



Prioritizing Asset Risk using Risk Priority Numbers

What is a Risk Priority Number?

A **risk priority number (RPN)** is a numerical value calculated during risk analysis, such as the Failure Mode and Effects Analysis (FMEA), to prioritize maintenance tasks based on an asset's criticality, and the likelihood and consequences of failure. It helps organizations effectively allocate resources to address high-risk assets and minimize the likelihood of failures.

In FMEA, risk priority numbers are calculated for each failure mode, or way in which an asset might fail. RPNs are then compared to one another in order to prioritize which failures should be analyzed first.

Risk Priority Number Formula

$$RPN = S \times O \times D$$



Severity (S)

Severity is the seriousness of the consequences of a potential asset failure. Many organizations choose to focus on only the most severe failures. Depending on your organization, severe failures may be considered ones that lead to a worst-case scenario such as bodily harm, or ones that most commonly threaten operational output.

Rate severity on a 10-point scale with 1 representing the least severe outcome (i.e., no discernible effect) and 10 representing the most severe outcome (i.e., may result in acute health or safety risk). Some organizations may use a qualitative approach instead, with ratings of low, medium, and high.

Criticality assessments, Pareto analyses, and other tools can also identify critical assets or assets with the most severe failures.



Occurrence (O)

Occurrence is the likelihood or frequency of the failure cause to happen. Like severity, occurrence is rated on a 10-point scale, where 1 equates to an extremely low probability of occurring (i.e., failure is essentially eliminated through preventive measures) and 10 equates a high chance of occurring (i.e., prevention standards and best practices not determined; failure is inevitable).

Maintenance teams can rely on resources such as maintenance history, owner's manuals, manufacturer documentation, industry standards, employee expertise and experience, and performance indicators such as Mean Time Between Failures (MTBF) to determine an occurrence rating.



Detection (D)

Detection is the probability of identifying a failure before it happens and represents the effectiveness of current controls to discover signs of imminent failure. Like the other factors, detection is also rated on a 10-point scale, though a 10 is considered unable to detect (i.e., test procedure has not yet been developed) and a 1 is very likely to detect (i.e., the testing method always detects the failure).

The maintenance team's ability to detect failures may be evaluated by the inspection and testing procedures currently in place, condition monitoring or predictive maintenance technologies, training and expertise, historical maintenance data, and other analyses.

Risk Priority Number Calculation Example

Severity	Occurrence	Detection
5	9	7

Risk Priority Number (RPN)

$$5 \times 9 \times 7 = 315$$

Calculate the risk priority number (RPN) for each asset failure by multiplying the **severity**, **occurrence**, and **detection** ratings together. Given that each factor can be rated on a scale of 1 to 10, the minimum RPN is 1 (e.g., 1 × 1 × 1) and the maximum RPN is 1,000 (e.g., 10 × 10 × 10). Then, order failures based on their RPN values. Higher values indicate higher-priority failures that require more attention and mitigation efforts.

Risk Priority Number Advantages and Disadvantages

- ✔ Helps prioritize maintenance tasks and risk mitigation activities.
- ✔ Brings focus to high-risk assets.
- ✔ Aids in objective decision-making and comparing the risk of different failure modes.
- ✘ Ratings are subjective and based on one's own judgments.
- ✘ A high RPN does not necessarily reflect a high risk. Some factors may overshadow or compensate for lower ratings than others.
- ✘ Must be balanced with other risk assessment factors.

References
 1. Failure mode and effects analysis - FMEA Handbook Design FMEA, process FMEA, supplemental FMEA for Monitoring & System response. (2019). Automotive Industry Action Group.
 2. What is FMEA? Failure mode & effects analysis | ASQ. What is FMEA? Failure Mode & Effects Analysis | ASQ. (n.d.). <https://asq.org/quality-resources/fmea>
 3. Hartwell, J. (2022, August 18). FMEA RPN - risk priority number. How to calculate and evaluate?. IQASystem. <https://www.iqasystem.com/news/risk-priority-number/>
 4. Peterka, P. (2024, March 26). Risk priority number (RPN) in FMEA for Operational Excellence. SixSigma.us. <https://www.sixsigma.us/six-sigma-articles/risk-priority-number-rpn/>