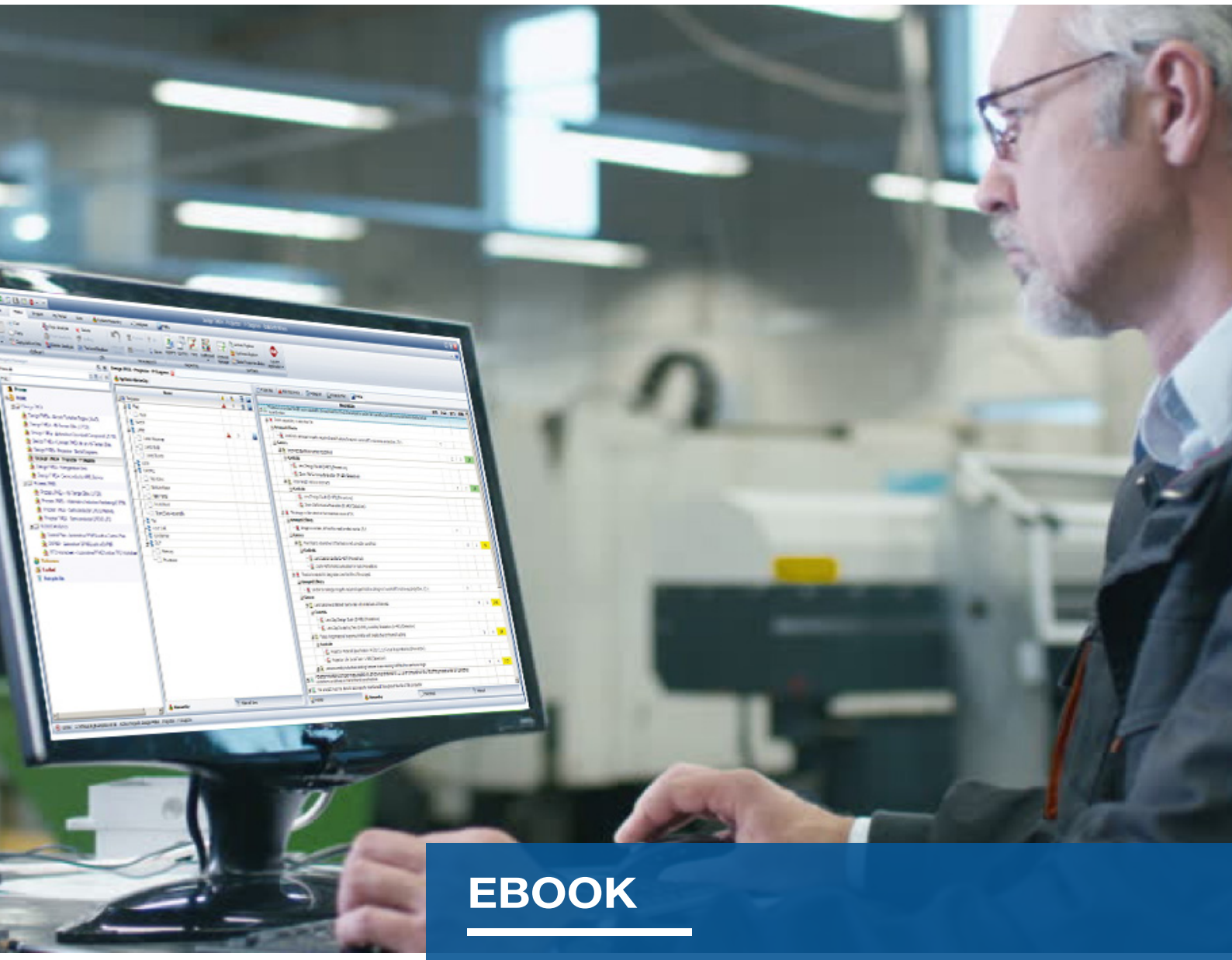
Holistic Asset MANAGEMENT



EBOOK

FMEA/FMECA GUIDELINE

ReliaSoft

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DEFINITION

Failure Mode and Effects Analysis (FMEA) is a reliability engineering methodology that systematically identifies and analyses the possible failure modes of each equipment and component, ranking and prioritising each failure based on its cause, effect and the probability of occurrence.

