



# Packaging Machinery Automation Playbook

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*Best practices for performance-based controls specifications*

**This playbook's objective is to give you a guide to developing specifications today based on both existing and emerging standards, with a healthy dose of best practices. Wherever possible, we've included sample specification language that you can use today.**

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# CONTRIBUTORS

The following experts contributed to this playbook:



**Gary Mintchell**  
*Editor*  
*Automation World*



**Keith Campbell**  
*Former engineering director, Hershey's*  
*President, Campbell Management Services*



**Paul Zepf**  
*P.Eng., M.Eng., CPP*  
*Zarpac Performance Infex*



**Patrick Reynolds**  
*Editor*  
*Packaging World*



**Stefan Schoenegger**  
*Ethernet Powerlink Standardization Group*

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# ADVISORY BOARD

Each article in this playbook was reviewed by one or more of the following packaging and automation professionals. *Packaging World* is grateful for their contributions and expertise.



**Keith Campbell**

*Former engineering director, Hershey's  
President, Campbell Management Services*



**Roy Greengrass, P.E.**

*Corporate Engineering  
Del Monte Foods*



**Paul Redwood**

*Equipment Engineering Manager, R&D  
Church & Dwight*



**Dr. Bryan Griffen**

*Global Electrical and Automation  
Engineering Manager  
Nestlé*



**John Henry**

*President  
Changeover.com*



**Sunny Ishikawa**

*Engineering Research Fellow  
Global Process & Equipment Technology  
Wrigley*



**Paul Zepf**

*P.Eng., M.Eng., CPP  
Zarpac Performance Infex*

## INTRODUCTION

# A different approach to packaging machinery automation

*For years the approach to machinery automation was to standardize on a single automation supplier. An alternative philosophy has the potential to expand options while lowering costs.*

**By Keith Campbell**

**Former engineering director, Hershey's  
President, Campbell Management Services**



Today we find ourselves with three predominant strategies in play for preparing controls specifications for packaging machinery.

Strategy one is no specification at all – just leave it up to the machine builder. This strategy would have worked with mechanical machines and *might* be okay for completely standalone machines in operations that can tolerate low OEE's. I've seen this strategy in practice, sometimes resulting in machines arriving at the dock that couldn't be used. I wouldn't recommend this strategy to anyone. It is like taking a trip without a destination in mind, and in that case, any road will get you there.

Strategy two is to continue with the specifications that have evolved over the years and that rely primarily on sticking with one automation partner in the hope that it will simplify parts, training and connecting systems together. I practiced this strategy during the 80's and 90's in the automation group at Hershey's, but, in today's fast-paced world where hardware is so cheap, many of the reasons that led to adopting this strategy are no longer valid. The preferred legacy suppliers are slowed down by concerns with backward compatibility and by the extra effort involved in developing proprietary platforms and communications systems.

One of the saddest statements I ever heard in my 35+ year career as an automation professional was when a colleague at a leading food company stated that his company

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## A different approach to packaging machinery automation

### Keith Campbell's take

READ KEITH  
CAMPBELL'S BLOG >>

Keith Campbell, founding director of the OMAC Packaging Workgroup and insightful blogger for *Packaging World*, has posted a number of blogs touching on PackML. Here is one.

<http://bit.ly/packml-blog-post>

had decided it was okay to forgo innovations until they could be brought to them by their preferred automation partner. The preferred supplier approach can easily limit innovation and increase purchase costs.

Strategy three is discussed in detail within the pages of this Playbook. This strategy rewrites specifications based upon functional needs and accepted international standards. It takes advantage of the economies of scale and the speed of developments in consumer and IT markets by using PC platforms along with open-system standards for software and communications. It opens up the possibility of gaining early competitive advantage, but requires a certain level of competent knowledge within plant operations. I would recommend this strategy to companies today that aspire to be world-class.

Some standards, like OMAC's PackML may be employed in either proprietary or open control architectures. Other standards may only be available within open architectures. Those of us old enough to remember IBM during its mainframe days will remember the saying that "no one ever got fired for buying IBM." This meant buying IBM proprietary designs. But their closed architecture eventually led to the downfall of their hardware business as the industry moved on to PC platforms that while technically not open, served as a defacto standard that permitted multiple hardware manufacturers to innovate.

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[A different approach to packaging machinery automation](#)

The convergence of machine control and factory management systems, capital justification, OEE and openSAFETY are also discussed in this Playbook. Each of these topics is equally applicable in proprietary or open architectures, although some may be less costly or more easily implemented in one versus the other.

So, read on, consider with an open mind, and decide for yourself how you want to specify packaging machines going forward and which best practices you want to employ in your quest for competitiveness. I hope that this Playbook will help guide you on your journey. ■

## CHAPTER 1

# Trends in packaging dictate advances in machinery technology and standards

*Packaging systems need to get 'smarter' to meet workforce challenges, marketplace dynamics, sustainability directives and more. This guide to specifying packaging automation identifies requirements, standards and even specification language to drop into your user requirements specification (URS) and electrical specification.*

Over the years, machinery and electrical specifications have put on some pounds. Eighty-plus pages are not unheard of. And while local codes do add their own arbitrary requirements, these well-intentioned attempts to create internal standards are becoming obsolete as international standards and regulations are increasingly harmonized.

It's also difficult for specifications created decades ago to fit the level of innovation in the package design, material, machinery and controls spaces today. Some CPG companies have discovered that the specs that had served them well for years have become a hindrance to innovation. And so, they've put their specs on a strict diet of functionality and recognized industry standards.

## **It's all about business imperatives, enabling technologies and standards**

This guide is all about connecting business imperatives with enabling technologies and the standards that future-proof those investments. In these pages you'll find actual specification language you can copy and paste and modify to fit your company's or your site's needs.

You'll also see the trends that are promising to make packaging operations more efficient, safe, productive and accessible to the people who use and maintain them.

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## Trends in packaging dictate advances in machinery technology and standards

The past decade's advances in packaging machinery came largely from mechatronic designs that traded away inflexible and fixed mechanical motion for more flexible and programmable servo motion, intermittent motion for the higher speeds and reduced noise and vibration of continuous motion, and dedicated motion for robotic flexibility. These are still highly relevant machine attributes that not all builders have adopted, or adopted to the fullest potential.

### **But what's driving the next big wave in productivity?**

Look to mainstream technologies for the answers: aircraft, cars, telephones, appliances, the Internet.

In short, we are making all of these everyday devices easy to access, use and service. We're making them capable of self-learning and anticipating our needs. Smart airplanes virtually take off and land themselves. Cars have video cameras to see where our rear view mirrors can't. Phones have integrated our previously state-of-the-art but separate email, GPS and Web functions into one device. We can program our home appliances from these phones. And of course, everything is connected to the Internet, from the cloud to...you guessed it... the packaging machine.

### **In a word: convergence**

In recent years, we've seen the motion controller converge with the PLC, then with the touchscreen HMI. Robotic kinematics were integrated into general motion control and the device network merged onto the motion network. Integrated (and open) safety systems can run over that same network and plug into the same hardware backplanes.

