How to design integrated safety into machines from the start?

Comment by Josep Plassa, EMEA Safety Product Manager

In any production or packaging line, safety systems are needed to protect employees and prevent malfunctions from damaging valuable products and equipment. A good safety system will bring a line to a halt, avoiding any potential accidents and allowing the line to be restarted quickly.

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In the past, whether at the individual machine level or a complete production line, safety was only considered as an afterthought. More specifically, each piece of equipment was designed to perform a specific task. Only then, would any necessary safety measures be added, often as a separate system. This was also true for the production lines into which they were integrated.

What exactly is integrated safety?

Today, all equipment needs to have safety designed in right from the start. Thus, integrated safety simply means considering safety during the initial design phases, both for individual machines and the complete production line. In this way every aspect of the machine's operation is accounted for and is captured in the data used by the control system.

Machines designed with integrated safety in mind deliver the maximum safety and security. In addition, should a problem occur, they provide all the data needed to evaluate what went wrong and ensure that a similar issue does not occur again. Without this data, when a production line stops there is no immediate way to know what went wrong and tracking down the problem could be costly in time and production.

This is not the case in a production line made up of integrated machines. Each component and activity in the line is closely monitored – in real time – by the control software. A control system, like OMRON's Sysmac, brings together the intelligent, integrated, and interactive elements of the system. This allows problems, or even potential problems, to be identified early and very specific actions to be taken. These actions can, for instance, modify production to compensate for an isolated issue without shutting down operation completely. Even if a complete halt is required the system can decide whether the machine/line can remain powered, moving to a standby condition rather than a complete or emergency stop. And as long as it has power, data continues to flow so the controller still know what is happening. This means the controller, or operator, can maintain optimum performance even during times of operational disruption.

Just as important, it is also safer and more efficient for the maintenance personnel. They have full information on any issues even before going to the line, so they can be correctly prepared to fix it. They know what tools might be needed and what safety precautions to take. Furthermore, the line's safety functions are also still active to protect them should an issue arise during the maintenance.

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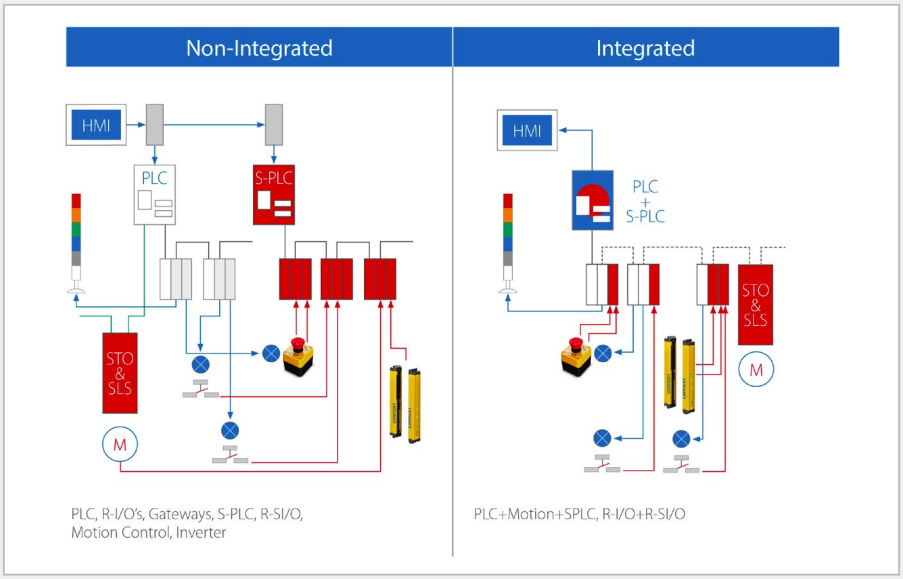
Example of integrated safety

In a non-integrated system a basic programmable logic controller monitors and executes motion, while a separate on/off safety relay safeguards operation. In an integrated system all signals and inputs are merged in an intelligent controller which replaces discrete safety relays with advanced logic.

The sub-system safety output is shared by SF Emergency Stop and Protective Stop.