Failure Mode, Effects and Criticality Analysis (FMECA) takes the FMEA process one step further. It looks at the likelihood and criticality of each failure mode, allowing for a more accurate and robust analysis.

CONTENT

The Value of FMEAs

- at the operation and maintenance stage -

Many of us have simply inherited the asset and maintenance strategies we have. And we have inherited all the defects and reliability problems with it.

FMEA is not just useful within the design phase of the equipment or process, it also guides the maintenance and reliability team's most effective efforts. Two main benefits:

1) Determine the optimum value-added maintenance tasks.

Using FMEAs on installed equipment that is already operational can pre-empt or proactively mitigate the failures.

By identifying the potential and actual failure modes of the assets, we can then understand the risks and impact associated with these failures.

FMEA is the backbone in developing maintenance strategies, such as Reliability Centred Maintenance (RCM), Predictive Maintenance and a carefully planned Preventive Maintenance Strategies. By understanding all the failure modes, we can ultimately determine the optimum maintenance strategies or actions to prevent these failures from occurring with a high level of assurance.

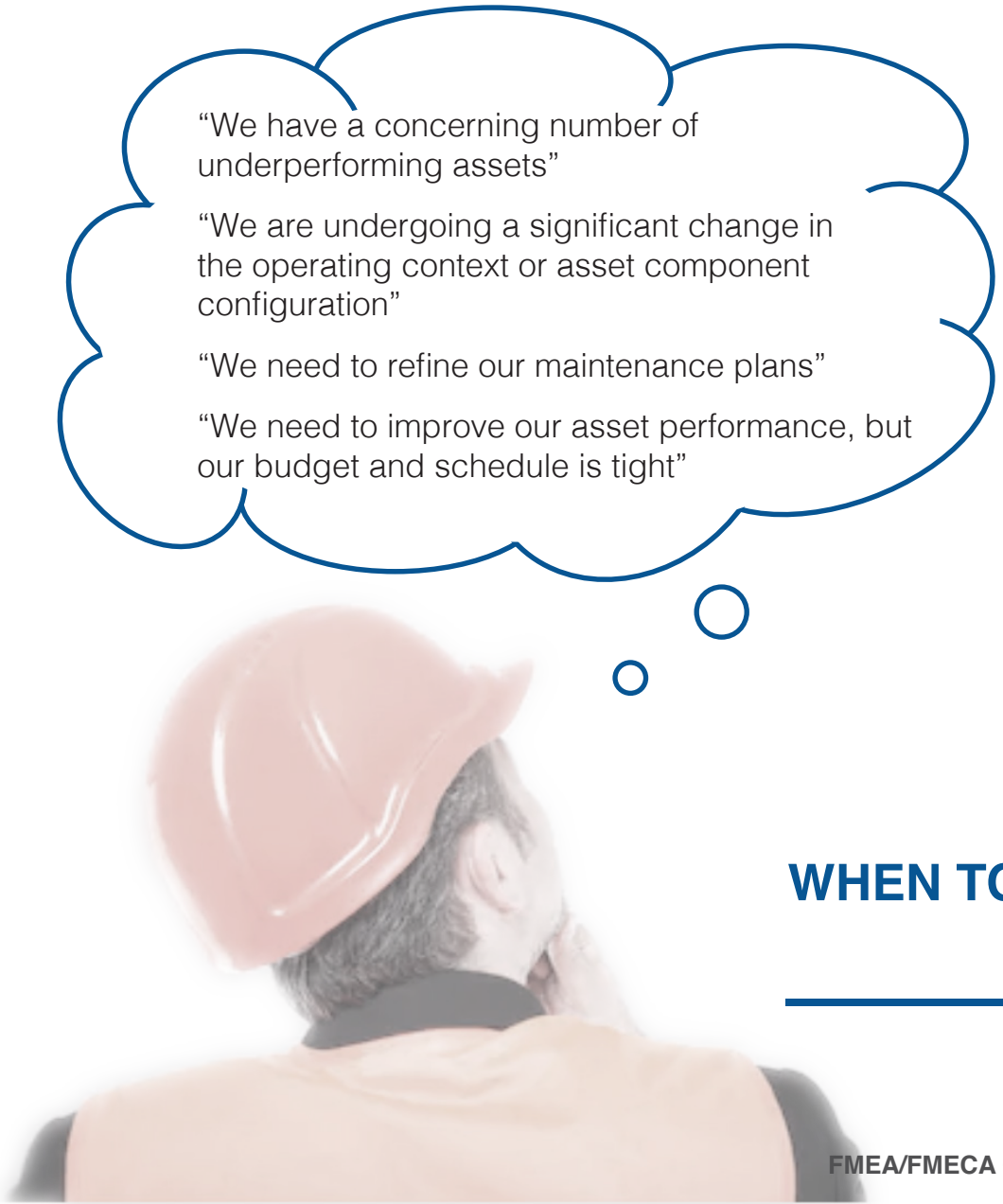
2) Improve the long-term reliability and the cost of ownership.