## CHAPTER 1

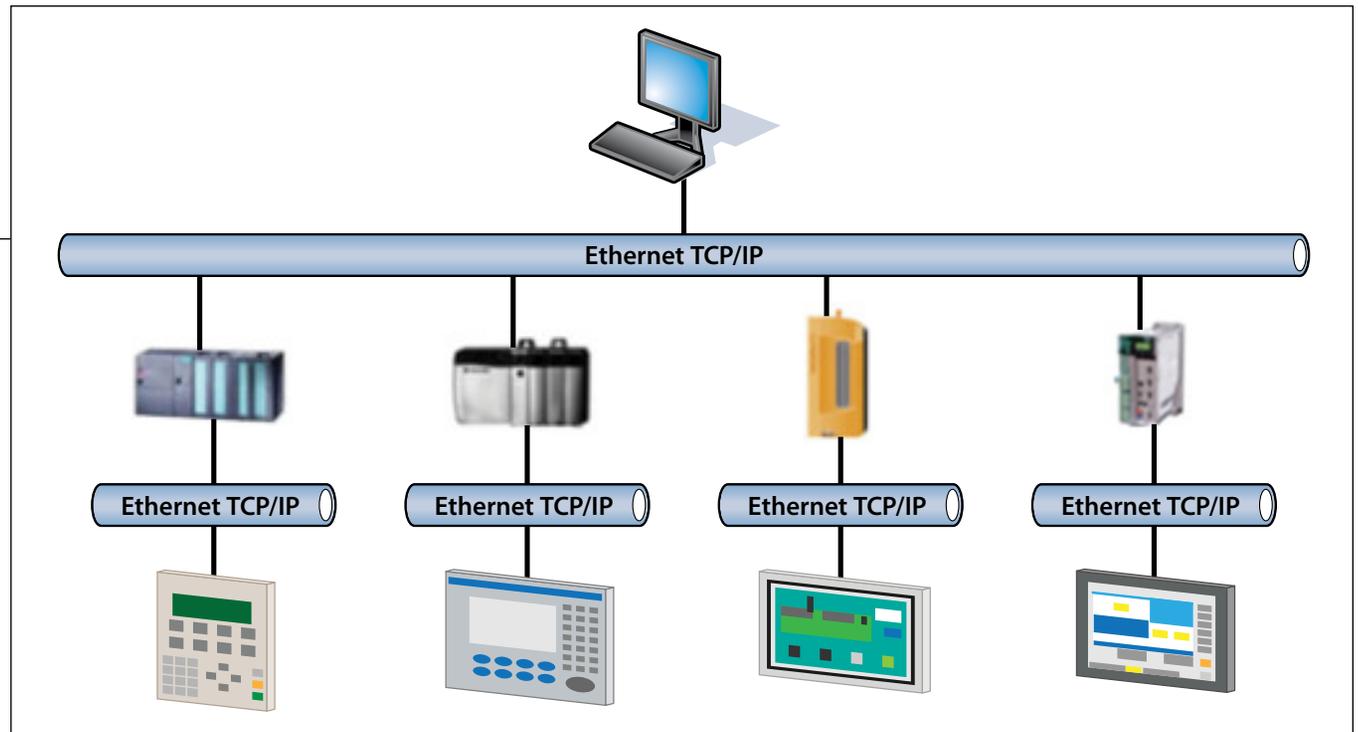
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### Trends in packaging dictate advances in machinery technology and standards

Broader use of standards will make it easier to vertically integrate packaging machinery and packing lines with MES and ERP systems.

Source: Nestlé

At the same time, we've watched the hardware converge into a single platform alongside the software integration. When it comes to specifying the control system for a packaging machine, it is getting harder to justify an argument for a premium priced standalone PLC with special modules for motion, a separate HMI panel incapable of doing much else, and a PC for handling things like production data acquisition, vision and serialization systems, and possibly interactive work instructions for operators and troubleshooters.



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Trends in packaging dictate advances in machinery technology and standards

## Different automation cultures, divergent perspectives

In North America, the automation industry has learned to avoid the term 'PC-based control' – because too many engineering managers lived through Windows NT and CE, with hard real-time operating systems that relied on watchdog timers and schemes to interrupt Windows. This led to an abject fear of the 'blue screen of death.' There were claims by soft logic suppliers that cheap 'whitebox' PCs from Walmart could substitute for industrial PCs. And of course at the time we didn't have massive Flash solid state drives, and many spinning disk drives failed on the factory floor.

While the allure of PC-based control in the mid-1990's was well-founded, the immature software and hardware of the early days were not sufficiently robust for industrial applications, causing many machine builders and packagers to rethink switching.

In Europe, they never feared 'PC based control.' In fact, they embraced the relevant force driving their advances – a combination of Moore's Law and recognition that control applications like logic and motion should not be dependent on hardware configurations. They are in fact software functionalities that happen to run on hardware.

The same holds true today for safety networks, which are really protocol extensions running on the application layers of the various flavors of industrial Ethernet. Once you think in terms of software, you free yourself of increasingly irrelevant and limiting classifications like PLC and PAC. What you really need is the appropriate control hardware to run the software that delivers the desired functionality.

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### See the coming convergence?

Once you gain the benefit of Moore's Law you catch a ride on the incredible, ongoing rise in processing power and the simultaneous drop in processor cost that high volume, mainstream computing markets have created. That's exceptionally true today with mobile computing and device markets that have led to powerful multicore processors and economical, compact processors that run cooler, consume less energy and withstand vibration and ambient temperature extremes.

The formula includes a proven real-time operating system that is totally separated from and has absolute priority over Windows. This requirement has been clear and deliverable for over 15 years, driven by mission critical computing applications in the medical, energy, telecom and aerospace industries. Much of PC-based control's bad rap came from using a real-time operating system that interrupted the hardware abstraction layer (HAL) of Windows™ instead of running Windows in the background.

What's been harder to achieve until more recent advances in processing and memory power is the complete integration of control functions into a single software development environment, a single program and a single processor, independent of hardware targets and therefore scalable, using the international automation programming standards called out in IEC 61131-3 ([www.plcopen.org](http://www.plcopen.org)).

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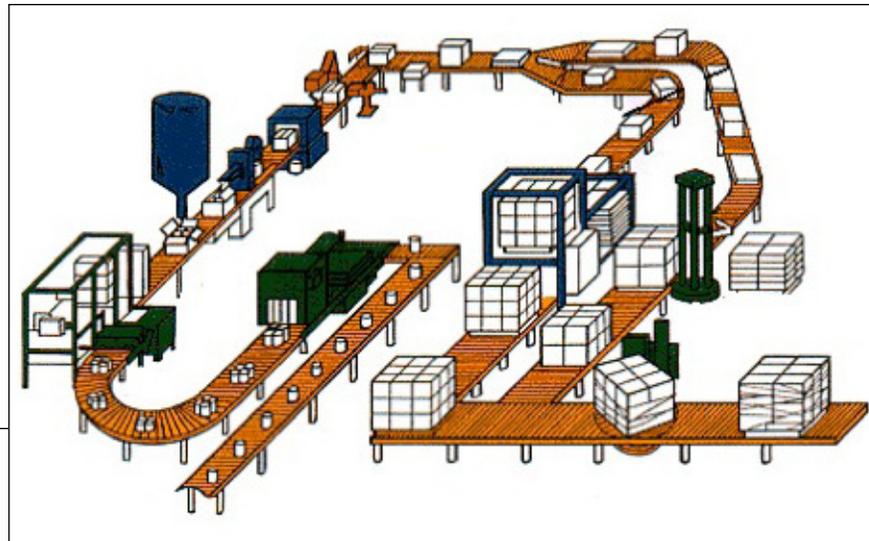
Trends in packaging dictate advances in machinery technology and standards

Retail-Ready Personalized Packaging, which depends heavily on manipulation of variable data, can be implemented more readily when packaging lines and packaging machinery are governed and integrated by widely agreed-upon standards.

### Convergence between control and management functionalities

But this still isn't the full meaning of the convergence. For that, we need to cross over to the Windows™ side of the processor. Depending on the criticality, it could be a relatively pedestrian Pentium® M or it could be a powerful dual or even quad core processor. It doesn't really matter, because all are readily available and affordable. What matters is the ability to run Windows, usually embedded, or Linux, for the new breed of management software applications that increasingly need to work alongside control.

This is where packagers plan to unlock the next round of game-changing improvements to productivity. We're already seeing it. True, the state of servo technology continues to advance



with recent breakthroughs from automation suppliers, such as distributed servo motor/drives, safe motion and safe robotic control. But packagers now have the chance to realistically marry control with factory management systems.

So, all the productivity enhancing applications that

typically run on a standalone PC – production scheduling, recipe management, OEE, training videos, data historians and the like – can run on the PC portion of the machine control. They

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### Trends in packaging dictate advances in machinery technology and standards

can be called up as needed by a condition in the control program to assist plant floor personnel. And they will do it with immediacy, in addition to periodic uploads to a data historian for offline analysis and future corrective action.

Technology providers have come so far in control – especially motion – that they're really good at synchronizing sub-millisecond activities. Now it's time to catch up on the non-realtime side of the equation, which is how people manage our processes.

### Convergence between previously siloed functions

Automation strategists are also recognizing that each new software functionality improves more than just its own intended application. For example, a safer machine has more uptime, so its OEE numbers will be better. Better OEE means a machine that is more energy efficient because it's running at steady state rather than stopping and starting.

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Energy efficiency and making good product make for sustainability. Making less scrap also means better quality. And so on, the bottom line being improved profitability.

And so it goes. This convergence has the potential to increase productivity of the whole beyond the individual applications. And software convergence can certainly enable many aspects of lean manufacturing initiatives.

### **New applications are driving adoption**

As slowly as technology adoption appears to move in industrial control versus IT or consumer markets, the need to do so is accelerating. And indeed, many in the packaging automation community see developments such as PackML, OPC, MES and OEE leading the way.

Serialization is the next big thing, first in pharma and eventually wherever traceability is an issue, as in 'farm-to-fork' food safety. This involves unique man- and machine-readable codes for each package. That requires interfacing the packaging machinery control system to the coders and banks of vision cameras to confirm the coding. The data and vision processing intensity calls for powerful industrial PCs and networks capable of high speed, deterministic operation.

