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## MACHINE SAFETY

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# SAFETY COMPONENTS: SMARTER MACHINE TECHNOLOGY DRIVES SAFER BOTTOM LINES.

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Safeguarding machinery while protecting the workers: What could be simpler to comprehend about design and use of machine-safety components?

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By **C. Kenna Amos**, Contributing Editor

**S**ome current trends reveal that industry understands. For example, making safety an integral part of the design is one trend that Jürgen Bukowski notes. “That is not only to switch something off because a worker is there doing maintenance, but also to look intelligently at safety,” says the program manager in the Safety Systems Group with automation components supplier Sick Inc. ([www.sickusa.com](http://www.sickusa.com)), Minneapolis. Risk assessment—a tool more established in Europe—facilitates safer design, he states. And by using microcontrollers, designers and manufacturers enhance reliability by allowing metrics such as mean time to failure, he adds.

Two other recent trends that will extend into the near future include software-based products and network-integrated products, Frank Webster observes. “As processors get more powerful, smaller and cheaper, we find we can make more complex devices at lower costs,” suggests the vice president of standards and special projects at Omron Scientific Technologies Inc. ([www.sti.com](http://www.sti.com)), a Fremont, Calif., automation products vendor. But is complex always better? While saying that it isn’t, Webster notes that higher-capability and faster processors make it possible to have a single box or cabinet. That enables fewer and smaller cabinets, and reduces power requirements, he notes.

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## Safety Components: Smarter Machine Technology Drives Safer Bottom Lines

However, more complexity increases risk of having design errors, Webster remarks. “For example, when most safety functions depend on software, it becomes very critical that the software is well designed and verified.” To help compensate for these needs, he mentions two relatively new and “roughly equivalent” functional safety standards being used now: “ISO 13849: Safety of machinery—Safety-related parts of control systems—Part 1: General principles for design,” published by the International Organization for Standardization (ISO, [www.iso.org](http://www.iso.org)); and “IEC 62061: Safety of machinery—Functional safety of safety-related electrical, electronic and programmable electronic control systems,” published by the International Electrotechnical Commission (IEC, [www.iec.ch](http://www.iec.ch)).

A member of the working groups that wrote those standards, Webster says that ISO 13849’s features allow use of hydraulics and pneumatics as well as electrical devices, “types of energy very common in industrial machines.” However, the IEC standard is not familiar to machine builders, but “it’s very familiar to high-level control designers; for example, with programmable logic controllers.”

### Human/robot collaboration

Closer human-machine collaboration represents yet another trend that Webster sees. In robotics, he believes that means having proximity sensors, or proxies, in the robots. “The other sensor technology in which there’s a great deal of research is vision-protection devices.” He predicts that general-purpose vision-based safety sensors will grow in popularity in the human-machine collaboration arena, where material-handling and manual operations exist in a process. “The most vivid example: a robot moving a heavy piece of material and a human attaching something to it.”

Calling overall robot-human collaboration a “hot” trend, Eric Hollister notes that the concept of humans working intimately with robots, as opposed to being separated by fences and guards, has been a theoretical topic for “quite some time.” ISO’s new standard “10218—Robots for industrial environments—Safety requirements”—addresses such collaboration, adds the product manager with industrial safety products vendor Pilz Automation Safety L.P. ([www.pilzusa.com](http://www.pilzusa.com)), Canton, Mich.

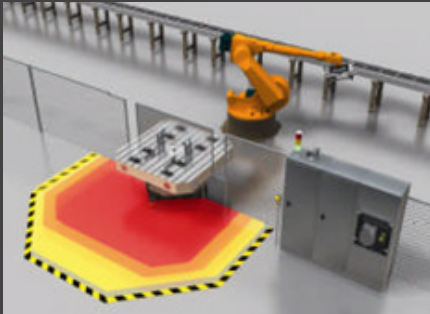
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And to address safety in robot cells, Siemens plans to release in the United States, by Dec. 1, the Sirius safety relay 3TK2810-1 device for speed monitoring, states John D'Silva, target-market consultant for safety with Siemens Industry Inc. ([www.siemens.com](http://www.siemens.com)), Norcross, Ga. "It facilitates simultaneous monitoring of standstill, set-up and automatic speed. It also features a function for interlocked protective door monitoring." The device can have both encoder and prox in the same box, he comments.

