Performance With Intelligent Safety System Design

George Schuster - CFSE, Senior Industry Consultant, Safety and Sustainability Solutions - Rockwell Automation

Ask any production line manager about the importance of safety and they will likely tell you about the critical role it plays in helping to protect personnel, reduce injuries, and meet compliance demands. These are all valid objectives, but manufacturers and machine builders are missing opportunities if they only focus on avoiding negative consequences rather than striving for greater performance — e.g. increased productivity, improved competitiveness and overall profitability.

Historically, the industry viewed safety practices as punitive actions or compliance activities, not as opportunities to deliver real value or gain a competitive edge. These days, however, manufacturers understand that a well-designed safety system can help improve their efficiency and productivity, and machine builders increasingly recognize how safety systems can improve both business and machine performance, helping differentiate themselves to potential customers.

The combination of functional safety standards, new safety technologies and innovative design approaches are positioning safety as a core system function that can deliver significant business and economic value. This includes financial returns beyond the benefits of reducing costs associated with accidents and medical expenses.

A Systematic Approach

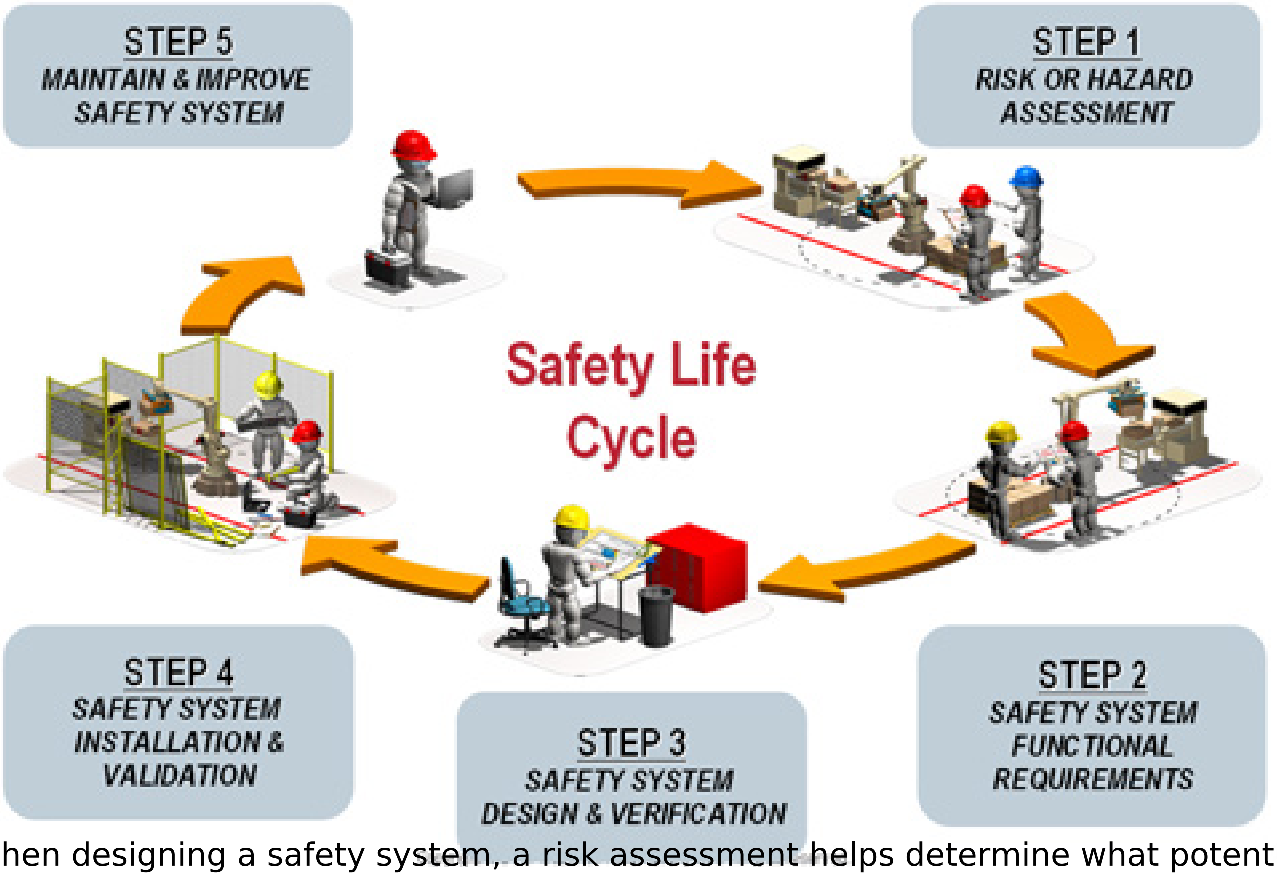
To achieve a higher level of functional safety and experience the resulting benefits, system designers must have in-depth understanding of the manufacturing process and a clear determination of machinery limits and functions, as well as a thorough knowledge of the various ways that people interact with the machinery. They also need to take a practical, rigorous approach to safety system design and be willing to implement and apply new safety technologies and techniques.