Another is on-screen help systems. Today, too many work instructions still take the form of PDF files of instruction manuals, when they really should be interactive – using video and/or animation – and walk the operator or maintenance tech through the solution step by step. Moreover, troubleshooting steps should come up automatically, triggered by a bit in the control program when a fault occurs. This calls for not only a Windows environment, but communication between the Windows and real-time worlds on the same processor.

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This immediacy means faster resolution and consistent troubleshooting, with less need for escalation and off-line training, faster escalation to the appropriate level if needed, and consistent procedures. Recording incidents along with their remedies will yield important information for root cause analysis and for preventive maintenance tools to avoid incidents from reoccurring in the future.

### The unified platform arises

It now becomes possible to envision a single, unified platform that:

- does all we've discussed in terms of **control**
- with easy access to **data** inside the processor by non-realtime factory management applications running on Windows, Linux or another mainstream operating system
- serves data up to screens on the HMI panel as well as any other **interface** device authorized to access the information
- is based on international **standards**, not proprietary or one-off interfaces, so that it becomes control platform independent and – importantly – consistent worldwide

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Trends in packaging dictate advances in machinery technology and standards

From a practical standpoint, these developments effectively provide a viable alternative to single-vendor control specifications. A number of international standards and best practices that support this alternative approach are encapsulated in what is known as the OMAC Packaging Guidelines (see Chapter 2). Nestlé is embracing this philosophy by adopting these guidelines and asking its preferred automation suppliers to as well.

As a result, some packagers are migrating to a standards-based functional specification with preferred, compliant vendors. This new freedom of choice can increase the number of options—and capabilities—available to machine builders.

### How to turn a trend into a standard

What will such a universal specification look like? Quite likely it will look like *PackSpec*, a new initiative of the OMAC Packaging Workgroup. According to the *PackSpec* committee's September 27, 2011 report to the OMAC Packaging Workgroup, the specification could deliver the following benefits:

- **A streamlined quoting process** – based on performance, functionality and footprint)
- **Quicker machine development and building**
- **More accurate and effective FAT** – including Installation Qualification, Operational Qualification (IQ/OQ) (*PackConnect*) and Manufacturing Execution System (MES) (*PackML*)

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Trends in packaging dictate advances in machinery technology and standards

- **Easier factory integration**
- **Machines designed to be deployed world wide**
- **An accurate document set to support the machine into the distant future**

The same push for a standard is taking place in networked safety. Recognizing that safety is really a protocol extension running on the application layer of the various flavors of Ethernet, it becomes clear that there's no reason for a second 'fieldbus wars' with each vendor developing its own safety protocol to run on proprietary networks.

That's the premise of openSAFETY, and in turn, the PackSafety committee's charter. It is significant that Nestlé has also come out in favor of an open safety protocol such as openSAFETY and is chairing the PackSafety initiative in OMAC.

## The end game

Beyond the all-important implementation roadmap, the real end-game is to push productivity to the next level. That's what convergence is all about. It leverages what were isolated technologies, now converged on a single platform that plant personnel can quickly access, understand and respond to. And to make it all work, it takes standards.

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Trends in packaging dictate advances in machinery technology and standards

This requires that manufacturers change their specifications to reflect the new reality, because machine builders need a clear requirement in order to justify investment in newer technologies.

For starters, this playbook’s objective is to give you a guide to developing specifications today based on both existing and emerging standards, with a healthy dose of best practices. And wherever possible, we’ve included sample specification language that you can use today.

In the long run, the way to make change happen is to become active in users groups such as OMAC and relevant machinery associations such as AMT and PMMI, to help develop the standards and to drive adoption.

To wait for somebody else to make it happen is to sacrifice first mover advantage. And once that time is lost, it can never be regained. ■

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## CHAPTER 2

# It's time to put packaging machinery control specifications on a diet

*In recent years, there's been a quiet evolution in which corporations have cut infinitely detailed electrical specifications down to a manageable size, based on international rather than internal standards. How do you know when it's time to skinny down your spec?*

Electrical specs tried very hard for years to maintain the sanity of plant technicians by defining everything right down to wire color. And with good reason. Just as it makes sense to have a common look and feel to the control panel today, there was a time when a technician using general knowledge and tracing which-wire-color-meant-what was the human-machine interface.

Now we have networked sensors and communications, so many of those wires don't even exist any more. In the best of cases we have interactive help instructions (see Chapter 7). And while attempting to consistently enforce a 100-page electrical specification is its own challenge, the whole cart is turned over when an acquisition or merger causes a company to inherit someone else's machinery.

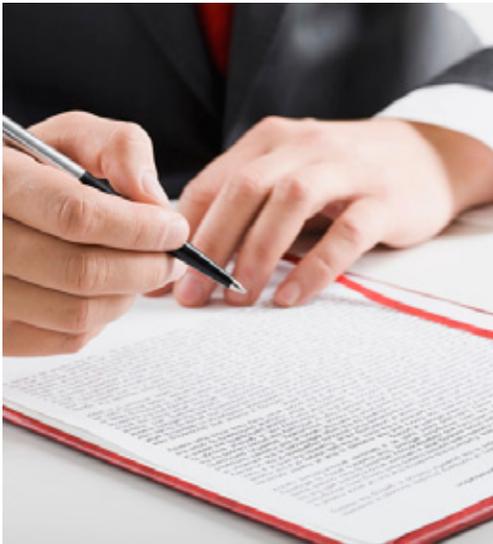
The same problem arises when equipment from a facility following its own 'plant specification' is moved to a plant with a different specification. Not to mention the time and cost to maintain individual plant specifications. This poses a real challenge to corporate engineering and procurement managers. As technologies advance, the time and effort to continually update a standard can become futile and can result in the use of outdated components.

For these reasons, some corporate engineering departments have begun putting their control specifications on a diet, choosing instead to specify required functionalities, reference

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It's time to put  
packaging machinery  
control specifications  
on a diet



international standards, and qualify conforming suppliers based on performance as well as compliance to such standards.

These functional specifications give packaging machinery builders the opportunity to differentiate based on innovation and value.

While vendor-based electrical specifications are still in wide use, there is a growing trend toward standards-based functional specifications with preferred suppliers. This practice limits the number of suppliers to support while promoting a healthy sense of competition.

A notable recent example of the trend to standards-based specifications is the packaging automation specification implemented worldwide by Nestlé, which follows the OMAC Packaging Guidelines and names four preferred suppliers.

One straightforward way of developing such a specification is to start in principle with the [OMAC Packaging Guidelines Version 3.1](#) the compilation of standards defined back in 2004. Though it has not been updated recently, it remains valid in concept.

That is, the guidelines call out IEC-compliant buses and IEC 61131-3 programming languages. It provides a glossary of terms. And it defines packaging line types from stand-alone machines to highly integrated lines.

Under the new PackSpec initiative, these guidelines will be incorporated into a functional specification document that can be used in whole or in part, with the expectation of a base level of consistency worldwide.

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It's time to put  
packaging machinery  
control specifications  
on a diet

DOWNLOAD  
SAMPLE SPEC >>

<http://bit.ly/pw-functional-spec>

Until then, a combination of the standards called out in the OMAC Packaging Guidelines and recent advances in control functionality can be used to generate a practical interim specification.

To assure inclusion of current and widely available control functionalities, sample language has been provided in this chapter for download to supplement specifications as applicable to user requirements. This language is intended for evaluation by controls engineers in collaboration with their peers in packaging engineering and procurement.

*The following language can be downloaded in a Microsoft® Word® format that can be copied and pasted in whole or in part, and modified to meet applicable requirements.*

### Sample specification language

## New functional requirements for packaging automation systems

*The language on following pages (which can be downloaded as an editable Word document using the link at left) provides controls engineers with descriptions of functionalities that have become available in recent years that may be useful for inclusion in a functional, performance-based control specification, based on relevant international standards rather than proprietary products.*

*Pick and choose which elements are best adapted to your existing electrical specification.*

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continued

## It's time to put packaging machinery control specifications on a diet

(Disclaimer: This language is offered on an as-is basis, and *Packaging World* in no way assumes liability for damages arising from its use.)

It is the intention of (name of company) to implement industry best practices and applicable standards in packaging machinery automation to minimize total cost of ownership, including but not limited to optimization of: initial equipment cost and lead time, training, maintenance, equipment efficiency and availability, changeover flexibility, scalability, and reconfigurability.