FMEA is not a one-off method, it should be maintained throughout the life cycle of the asset. The primary purpose of an equipment maintenance plan is to minimise

the impact of unplanned events on safety, asset productivity and the environment.

Through a living FMEA program, organisations can reach maintenance plan goals, enhance continuous improvement, reduce the asset life cycle cost and eventually improve and sustain the long-term reliability of the asset.

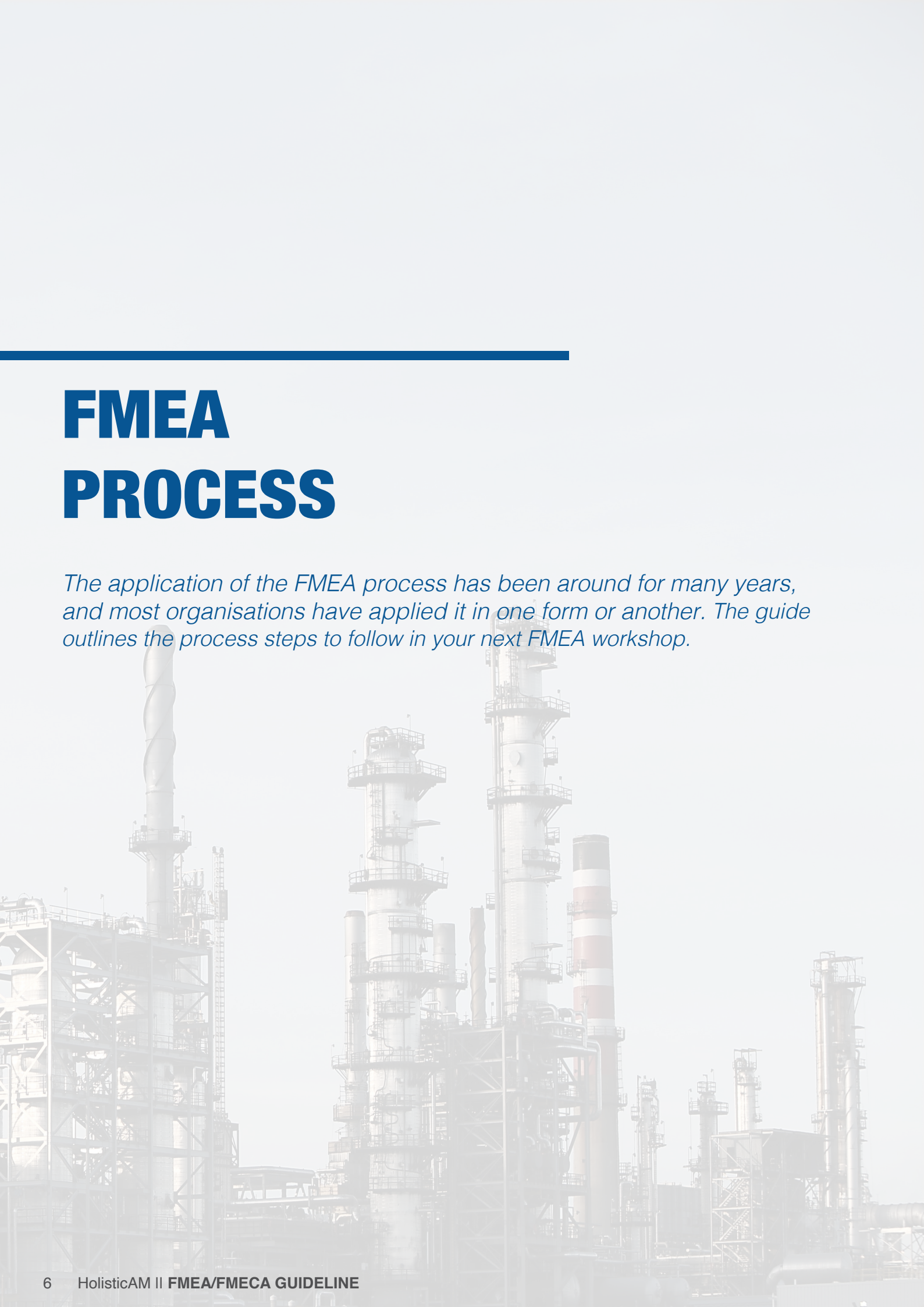
> **Many of us have inherited the asset and maintenance strategies with existing defects and reliability problems....**



