

A Fundamental FMEA FLAW

*How to increase the efficiency and effectiveness of failure mode
and effects analysis | by Gary G. Jing*



Just the Facts

Although failure mode and effects analysis (FMEA) seems simple and straightforward, many people struggle with it. Not considering the costs associated with FMEA is among many reasons causing the struggle. This can lead to ineffective and inefficient business decisions.

To make FMEA more effective and efficient, the different sections of an FMEA form can be prioritized and resources can be focused on the most important sections.

Expectations about how failure mode and effects analysis (FMEA) should be done vary significantly. People with different backgrounds or who work in different industries have vastly different experiences. Still, there are two consistent struggles with the tool:

- + **Efficiency.** Significant resources are invested in FMEA before it is known how effective it will be.
- + **Effectiveness.** Because FMEA focuses on potential future problems, its effectiveness isn't immediately verifiable. Objective measures to evaluate its quality and effectiveness are lagging.

This article sheds some light on these challenges and provides countermeasures to help you better handle FMEA activities and get the most out of your efforts.

The biggest struggle

Efficiency often is the biggest complaint about FMEA. A humorous cartoon called "Cowboy After OSHA Inspection" does a good job illustrating this.¹ The cartoon depicts a cowboy sitting on a horse, outfitted with every piece of safety gear imaginable—roll bar, hard hat, backup lights, safety goggles and grab rail.

Much like the cowboy metaphor, FMEA activities can be excessive and burdensome, which can overshadow the original intent of the activity. A consequence is that truly important matters are buried among mountains of trivial things—a big distraction and danger to the issues that truly matter.

FMEA is time consuming and involves many people from various functions. In the corporate

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environment, people are constantly overloaded, so anything that increases efficiency and alleviates the time burden of FMEA will be widely embraced and deeply appreciated.

The second—and maybe more serious—struggle is FMEA's effectiveness, which goes hand-in-hand with efficiency. Because the focus of FMEA is on potential future problems, its effectiveness is difficult to evaluate during the activity, and often there are inefficiencies that make the situation worse.

Typically, efficiency and effectiveness dictate return on investment (ROI). Efficiency is measured by comparing production with costs (such as energy, time and money), and effectiveness is the degree to which something is successful in producing a desired result.

FMEA consumes a huge amount of already heavily drained resources, but doesn't guarantee its result. Under time pressures and delayed effects, people tend to cut corners. In this case, FMEA becomes a checkmark on the task list, procedurally oriented with diminishing effectiveness.

A fundamental problem

There is a fundamental deficiency in FMEA and root cause analysis (RCA). Two dimensions are needed to make meaningful business decisions, as illustrated in Figure 1. One dimension represents investment (cost, effort and difficulty) and the other represents return (impact and reward). Yet, traditionally, the investment aspect isn't considered in either FMEA or RCA—all FMEA evaluations focus solely on return. This has caused serious problems and consequences, such as augmenting FMEA's inefficiency and thus ineffectiveness.

The effect of FMEA is already hard to evaluate. Without cost information, sound business decisions can't be made. That is the dilemma with FMEA, but this fundamental problem hasn't been recognized by many people or addressed by many publications.