1. Wherever feasible, control system will follow applicable OMAC Packaging Workgroup guidelines to maximize operational efficiencies in implementation, operation, maintenance and reconfiguration.
2. System shall support centralized, distributed or a combination of centralized and distributed control for optimized performance based on application requirements.
3. Servo motion technology is strongly encouraged for flexibility and performance in primary package filling, sealing, labeling and secondary packaging.
4. Integrated control for logic, motion, robotics and related functions shall be implemented in a system providing languages (FB – Function Block, FBD – Function Block Diagram, IL – Instruction List, LD – Ladder Diagram, SFC – Sequential Function Chart, ST – Structured Text) of the international control language standard IEC 61131-3.

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It's time to put packaging machinery control specifications on a diet

5. A unified software development environment will integrate all control programming, visualization, and implementation of the PackML state model. Program development in this environment will be modular and scalable across the automation supplier's available hardware targets.
6. IEC 61131-3 conforming Function Blocks shall encapsulate and simplify parameterization of complex control functions wherever possible and practical; Structured Text especially within Function Blocks to efficiently execute critical functions; and Ladder Diagram and/or Function Block Diagram for sequential logic tasks.
7. No more than one such Function Block shall be required to initiate a single axis, and no more than two shall be required to perform any multiaxis motion tasks.
8. All data and code shall be stored in removable, non-volatile, non-mechanical memory. Application data and parameters database shall be saved according to standard file extensions (such as .xml and .csv).
9. The OMAC PackML™ state model, modes and naming conventions shall be used to describe machine states for standardized operation, monitoring, analysis and business management information access via OPC, XML or other standardized data structures and interfaces. The controller shall be capable of creating a PackML enabled supervisory layer.

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It's time to put  
packaging machinery  
control specifications  
on a diet

10. Provision shall be made for remote diagnosis of the control system via Web, to communicate via Ethernet, modem or similar appropriate standardized interface.
11. The integrated control system shall be sufficiently powerful to execute in a single application program on a single controller, to avoid inefficiencies caused by multiple control modules or software calls between application programs, and backplane and/or network communications between control components.
12. Machine documentation shall be included as part of the machine control system to reduce the possibility of losing printed or electronic documentation.
13. Control system shall permit changeover and reconfiguration via recipe management to run different products.
14. Integrated motion (motor and drive) shall be available, and shall provide a choice of conventional motors and drives, drive-onboard-motor and machine-mounted drive independent of motor configuration and brand.
15. The system shall be implemented in such a way that it is unnecessary to re-home axes upon re-start.

# EXTREME PACKAGING PERFORMANCE

Technology by **THE INNOVATORS**



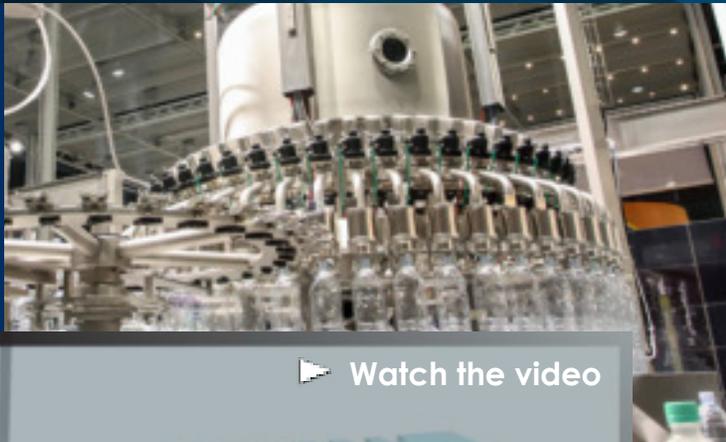
Watch this new 250 cpm shrink wrapper leverage B&R's latest automation technology to simplify operation, stay in synch with product while making bag size changes, and deliver smooth, strong side seals at high speeds.

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It's time to put packaging machinery control specifications on a diet

16. The processor shall be capable of independently controlling multiple modules if the application requires, thus enabling simplified monobloc machine control. The controller family should be scalable, with a single controller capable of controlling the largest number of anticipated axes within a 2 millisecond network update rate.
17. If the application requires, control system shall be capable of advanced polynomial algorithms, changing cam profiles and related commands on the fly for efficient format changes, and providing onboard event logging and access in plain language to diagnostic messages.
18. The control system shall be capable of performing data collection and serving compiled data to upper control layers asynchronously via FTP.



## How to drastically reduce support costs?

With the Industrial Router eWON Cosy, Machine Builders and System Integrators can troubleshoot machines remotely without going on site, drastically reducing support costs.



[www.ewon.biz](http://www.ewon.biz)

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continued

It's time to put packaging machinery control specifications on a diet

19. The control system shall provide direct connectivity to a database with no need for an intermediate 'data concentrator,' to facilitate the emerging requirement for serialization and product record keeping.
20. Communications shall be performed via IEC conforming standardized industrial control networks, as well as Ethernet TCP/IP for information handling.
21. The control network shall support IEC-conforming open, integrated safety protocol extension.
22. Integrated safety functionality shall be available, including safe motion functionalities.
23. To maximize energy efficiency, high efficiency power supplies, regenerative power supplies for servo drives, and a common DC bus between servo drives shall be available. ■

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## CHAPTER 3

# How to calculate Overall Equipment Effectiveness: A practical guide

By **Paul J. Zepf**  
M.Eng. P.Eng. CPP  
Zarpac, Inc.



## OEE Overview and Efficiency versus Effectiveness

There is a lot of confusion out there about OEE (Operational Equipment Effectiveness) and about the words efficiency and effectiveness. Let us look at these things in an objective and clear manner.

Is OEE just a nice-to-have? No, it is a simple yet powerful roadmap that helps production floor people and management to visualize and eliminate equipment losses and waste.

OEE is not a fad. First of all, OEE has been around for decades in its elemental form. The words efficiency and effectiveness have been around longer, but have only been used in a confused manner in the last decade or so. To start, we have to make a clear distinction between *effectiveness* and *efficiency* before we can discuss OEE.

Effectiveness is the relation between what theoretically could be produced at the end of a process and what actually came out or was produced at the end of the process.

If your machine or system is capable of making 100 quality products an hour, and it makes only 70, then it is 70% *effective*, but we do not know how *efficient* it was, because nothing is said about what we had to put in (how many operators, energy, materials, etc.) to get the 70% effectiveness.

## CHAPTER 3

continued

## How to calculate Overall Equipment Effectiveness: A practical guide

So if a machine or system runs 50% effective with 1 operator and becomes 65% effective with 2 operators, the effectiveness goes up 30% (yes, 65 is 30% more than 50...) but its efficiency dropped down to 50%, based on labor!

The same goes for *yield* or more commonly known as *quality* (basically saleable product). If you are bottling a beverage, all filled, labeled and capped bottles could theoretically be perfect, so the quality would be 100%. But if you throw away half the filled bottles because of packaging or material defects, your yield or quality is only 50%. In this example you would be 100% effective but only 50% efficient.

### A simple example

Basically OEE is about (as the name says) effectiveness: it is the rate between what a machine theoretically could produce and what it actually did. So the fastest way to calculate it is simple: If you take the theoretical maximum speed (for example 60 products per minute) you know that at the end of a 480 minutes shift there should be 28,800 units.

1 shift = 8 hours = 480 minutes

Maximum production speed = 60 products per minute

$480 \times 60 = 28,800$  units

## CHAPTER 3

continued

### How to calculate Overall Equipment Effectiveness: A practical guide

Then we need to count what we produced at an end point in the production process such as what's on the pallet going to the warehouse. If there are only 14,400 good products on the pallet your effectiveness was 50%, right?

Not rocket science so far.

### The A-P-Qs of OEE

Why does the OEE formula in Figure 1 include availability (A), performance (P) and quality (Q)? What do these words mean and what value do they bring? They'll help us find where those other 14,400 products that should have been on the pallet disappeared to.

OEE raised the bar and moved us away from the traditional efficiency calculation as a measure of production line output that was easily manipulated to show mediocre lines running at efficiencies up to 150%.

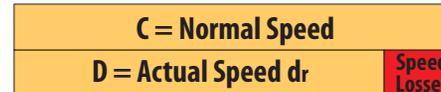
$$\text{OEE} = \text{Availability} \times \text{Performance} \times \text{Quality}$$

$$\text{OEE} = \frac{B}{A} \times \frac{D}{C} \times \frac{F}{E}$$

#### Availability



#### Performance



#### Quality



**Figure 1:** The simple overview of the elements of OEE and how they inter-relate in OEE.

## CHAPTER 3

continued

## How to calculate Overall Equipment Effectiveness: A practical guide

Here is the power of OEE. OEE, when broken into its three main components, is going to track down where we lost it. Every day that we run 50% OEE, we can lose units in different ways, and every loss has its own cost structure.