Despite trends or technology, "the ultimate goal is to protect every operator and maximize efficiency," Sick's Bukowski emphasizes. And underlining that "safety is elimination of risk," Omron STI's Webster thinks that "safety is already pretty good." Technology is getting smarter, he adds—and "smarter means you can increase production without increasing risk." 🙏

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# BRINGING SAFETY INTO THE PRODUCTIVITY EQUATION

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Modern safety standards, along with trends in networking, are enabling the safety function to have a positive impact on operational efficiency while also safeguarding people and property.

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By **Greg Farnum**, Contributing Editor

**P**ackaging automation professionals tend to be very aware of safety, knowing that safety failures can have both human and business costs. They are typically less aware, though, of the seeming avalanche of safety standards that are increasingly affecting both automation vendors and users, or of the changed assumptions that underlie those standards.

Certainly the fact that there are a number of relevant standards, each with their own code-like set of letters and numbers, can make the subject a bit confusing. Still, it's important to have a basic understanding of the standards: In part because of the effect they are having on machine and

system design and implementation, and in part because of the effect they can have on your bottom line.

That last statement may seem a bit cryptic, but as the inimitable Charlie Chan might have observed, "Have patience... all will become clear momentarily." First it is necessary to sort out the standards themselves, and most observers agree that the place to start is IEC 61508.

As Stephan Stricker, product manager for automation supplier B&R Industrial Automation Corp. ([www.br-automation.com](http://www.br-automation.com)), Roswell, Ga., points out, "IEC 61508 is

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## Bringing Safety into the Productivity Equation

a broad standard from which several newer, more targeted standards have been derived.” This generic standard marked a drastic shift in the approach to safety. Previous safety standards had always been prescriptive: You must do this; you must not do that. With IEC 61508 and the subsequent standards derived from it, the approach became more functional. Functional safety evaluates the safety of a system or piece of equipment in relation to a broad range of “real-world” inputs, including the operation of upstream and downstream systems, as well as likely operator errors and environmental disruptions.

Importantly, functional safety is a holistic, or end-to-end approach, one that employs the concept of safety lifecycles. This looks at a component or system over its complete lifespan, from the design stage all the way to final decommissioning. The goal is to improve the overall level of safety, with an added benefit of improving the functional operation of the machine or system as well.

The claim that safety standards can improve machine operation seems counterintuitive to many of us who often tend to think of safety strictly in terms of signs saying things

like “Keep hands away from moving parts.” However, Dave Kirklen, business developer for the packaging industry for automation vendor Siemens Industry Inc. ([www.sea.siemens.com](http://www.sea.siemens.com)), Alpharetta, Ga., provides some insight into one of the ways that can happen.

“In the past, the machine builders would simply point guard everything; that is, put a barrier between the person and the machine.” That, says Kirklen, came with a cost in terms of productivity, as operators will need to interact with the machine at some point. If they need to shut the machine down to disable the barrier in order to get at the machine, it’s like a very expensive taxi ride with the cost rising every minute.

### Improved access, greater uptime

What we’ve seen over the past few years, Kirklen says, “is that companies are coming up with ways to achieve the required levels of safety and not have to barrier guard the machine from the operator. The idea is to minimize the number of times the machine must be shut down, thus maintaining productivity while still safeguarding the operator.”

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Going forward, he maintains, safety is going to be viewed as more of an enabler for production machines, as a factor in building “a net positive ROI, an aid in building better machines that increase reliability and availability.”