WHEN TO PERFORM FMEAs?

FMEA PROCESS

The application of the FMEA process has been around for many years, and most organisations have applied it in one form or another. The guide outlines the process steps to follow in your next FMEA workshop.



BASIC ELEMENTS IN AN FMEA

Generally, an FMEA process requires the FMEA team to identify and perform the following elements:

- ☑ System Hierarchy
- ☑ Equipment / Component (s)
- ☑ Function(s)
- ☑ Failure(s)
- ☑ Cause(s) of failure
- ☑ Effect(s) of failure
- ☑ Current control(s)
- ☑ Risk associated with the issue(s)
- ☑ Recommended Task, Action and Plans
- ☑ Implementation of Actions
- ☑ Review FMEA performance results

Note:

Two common methods to assess **the risk associated with the issue(s)**:

- *Risk Priority Numbers (RPNs)*
- *Criticality Analysis (FMEA with Criticality Analysis = FMECA)*

13 STEPS TO PERFORM FMEAs

An FMEA process has 3 stages: 1) Preparation Stage, 2) Diagnosis and Analysis Stage, and 3) Action and Maintenance Stage. Within these 3 stages, we proceed through 13 steps to complete a thorough FMEA analysis.

Preparation Stage

Step 1: Assemble a cross-functional FMEA team of subject matter experts.

Step 2: Gather and review relevant information on past failures, work order history, drawing photos, manuals, etc.

Step 3: Recognise the function(s) and feature(s) of the FMEA scope, to have a thorough understanding of the fundamentals and procedures of FMEA.

Diagnosis and Analysis Stage

Step 4: Based on the function(s), identify and analyse all the equipment or component(s), in which something might fail sooner or has the potential to fail in the future. These are failure mode(s).

Step 5: Identify the Severity Rating of different failure modes. Ask: what effect(s) or consequence(s) will the failure mode have on the asset, process or product?

Step 6: Diagnose the potential cause(s) or mechanism(s) of the failure(s). This requires a good combination of tools and the FMEA team's knowledge base.

Step 7: Identify the Occurrence Rating for each potential cause. Make best educated assumptions to the likelihood of failure happening because of that cause.

Step 8: Identify the current control(s) to avoid failure mode(s) or cause(s) occurring.

Step 9: Determine the Detection Rating. Ask: when the failure occurs, is it obvious or invisible to the user?

Step 10: Evaluate the risk based on FMEA Risk Priority Number (RPN). Calculate the RPN through the formula: RPN = Severity x Occurrence x Detection. Compare the FMEA RPN of each issue and prioritise problems for corrective actions.

Action and Maintenance Stage

Step 11: Perform corrective actions, assign tasks to the right people.

Step 12: Re-evaluate RPN rank once risk mitigation actions complete.

Step 13: Distribute, review and update the analysis as appropriate.

FMEA PROCESS FLOW

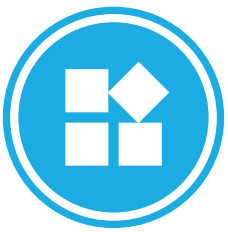
Preparation Stage

1. Assemble a cross-functional FMEA team

Experts on design, manufacturing, reliability, maintenance, purchasing, sales, marketing, customer service, etc.

