Failure modes and effects analysis

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It's a good way to assess risks when formulating your maintenance plan

Survivor USA Plant of the Year
How maintenance and asset management helped it beat the odds.

If ever there were a topic that sounded more appropriate for plant maintenance and engineering, I don't know what it could be. Maintaining the highest degree of productive uptime is what you do for a living. It's one secret to the success of any manufacturing operation. And it's the plant manager and the engineering staff who sniff out the root causes of equipment failure and prioritize the time devoted to a problem on the basis of the failure's consequence. Expertise with failure modes and effects analysis is something that ought to be of value to any plant professional.

Join me for this month's dive into the morass we call the Web in search of zero-cost, non-commercial, registration-free resources aimed at providing you with practical information to head mechanical failures off at the pass. Remember, we search the Web so you don't have to.

History

The United States military first developed and published a methodology for failure mode and effects analysis right after World War II. Originally designed to ensure a degree of reliability that would protect the safety of troops and equipment, the document has since been adopted and adapted by a number of organizations for a variety of purposes. A brief history of the original document resides at http://www.fmeca.com/ffmethod/history.htm, courtesy of The Haviland Consulting Group in Grand Rapids, Mich.

Many of the FMEA variants emerged in the form of applications customized for product design purposes. It is, after all, more sensible to design safety and reliability into a product before the marketplace makes it abundantly clear that it's only so much unusable junk rolling off someone's assembly lines. Other variants focus on the healthcare field, a venue where reliability and safety are, in the main, good things to have happen.

A portal

An efficient way to access information about a particular topic is through a Web site that links to other related Web resources. One such Web site is The FMEA Info Centre, operating from Oostmalle, Belgium. It bills itself as a non-commercial, Web-based inventory dedicated to the promotion of our topic for the month.

The features your mouse can uncover there include the latest scoop on books and publications about the FMEA, abstracts of technical papers published between 1996 and 1999, links to consultants, downloads, example calculations, as well as links to FMEA research, software and standards. The site is an international entity and some material is presented in German, French and other languages. Let your mouse sneak its way into this portal at **http://www.fmeainfocentre.com/** to get a good grounding in the world of FMEA.

Incidentally, there are two download areas on this site. One is accessed from the main menu at the top of the home page. The second is more difficult to find, probably

because of the typo in the URL
http://www.fmeainfocentre.com/downlaod_area.htm.

Worksheets

FMEA requires one to identify and describe each specific risk to be analyzed and attach numerical values to three relevant variables. This forms a matrix, a worksheet, which documents your calculations and subsequent analysis.

To get started, you'll need a blank FMEA worksheet. A good place to get one is from Adams 12, Five Star Schools in Thornton, Colo. Download the PDF, sharpen your pencil, give it some thought and you're in business. Have your mouse fetch the sheet from **http://www.adams12.org/Quality/documents/FMEAWorksheet.pdf**.

Three big numbers

The typical FMEA program assigns a value to three variables (severity, probability, detectability) needed for a straightforward computation that determines the relative importance of a particular failure mode. It's a good idea for your FMEA program to include a standard so that everyone examining a particular failure mode can establish reasonably similar estimates for the three factors. An example of one such standard is found on the Web site operated by iSixSigma LLC, Ridgefield, Conn. Have your mouse climb up to **http://www.isixsigma.com/tt/fmea/** to click on FMEA For Information Technology. Although the rating standard shown there is for IT purposes, the generic aspects of the approach that are useful for plant maintenance and engineering will jump off the screen into your lap.

OK, so we know how to agree on the numbers, right? Now what? That's a question someone posted to the iSixSigma forum. As you would expect, there are experts out there with answers. Before you leave this site, take the time to read the advice offered to one FMEA beginner. The specific forum page is **http://main.isixsigma.com/forum/showmessage.asp?messageID=30127**. Don't bother with the follow-up entries listed at the bottom. They add nothing new to the discussion.

The next step is to start filling out the paperwork. There's a good example of a completed worksheet on the Web, posted there by our friends in Belgium. This Excel spreadsheet, found at **www.fmeainfocentre.com/download/fmeaIII.xls**, is a self-contained FMEA program in progress. It includes a functional FMEA worksheet, an explanation of cell contents and color-coded standards for assigning values to the variables.

By way of comparison, investigate the FMEA worksheet format that Safety Management Services Inc., West Jordan, Utah, uses for process hazards analysis. Mouse your way to **http://www.smsink.com/services_pha_fmea.htm**. Read the explanatory main body copy, then move to the upper right and click on the links to the completed sheets.

If you're a Star Trek fan, you might want to refer to the FMEA worksheet for the Starship Enterprise, which is posted at **http://www.snoino.com/functions-and-failures.htm**.

Another example

Every plant has a fire sprinkler or fire suppression system, insurance regulations being what they are nowadays. That includes installations owned and operated by our military, the very folks who came up with the FMEA concept in the first place. As a result, I'd conclude that there are very few fires in military buildings.

If you're interested in learning how your Department of Defense applies FMEA, all you need do is visit this next site, where ABS Consulting's Risk Consulting Division, Knoxville, Tenn., posted Using a Risk-based Maintenance Approach to Develop Planned Maintenance Guidelines for Fire Protection Systems. This prodigious paper describes a six-step, risk-based maintenance approach underlying planned maintenance guidelines that ensure the reliability of fire detection and suppression systems. That even sounds military, doesn't it?

Nevertheless, you might want to pay homage to people who invested their time and effort in the project by making a sacrifice of your mousie at **http://www.jbfa.com/rbmfire.html**. What you'll see on the site might even be something you could use in your own plant, perhaps for benchmarking purposes if nothing else. Besides, we've heard the jokes about the army spending $800 for a toilet seat and wonder how that could be. If one assumes they expended this much effort to build in the quality that ensures safe seating, it might explain everything.

The downloads

Although it's possible to perform FMEA with paper and pencilthe U.S. military did it back in the 1940sit makes more sense to use software. It's conceivable that you could do the work using Excel, but this is an Internet column, after all, and I'm sure you expect more than something that simplistic.

The software development house, 1984 Ltd., in Rayleigh, England, offers QPAKDemo.exe, a free, modular software package that handles FMEA, control plans, calibration, corrective actions, training records and more. Downloading the 18 MB file requires about 90 min. at 56K kbps, or about 10 min with ADSL. It's free, so it's reined in with some restrictions. It ceases to function after 30 days, there's no integration among modules, it allows only restricted creation of new documents and it operates in single-user mode only. If you want to explore the topic and can deal with these downside aspects, point that acquisitive little mouse of yours in the general direction of **http://www.1984.uk.com/download/files/QPAKDemo.exe** to get the goods.

Higher uses

Ultimately, the exercise with failure modes and effects analysis must lead to a decision that justifies making the effort. Placing a decision in context gives it a bit more muscle for promoting some change that mitigates some risk. Reliability-centered maintenance is an example of a context that uses FMEA.

RCM Overview, a document by American Management Systems, Fairfax, Va., argues that FMEA integrates with RCM. Especially interesting on the page is the section about "backfit" RCM and the six steps needed to achieve it. Visit **http://www.amsinc.com/cmt/OVERVIEW.asp** for a worthwhile read.

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