OpsPilot

FMEA Module — User Manual

Failure Mode & Effects Analysis · AI Engineering Co-Pilot

What this guide covers — what FMEA is and why it matters, how the OpsPilot FMEA module works, the questions it will ask you, how it scores and ranks risk, and exactly what you receive at the end. A fully worked example (Reciprocating Compressor K-201) runs through the document so you can see a real input-to-output journey.

1. What is FMEA?

Failure Mode and Effects Analysis (FMEA) is a structured method for finding the ways a piece of equipment can fail *before* it fails — then ranking those failures by risk so the most important ones get attention first. Instead of reacting to breakdowns, FMEA works through each part of an asset, asks how it could fail, what would happen if it did, and how likely that is to slip through undetected.

Each potential failure is scored on three dimensions, and the three scores multiply together into a single Risk Priority Number (RPN) that lets a whole asset's failure modes be ranked on one consistent scale:

Dimension	Question it answers	Scale
Severity (S)	If this failure happens, how bad is the consequence — to safety, environment, production, or the asset itself?	1 (none) – 10 (catastrophic)
Occurrence (O)	How likely is this failure to occur, given the design and operating context?	1 (very unlikely) – 10 (almost certain)
Detection (D)	How likely are current controls to catch it before the consequence is felt? (Higher = harder to detect.)	1 (almost certain to detect) – 10 (no detection)

Risk Priority Number: **RPN = S × O × D** — ranging from 1 to 1000. A high RPN flags a failure mode that is severe, likely, and hard to catch — exactly the combination worth acting on.

FMEA is used across mining, oil & gas, power, water and manufacturing, and underpins reliability and maintenance strategy. The OpsPilot module follows the recognised standards — *IEC 60812:2018, SAE J1739, the AIAG-VDA FMEA Handbook, and ISO 14224* for equipment taxonomy and reliability data — so the output is defensible in an audit.

2. What the OpsPilot FMEA module does

The hard part of FMEA has always been the blank page: knowing every credible failure mode, scoring each one consistently, and not missing the dangerous-but-rare events. The OpsPilot FMEA module removes that barrier by running the analysis as a guided conversation between two roles:

Role	Responsibility
🎯 **AI Coach** (OpsPilot)	Breaks the equipment into components, identifies all credible failure modes, assigns best-estimate S/O/D scores, calculates RPN, challenges inconsistent scores, and drafts the complete FMEA.
👷 **Technical Expert** (you)	Brings the ground truth — the specific equipment, its operating context and failure history. You validate the scores, add any failure modes that were missed, and confirm the high-risk items.

The result is a draft produced in minutes rather than days, with a human expert keeping it honest. OpsPilot never replaces engineering judgement — it does the heavy lifting and *you* remain the validator.

3. How it works — the guided process

The module moves through eight stages, one question at a time. You can pause at any point — if a long answer is built in parts, typing “continue” resumes exactly where it left off — and you can stop early and generate the report whenever you have enough.

#	Stage	What happens
1	System definition & boundary	Names the asset, its function, what is in and out of scope, redundancy, and the ISO 14224 taxonomy and reliability baseline (criticality, MTBF, MTTR, availability target, data sources).
2	Subcomponent breakdown	Splits the asset into 3–8 functional subcomponents, each with a one-line function. You confirm or add to the list.
3	Failure mode identification	For every subcomponent, lists all credible failure modes — functional, degraded, intermittent, and spurious. You add any that were missed.
4	Interactive FMEA table	OpsPilot drafts every failure mode as a row with best-estimate S, O and D. You adjust scores via dropdowns; the RPN recalculates live.
5	Score challenge & validation	OpsPilot challenges scores that look inconsistent and confirms the high-risk items with you.
6	High-RPN action recommendations	For the top risks, recommends specific actions with a suggested owner and target date.
7	Maintenance strategy per component	Suggests the right maintenance approach (predictive, preventive, run-to-failure) for each component, linking to RCM logic.
8	Report generation	Unlocks the Excel report — a complete, audit-ready FMEA workbook with a live RPN table.

4. What you will be asked — have this ready

You do not need to prepare anything formal, but the analysis is sharper and faster if you have these details to hand. OpsPilot will ask for them in order:

Stage 1 — the asset and its context

- Equipment name and primary function (one sentence).
- System boundary — what is included and excluded, and the redundancy arrangement (single asset, duty/standby pair, parallel train).
- Asset tag / equipment ID (e.g. K-201), and the ISO 14224 equipment class and sub-class (e.g. Mechanical — Compressor — Reciprocating).
- Asset criticality (Class A–D), and the reliability baseline where known: current MTBF, typical MTTR, and the availability target.
- Failure-data sources to underpin the scores — OREDA, internal CMMS history, OEM data, or SME judgement — captured so the scoring is auditable.