If we lose 14,400 products because the machine ran flawlessly, with no quality loss but at half the maximum speed, that's completely different from producing 28,800 products at full speed, and then dumping 14,400 out-of-spec products into the landfill.

Effectiveness is:

**Making the right thing** – the right product or SKU at the right speed (Performance)

**Making it the right way** – no rework, no defects, no waste (Quality)

**Making it at the right time** – producing as planned, keeping the machine up and running, minimizing time losses (Availability)

So how do we find out what we lost and where? And how do we prevent it from happening in the future?

## CHAPTER 3

continued

## How to calculate Overall Equipment Effectiveness: A practical guide

### Availability

Going back to the bottle example, let's track down a normal day. A standard shift takes 480 minutes. Our operators take 10+30+10 minutes in breaks as well as do 2 changeovers of 35 minutes each and lose 60 minutes of machine downtime during the shift. The rest of the time the machine is in the running mode.

Breaks = 10 minutes morning + 30 minutes lunch + 10 minutes afternoon = 50 minutes

Changeovers = 2 x 35 minutes = 70 minutes

Machine downtime = 60 minutes per shift

Total = 180 minutes lost time

This means we lost 180 minutes and there are only 300 minutes left to be effective. Even if we run the rest of the time at full speed with no quality losses, we can never be more than 62.5% effective during this shift. This ratio we call 'Availability' or how time is used.

480 minutes – 180 minutes = 300 minutes

$300 \div 480 = 62.5\%$  Availability

Let's see how we spent that 62.5% of our time that is available ...

## CHAPTER 3

continued

## How to calculate Overall Equipment Effectiveness: A practical guide

### Performance

Let us also assume our packaging system has an ideal cycle time or takt time of 1 second per bottle, which is 60 bottles per minute. (Takt time, derived from the German word Taktzeit which translates to cycle time, sets the pace for industrial manufacturing lines.)

This means in the remaining 300 minutes, the machine or system can make  $300 \times 60$  bottles = 18,000. So if at the end of this shift the machine would have made 18,000 bottles during the time it was running, it performed at 100% speed. If production would be at a slower speed, let us say the cycle time would be 1.5 seconds, it would slow down the maximum speed by  $2/3$ , and thus its performance would become 66.7%. The actual output now at 66.7% performance is 12,000 bottles.

$300 \text{ minutes @ } 1 \text{ second per bottle} = 300 \times 60 \text{ bottles} = 18,000 \text{ units}$

$1.5 \text{ seconds per bottle} = 1 \div 1.5 = 2/3 = 66.7\% \text{ Performance}$

$66.7\% \times 18,000 \text{ bottles} = 12,000 \text{ units}$

Running at 66.7% performance in this case equates in time to losing another  $300 \times 33.3\% = 100$  minutes or the line ran on average  $2/3 \times 60 = 40$  bottles per minute.

If at this point all output would be within specification or saleable, what would be the effectiveness?

## CHAPTER 3

continued

## How to calculate Overall Equipment Effectiveness: A practical guide

From the 480 minutes we lost 180 minutes in 'not running' and 100 minutes due to 'too slow a cycle time'; so  $(480 - (180 + 100)) / 480 = 41.7\%$  so far.

$$(480 \text{ minutes} - (180 \text{ minutes} + 100 \text{ minutes})) \div 480 = 41.7\% \text{ Efficiency}$$

### Quality

Whether this is the actual effectiveness depends on how many bottles were within specification. If from the 12,000 bottles, there were 3,000 out of specification, then the quality rate of those bottles was  $(12,000 - 3,000) / 12,000 = 75\%$  or converting to minutes would be 3000 bottles / 60 bottles per minute = 50 minutes lost due to quality.

$$(12,000 - 3,000 \text{ defects}) \div 12,000 = 75\% \text{ Quality}$$

$$3,000 \text{ bottles} \div 60 \text{ bottles per minute} = 50 \text{ minutes lost Quality}$$

In other words, we lost 180 minutes by not running; from the remaining 300 minutes we lost 100 minutes by slow running; from the remaining 200 minutes we lost 50 minutes making scrap. As a result the line yielded 150 minutes of perfect running at quality and at rate.

Theoretically we could make  $480 \times 60 = 28,800$  bottles. At the end there were 9,000 bottles that were saleable, so the Overall Equipment Effectiveness was 31.25%.

$$9,000 \div 28,800 = 31.25\% \text{ OEE}$$

$$\text{Availability (62.5\%)} \times \text{Performance (66.7\%)} \times \text{Quality (75\%)} = 31.25\%$$

## CHAPTER 3

continued

## How to calculate Overall Equipment Effectiveness: A practical guide

### Time equals money

OEE is purely time based (time converted), but since 1 takt time equals 1 bottle, OEE can be calculated in bottles for ease of use. Most operators will not say 'Today I ran at a takt time of 1.5 seconds but instead "today I ran 40 products per minute" — which is the same thing. Likewise, "I stopped for 5 minutes" is the same as "I lost 200 potential bottles I should have made".

OEE helps to create this kind of awareness; with operators, with engineers, with logistic departments, and with anybody else involved in the value adding process. It gives a common language to everybody involved in manufacturing and leads to effective and efficient improvements.

### The straightforward approach to OEE

OEE and its basic approach have been around for decades in other industries and have recently moved into the packaging area. Although the concepts are fairly simple, their definitions and application have varied considerably, preventing any ability to use them as benchmarks and performance tools within and between plants, let alone between companies. The idea is to present a common definition and straightforward spreadsheet format to bring about clear, common approach.

## CHAPTER 3

continued

## How to calculate Overall Equipment Effectiveness: A practical guide

### A practical definition of OEE

OEE is the Overall Equipment Effectiveness of a defined production process during the defined operative period or mode in which all activities related to production, personnel and inputs are accounted for during all producing or dependent activities within a defined scheduled time or operative mode time. The defined production process is the start and end boundary under review such as depalletizing to palletizing or making it through to warehousing.

OEE is defined as the product or cost function or interplay of all availability or uptime of the operative mode *multiplied* by the performance or actual resultant production speed (from actual dialled rate and ramping rates) divided by the normal or steady state speed and then *multiplied* by the quality or the output of quality product divided by the input of the critical component or aggregate of all the inputs (components consumed, lost, reworked, destroyed or unaccounted for during the production process). For a diagram, please refer back to Figure 1, page 30.

Quality is a fraction that is 1 minus the waste (waste and rework). Rework is usually considered within quality, but is the most difficult to segregate out. Quality does not typically relate to defective components not staged to the production line, but once staged to the production line they have to be considered. This forces out pre-checks, because once it hits the production line, there are time and impacts to the ongoing production process such as removing and replacing staged defective products, materials and supplies.

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## How to calculate Overall Equipment Effectiveness: A practical guide

### Scope of analysis

Although OEE could be done on a machine-by-machine or product-by-product basis or shift-by-shift bases it is usually the amalgamation of one week's or one month's production of a given size and product (by machine or line), because looking at smaller slices may not give statistically relevant data for decision making. Trends or specific comparisons could be done, along with looking at a month's worth of production runs of the same product, family of products or extremes of product sizes and formulations.

Looking at less than 10,080 minutes (one week) of operating time is not significant in and of itself for decision making, but may be adequate for trends and verifications of a decision implemented earlier to insure positive directions or to ensure the anticipated results are being achieved.

The reason for this definition of operative mode is to capture all activities required to ensure the production process could be carried out. Some companies in the past hid their changeover, PM, holidays, training and cleaning by doing it in the so-called unscheduled production time or dumping it on a particular off time, but really it is part of the nature of the production process.

The production scheduled time is the time period in which allotted defined products are to be produced, but process dependent activities or situations must be done or considered beforehand (such as holidays) to ensure the schedule can be met or be reasonable.

## CHAPTER 3

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## How to calculate Overall Equipment Effectiveness: A practical guide

The calendar hours or calendar time are the sum of operative mode activities and potential mode activities that make up a week (10,080 minutes) or month (average 43,800 minutes) or defined period in which the asset as a functioning production element exists in the plant. If any asset is removed from the process in such a way as to make the process for a given product not viable then the expected OEE number is considered zero.

This also applies to product recalled from the market that is reworked or scrapped. A total recall in reality yields zero OEE for the period that produced the recalled product. A partial recall will only deal with the loss of the defined Lot or Batch within the total, but will depress the OEE for that period considerably.