2. Gather and review relevant information

Include past failures, work order history, drawing photos, manuals, etc.



3. Recognise the function(s) and feature(s) of the FMEA scope

A thorough understanding of the fundamentals and procedures of FMEA.

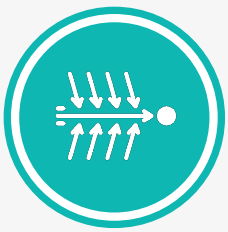
Diagnosis and

4. Identify failure mode(s)

Analyse all the equipment or component(s), in which something might fail sooner or has the potential to fail in the future.

5. Identify the Severity rating of different failure modes.

What effect(s) or consequence(s) will the failure mode have on the asset, process or product?



6. Diagnose the potential cause(s) of the failure(s)

What are all possible causes for each failure mode? Requires a combination of tools and the FMEA team's knowledge base.

Analysis Stage

7. Identify the Occurrence rating for each potential cause

Make your best educated assumptions to the likelihood of failure happening because of that cause.

8. Identify the current control(s)

What tests, procedures or mechanisms that you now have in place to avoid failure mode(s) or cause(s) occurring?

9. Determine the Detection rating

When the failure occurs, is it obvious or invisible to the user?

10. Calculate FMEA Risk Priority Number (RPN)

Evaluate the risk through the RPN formula. Compare the FMEA RPN of each issue and prioritise problems for corrective actions.

RPN = Severity x Occurrence x Detection

Action and Maintenance Stage

11. Perform corrective actions, assign tasks to the right people

12. Re-evaluate RPN rank once risk mitigation actions complete

13. Distribute, review and update the analysis as appropriate

Click Here to download our one-page FMEA Process Infographic

FACTORS THAT DETERMINE A SUCCESSFUL FMEA OUTCOME

Though FMEA is gaining widespread acceptance and recognition because of its inherent benefits, not every organisation gets uniformly great results. A successful application of FMEA can be determined by many external and internal factors.

For example, the FMEA project will not succeed if:

- the team lacks a sound knowledge of FMEA fundamentals,
- the team fails to make proper preparation for the FMEA procedure,
- the team does not understand and avoid some common mistakes,
- there is no skilled FMEA facilitator to guide and support the team.

FMEA Success

Factor 1: a sound knowledge of the basics of FMEA

There is no substitute for learning these fundamentals [of FMEA]. – Carl S. Carlson

To conduct an FMEA successfully, the first prerequisite factor is a sound knowledge of the basics of FMEA.

The facilitator must have a comprehensive understanding of the fundamentals and procedures of FMEA, and the assembled team must have a detailed understanding of the elements in order to properly perform the analysis.

Factor 2: proper preparations for the FMEA procedure

(1) Determine the scope

The scope of an FMEA program means the boundaries that establish the issues. A clearly defined scope that is recognised by every team member will prevent the FMEA project from suffering the effects of “scope creep”.

Consider:

- *What are the major elements (e.g., subsystems or components) the team will analyse?*
- *What are the interfaces between lower level subsystems or components, interfaces with the environment and/or humans, and other elements?*

Factor 2: proper preparations for the FMEA procedure (continued.)

(2) Visual Drawings

Visualising the scope ensures that the FMEA team agrees on the precise extent of the FMEA, and every element and interface of the issue is under consideration.

Depending on the types of FMEA, there are 4 commonly used diagrams: FMEA Block Diagram, FMEA Interface Matrix, Parameter Diagram, and Process Flow Diagram.

(3) Assemble the right team

To have an FMEA success, people are the key. Research shows that some FMEA teams fail because of inadequate team composition.

The FMEA facilitator needs to consider questions like:

- *What kinds of experts should be on the team?*
- *What is the best team size? and*
- *If these subject matter experts can ensure attendance?*

(4) Establish ground rules & assumptions

Before starting an FMEA, the team should agree on the documented ground rules and assumptions about the project.

Ground rules ensure the team has an effective manner to conduct the FMEA process (e.g., meeting norms).