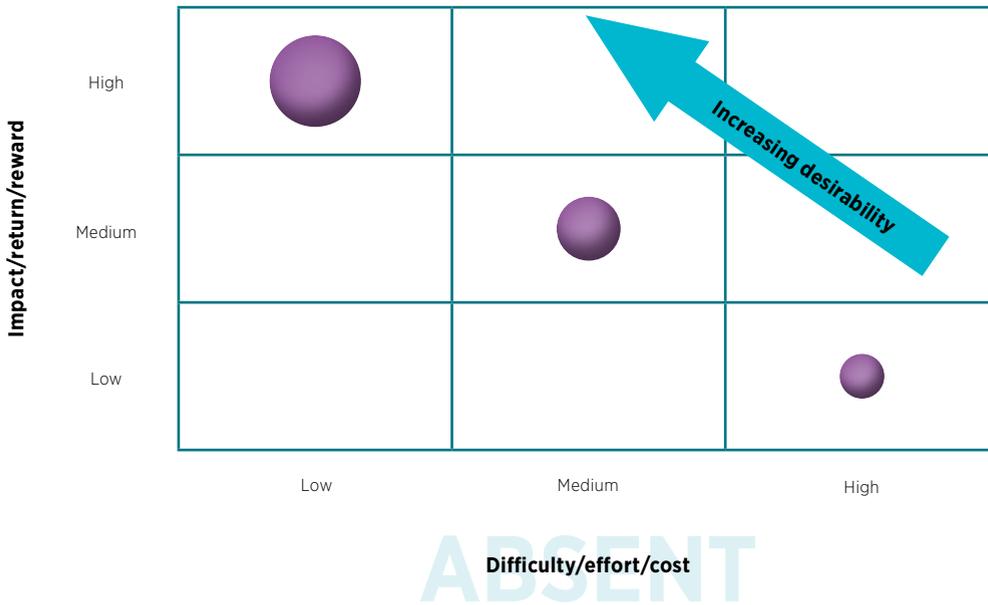
In practice, people typically factor in the cost aspect when selecting actions—mostly ad hoc and subconsciously in many cases. I, however, strongly advocate formalizing cost analysis by adding two columns representing the two dimensions needed for decision making



FIGURE 1

Two dimensions needed for making business decisions

The cost aspect needed for business decisions is usually not considered in FMEA (or RCA).



FMEA = failure mode and effects analysis

RCA = root cause analysis

Typical ways to boost FMEA quality

So how do you deal with this dilemma and boost the effectiveness and efficiency of FMEA? Without direct, effective measures, people turn to more tangible, easier yet indirect measures, such as:

- + Emphasizing formality (and structure).
- + Having the right focus.
- + Driving quantity.

Emphasizing formality and structure elevates the seriousness of FMEA activity with the hope of driving quality. Sometimes people stretch it too far and misinterpret format and formality as quality. Positive correlations do exist, but format and formality do not guarantee quality or effectiveness.

Different industries have different expectations of FMEA. For highly regulated industries, such as the medical device, aerospace and automotive industries, FMEA—often prescribed as a required

deliverable—is more formal and handled more seriously. In this case, efficiency isn't the primary concern—thoroughness is. For less-regulated industries, it can be less formal and ad hoc. For Six Sigma applications, it usually is more flexible, less formal and frequently customized. In these situations, efficiency is of more concern.

There is no perfect FMEA (or perfect outputs for any subjective analyses). Different people doing the same subjective analysis will get different results, which is OK. The key is iteration. Based on the Delphi method,² results will converge through iterations, so use your own judgment to decide the best practice and approach for you.

Having the right focus improves the efficiency of investment and ROI. Focusing on new, unique and difficult (NUD) items and easing up on easy, common and old items, for example, can significantly boost efficiency. It also is the hope that quantity will bring out more valuable contents and thus improve effectiveness, as discussed later.

Dealing with the challenges

One way to deal with these challenges is to differentiate the importance of the different sections of an FMEA form. See Table 1 (p. 32) for a sample. Not all of the form's columns are equally important—some deserve more attention than others. A major reason FMEA is inefficient is because time and resources aren't spent wisely. How to prioritize the columns depends on what the FMEA is for and what you want to get out of it.

As mentioned, not all columns on an FMEA form are equally important. The most important task of FMEA is to identify potential problems as thoroughly and completely as possible, which is captured in the potential failure modes section, making it the most important. In a way, failure modes represent the concerns people have about the subject. One of the biggest fears with FMEA is that some potential problems were missed during FMEA but occurred later. After a potential problem is identified, people usually can do a reasonably good job of evaluating it and identifying countermeasures.