Any scheduling and labor considerations are considered integrated within OEE. One could expand out from OEE with other ratios such as schedule capability in which labor and scheduling times are evaluated and their interplay is calculated as ratios or costs to operations, but OEE keeps a top line view that fits for the vast majority of industries and conditions in a simple but powerful way.

High OEE numbers are indicative of high schedule fulfillment and optimized labor. Schedule fulfillment and optimized labor are a byproduct of the optimized process. OEE is the roadmap for insight, direction and verification of all other activities such as continuous improvement, lean, six-sigma and upper level accounting information. It gives the correct window in viewing the Cost of Quality.

## CHAPTER 3

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## How to calculate Overall Equipment Effectiveness: A practical guide

### OEE and the cost of quality

The “Cost of Quality” isn’t the price of creating a quality product or service. It is the cost of not creating a quality product or service (For details visit the ASQ – [American Society for Quality](#)).

Every time work is wasted, there is a loss that results in the “Cost of Quality” escalating. When talking about waste, we can define or look at many definitions, variations or types of wastage such as: waste of waiting, over-production, inventory or work-in-process, transport, motion, input defects, producing defective products, unnecessary process steps, delaying

In looking at operations, OEE simply gives the clear and powerful picture window view of the ability to sustain quality production or how availability (time), quality (good product) and performance (speed) interact. The Losses portion is the fraction of the time that is lost due to the inability of the production process to be consistent and under control. These losses relate to time down or downtime, rate losses in the process and the scrap and rework generated during the operative mode.

The operative mode is not only the planned scheduled production time but that time that encompasses the nature of the production process and its supporting activities that are connected, dependent or required to be done to ensure the timely production of the scheduled product. This means that apportioned preventive maintenance, changeovers, cleaning and/or sanitizing are included.

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## How to calculate Overall Equipment Effectiveness: A practical guide

### The concept of Downtime as understood in availability

For simplicity and order, the downtime of any machine or system can be divided into two parts – *planned downtime* events and *unplanned downtime* events.

*Planned* events can be defined as those events in which no output of saleable product results and which management has control over the timing and extent of the activity; mandates them or the country's regulations define part or all of them.

Holidays are always mandated activities dictated by management, government or both. One could argue that holidays should be left out, but that is incorrect, since it is a management decision to not use that time during a normally operative mode and it is not proper to slip it into the potential mode.

One can break down planned events into as many categories as one likes. Beware, when holidays are included in the analysis, some days or weeks or months will show depressed numbers and need to be highlighted. Because of this, there is a tendency to not include them. But one should include them as they happen.

One can break down *unplanned* events into as many categories as one likes, but the most common ones are the unit ops or machines. The unit ops could be further subdivided into primary and secondary machines, zones, faults, etc.

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## How to calculate Overall Equipment Effectiveness: A practical guide

*Primary machines (PM)* are unit ops that are capital equipment that has a direct involvement in assembling the package such as unscramblers, rinsers, fillers, cappers, labelers, cartoners, case packers, palletizers, etc.

*Secondary machines (SM)* are minor unit ops that convey, manipulate, collate, inspect, code or mark the package such as conveyors, combiners, dividers (when separate from a primary unit op), coders (laser, inkjet, impression, etc.), checkweighers, X-ray, Gamma inspection, independent fill, cap or label detection, rejection units (independent of the major unit op, etc.

Most companies, especially companies with no or poor ability to identify unplanned downtimes or losses, should use the OEE macro analysis and use the lumped or aggregate estimate number until improved data acquisition approaches the estimate number. All times should be in minutes not hours, with precision down to a tenth of a decimal, for a more granular view of the problem.

One can also look at unit ops as VE (value enabling), VA (Value Producing or Value Added) and NVA (no value added, such as a conveyor that simply needs to get product from point A to point B without inducing any quality defects).

### **A proven technique in manufacturing comes to packaging**

Typically OEE is confined to the production or packaging process, but does not need to be. Making, distribution, etc. could be included or viewed separately, but the boundaries must be clearly defined and the approach standardized across all lines and plants. Exercise caution

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## How to calculate Overall Equipment Effectiveness: A practical guide

when using and/or comparing inter-company OEE values because they maybe useless if the boundaries are different.

In fact, OEE was embraced by manufacturing industries, from automotive to electronics, long before it trickled down to packaging. It is a proven technique, with extensive resources available in the marketplace, and a useful methodology that can be applied to the smallest operation with manual data collection to the largest organization with sophisticated OEE software tools and automated data acquisition systems. And OEE is one of the major applications justifying the investment to implement PackML (Chapter 5). ■

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## CHAPTER 4

# How to justify capital projects: Speaking finance gets results

*Engineering and information technology managers who learn to speak the language of finance find the path to approval for automation projects. It's easier to convince people when you talk their language.*

**By Gary Mintchell**  
Editor, Automation World

*Note: This article is as relevant today as it was in 2003 when first published. It has been updated with improvements from the Playbook's editorial advisory board.*

For technical managers, it seems like a “no brainer.” Applying new technologies will make the process better, faster and more consistent. Then the inevitable happens—the capital review team, whose members may not know a proximity sensor from a pressure transmitter say, “No money available.”

Keith Campbell, veteran of Hershey's engineering management team with many years of experience justifying automation expenditures, says, “Do it in their language, it's easier to convince them.”

Shrewd managers make capital decisions based on return on investment. You have to show them how your project will impact the bottom line. If you can't show the monetary justification in the language of finance, you'll never convince them.

## Different languages

This language has terms like cash flow, capital and interest. Campbell, who reveals these definitions later, advises, “You must identify the positive cash flows you create with a new

## CHAPTER 4

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## How to justify capital projects: Speaking finance gets results

system, and then, using your company's method for calculating cash flow, do the math."

Even if we are on a solid footing with the language of finance, we may not be so good at seeing our projects through an investor's careful eyes. Peter Martin, vice president of Invensys, a Foxborough, Mass., supplier of process controls and software, says, "When you are justifying automation, it's important to remember that it's an accounting problem. It is possible to solve the accounting problem through engineering principles, however. For instance, where is the biggest cost accounting database in manufacturing? It is information from all the sensors in the production process." In other words, tap into the data you have, and translate them into financial numbers. (See Chapter 3 which discusses use of familiar units when stating OEE results. It's an easy step to move from units to unit cost, for example).



Technical managers may be sitting on a gold mine of cost detail that can be used to determine where the manufacturing problems lie, as well as the crucial data that can be used to figure out the best solution—and how to get through the financial maze to approval.

This advice directly leads to the conclusion that bringing a finance person into the automation buying team will reap huge rewards at the justification stage. This person would be involved in the analysis at all stages of the project, and will be well positioned to translate benefits into the correct numbers.

Why is there such an emphasis on financial analysis these days? Steve Loranger, area vice president for Emerson Process

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## How to justify capital projects: Speaking finance gets results

Management, an Austin, Texas-based process controls supplier, notes the changing value of automation over the last 25 years. "Automation drivers from the 1950s to 1975 went from pneumatics to electronics by emphasizing speed of operation and labor improvements with limited automation improvements. Drivers from 1975 to 2000 were repeatability and quality. During this time, computers went mainstream, there was improved control and information integration became essential. Now, drivers are economics and business optimization, due to globally integrated manufacturing and activity-based cost accounting."

A new automation project can be designed to solve any of a number of problems in the plant. The sidebar accompanying this article provides several areas of improvement that can result from the project. Some of the areas can be hard to quantify, but it is essential to try to cost-justify as many as possible.

For example, it may seem hard to quantify safety and ergonomic improvements that result from improved automation. But safety and insurance experts may be able to help document savings that can include anything from avoiding lost work-days to lower insurance premiums. Boston-based Liberty Mutual released its 2003 Fall Workplace Safety Index, and concluded that the financial impact of workplace injuries in the United States is growing faster than the rate of inflation.

Insurance premium savings are certainly welcome, but a greater value to an investor is reducing risk to future earnings. Failure Mode Effect and Criticality Analysis is a powerful tool that can be used to demonstrate the risk of a catastrophic safety event involving loss of life or limb. More often than not, risk elimination will strengthen the case for capital approval.

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## How to justify capital projects: Speaking finance gets results

### Lifecycle costs

Bill Egert, engineering vice president of Addison, Ill.-based integrator Logic One Consulting, and member of the Board of Advisors for the Robotics International division of the Society of Manufacturing Engineers, advises calculating all of the costs associated with the life cycle of machines. He notes, “Check out costs associated with changes. For instance, on robotics, evaluate the tooling changes needed to support product changeover plus auxiliary equipment such as feeders, conveyors and workstations associated with material handling.”