Assumptions is the basis of an FMEA that will affect throughout the analysis. Different types of FMEA will need different assumptions.

(5) Gather Information

Adequate information and document preparation will save every subject matter expert's time.

Information includes: bill of materials, legal and regulatory, past FMEAs, field history, technical requirements, and specification, etc.

Factor 3: avoid common mistakes

Performing a successful FMEA requires the team to understand and avoid common mistakes.

Here are **10 common FMEA mistakes**:

1. Fail to use FMEA to drive product or process improvements.
2. Fail to address ***ALL*** high-risk failure modes.
3. Miss the opportunity to improve the design verification plan or process control plan based on the failure modes or causes from the FMEA.
4. Ignore interfaces between parts and subsystems or between the system and environment.
5. Disconnect between the FMEA and information from the field or plant.
6. Having the wrong level of detail in the analysis.
7. Perform FMEAs too late.
8. Have inadequate team composition and participation.
9. Use of improper FMEA procedures and documentation.
10. Inefficient use of time.

Factor 4: a skilled FMEA facilitator

Proper facilitation is crucial to the success of an FMEA process.

An FMEA facilitator provides structure to all interactions, allowing the FMEA team to function effectively and make high quality decisions.

FMEA FACILITATION

FMEA is a team activity. Skilled faciliator are a helper and an enabler whose goal is to support the team so collectively they can perform with excellence.

FACILITATORS CREATE TEAM SYNERGY...

Maximise the value of information in data systems

Maximise the value of each member in the FMEA team

Core Skill Set Required for an FMEA Facilitator

A deep theoretical and practical understanding of FMEA fundamentals and procedures

Facilitation skills (including team meeting skills)

- Preparation
- Interpersonal Skills
- Time Management
- Control

Essential FMEA Facilitation Skills

A competent FMEA facilitator generally needs to possess the following essential skills:

- Sharp analytical skills to enable efficient and effective workshop preparation (See details on next page);
- The ability to suppress their own opinions and biases – not take things personally;
- The ability to read people in order to understand how best to extract their expertise;
- The ability to listen actively and acknowledge the value that each team member contributes;
- The ability to rephrase another person's ideas and bring the whole team to a common understanding;
- The ability to ensure balanced input from all team members;
- The ability to 'stick to the script' without creating unease or conflict;
- The ability to control the room and keep everyone focused on the task at hand and the meeting objectives.

FMEA WORKSHOP PREPARATION CHECKLIST

For All FMEA Projects (existing and new)

- ☐ Choose Suitable FMEA Software
- ☐ Select or Modify FMEA Scales and Columns
- ☐ Identify Roles and Responsibilities
- ☐ FMEA Team Training
- ☐ Meeting Logistics
- ☐ Define the System Hierarchy (for System and Design FMEAs)
- ☐ Define the Process Steps (for Process FMEAs)
- ☐ Access to Failure Information

For Each New FMEA Project

- ☐ Determine the Scope of the Analysis
- ☐ Make the Scope Visible (for System and Design FMEAs):
  - ☐ FMEA Block Diagram
  - ☐ Parameter Diagram
  - ☐ FMEA Interface Matrix
  - ☐ Functional Block Diagram
- ☐ Make the Scope Visible (for Process FMEAs):
  - ☐ Process Flow Diagram
  - ☐ Process Flow Diagram Worksheet
- ☐ Assemble the Correct Team
- ☐ Establish the Ground Rules and Assumptions
- ☐ Establish the Role of Suppliers
- ☐ Gather and Review Relevant Information
- ☐ Prepare FMEA Software for First Team Meeting, include:
  - ☐ FMEA scales
  - ☐ FMEA worksheet
  - ☐ FMEA procedure

WHAT HOLISTICAM CAN HELP

If your organsation does not have sufficient time, expertise or resources inhouse to conduct the FMEA/FMECA projects, HolisticAM can assist.

ABOUT HOLISTIC ASSET MANAGEMENT

WHO WE ARE?

Holistic Asset Management (HolisticAM) commenced operation in 2016 and provides specialist services in Asset Management, Reliability Engineering and Maintenance Management.

