Fast and Easy Failure Mode and Effects Analysis (FEFMEA)

Introduction

Failure Mode and Effects Analysis ordinarily proceeds as follows (McDermott, Mikulak, & Beauregard, 1996):

Step 1: Review the process.
Step 2: Brainstorm potential failure models.
Step 3: List Potential effects of each failure mode.
Step 4: Assign a severity rating for each effect.
Step 5: Assign an occurrence rating for each failure mode.
Step 6: Assign a detection rating for each failure mode and/or effect.
Step 7: Calculate the risk priority number for each effect.
Step 8: Prioritize the failure modes for action.
Step 9: Take action to eliminate or reduce the high-risk failure modes.
Step 10: Calculate the resulting RPN as the failure modes are reduced or eliminated.

For problems in environments where prioritization is easier, cost of change lower, and pace of change faster, I like to use the following modified version I call Fast and Easy Failure Mode and Effects Analysis (FEFMEA).

Step 1: Review the process.
Step 2: Brainstorm potential failure models.
Step 3: List Potential effects of each failure mode.
Step 4: Pick which ones you want to fix in what order

Implementing FEFMEA

Review the Process

This conforms to classic FMEA.

- Draw a diagram or model of the system or process
    - Use any model that is easy to follow and understand
    - Number or label all of the parts of the model, this makes it easier later during discussion

    - It is much better if the person who built the system, product, or process creates the drawing
- As a group, meet to review the model
    - Present a walk-through one part at a time, this is what the number and labels are for
    - It is better if the person who made the drawing presents the walk-through
    - Make sure everyone in the meeting has a chance to ask clarifying questions
    - Allow modifications of the model/drawing if needed based on clarifications

Brainstorm Potential Failure Modes

This likewise conforms to classic FMEA. The team members should represent varied skills and perspectives. During brainstorming, do the following:

- Proceed with one part of the model at a time.
- At each part, ask what potential failure modes might be possible – a failure mode being something which might happen or go wrong.
- Record every failure mode along with the part of the model it represents, describing what it is that happens.
- Do not censor or self-edit at this point. Brainstorming means collecting all ideas and removing/trimming later.
- After finishing brainstorm, categorize and group failures together into related categories that make sense to the team.

Failure modes are things that might happen, for example “Call to external service may be interrupted by network problems” or “User may enter incorrect credentials.”

A sheet such as the following might prove useful, but any format that captures the same ideas ought to work well:

Component	**Failure Mode**	**Effect**	**Priority (High, Med.,Low)**
Name component	*Describe thing that might happen*	*Describe damage that might occur*	*Indicate importance of fixing*

List the Potential Effects of Each Failure Mode

This step is more informal than classic FMEA. In classic FMEA the effects weigh heavily on later risk calculations, so there is a lot of emphasis on getting effects exactly and precisely described to preserve the integrity of later calculations. For fast and easy analysis, all that

is needed is a roughly accurate description of the effect, which might be “user data is lost” or “user will be confused and might not be able to complete task.”

This step can be combined with the failure mode brainstorm, although sometimes we don’t realize possible effects until we consider failure modes later. The important part of capturing the effects is to help decide which items need to be fixed and how. The effects describe the harm and the damage, not just what happened.

Pick Which Ones You Want to Fix and in Which Order

This is where the FEFMEA is most different from classic FMEA. Classic FMEA has seven steps for calculating the Risk Priority Number (RPN), choosing which problem to fix, and measuring the result of doing so. FEFMEA gets right to the point of choosing what to do without the deep calculation.

Look at the list of failure modes and pick the ones to fix and in what order based on what seems right. Which effects seem to do the most damage to your customer and your business? Which failure modes seem the most likely to occur? Indicate which to address via the High, Medium, and Low values in the sheet if you like.

All the classic RPN calculation is about answering those same two questions. Classic FMEA requires calibrating everyone’s definitions of failure, severity, priority and frequency to prevent misalignment and to keep priority calculations in sync with team goals. In FEFMEA we spend less time making that decision, relying more on what we immediately know, what we can learn with quick investigations, or what we intuitively believe or prefer.

Testing After Performing FEFMEA

Ordinarily FMEA is about driving changes in a product or system, and then measuring the impact of those changes. It is not so common people discuss FMEA as a source of test ideas and activities.

I advise people to use FEFMEA (or classic FMEA) as a source of testing ideas in this way:

1. Get as far as step 3 where the failure modes and effects can be identified
2. For each failure mode, explore how to create that failure mode as a test condition
    a. Explore the code – look for classic points of failure such as data read and write, calls to external components, attempts to use resources, attempts to free resources, data that comes from or goes to a user

   b. Construct use cases that walk up to the point in the process or interact with the component where the failure is assigned. At the point of failure mode potential, alter the test procedure to simulate that failure mode.
   c. Examine the relationship of data values/structures/attributes to invoke failure. Prepare test data in that form and feed it to the system.
   d. Explore failure modes that rely on the environment. Exacerbate environmental conditions with things like network noise, starved resources, resource failure, service failures, non-responsive systems, error events. Attempt to introduce those failures at the same point where the given component is in use or activated.
   e. Invoke race conditions which cause the potential failure point.
   f. Examine guards meant to prevent failure modes and explore ways those guards may be dependent on conditions not always true, bypassed, disabled, or otherwise rendered ineffective.
3. Sometimes just knowing how to create the condition is sufficient to report a product defect. The “the following condition makes the failure possible” would be the bug report.
4. Sometimes you need a demonstration of the failure in action as evidence it can happen. In that case you would ran a test invoking the failure condition and reporting the effect.

The “do not censor” rule during brainstorming is particularly important during failure testing. It is a common response when a failure mode is suggested during brainstorm for designers and developers to answer “That is handled by <thing they meant the product to do…>”. That response sounds as if it nullifies the need for testing, when in fact it does the opposite. The statement makes clear there is a product requirement and attempted implementation to handle that condition specifically. That means the thing just brought up in the brainstorm is now something that needs to be tested.

Bibliography

McDermott, R. E., Mikulak, R. J., & Beauregard, M. R. (1996). *The Basics of FMEA*. Portland, OR: Productivity, Inc.