

Introduction to Zonal Safety Analysis (ZSA), Particular Risk Analysis (PRA) and Failure Mode and Effect Analysis (FMEA)

Sofema Aviation Services (SAS) www.sassofia.com identifies the key difference between the described analysis techniques.

The core focus of aviation safety is to minimize and manage risks associated with aircraft operations. In-depth safety analyses such as ZSA, PRA, and FMEA are instrumental in identifying, evaluating, and mitigating these risks. In an industry where safety is paramount, having a comprehensive understanding of these methodologies is essential.

A holistic approach combining all three methods is recommended for a comprehensive safety analysis.

- First, conduct a ZSA to identify risks on a broad level.
- Next, perform FMEA for each identified system within the zones.
- Finally, use PRA for any unique or novel aspects that fall outside the scope of typical regulations. Collaborative and interdisciplinary teamwork, continual review and updates, and proactive risk management are essential for effective safety analysis.

Zonal Safety Analysis (ZSA)

Zonal Safety Analysis is a systematic approach used to assess and manage risks within different zones or areas of a system.

Zonal Safety Analysis provides a structured and systematic approach to identify, assess, and manage risks within specific zones or areas of a system. It helps organizations enhance safety, prevent accidents, and create a safer working environment by effectively addressing hazards and implementing appropriate risk mitigation measures.

- It involves dividing a larger system into smaller zones and analyzing the safety risks associated with each zone independently.
- The goal is to identify potential hazards, assess their severity, and implement appropriate measures to control or mitigate those risks.
- ZSA is commonly used in complex systems.



The methodology for Zonal Safety Analysis typically involves the following steps:

- Begin by defining the system under analysis and identifying its different zones or areas.
 - This could include physical locations, subsystems, functional areas, or any other relevant divisions within the system.
- Conduct a thorough analysis to identify potential hazards within each zone or area.
 - Hazards can include anything that has the potential to cause harm, such as machinery malfunctions, environmental factors, human errors, or process failures.
- Assess the identified hazards to determine their severity and likelihood of occurrence.
 - This involves evaluating the consequences of a hazard and the probability of its occurrence.
 - Various techniques can be employed, such as qualitative or quantitative risk assessment methods, to assign risk levels to each hazard.
- Once the risks are assessed, develop strategies to mitigate or reduce the identified risks within each zone or area.
 - This may involve implementing engineering controls, administrative controls, or adopting safety procedures and protocols to minimize the likelihood or impact of a hazard.
 - Document the findings, analysis, and mitigation measures for each zone or area.

Note - Zonal Safety Analysis is an iterative process that may involve refining the analysis as more information becomes available or as the system evolves over time.

o It is essential to periodically review and update the safety analysis to account for changes in the system, new hazards, or improved mitigation measures.

Particular Risk Analysis (PRA)

Particular Risk Analysis, also known as Particular Risk Assessment, is a method used to evaluate and manage risks associated with specific tasks, operations, or activities within a system.



- PRA focuses on analyzing the risks of individual components, processes, or actions and assessing their potential consequences.
- It involves identifying hazards, evaluating their likelihood and severity, and determining appropriate risk control measures.

The methodology for Particular Risk Analysis (PRA) typically involves the following steps:

- Begin by clearly defining the boundaries and objectives of the PRA. Determine the specific project, operation, or activity that will be analyzed, and identify the key stakeholders involved.
- Identify and document all potential hazards associated with the project, operation, or activity. Hazards can be physical, chemical, biological, environmental, or related to human factors. Conduct site visits, review existing documentation, and engage subject matter experts to ensure a comprehensive list of hazards.
- Assess the risks associated with each identified hazard.

o This step involves evaluating the likelihood of the hazard occurring and the potential consequences if it does.

o Use appropriate risk assessment methodologies such as qualitative, semiquantitative, or quantitative analysis, depending on the complexity of the project and available data.

• Once risks are assessed, prioritize them based on their potential severity, likelihood, and the level of control measures already in place.

o This helps in allocating resources and attention to the most critical risks that require immediate attention.

• Determine the existing control measures that are already in place to mitigate the identified risks.

o Evaluate their effectiveness and identify any gaps or areas where additional measures are needed.

o Consider engineering controls, administrative controls, and personal protective equipment as appropriate.

• Develop strategies to mitigate the identified risks.



o These strategies can include implementing additional control measures, modifying existing processes, providing training and awareness programs, or altering the project design.

o Each strategy should be tailored to address the specific risks and should be practical and feasible.

Failure Mode and Effect Analysis (FMEA)

Failure Mode and Effect Analysis is a structured and systematic approach used to identify and analyze potential failures within a system, process, or product.

FMEA aims to proactively identify failure modes, understand their causes and effects, and develop strategies to prevent or mitigate their impact. It involves evaluating the likelihood, severity, and detectability of potential failures and prioritizing them based on risk levels. FMEA is widely used across industries, such as automotive, aerospace, and healthcare, to improve product reliability, safety, and quality.

Consider the following steps typically involved in conducting an FMEA:

- Select the scope: Define the boundaries of the analysis, including the specific process, system, or product that will be analyzed.
- Clearly define the purpose and objectives of the FMEA.
- Gather a team of subject matter experts from different disciplines who are familiar with the process or product being analyzed.

o This may include engineers, designers, operators, quality specialists, and other relevant stakeholders.

• Break down the process or system being analyzed into its individual steps, components, or functions.

o Create a flowchart or diagram to visualize the sequence of events or interactions.

• Identify potential failure modes:

o For each step, component, or function, brainstorm and identify all possible failure modes.

o A failure mode refers to the specific way in which a component or process step could fail or deviate from its intended function.



• Once the failure modes are identified, assess the potential effects or consequences of each failure mode on the overall process or system.

o Consider factors such as safety, performance, reliability, quality, and customer satisfaction.

o Assign a severity rating to each failure mode based on the impact of its potential effects. Use a scale (e.g., numerical or descriptive) to rank the severity, where higher values indicate more severe consequences.

o Determine the potential causes or factors that could lead to each failure mode.

o Consider design flaws, human errors, environmental factors, material properties, and any other relevant factors that may contribute to the occurrence of the failure mode.

o Assign an occurrence rating to each potential cause based on the likelihood of its occurrence. rank the occurrence, where higher values indicate a higher likelihood of occurrence.

- Evaluate the existing controls or preventive measures in place to detect, prevent, or mitigate each failure mode.
- Determine their effectiveness and assign detection ratings, indicating the likelihood of the control mechanism detecting the failure mode before it leads to an adverse effect.
- Calculate the Risk Priority Number (RPN) for each failure mode by multiplying the severity, occurrence, and detection ratings.

o The RPN provides a quantitative measure of the risk associated with each failure mode, with higher values indicating higher priority for further action.

o Sort the failure modes based on their RPN values, and prioritize the failure modes with the highest RPNs for further analysis and action. (Focus on failure modes with high severity, high occurrence, and low detection ratings.)

 Develop appropriate actions to reduce or eliminate the identified failure modes. This may involve design changes, process improvements, additional controls, training, or other corrective measures. Assign responsibilities and timelines for implementing the actions.



Next Steps

Sofema Aviation Services (<u>www.sassofia.com</u>) offers training to cover CS 25 System Safety Assessments – please see the following link <u>https://sassofia.com/course/type-certification-system-safety-assessment-5-days/</u>

For additional questions or comments – please email team@sassofia.com