The second most important section is the actions (or countermeasure) column. This is where you will identify countermeasures to the potential failure modes. All identified

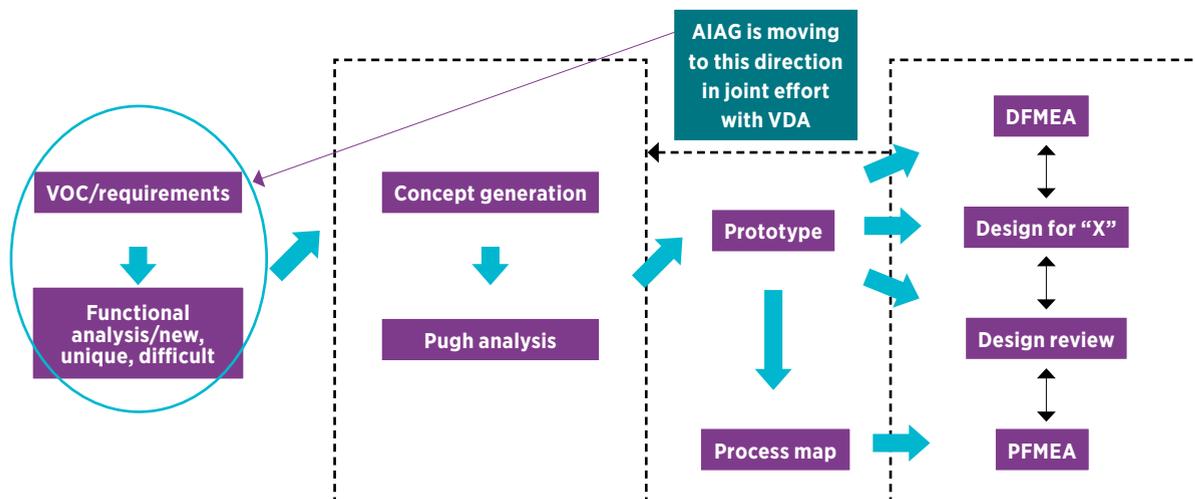
concerns must be contained at an acceptable level. One useful tip is to be conscious of the cost of the countermeasures and pick the ones with high ROI. This requires evaluating the cost of proposed actions and comparing it against the expected effects.

The third most important section is the risk priority number (RPN), which assesses the risk of each concern and establishes priorities to guide responses. This section needs some clarification:

- + The RPN is almost always highly subjective due to a lack of sufficient data at the time of evaluation. In fact, uncertainty is what risk is about. If there is no uncertainty, there generally is no risk.
- + Frequently, the RPN is mistreated as the most important thing in FMEA. However, overall, it plays a fundamentally supportive role by helping to address failure modes and countermeasures with establishing priorities and focus. The RPN should not be the primary focus in FMEA. One frequent mistake in FMEA practice is spending too much time on RPN scoring.

FIGURE 2

Example of how LDFSS integrates relevant activities (product development stage)

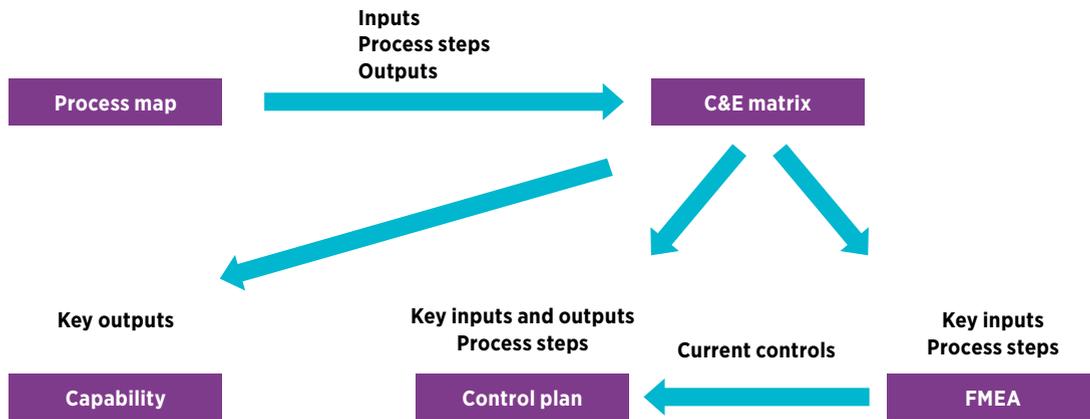


AIAG = Automotive Industry Action Group
DFMEA = design failure mode and effects analysis
LDFSS = lean design for Six Sigma