The functional safety lifecycle, as defined in standards IEC 61508 and IEC 62061, provides the foundation for this detailed, more systematic design process for machinery applications. A key objective of the safety lifecycle is addressing the cause of accidents. To do this, designers aim to create a system that helps reduce and minimize risks, meets appropriate technical requirements and helps assure personnel competency. Previous standards have relied on prescriptive measures defining specific safeguarding. The new functional standards are performance-based, which makes it easier for designers to quantify and justify the value of safety. This approach uses a more methodical, deterministic approach and offers the ability to tailor the specific safety functions to the application. It helps reduce cost and complexity, improves machine sustainability, and helps achieve a more optimum level of safety for each defined safety circuit or function to improve the return on investment.

Safety Lifecycle phases

Conducting a risk assessment is the first phase of the safety lifecycle. A risk assessment provides the basis for the overall risk reduction process, which involves the following steps:

- Help eliminate hazards by design using inherently safe design concepts.
- Employ safeguarding and protective measures with hard guarding and safety devices.
- Implement complementary safety measures including personal protective equipment (PPE).
- Help achieve safer working practice with procedures, training and supervision.



When designing a safety system, a risk assessment helps determine what potential hazards exist, and which safety mechanisms should be implemented to help ensure adequate protection against them.

The functional lifecycle provides the framework for several highly effective “design-in” safety concepts. These include passive, configurable and lockable system designs.

Easier and More Intuitive

A passive approach aligns with the design philosophy that safety systems should be easy to use and not hinder production. The reason that operators might elect to bypass safety systems is that the systems are cumbersome or impractical or do not easily accommodate maintenance and operating procedures.

An effective passive system design performs its function automatically — with little if any effort required on the part of the user. Moreover, when intelligently applied, a passive design can help boost productivity.

For example, in many production operations, manufacturers often use a light curtain to help prevent machine motion when an operator enters a hazardous area. Other approaches, such as a safety interlock gate, require operators to perform a task to initiate the safety function. Even if it only takes 10 seconds to open and close the gate for each cycle, that time accumulates over the course of a 200-cycle day. With a light curtain, the operator simply breaks the infrared barrier when entering hazardous areas and the operation comes to a safe stop. Over time, this passive design helps increase productivity and creates a positive return.

Another approach that helps limit exposure to hazards and reduces the incentive to bypass the safety system is a configurable design, which allows operators to alter the behavior of the safety system based on the task they need to perform.

For example, in many cases, an operator may need to access a machine and still need some form of power enabled to perform a maintenance function, clear a jam or teach a robot. The initial risk assessment identifies and defines all the tasks, including these, that must be performed on the machine with or without power. The assessment offers insight to create a configurable design that meets global safety requirements, helps increase productivity and helps reduce the incentive to bypass the system. In most cases, inexpensive components, like push buttons, selector switches and lights, are all that is needed to achieve an acceptable level of safety.

Turning Safety into Productivity

Using a lockable system design to systematically reduce mean time to repair (MTTR) can help boost productivity. This approach allows operators to select a safety configuration then lock it in place at the point of entry. In addition to helping protect configuration changes, a lockable design also helps achieve higher productivity by using the safety system in lieu of lock-out/tag-out (LO/TO) for many routine maintenance and setup procedures.

For example, in a LO/TO situation, operators may need to use six locks to safely shut down a line including electronic, pneumatic and robotic systems. Shutting down the entire machine can be time-consuming and inefficient – causing excessive downtime that hinders productivity. If the safety system meets the target safety level – and complies with standard ANSI Z244-1 – the safety system can be used to disable the hazards. In this case, LO/TO is not required. Instead of locking the disconnect switch, operators only lock the safety system.

The potential cost savings associated with reducing the LO/TO downtime by even a few minutes often proves to be substantial. For example, let's say a manufacturer is able to reduce MTTR by two minutes using this lockable design approach. If the value of one minute of downtime is $10,000, and the plant averages 3,000 downtime events per year (eight per day), the value of the safety solution equates to roughly $60 million per year ($10,000 X two minutes X 3,000).

The far-reaching economic benefits of a well-designed safety system are too significant to overlook. Using reliable safety technology and the rigorous approach defined in the Safety Lifecycle, manufacturers and machine builders can harness the inherent value of intelligent safety system designs to help drive productivity, reduce labor costs and ultimately increase the bottom line.