Headquartered in Melbourne, HolisticAM is flexible and has delivered personalised asset solutions worldwide.

WHY WE DO OUR BUSINESS?

We believe that managing assets can contribute great value to an organisation's success.

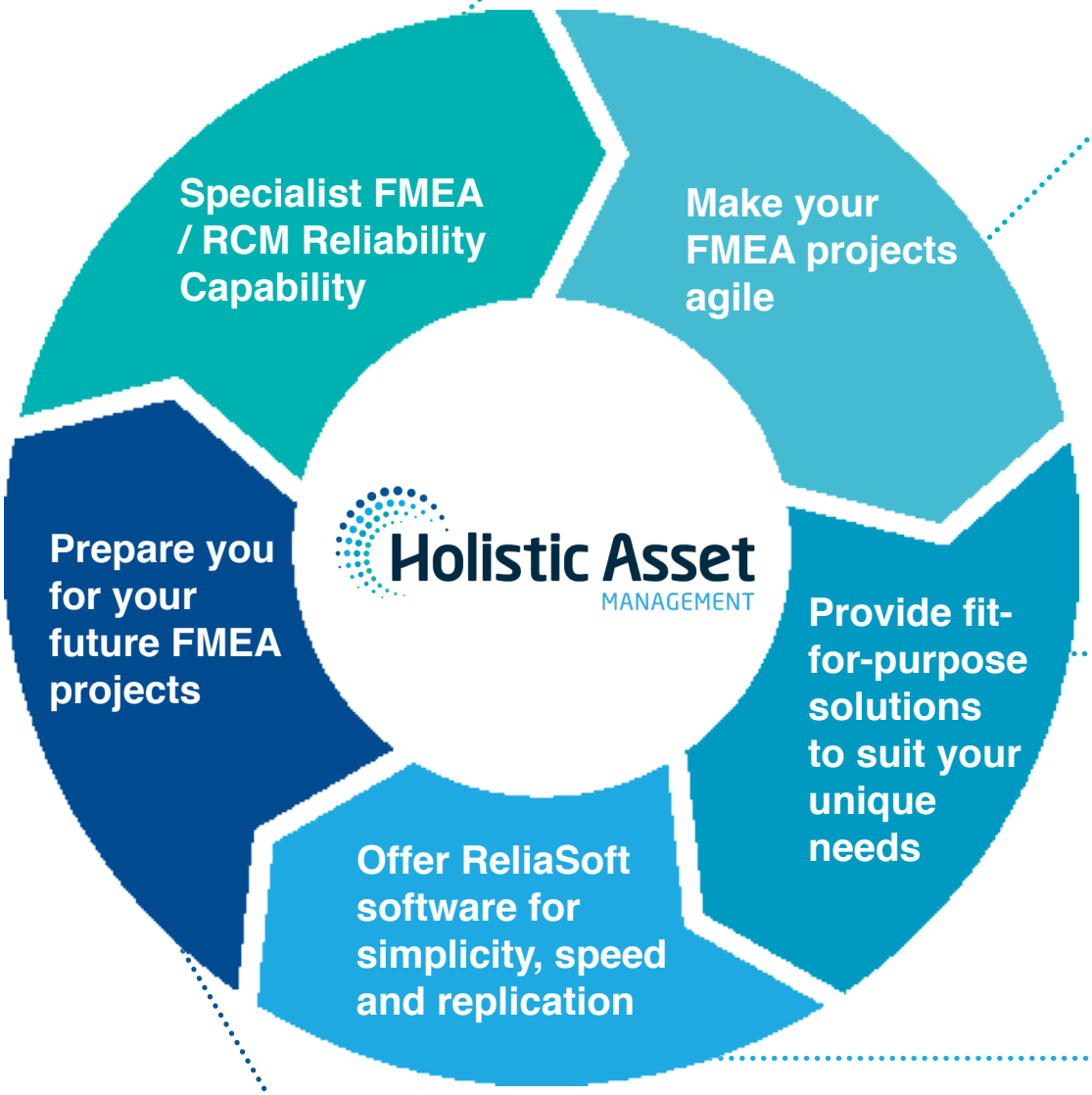
We have witnessed many organisations facing asset performance issues in their operation. They are from various industries, but the problems they have are quite similar. We know how to solve these frustrations, and most importantly, we know the numerous benefits behind it.