The main reason that today’s functional safety standards allow this type of nuanced response to nonstandard conditions, rather than the blunt on/off, go/no go response of former days, is that they embody risk assessment. Risk assessment uses specified models contained within the standard to permit risk levels to be determined for every component in a safety system. That is, you can quantify the possibility that any particular component in that system will fail to perform its function. Put all those numbers together and you’ve got a picture of the risk level of the system as a whole. Now comes the tricky part: How much risk are you willing to accept?

That’s not an invitation to skimp on safety; rather, it’s an acknowledgment that the levels and quality of risk vary. For instance, you could accept a greater level of risk from a component whose failure could lead, at worst, to a minor injury than you could from a component whose failure could lead to dismemberment or death.

As Mike Miller, global safety market development for Rockwell Automation Inc. (www.rockwell.com), Milwaukee, observes, “By defining the hazards of a machine and the associated risk levels of each hazard, the most suitable, functional and cost-effective mitigation techniques can be applied.” He says that when this work is done during the initial design phase, machine builders can avoid the costly—and common—process of having to add additional safety features after installation.



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For machine builders there is also an image or public relations benefit: "It also helps the end user see the value the OEM is adding to the machine by mitigating the hazards associated with a machine. It is a win-win situation for both parties involved," says Miller.

Not only has the adoption of risk assessment permitted a more nuanced approach to safety, one that can potentially lead to a reduction in work stoppages and other bottom line benefits, but some believe it results in a heightened level of worker safety as well.

### Identifying more hazards

The general approach to machinery and workplace safety "has changed due to the adoption of risk assessment by standards and the EU directive, and the fundamental process used to reach an acceptable level of risk," stresses Fred Hayes, director of technical services for the Packaging Machinery Manufacturers Institute, (PMMI) ([www.pmmi.org](http://www.pmmi.org)). "There is no such thing as 'absolutely safe,' but proper application of the risk assessment process, particularly using the task-based approach, will result in the identification of more hazards. The

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application of risk reduction measures to reduce these risks to an acceptable level provides better worker protection.”

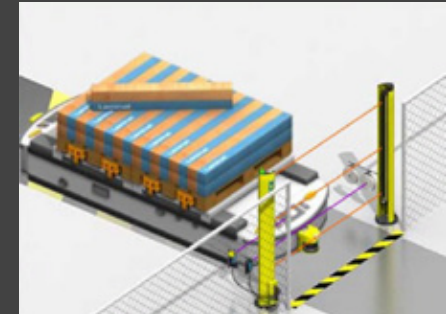
Earlier we mentioned an array of standards but have spoken so far only of one, IEC 61508. Other standards bodies have developed standards more targeted at their specific constituencies but embodying the fundamental concepts of IEC 61508. These include ISO 13849 and—of particular import for the packaging industry—ANSI/PMMI B155.1.

“ISO13849 is used for lower complexity safety systems, including programmable electronic but also pneumatic and hydraulic,” explains B&R’s Stricker. “ANSI/PMMI B155.1 contains the safety requirements for packaging machinery and packaging-related converting machinery.”

“ANSI/PMMI B155.1, titled: ‘Safety Requirements for Packaging Machinery and Packaging Relayed Converting Machinery,’ is certainly one to start with,” says John Piccinic, regional manager for Pilz Automation Safety L.P. (www.pilz.us), Canton, Mich. That’s because it is a detailed risk assessment methodology and the associated documentation requirements are contained within it.

“Risk assessment should be the start of any sort of safety engineering effort and that is the essence of the B155.1 standard,” Piccinic stresses. In addition, he says that B155.1 references other important standards that are frequently helpful for designers.

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These standards both reflect and guide the changed approach to safety, a change which Stricker sees as very positive: “Safety has become a part of the machine design rather than something that you have to add to your machine.” The reason for this change, he says, is that newer standards require you to think about safety upfront, identifying hazards and doing risk assessment and risk reduction during the design phase.

“Making safety a part of your machine concept design can help to avoid hazards at a point where changes are easier to implement. And sometimes you can even eliminate the hazard completely with a small design change,” says Stricker.

