Breaking Tradition

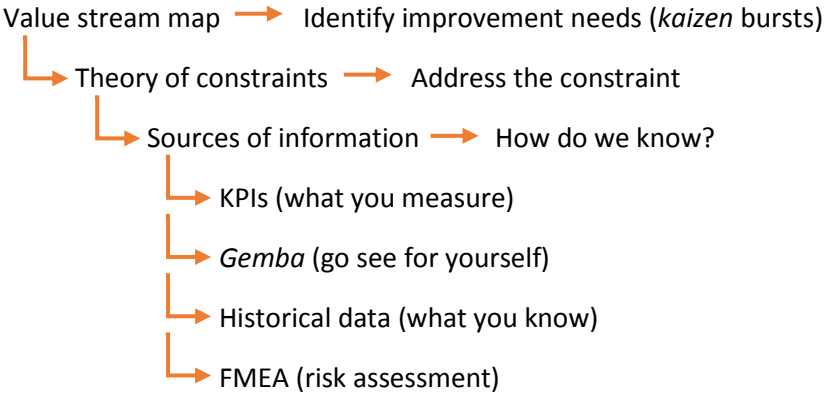
Combining value stream maps and traditional FMEAs for more effective CI strategies

by Richard Maclin

At their core, Six Sigma practitioners are problem solvers. Organizations rely on them to lead teams and find and implement solutions to daily problems. Inevitably, they'll be asked, "Where should we start?"

Failure mode and effects analysis (FMEA) should be in the list of continuous improvement (CI) tools you use to get the ball rolling. An FMEA is a step-by-step approach for identifying all possible failures in a design, manufacturing or assembly process, or a product or service. Figure 1 illustrates a typical role an FMEA might play in an organization's CI strategy.

An FMEA's role in continous improvement / FIGURE 1



FMEA = failure mode and effects analysis KPI = key process indicators

Value stream mapping

Before documenting a value stream, an organization should clearly define its mission and vision statements, and use them to develop a top-level strategy (*hoshin kanri*). That strategy directs the

leadership team to drive change (performance improvement) into the business process. And this eventually leads to the question: "Where should we start?"

A value stream map (VSM) gives a high-level view of the entire business process. It can be used as a diagnostic and planning tool, and it allows the organization to identify areas suffering from poor processes or performance. Those pain points are highlighted with *kaizen* bursts (intense, short-term projects that create rapid improvements) and are targeted for improvement.

After the pain points are identified in a VSM, a team might ask, "Should we work on all of them at the same time?" The answer is: probably not.

Setting priorities

The theory of constraints explains that unless you are working on the (singular) constraint, improvements don't result in overall change in throughput, inventory or operating costs.[1] In other words, improving a part of a process while ignoring the most limiting or costly part will not improve the total business process performance. You must first identify and address one constraint before moving to the next one.

After you identify a constraint, you must prioritize what should be fixed. CI leaders use several sources of information to craft their plan of attack, such as:

- **Key process indicators—**These can be for organizational, divisional, departmental, process or team levels.
- ***Gemba*—**Go see for yourself, and observe what really happens in the process.
- **Historical data—**Dive deep into the numbers, which can include high-level analysis, and data for quality or downtime.
- **FMEA—**Use this as a risk assessment, and focus on the highest risks.

While these other tools often provide useful direction for problem solving, let's focus on FMEA and consider how it can be used as part of an effective CI culture.

FMEAs and prioritizing risks

Many organizations complete FMEAs out of compliance, either due to regulatory or customer-specific requirements. A production part approval process, for example, ensures manufacturers and suppliers can communicate and approve production designs and processes before, during and after manufacture.[2] After this type of document is completed and approved, it is typically not pulled out of the file or book until the next required submission date or during an audit.

If this is the extent of how you use an FMEA, you are missing out on a great source of information for problem solving. Used to it full potential, an FMEA allows you to:

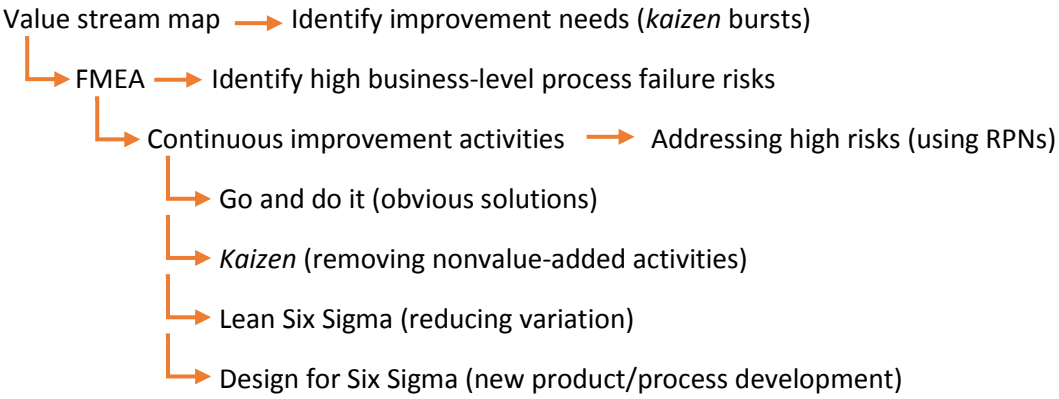
- Review each process step.
- Identify failure modes (what can go wrong) at each step.
- Answer the question: "When things go wrong at a given step, what effects are felt by the customer?"
- Rate how severe each effect is to the customer.
- Identify potential causes for each failure mode.
- Rate how likely each cause is to occur (based on data when possible).
- Define current controls for each cause.
- Rate how likely your process is to detect each cause for each failure mode.
- Use the severity, occurrence and detection ratings to calculate the risk priority number (RPN).
- Focus on high RPNs to identify, plan and implement improvement actions.
- After taking improvement actions, update RPNs to show reduced risks.