Non-integrated and Integrated architecture



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Reliability

Integrated safety also takes away the uncertainty present when relying on humans to record data. Knowing when to carry out maintenance is a critical factor in reducing the chances of parts breaking down, which could directly affect not only production but operator safety too.

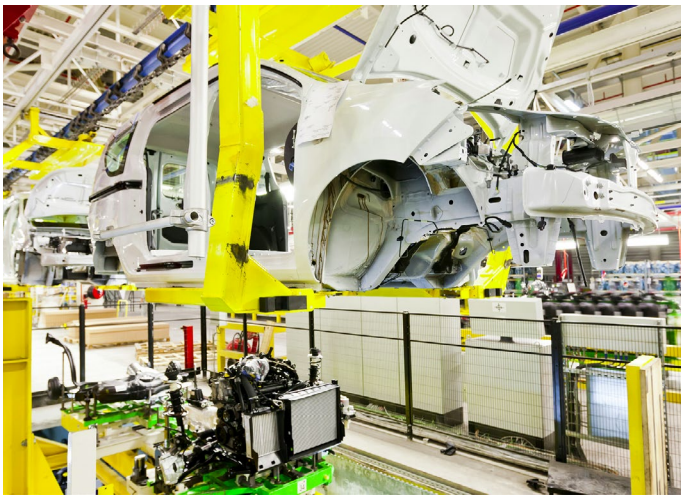
In a non-integrated system, accurate maintenance scheduling means operators need to keep a reliable and accurate log of incidents and operations. In older systems, this may simply be a handwritten journal kept at the operator station! And even if the journal is well-maintained, the information is not available in a digital format. Hardly the best way of keeping track of a machines' condition to ensure safe operation and schedule predictive maintenance.

With an integrated system all the information is automatically recorded locally and can also be made available online. By digitally capturing every event, such as each time a door is opened and closed, statistics such as the mean time between failures can be checked and preventive maintenance scheduled.

Safety services

Whether you are building equipment for production lines or running them, then you want to make sure that your equipment and/or line is safe and meets any local or international regulations. Companies such as OMRON offer a variety of services aimed at providing safety advice. The primary goal of these services is to ensure that production lines have zero accidents while improving production, increasing safety, and making the line more flexible.
Typically, these services will start with a machine safeguarding assessment that provides a diagnostic validation of equipment, highlighting areas that can be improved. While small improvements can often be handled by the manufacturer's own technicians, more significant improvements may require design and implementation of a custom solution along with additional training on new features by trained experts.

Additionally, validation and assessment of safeguards can also be performed, ensuring machines and systems meet the region's equipment regulations. Safety services, whether provided by OMRON or another party ensure that your line meets all relevant safety requirements and regulations, so you can focus on meeting your production targets.



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The role of AI in integrated safety

With the growing use of artificial intelligence (AI) in industrial automation, there is increasing interest in how AI can contribute to safety systems. AI technologies can support functions such as predictive maintenance or anomaly detection, helping operators anticipate and respond to issues before they become critical. However, when it comes to Functional Safety, the direct integration of AI into safety-related control systems remains a challenge. AI systems, particularly those based on neural networks, are not deterministic. Their performance can vary over time depending on training data and environmental conditions, making it difficult to evaluate their reliability in all operating scenarios. Because Functional Safety requires systems to behave predictably and meet strict failure probability criteria, core safety functions must still be handled by certified, deterministic logic. For this reason, the role of AI in safety should currently be limited to supportive functions, while the main safety logic remains within the scope of proven and certifiable technologies. https://industrial.omron.eu/en/news-discover/blog/ai-and-functional-safety

Conclusion: Building safety into the future

Designing safety from the start is the most effective way to protect people and keep machines running reliably. An integrated approach gives engineers the data, diagnostics, and control they need to respond quickly and keep production on track. AI can support this by spotting issues earlier, but core safety still depends on technologies that are proven and predictable. When safety and performance are considered together from the beginning, the result is a system that's not only compliant, but built to last.

Discover OMRON's Safety Products and Services

OMRON provides safety components, controllers, and expertise to support integrated safety from concept to commissioning. For more information, please visit: https://industrial.omron.eu/en/products/safety

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