PFMEA = process failure mode and effects analysis
VDA = German Association of the Automotive Industry
VOC = voice of the customer

FIGURE 3

Example of how DMAIC integrates relevant activities (post production release)



C&E = cause and effect **DMAIC** = define, measure, analyze, improve, control **FMEA** = failure mode and effects analysis

+ Overemphasis on the RPN should be avoided. In fact, the Automotive Industry Action Group and the German Association of the Automotive Industry are moving away from the RPN in their new practice. Everything else on the FMEA form is in a secondary supporting role to the three sections mentioned to help make better informed decisions.

Spend resources wisely

Group resources can be better leveraged by redirecting the FMEA team's brainpower to the activities that add the most value. The two most important columns on the form (failure modes and actions) can benefit most from the team. The group should focus on brainstorming those columns, and an experienced leader can take care of the rest with a small sub-team.

One of the least-efficient ways of performing FMEA is to have the whole team watch the notetaker write everything down on the FMEA form. A better way is for the experienced leader to pre-populate the form and have the group review (revise and amend) the outputs. This is more applicable when a previous or similar FMEA is available as a starting point.

When an existing FMEA can't be leveraged, following this practice can make FMEA more efficient and effective:

1. Have the team focus on brainstorming the failure modes (concerns) as thoroughly as possible. Try to beef up quality through quantity, which is still an indirect measure but has more substance than format and formality. Instead of using a computer, use sticky notes to capture ideas. Explain each idea thoroughly to the team and, if needed, discuss for clarification or countermeasures. Assigning a preliminary risk level (low, medium or high) before performing the formal RPN evaluation can help efficiency.
2. Use breakout sessions during which subgroups of the team can process the submitted items, including entering them into the FMEA form, analyze them and fill out relevant supporting sections. Depending on what the FMEA is used for, some supporting information may not be needed.
3. When the analysis is complete, have the whole team review and refine the outputs together.

Integrate FMEA with related activities

There are many activities that have a similar intent of preventing future problems, such as design review, dynamic control plans and Six Sigma. It is more effective and efficient to systematically integrate FMEA with these related activities than to perform FMEA by itself.

TABLE 2

Activities and schedule of joint event

	Pre-event	Day 1 Morning	Day 1 Afternoon	Day 2 Afternoon	Day 2 Afternoon	Day 3 Afternoon	Day 3 Afternoon	Post-event
Stage 0: Prep and kickoff	Lead optionally pre-draft QFD and FMEA							
Stage 1: Review current design		VOC updates, teardown prototype, touch, feel						
Stage 2: Brainstorm/document concerns			Whole team brainstorm, prioritize concerns	Breakout to document concerns on FMEA, quickly assess risk				
Stage 3: Generate better solution				Multiple rounds of ideations on top concerns	Breakout to consolidate ideas and review counter-measures	Breakout to further develop ideas		
Stage 4: Finalizing							Breakout to review QFD	Finalize improvements and FMEA

FMEA = failure mode and effects analysis

QFD = quality function deployment

VOC = voice of the customer

REFERENCE AND NOTE

1. Jack Benton, "Safety Photo of the Day—OSHA Cowboy," EHS Safety News America, Sept. 7, 2016, <http://tinyurl.com/y2o6ujwx>.
2. The Delphi method is a forecasting method. Several rounds of questionnaires are sent to a group and the anonymous responses are aggregated and shared with the group after each round. The respondents can adjust their answers in subsequent rounds. It is believed that during this process, the range of answers will decrease and the group will converge toward the "correct" answer.

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