After a CI team has identified the constraint, it must identify the areas of greatest observed waste, variation or risk of process failure. Using an FMEA that represents the current process, the team can quickly identify the highest risk features of the process and immediately begin work to reduce their occurrences and increase their likelihood of detection.

Addressing areas with high RPNs may require methods such as *kaizen* events or lean Six Sigma projects. Regardless of your method, after actions are taken to reduce the risks of high RPN failure modes, you must update the FMEA. Document those actions and update the RPNs based on the new process.

This is a typical (and sadly underused) way an FMEA can help in problem solving. But there also are alternative uses for it, such as during product design (a design FMEA) and for production processes (a process FMEA). You can combine an FMEA with a VSM to create an additional type of FMEA (see Figure 2).

FMEA combined with value stream mapping / FIGURE 2



FMEA = failure mode and effects analysis

RPN = risk priority number

Using an FMEA in this manner is referred to as a business-level failure mode and effects analysis (BFMEA). The team develops a VSM of the entire business process—such as customers, suppliers, order handling, internal process steps (high level), inventory or lead times—with the process details fresh in mind and constructs a BFMEA considering the potential failure modes for the entire business. After high RPNs are identified, the team plans CI activities for the coming weeks or months. These plans should prioritize potential failure modes that have both high RPNs and directly align with the organization's strategic objectives.

BFMEA applied to a machine shop / TABLE 1

Input process step	Potential failure mode	Potential effect(s) of failure	SEV	Potential cause(s)	OCC	Current controls	DET	RPN
10. Customer faxes order	Wrong item	Customer return	8	Customer using old product list	2	Website product list	4	64
				Entry error	4	Order-handling database validates item number	1	32
	Missed order: Fax not received	Customer complaint	7	Fax machine failed	2	Sending fax machine with receipt verification	2	28
				Fax thrown away	4	Unclaimed fax inbox on wall	7	196
				Fax taken by someone else	3	Unclaimed fax inbox on wall	7	147
	Insufficient quantity on hand	Late delivery	8	Supplier lead time too long	4	Maintain two weeks of RM inventory	5	160
30. Release supplier B purchase order (auto email)	Wrong material	Product failure	8	BOM error	2	ERP BOM review	3	48
	Wrong quantity	Receive insufficient material	7	BOM to quantity error	1	Automatic BOM conversion to quantity	1	7
	Lead time exceeds customer need date	Late delivery	8	Material not available at supplier B	2	Maintain two weeks of RM inventory	5	80

SEV = severity OCC = occurrence DET = detection ERP = enterprise resource planning

RM = raw materials BOM = bill of materials RPN = risk priority number

Table 1 shows a sample of a BFMEA for a simple machine shop (I know, there is no such thing as a "simple" machine shop). Risks and known issues are identified in the VSM but are more clearly defined in the BFMEA. Table 1 shows the process steps highlighted in blue: These indicate needed CI activity in the same areas that the VSM identified a need for *kaizen* bursts. The BFMEA allows the team to more quickly target specific process steps and causes of potential failures. CI activities can be scheduled to address the highest RPNs first and lower RPN causes later.

The strengths of this blended approach include:

- CI professionals are familiar with an FMEA.
- Using defined process attributes in VSMs allow easy translation to a BFMEA.
- Using a BFMEA validates the observations and historical perspectives experienced during a VSM.

Of course, the team should revert to the traditional use of design FMEA and process FMEA during any given CI activity for more granular, process-specific information. When paired with a VSM, however, the BFMEA is an effective diagnostic and planning aid and is a nice addition to your CI toolbox.

References

1. Eliyahu M. Goldratt and Jeff Cox, *The Goal: A Process of Ongoing Improvement*, North River Press, 2014.
2. Madalyn Muncy, "PPAP 101: What You Need to Know," RGBSI.com, www.rgbsi.com/what-to-know-about-ppap.

About the author

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