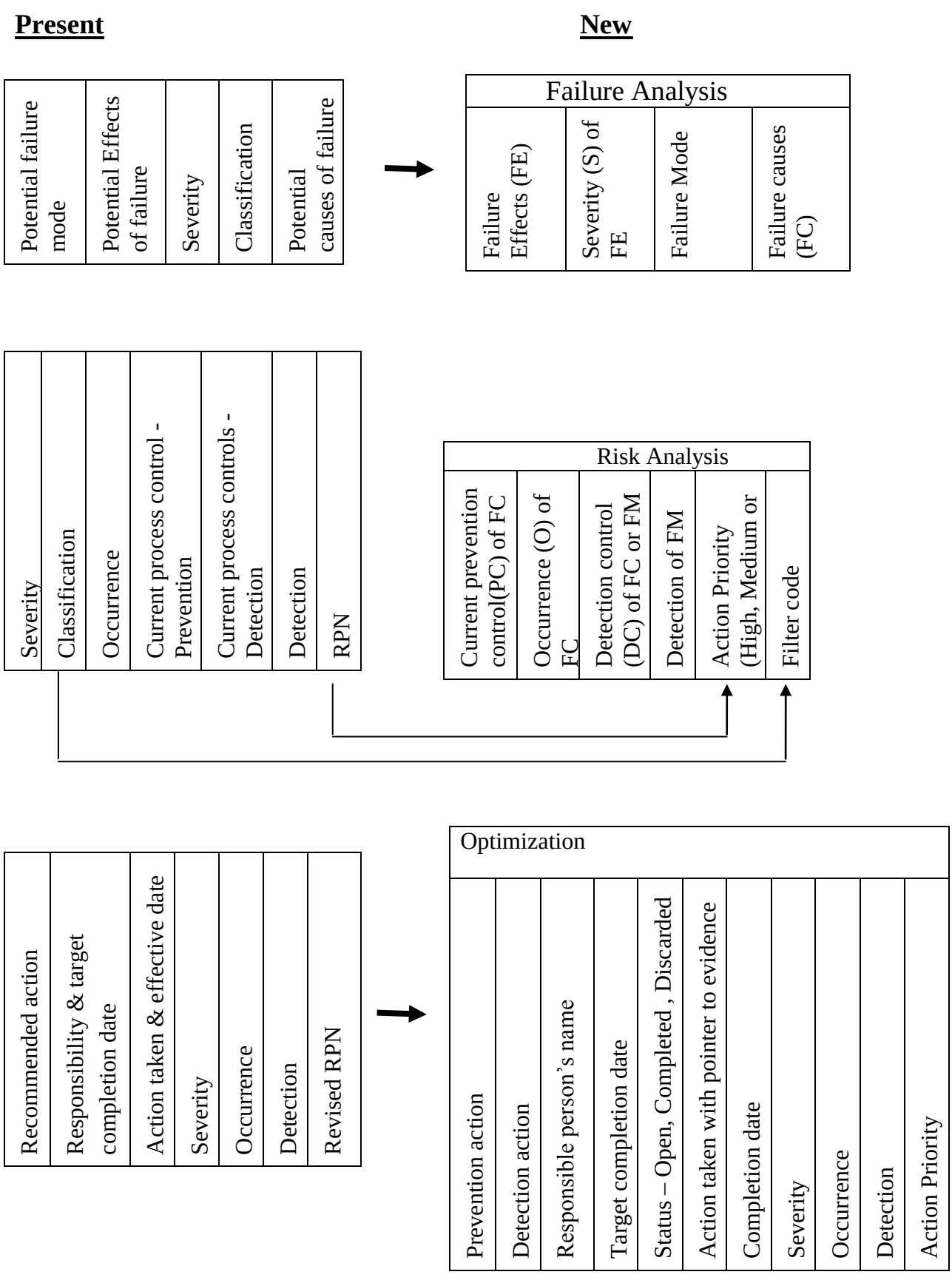
The following tables explain how the present forms get changed in the new arrangement.

