FMEA: Failure Mode and Effects Analysis

FMEA stands for Failure Mode and Effects Analysis, a structured method for finding what could go wrong in a product or process before it happens. The team lists the possible failures, judges how serious and how likely each one is, and decides where to act first. The method has been used in industry for many decades, and it is now common in the automotive industry and in many other sectors. A harmonised guide, the AIAG and VDA FMEA Handbook, was published in 2019.

1. Failure Modes and Effects

The first part is to list the failure modes. A failure mode is the way in which a step, a part or a function could fail, such as a part that breaks or a step that is skipped. For each failure mode, the team writes the effect, meaning what the customer or the next step would experience, and the cause, meaning why it could happen. Asking these three questions in a group, with people from different roles, finds risks that one person would miss.

Example: Before a bicycle ride, a cyclist lists the failure modes of the brakes. One failure mode is that the brake does not grip, the effect is a crash, and a possible cause is worn pads.

At work: Dina, a quality engineer at a company that makes electric kettles, lists the failure modes of a new kettle. One is that the kettle does not switch off when it boils dry; the effect is overheating, and the cause could be a faulty thermostat.

2. Rating the Risk

The second part is to rate each failure on three scales. Severity measures how serious the effect is. Occurrence measures how likely the cause is. Detection measures how likely the current controls are to find the problem before it reaches the customer. The ratings usually run from one to ten, and a higher number is worse, so a high detection rating means that the problem is hard to detect.

Example: Rating severity, occurrence and detection, the cyclist gives the brake failure a very high severity, because a crash can cause injury. Occurrence is low because the pads are fairly new, and detection is good because a quick test before the ride shows a weak brake.

At work: Rating severity, occurrence and detection, Dina's team gives the kettle failure a severity of nine, an occurrence of three and a detection of four. A squeaking lid gets a severity of only two.

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3. Setting Priorities

The third part is to decide which failures need action first. In the classic method, the three ratings are multiplied to give a risk priority number. The 2019 handbook moves to an action priority table, which gives more weight to severity and sorts actions into high, medium and low. In both approaches, a very severe failure deserves attention even when it is rare. Priorities guide the team's time, but they do not replace good judgement.

Example: Setting priorities, the cyclist fixes the brake first, even though a squeaking chain is more likely to happen. A rare failure with a severe effect comes before an annoying but harmless one.

At work: Setting priorities, Dina's team ranks the thermostat failure as high priority, because its severity is so high. The squeaking lid goes to the bottom of the list.

4. Acting and Re-Rating

The fourth part is to take action and then rate again. Actions can prevent the cause, for example with a better design, or improve detection, for example with an extra test. Each action has an owner and a date. After the action is done, the team rates the failure again to check that the risk has really fallen. FMEA is a living document, updated when the design or the process changes.

Example: Acting and re-rating, the cyclist replaces the pads and tests the brakes before every ride. Occurrence drops further, and detection stays good.

At work: Acting and re-rating, Dina gives an owner and a due date to the task of adding a second safety cut-off to the kettle. After the test, the team re-rates occurrence and detection, and the risk falls.

Conclusion

In summary, FMEA is a structured way to find and reduce risks before they become real failures. The team lists failure modes, effects and causes, rates severity, occurrence and detection, and sets priorities. Then it takes action and rates again. The AIAG and VDA handbook of 2019 is a widely used guide. FMEA works best as a team activity that is kept up to date.

Sources

• AIAG and VDA (2019). AIAG & VDA FMEA Handbook, 1st edition. Automotive Industry Action Group (AIAG) and Verband der Automobilindustrie (VDA) – https://www.aiag.org

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• VDA, Verband der Automobilindustrie (German Association of the Automotive Industry) – https://www.vda.de

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