Don’t dismiss employee turnover or morale as a factor that can’t be quantified. Egert reveals, “We had a printed circuit board assembly machine with robots where the component lead straightness was specified. But the manufacturing of one of the components, a relay, was sent to Mexico in order to save costs. Constant employee turnover in that plant caused quality problems including solder buildup or tape missing over a hole. The problems just couldn’t be controlled.”

This organization clearly suffered because the decision to source in Mexico did not take into account quality tolerances. Compounding the problem, operations and finance folks couldn’t team up to demonstrate the cash impact of the scrap and productivity loss.

Justification is technology independent. The same rules apply to buildings, automation systems and computer systems, and to various scopes such as the entire project, just a portion of a project or even when evaluating competing quotes.

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## CHAPTER 4

continued

### How to justify capital projects: Speaking finance gets results

Campbell says the fundamentals of justification include these steps:

- Identify the base case
- Identify alternatives to the base case
- Determine cash flows associated with the alternatives vs. the base case
- Use your company's financial rules to evaluate the alternatives (payback period, net present value, rate of return, hurdle rate).

The base case is the current state of affairs. Include all the financial data that can be compiled. Then, having identified the correctable problems, document various alternatives to the base case.

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## How to justify capital projects: Speaking finance gets results

Quantify all the risk, benefit and loss factors that you can. Take a balanced approach addressing significant pros and cons to demonstrate your thoughtfulness and enhance your credibility. Calculate the numbers and compare to the company's financial rules. Those results can then be compared to determine the best alternative to present to management for funding.

Because projects are expected to pay back funds over several years, it is important to find a way to normalize the amounts in order to keep the analysis in proper perspective.

### Present value

The first step is to determine the present value, which is defined as the value of all future cash flows discounted at the cost of capital, minus the cost of the investment. Discounted means that a future cash flow is worth less (discounted) than a present cash flow.

So, \$100 received three years from now at 8% cost of capital is the same as receiving \$79.38 today.

The Net Present Value (NPV) is the present value of all future cash flows discounted at the cost of capital, minus the cost of investment. Cost of capital is a weighted combination of the cost of debt (long term debt and leases after tax) and the cost of equity (preferred and common stock). All future cash flows means that the PVs are summed over some time horizon, often 5 or 10 years. Subtract the cost of the initial investment from the sum of the PVs to get NPV. The greater the NPV, the better the investment.

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## How to justify capital projects: Speaking finance gets results

What if the company just took the funds and invested them? A valuable comparison is the return due to the business investment versus an anticipated return from automation project investments. The Internal Rate of Return (IRR) is the interest rate that equates the present value of future cash flows to the investment outlay. The IRR assumes that cash flows can be reinvested at a rate equal to the IRR.

The hurdle rate is the minimum rate of return to justify an investment. This includes cost of capital, risk premium (which will include analysis of the track record of the group asking for money, type of investment and allowance for overruns), and other factors such as working capital requirements.

Calculate the cash flows and rates of return for all of the alternatives and then the best solutions will pop out. If the numbers don't make the hurdle rate, then re-evaluate the benefits. (Microsoft® Excel® has functions that easily calculate NPV as well as payback and IRR justifications).

Emerson's Loranger discusses the analysis from a slightly different point of view. See the graphic "Connecting The Balance Sheet And The Income Statement." The balance sheet is where assets and liabilities are tabulated and the income statement is where income and expenses are calculated. The analysis entails comparing the Return on Invested Capital (operating earnings from income statement divided by invested capital shown on balance sheet) to the weighted average cost of capital, or hurdle rate. The difference is the economic value added.

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## How to justify capital projects: Speaking finance gets results

Analysis is good, but often engineers looking at automation projects become infatuated with new technologies and fail to match the project up with business strategies. As Loranger shows in the Business Planning Framework graphic, technology managers find their comfort zones in evaluating automation technology alternatives. The profit zone for the business, however, lies in meeting or exceeding plant, production and business objectives. So, when looking for projects with the highest probability of approval, make sure that they align with one or more of the objectives in the Profit Zone.

### Train managers

Logic One's Egert offers some additional tips on putting together a justification package. "Get management trained on technical aspects," he states. "They have lots of knowledge and experience on finance and marketing, but not much on technical aspects."

A progressive, smart manager will have those technical people. A manager with technical skills will be able to see some problems coming." Another problem is management embracing new technology with no strategy for implementing, no urgency for training or no technical champion to embrace and learn the new stuff.

It's not just a matter of providing training in some cases, but whether the workforce has the basic background skills to make training a practical option.

One approach that might change all of the calculations would be to lease new equipment, rather than purchase it. Paul Frechette, president and chief operating officer of Key Equipment Finance, commercial leasing services, a Superior, Colo. unit of Key Corp., says, "80 percent of

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## How to justify capital projects: Speaking finance gets results

American businesses lease equipment. They do it understanding that it is use of equipment, not ownership, that creates profits. Leasing from the vendor or from a lessor experienced in the field often yields the best deal, because they understand the value of the residuals (the value of the equipment after the term of the lease is over). The bigger lessors have been doing this for a long time and want repeat business, so they treat the residuals well. Their goal is to become trusted advisors.”

Assistance in evaluating leasing options is available from equipment sales people. Another resource close at hand would be people in the company’s own finance department. They probably are already leasing equipment and have the process figured out. ■

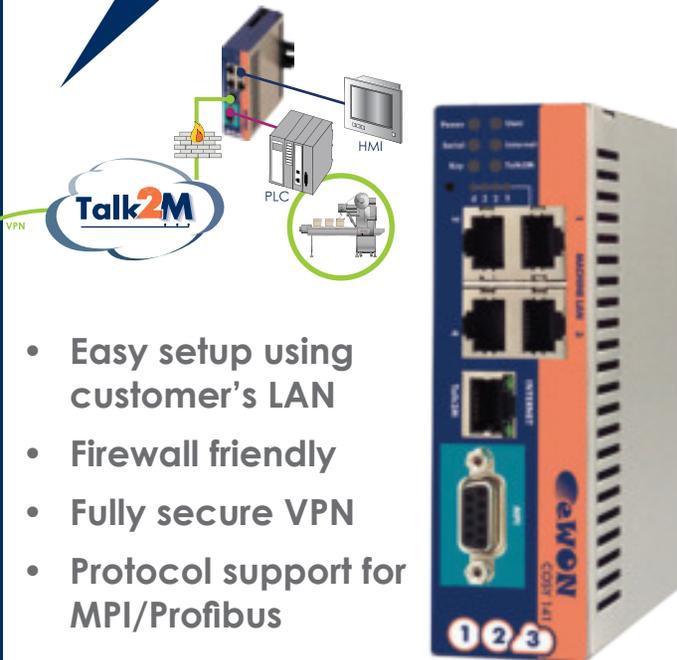
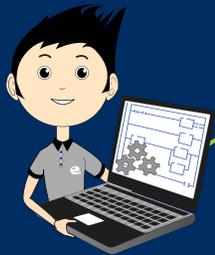
## Who are you competing with internally for dollars?

Make sure your project proposal appeals to your company’s, your business unit’s and your project stakeholder’s priorities. After all, you are competing for the same capital as everyone else. This isn’t political. This is survival. Don’t let that ‘green roof’ win over your packaging line!

- Sustainable packaging – what will really do the most to reduce your ‘total system carbon footprint?’ Will it be that green roof proposal, or your line that will run lightweighted packs with less scrap and less energy? Packaging lines won’t make the same photo opp that



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### How to justify capital projects: Speaking finance gets results

goats munching turf on your plant roof will – but your Chief Sustainability Officer should like your numbers better.

- Will your proposed system save water, compressed air usage, electricity, and/or floor space that must be lighted, heated and cooled? Most plants today face corporate mandates to hit reductions in all these resources, and every bit helps.
- Consider distributed drive technologies that reduce the heat buildup inside electrical cabinets and eliminate the need for costly air conditioning and filtration, along with reduced floorspace. To maximize energy efficiency, also consider high efficiency electrical power supplies, regenerative power supplies for servo drives, and a common DC bus between servo drives.