5. FMEA Format

The new FMEA format will have about 27 columns as explained below as against 17 columns at present



Following are applicable for both DFMEA & PFMEA

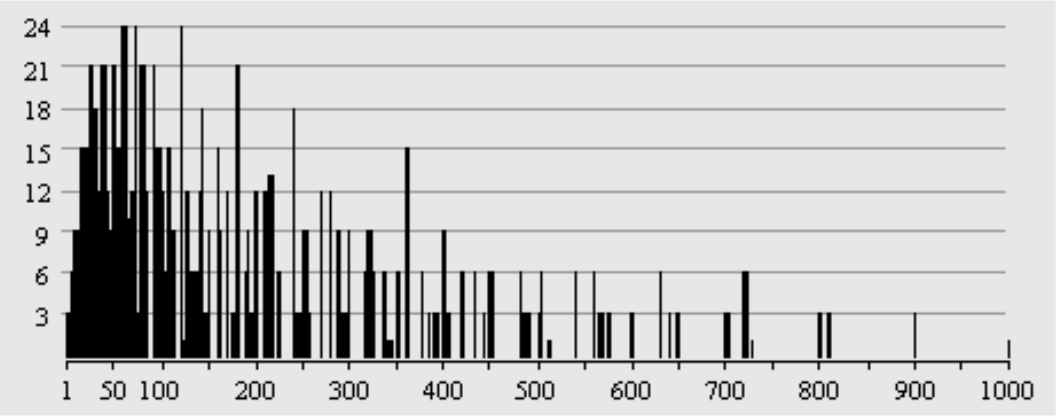


6. .RPN is replaced by Action Priority (AP)

The Risk Priority Number (RPN) is replaced with Action Priority (AP) with High, Medium or Low categories to reduce the risk of failure. This is considered to be the most significant change in the new FMEA. For many years, Quality professionals have been pointing out two major flaws in RPN methodology. It may be noted that the RPN is determined by multiplying the "Severity x Occurrence x Detection (or S x O x D)" rankings. Though this methodology results in 1000 different combinations, the number of different RPNs are only 120. For example, see below how RPN value of 360 can have 15 different SOD combinations. The other problem is that even these 120 values of RPN are mostly crowded with in the value of 400 as shown below. (i.e. 120 values of RPN are not uniformly distributed between 1 and 1000)

S	O	D	RPN	Comments
10	9	4	360	High effect with high occurrence & moderate detection
10	4	9	360	High effect with moderate occurrence & high detection
4	10	9	360	High effect with high occurrence & detection

The above table can be expanded to find 15 different combinations of SOD for the same RPN value of 360. Then raises the question on how to prioritize the actions if RPN is the only criteria. The new FMEA-VDA resolves this issue as described below.



(Figure shows how the RPN values are crowded with in 400 though it can be 1 to 1000)

Deciding the Action Priority (AP)

The new (draft) standard still uses the familiar Severity, Occurrence and Detection rankings each in the range between 1 and 10. However, instead of multiplying them to have RPN, the Action Priority (AP) in terms of High (H), Medium (M) and Low (L) is determined using a table that lists roughly 30 different combinations as shown below.

S	O	D	AP	Justification for Action priority
9-10	6-10	1-10	H	High safety and /or regulatory effects that have moderate to high occurrence rating and any detection rating
9-10	4-5	7-10	H	High safety and /or regulatory effects that have moderate occurrence rating and high detection rating
9-10	4-5	5-6	H	High safety and /or regulatory effects that have moderate ratings in both occurrence & detection
9-10	4-5	1-4	M	High safety and /or regulatory effects that have moderate occurrence rating and low detection rating
9-10	1-3	7-10	H	High safety and /or regulatory effects that have low occurrence rating & high detection rating
9-10	1-3	5-6	M	High safety and /or regulatory effects that have low occurrence rating & moderate detection rating
9-10	1-3	1-4	L	High safety and /or regulatory effects that have low ratings in both occurrence & detection rating
5-8	8-10	2-10	H	Moderate to high safety and /or regulatory effects that have high occurrence rating and any detection rating
5-8	6-7	7-10	H	Moderate to high safety and /or regulatory effects that have moderate occurrence rating and any detection rating
2 - 4	1-3	1-4	L	Low priority due to perceived quality (appearance, sound, hap tics) with low occurrence rating & low detection rating
1	1-10	1-10		Low priority due to no discernible effect

Action Priority (AP) tables are available for the three types of FMEAs – DFMEA, PFMEA and FMEA-MSR.