### Global harmonization

PMMI’s Hayes notes that along with furthering the goals of fewer injuries and less downtime, today’s standards can have strategic business implications as well. “The requirements in the ANSI/PMMI B155.1 have been harmonized with the essential health and safety requirement of the EU machinery directive and the European and ISO standards that support the machinery directive. Therefore a packaging machinery

supplier may build to a U.S. standard and meet the requirement of the EU machinery directive.” He says that the goal of harmonizing ANSI/PMMI B155.1 with the European standards is “one standard, one conformity assessment, ship anywhere.”

ANSI/PMMI B155.1, Hayes continues, is important for global consumer packaged goods (CPG) manufacturers because “most of the growth markets for CPG companies are outside of the U.S.” Therefore, he says, CPG companies want machinery that is compliant with the requirements of the U.S. standards and the EU machinery directive to serve their needs in the U.S. and the global markets.

Siemens Kirklen seconds that point this way: “The move to harmonize different national standards is a positive trend, despite all the politics that are sometimes involved.” He insists that for the user confronted by two relevant standards, it’s better to adopt the more stringent one. And, he stresses, this no longer needs to involve high cost. “By adopting the more stringent standard you’ll be sure you’re not locking yourself out of any potential markets, and probably building a better machine as well,” Kirklen says.

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Rockwell's Miller puts it this way: "A machine builder in Arkansas is just as likely to sell machinery to Brazil, India or France as he is to sell to New Jersey. To that end, it has become more important to design machines to global standards rather than to specific regional standards."

### Integrating safety

Safety data isn't static. Most of it moves from the point where it is generated to a point or points up the information and control ladder. In the past, this has generally taken place over a dedicated safety network and employed a dedicated safety controller.

That picture is changing. A growing number of companies and safety professionals maintain that modern high-speed networks can carry safety as well as machine control data without risk of compromising the safety data, and that today's powerful controllers can accommodate safety and machine control with no loss of integrity to either.

This battle between dedicated and integrated control is far from over, but the integrated approach is definitely winning. It is winning because of its many advantages, including dramatically less wiring, as well as dramatically less wiring time and the cost savings related to that, along with easier programming and faster commissioning.

In addition, troubleshooting is easier with an integrated system because all relevant information can be read via the Internet connection and the control



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system's HMI (human-machine interface). This is a powerful argument in favor of greater integration. As Brian Whitt, senior packaging market manager for sensor and safety device manufacturer Sick Inc. ([www.sickusa.com](http://www.sickusa.com)), Minneapolis, observes, "Most companies want easy diagnostic capabilities and the ability to troubleshoot a machine remotely over the Internet via whatever protocol they design in."

### Nestlé and openSAFETY

Large international companies like Nestlé are well aware of the value of integration, and are actively seeking to speed the pace of that integration. Nestlé's most important automation suppliers include Siemens, Rockwell Automation, Schneider Electric ([www.schneider-electric.com](http://www.schneider-electric.com)) and B&R, and they use Profinet, EtherNet/IP, Sercos III and Powerlink for their respective controllers. Currently, a Nestlé engineering team in Switzerland is preparing a pilot implementation of a packaging line in cooperation with these suppliers to develop manufacturer-independent standards for the integration of different control systems. The team is focusing on the use of open communication technologies.

The Nestlé integration project has two key goals: First, create a specification for packaging machines in accordance with the packaging machine language PackML. Second, introduce an openSAFETY-based safety standard that is independent of the controller and bus system, and will facilitate the unrestricted exchange of safety-related information between machines and control systems from various manufacturers.

openSAFETY is a safety protocol, which has been certified for use in systems with a SIL 3 safety integrity level by the German testing authorities TÜV Rheinland and TÜV Süd, has been used in a series of production applications since 2008. Importantly, it is independent of the bus system and interoperable with all transport protocols thanks to "the black channel principle." This means that any transport protocol can be used to transfer the safety-oriented data, which is packed in a special frame format.