Stages 2–3 — components and failure modes

- Confirmation of the subcomponent breakdown, and any subcomponents specific to your asset that should be added.
- Any failure modes OpsPilot misses for each component — particularly ones drawn from your own site's failure history.

Stages 4–7 — scoring and strategy

- Any Severity, Occurrence or Detection score you would change, with a one-line reason — OpsPilot updates the RPN immediately.
- Confirmation of the high-risk items, and acceptance or adjustment of the recommended actions, owners and dates.

Tip — the more honest the failure history and operating context you give, the more accurate the scores. “It failed twice last winter” is worth more than a textbook estimate.

5. How risk is scored and ranked

OpsPilot uses a 1–10 scale for each of the three dimensions, consistent with SAE J1739 and IEC 60812:2018. Severity is assessed against four consequence dimensions — Safety, Environment, Production and Asset Damage — and the worst-case score across the four is used.

Score	Interpretation	Detection note
1 – 3	Low — minor or no consequence / unlikely to occur.	1 = almost certain the control catches it.
4 – 6	Moderate — noticeable consequence / occasional occurrence.	Mid-range — controls may catch it.
7 – 8	High — serious consequence / likely to occur.	Weak detection — easily missed.
9 – 10	Severe to catastrophic / almost certain.	10 = effectively no way to detect before failure.

The three scores multiply into the **Risk Priority Number (RPN = S × O × D)**, and OpsPilot colour-bands every row so attention goes to the right place:

Risk band	RPN range	Meaning
CRITICAL	≥ 200	Act now — highest priority for action.
HIGH	100 – 199	Plan and schedule an action.
MONITOR	< 100	Acceptable — monitor and trend.

A standalone **Severity flag (⚠️)** also highlights any failure mode with a very high severity score even if its RPN is moderate, so a rare-but-catastrophic event is never buried by a low likelihood.

6. What you receive — the output

When the analysis is complete, the Excel Report button unlocks and you download a professional FMEA workbook with three sheets:

Sheet 1 — FMEA Worksheet

Every failure mode is one row, with a live RPN that recalculates the instant you change any S, O or D value, and red/amber/green risk banding. The columns are:

Ref	Function / Failure Mode	Effect & Cause	S · O · D	RPN	Priority
FM-01 …	What the component does and how it fails.	The consequence on the system and the primary cause.	Three live scores.	= S×O×D	Banded

Full column set: Ref · Function · Failure Mode · Effect · Cause · Prevention Control · Detection Control · S · O · D · RPN · Priority.

Sheet 2 — Action Plan

A focused list of the recommended actions for the critical and high-risk items, each with a Ref linking back to the worksheet, a recommended action, an owner, and a target date — ready to drop into your CMMS or improvement register.

Sheet 3 — Summary

A one-page cover: report ID, asset, date, methodology, an executive summary, and a live risk roll-up counting Critical / High / Monitor items — the page you put in front of management.

7. Worked example — Reciprocating Compressor K-201

This is the example used on the OpsPilot website. The expert defined K-201, a process-gas reciprocating compressor; OpsPilot broke it down and produced **16 credible failure modes**, scored and ranked. The risk roll-up came out as 3 Critical, 11 High, 2 Monitor.

A sample of the highest-risk rows, exactly as they appear in the worksheet:

Ref	Failure Mode	Effect / Cause	S·O·D	RPN	Priority
FM-07	Cylinder lubricator no-flow	Ring/liner scuffing, seizure / divider-block blockage	8·5·6	240	CRITICAL
FM-16	Suction scrubber high level	Liquid carryover into cylinder / level-control failure	9·4·6	216	CRITICAL
FM-14	Vibration trip fails to act	No protection during a fault / sensor fault or bypass	10·3·7	210	CRITICAL
FM-15	Rod-drop monitor failure	Undetected rider-band wear / probe drift	7·4·7	196	HIGH
FM-05	Crosshead bearing wear	Knocking, secondary damage / lube-oil contamination	7·4·6	168	HIGH

Notice FM-14: occurrence is low (3), but severity is 10 and detection is weak (7) — so the RPN still lands at 210, Critical. That is FMEA doing its job: a rare failure of a safety protection is not allowed to hide behind its low likelihood. The matching Action Plan entry reads — *“Restore vibration trip to voting logic; quarterly trip test — I&C Eng — 31 May 2026.”*

8. Getting the best result

- **Give real failure history.** Site-specific events sharpen the Occurrence scores far more than generic estimates.
- **Challenge the scores.** If a score looks wrong, change it and say why — OpsPilot will update the RPN and reasoning.
- **Watch the severity flag, not just the RPN.** High-severity, low-likelihood items deserve a deliberate decision, not a glance.
- **Stop early if you need to.** Type “generate the report” at any point and OpsPilot wraps up with what you have.
- **Treat the output as a living document.** The live RPN means you can revisit and re-score as conditions or controls change.