

A resilience engineering approach for sustainable safety

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Resilience Engineering in Safety Management**

Introduction

Resilience engineering is a safety approach that focuses on understanding and enhancing the ability of systems to cope with unexpected events and maintain functionality. It recognizes that failures and disturbances are inevitable in complex systems and that traditional safety measures may not be sufficient to prevent accidents.

Principles of Resilience Engineering

The resilience engineering theory is based on four pillars:

- **Anticipating failures:** Identifying potential hazards and developing strategies to mitigate their impact.
- **Monitoring for resilience:** Continuously assessing system performance and detecting early signs of degradation.
- **Responding to failures:** Adapting and improvising to maintain functionality despite failures.
- **Learning from failures:** Identifying and analyzing failures to improve future resilience.

Four Abilities of Resilience Engineering

Resilience engineering emphasizes four abilities:

- **Monitoring:** Gathering and interpreting data to identify threats and opportunities.
- **Responding:** Taking appropriate actions to maintain or restore functionality.
- **Learning:** Identifying patterns and improving practices based on experience.
- **Anticipating:** Forecasting future risks and developing strategies to address them.

Elements of Resilience Engineering

Key elements of resilience engineering include:

- **Redundancy and diversity:** Using multiple components or approaches to prevent single points of failure.
- **Controllability:** Empowering operators to make necessary adjustments to maintain functionality.
- **Modularity:** Designing systems with independent components that can be easily replaced or reconfigured.
- **Flexibility:** Adapting systems to changing conditions and unexpected events.

Concepts for Applying Resilience Engineering

To apply resilience engineering principles, consider the following concepts:

- **Focus on resilience, not failure:** Emphasize maintaining functionality despite failures.
- **Learn from experience:** Identify and analyze failures to improve future resilience.
- **Develop adaptive systems:** Design systems that can adapt to changing conditions and unexpected events.
- **Engage with stakeholders:** Collaborate with all parties involved in system operation to understand their perspectives and needs.

- **Use simulation and testing:** Evaluate resilience strategies through simulations and testing to identify vulnerabilities and areas for improvement.

Safety Resilience

Safety resilience refers to the ability of a safety management system to withstand disruptions and continue to protect employees and the environment.

EASA Definition of Resilience

According to the European Union Aviation Safety Agency (EASA), resilience is "the ability of an organization to adapt to, recover from, and withstand disruptions, such as accidents, incidents, or major changes in the operating environment."

Difference between Resilience and BCM

Resilience engineering focuses on maintaining the functionality of a system in the face of failures, while business continuity management (BCM) focuses on restoring business operations after a disruptive event. Resilience engineering is a broader concept that encompasses both prevention and recovery aspects.

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