We are passionate about asset management; we understand it, we get it. We believe the effective asset management is a HOLISTIC approach to creating value from asset design to disposal, flowing from CEO to shop floor creating a clear line of sight. We hope to help organisations recognise, believe, and see the real value of managing assets by understanding their needs to drive the business outcome.

SMARTER, FASTER, BETTER

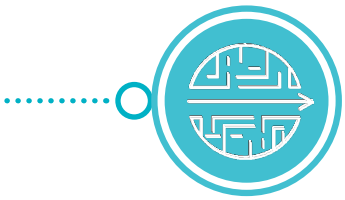
> **Effective asset management is a HOLISTIC approach to creating value from asset design to disposal, flowing from CEO to shop floor creating a clear line of sight.**

WE DELIVER TRUE VALUE-ADDED TO YOUR FMEA PROJECTS



Specialist FMEA / RCM Reliability Capability

HolisticAM is structured to accommodate all requests of any size or complexity. Our specialists offer a powerful combination of industry expertise, subject matter mastery and dedication to delivering excellence for your FMEA projects.



Make your FMEA projects agile

HolisticAM has extensive experience in conducting both FMEA and FMECA methodologies. We have an extensive FMEA Enterprise Library that lists thousands of components with known functions and failure modes. This enables us to offer a streamlined process for Asset FMEA application, which allows for rapid implementation of your projects.

Provide fit-for-purpose solutions to suit your unique needs

We understand that all sites have variation in operating conditions and requirements, so we don't apply a one-size-fits-all approach to building your maintenance strategies. We use our component FMEA library to build the base case and then apply your sites' unique situation to determine risk profile, frequency, trade requirements etc.

Offer ReliaSoft software for simplicity, speed and replication

As the exclusive representative in Australia and New Zealand of ReliaSoft Software, we offer good relational database software to optimise your FMEA projects. With the help of a software tool, you can establish consistency among your organization's FMEAs, build a "knowledge base" of lessons learned from past FMEAs, generate other types of reports for FMEA data and/or track the progress and completion of recommended actions.

Prepare you for your future FMEA projects

We do not just focus on meeting your present needs for your FMEA workshops but provide support to get you ready for your future projects. We have experienced workshop facilitators to lead and enable the full potential in the team. Also, we offer FMEA training to foster your FMEA team competencies.

FMEA SOFTWARE

When conducting an FMEA, you can simply use a paper form or an Excel spreadsheet to record your data. However, if a good software tool is used, the FMEA team can build powerful FMEA libraries which helps to reach their maximum performance level.

In HolisticAM, we use ReliaSoft XFMEA software to facilitate FMEA team workshops/meetings and data management.

XFMEA

ReliaSoft XFMEA software is a great tool for facilitating FMEA team workshops/meetings, combined with a risk discovery tool that offers enough flexibility to accommodate all FMEA techniques.

Key features:
FMEA and Related Analyses | Database-Driven | Highly Configurable | Flexible Reports

Benefits

- Save time and promote consistency by reusing relevant information from existing FMEAs;
- Offer centralised data storage for multiple users to work collaboratively on projects;
- Create a keyword-searchable knowledge base of reliability-related information for use;
- Charts, reports, automated e-mails and other features support decision-making and managing corrective actions;

How XFMEA can help

Build your living library of FMEAs

XFMEA provides for the ability to centralise your FMEAs in one location and maintain connections or relationships between analyses. It helps you to easily find, filter, re-use, and manage your living library of FMEAs.

Integrate with other ReliaSoft synthesis applications

XFMEA is part of the ReliaSoft Synthesis platform. The centralized FMEA library is accessible with any of ReliaSoft's other Synthesis-enabled applications: Weibull++ for life data analysis, ALTA for accelerated life testing data analysis or BlockSim for system analysis.

You can rely on our effective and economical solutions if your organisation does not have sufficient time, expertise or resources inhouse to accomplish specific reliability goals. Whether you need a quick statistical analysis, a complete assessment of your reliability program plan or something in between, we can assist.

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info@holisticam.com.au