



This white paper aims to provide a comprehensive view of the need for a system safety approach for those deploying and using autonomous systems for mobile equipment in the mining industry. It also aims to increase awareness of system safety and its benefits in delivering and maintaining safe and efficient mining.

How can system safety provide opportunities to improve safety?

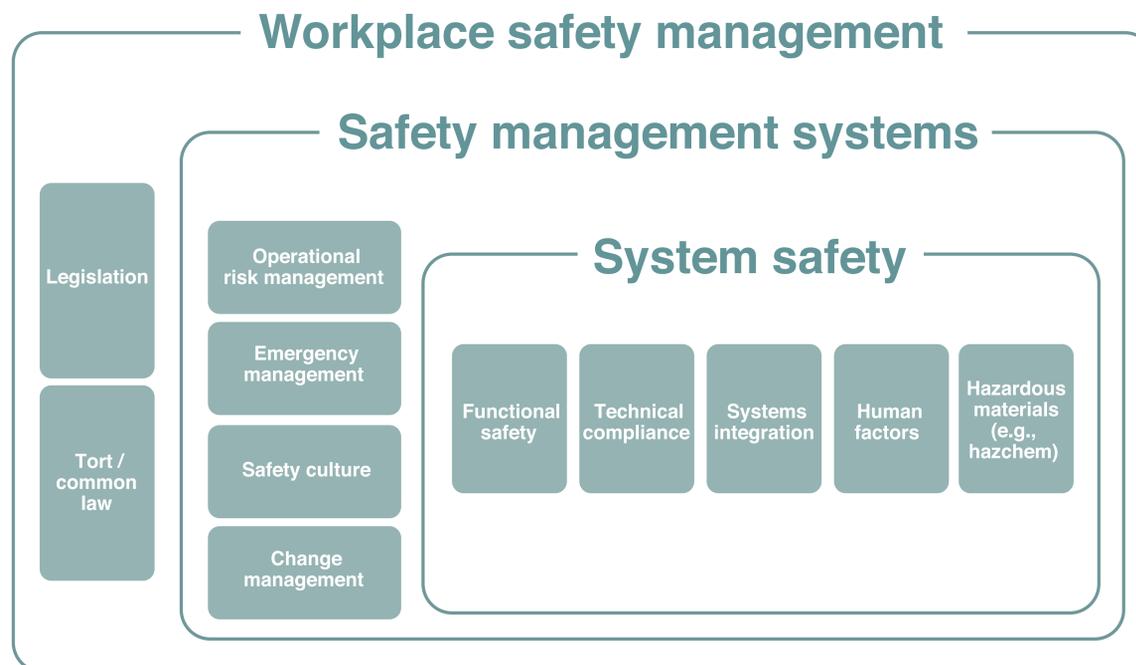
A system is considered safe when the risks associated with it are reduced to an acceptable level. Technological advances such as autonomous systems can make it possible to reduce certain risks by removing humans from dangerous situations.

What is provided in a system safety approach?

A system safety approach provides an overview of the overall effectiveness of the safety controls that extends beyond the machines and can be a useful qualitative tool for operations when assessing the overall safety of their systems.

The core content of this white paper is structured into four sections:

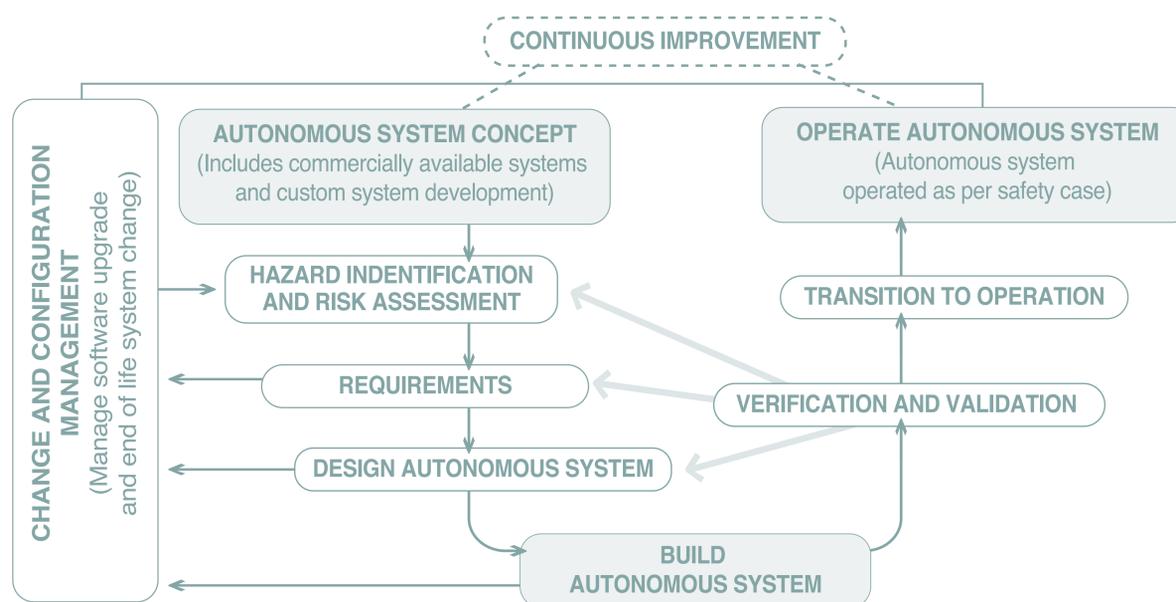
- **System safety management:** an overview of applying a system safety approach by describing an example of a lifecycle (Figure 1) and offering further considerations about hazard identification and risk assessment and non-deterministic systems.
- **Safety case:** definition of the purpose of a safety case in the context of autonomous systems in mining.
- **Human-systems integration:** the significance of eliminating or controlling risks to humans and the environment over the course of a system's lifecycle.
- **Software safety management:** context on some factors that influence the degree of risk reduction that can be considered for a software-based safety control in the development and operation of autonomous systems.



System Safety Viewed from the Broader Context of Workplace Safety

When managing the transition to autonomous systems for mobile equipment in mining, there are many aspects of safety to take into consideration beyond machine automation, including:

- Dynamic operating conditions (e.g., dump locations, new mining areas)
- Single vendor or multi-vendor fleets
- Integration of manually operated and autonomous equipment environments
- Interoperability of autonomous systems
- Operating conditions that are new or less mature for autonomous systems in mining



Example of System Safety Lifecycle