The actions denoted by letter "H" as per the AP table are "**MUST"** to be taken, those denoted by

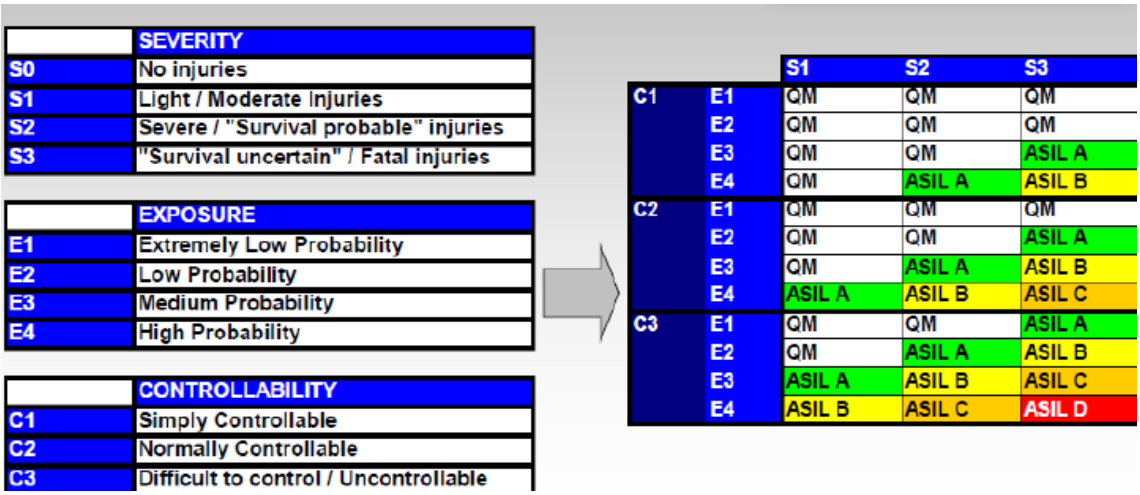
letter `"M" are **"SHOULD BE"** and those denoted by letter "L" are **"COULD BE"**. In the cases of "H" and "M" if it is felt that the current controls are adequate, justification for the same to be available.

FMEA – MSR (FMEA for Monitoring and System Response)

As mentioned earlier in this column, it is a new method added as a supplement to DFMEA to maintain Safety and Regulatory requirements during customer operation. FMEA-MSR is to analyze the potential failure that may happen in the component, its corresponding effect on the system and the detectability of the failure by the end user.

FMEA-MSR has been introduced to ensure safety goals as per ISO26262 which defines automotive functional safety related to electrical, electronic and software systems. However FMEA-MSR is applicable for any equipment and to be done involving the customer to understand the interfaces. It is to be conducted in the same way as any FMEA.

Functional safety as per ISO26262 is evaluated in terms of ASIL (Automotive Safety Integrity Levels). ASIL – Level A involves lowest risk and Level D involves highest risk. Levels A, B, C, D are determined based on of Severity (levels S1 to S3), Exposure (levels E1 to E4) and Controllability (levels C1 to C3) as shown below. (QM means Quality Management)



	SEVERITY
S0	No injuries
S1	Light / Moderate Injuries
S2	Severe / "Survival probable" injuries
S3	"Survival uncertain" / Fatal injuries

	EXPOSURE
E1	Extremely Low Probability
E2	Low Probability
E3	Medium Probability
E4	High Probability

	CONTROLLABILITY
C1	Simply Controllable
C2	Normally Controllable
C3	Difficult to control / Uncontrollable

		S1	S2	S3
C1	E1	QM	QM	QM
	E2	QM	QM	QM
	E3	QM	QM	ASIL A
	E4	QM	ASIL A	ASIL B
C2	E1	QM	QM	QM
	E2	QM	QM	ASIL A
	E3	QM	ASIL A	ASIL B
	E4	ASIL A	ASIL B	ASIL C
C3	E1	QM	QM	ASIL A
	E2	QM	ASIL A	ASIL B
	E3	ASIL A	ASIL B	ASIL C
	E4	ASIL B	ASIL C	ASIL D

It appears that the Action Priority concept in FMEA-VDG alignment might have emerged from the above ASIL table. FMEA-MSR has also got separate SOD tables and AP table as in the case of DFMEA and PFMEA.

Important Tail Piece

One question that will rise in everyone's mind is whether the FMEA-Alignment will result in task of redoing the present FMEAs in a company as no one likes doing a rework – be it a document or a product.

The good news is that such redoing is optional. As per para1.4.6 on page 19 of the draft guide, "**Existing FMEAs conducted with an earlier version of the FMEA Handbook may remain in their original form for subsequent revisions."**

Even if it is a minor product change, the draft of the Handbook also suggests that the team may decide to leave the FMEA in the existing format itself.

So the inference is to reap the benefit of AIAG-VDA FMEA alignment methodology in true sense with detailed work in new products and major product changes rather rushing with just document corrections.

With the above introduction, let us now look forward to AIAG-VDA Manual.

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