Bryan Griffen, global head of electrical and automation engineering at Nestlé Corporate Engineering, notes that "Nestlé uses automation and safety components from

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various manufacturers. An integrated standard for safety communication allows for a reliable transfer of safety data within the complete plant, irrespective of the manufacturer of its components. Additionally, the standard also facilitates engineering with regard to system design, commissioning, and maintenance and diagnosis of the safety systems.”

Though crystal balls are notoriously faulty, it seems safe to predict that the Nestlé project, along with international standards, point to the route that industrial safety will travel in the future. In addition, Rockwell’s Mike Miller points to another future safety development that has as yet been little talked about: safety and cyber security.

“Security is rapidly becoming very important. A safe machine on an open network must be secure to prevent someone from modifying the safety code in that machine either intentionally or accidentally,” Miller says. He adds that “IT professionals can bring significant insight into this aspect of a machine design.” 🙋

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# MANAGING ENVIRONMENTAL, HEALTH AND SAFETY COMPLIANCE

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Manufacturing organizations are often challenged with myriad environmental, health and safety (EH&S) regulations that need to be complied with across the enterprise. While finding information in a timely fashion is a constant challenge, the uncertainty surrounding change in future regulations and the complexity of managing regulations across different regions consistently haunts industrial organizations.

By **Nuris Ismail**, Senior Research Associate

**C**ompanies are looking for ways to reduce the cost of compliance, improve the safety of people, products and processes, and surpass corporate goals around sustainability. Recent Aberdeen research provides a roadmap for success, based on the best practices adopted by more than 175 executives to effectively manage the above challenges.

In 2011 the focus on compliance as a driving force behind EH&S programs has only increased. This year, 85 percent of surveyed organizations chose compliance as a top market pressure, followed by the risk of an adverse event as a distant second, at 45 percent. Indeed, as new regulations evolve, internal and external stakeholders are increasingly putting their attention on sustainable business, and the need

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to stay in compliance with these regulations is at top of mind for these companies.

There are four key performance indicators (KPI) criteria to distinguish the Best-in-Class organizations from Industry Average and Laggard organizations, as defined by Aberdeen. It is important to note that, by definition, Best-in-Class companies are not just good in one area, but instead are able to effectively manage performance in all four: compliance, safety, energy efficiency, and profitability. This means that the top companies are not only able to create a safer and more compliant working environment for their employees, but are also able to gain a competitive edge in the marketplace by possessing higher operational efficiencies at a reduced overall cost.

Underperforming companies are performing well-behind the Best-in-Class in these metrics, and need to take some strong steps to improve their EH&S programs. Such companies should use this research to understand the steps

taken by their Best-in-Class peers and implement those practices in their strategic, as well as tactical, actions to realize improved performance. This research can also be utilized to gain sponsorship from the senior management on the value of implementing the capabilities and technologies highlighted in the rest of the report.

### Strategic actions

From a strategies perspective, there are two major themes that emerge from executing a successful EH&S program: improve visibility into operations and building compliance into business processes. The most prevalent of these strategies is building compliance into business processes.

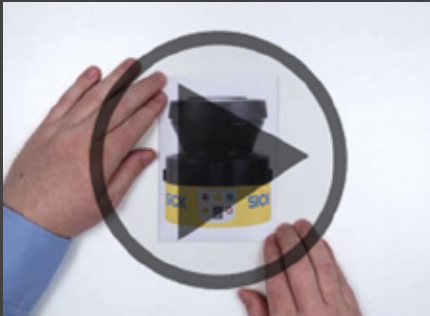
Depending on the area of the business under consideration, this can take on many different forms. When it comes to health and safety in operations, this can include: machine operators and maintenance personnel recording near misses/hits, verifying and documenting lockouts/tagouts and confined-

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space work, and taking a behavior-based approach to safety. When it comes to product development or the supply chain, building in compliance means ensuring that all stakeholders are using up-to-date product and material information, and verifying design decisions against regulatory requirements.

Coupled with this, Best-in-Class companies also understand the importance of improving visibility within operations, and having the capabilities in place to provide visibility to critical EH&S data to the right people, at the right time, and in the right form. 

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