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## How to justify capital projects: Speaking finance gets results

- How easily can your packaging system be reconfigured if the intended product line goes away? This is where automation can actually help the product marketers mitigate the risk of their program proposal.
- How is your company investing in growth markets? Could your automated line be readily deployed and supported worldwide with little or no modification, following international electrical and safety standards as opposed to the local site's internal standards? That could be a big plus.
- Headcount impact – programs that increase headcount don't fare well during a hiring freeze. Increasing capacity without increasing labor is a good justification. But automation that can efficiently scale throughput up or down with reduced attention from plant personnel sounds like a real winner.
- Don't forget convergence (Chapter 1) of advanced technologies and best practices that have a positive impact on seemingly unrelated aspects of operations. For example, implementing integrated safety doesn't just make a packaging line safer, it means more uptime which results in measurable Overall Equipment Effectiveness (OEE) improvements. And today, the safety network can be same network that links machinery together on a line, which also improves OEE. ■

CHAPTER 5

## Why PackML is good for packaging lines

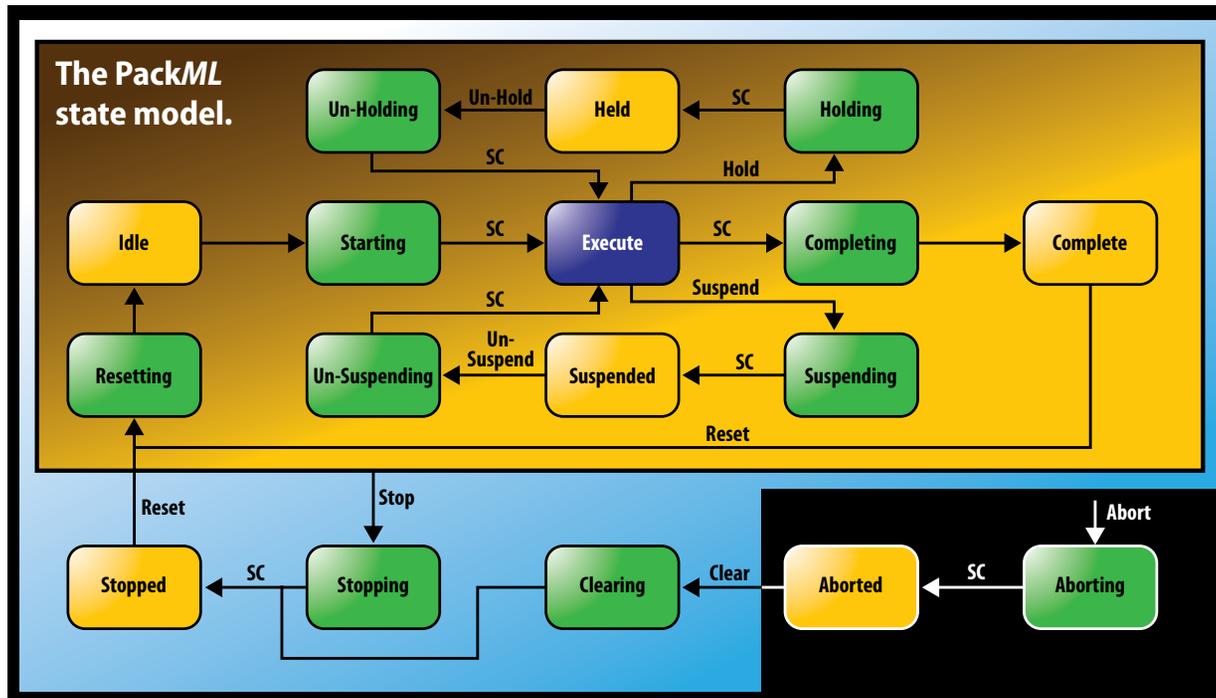
### PackML state model demo

DOWNLOAD THE DEMO >>

Download an interactive Excel demo that shows how the state model works.

<http://bit.ly/packml-demo>

What is PackML? Simply, it is a standardized way of looking at machine states, operating modes and tag names plus a modular approach to machine control code. It is being incorporated into ISA 88, the standard that for nearly two decades has proved its viability in the process control world.



For an in-depth description, links in this chapter will show you how to purchase the ISA documentation, see a demo on the OMAC website, and find the Wikipedia page describing the history and fundamentals of PackML.

Bottom line – PackML will make it easier for you to get consistent data out of machines on a packaging line from different OEMs and implemented using different control systems. It gives operators and technicians a common look and feel. It also promotes modularity, which, properly applied, streamlines programming and troubleshooting.

## CHAPTER 5

continued

### Why PackML is good for packaging lines

**PackML defined**

**LEARN MORE >>**

In this Wikipedia entry, see some of the development history, objectives and PackML functions.

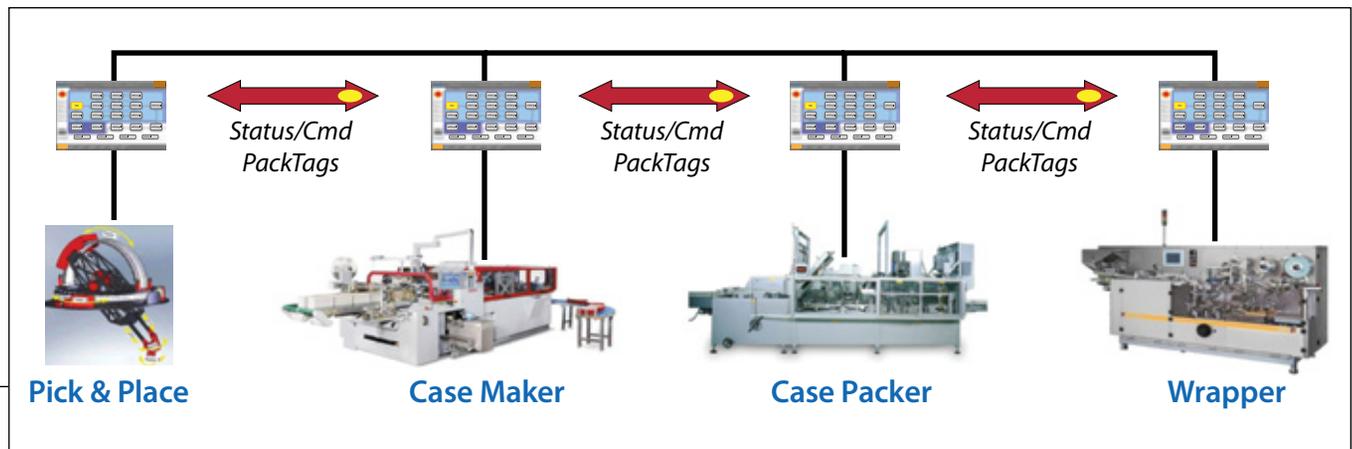
<http://bit.ly/packml-defined>

Nestlé has demonstrated the use of PackML as a unifying standard that lets discrete pieces of packaging equipment communicate freely with each other even though each machine has a controller supplied by a different technology provider.

On a solitary machine this is interesting. But start producing lots of machines or installing lines, and the economies of scale really favor those who've adopted PackML. Start looking to gather production data for OEE or MES in a multivendor environment and PackML becomes a must-have.

What PackML *isn't* is rocket science. PackML merely standardizes commonly used machine modes, states and tag names. The fact that every machine builder, software supplier and integrator has in the past had to develop their own incompatible terms is why PackML exists...as well as why some of these suppliers are reluctant to give up their proprietary solutions.

It is important to note that PackML does not impinge on a machine builder's intellectual property, it simply standardizing aspects of communication the way that Ethernet TCP/IP did for non-realtime networking.



## CHAPTER 5

continued

## Why PackML is good for packaging lines

Nestlé's Bryan Griffen, chair of the OMAC Packaging Workgroup and OMAC board member, has made it clear in a number of public speaking engagements that PackML will play a key role in Nestlé's efforts to bring greater efficiency to its packaging operations.

### PackML benefits: a snapshot

PackML stands for the Packaging Machinery Language. It provides a standardized way to collect uniform data across machines, lines, shifts, plants and business units. This uniformity is essential to productivity-enhancing initiatives such as Overall Equipment Effectiveness (OEE) analysis and to simplify MES functions.



Essentially, PackML is a simple concept that standardizes key data point acquisition across different makes of packaging machinery. It reduces the learning curve for plant personnel by providing a common look and feel. PackML is independent of the control system vendor or programming language in use. It integrates readily to business systems with OPC, and promotes standardized, flexible data sets.

The machine builder's initial investment is reusable across machines, which reduces subsequent software development costs and time to market, while reducing the amount of customized code to test and thereby increasing reliability. It predefines machine interface, integration and startup. It also simplifies after-sale support.

**CHAPTER 5**

continued

**Why PackML is good for packaging lines**

P&G corporate engineers Jason DeBruler (left) and OMAC board member Dan Amundson (right) re-programmed a Pace bottle unscrambler so that it would be compliant with the ISA-TR88.00.02 standard, also known as PackML.

**PackML at Procter & Gamble**

**LEARN MORE >>**

How P&G re-programmed an unscrambler to be PackML-compliant.  
<http://bit.ly/packml-pg-unscrambler>

Packagers benefit from PackML by including it in their electrical specifications and requests for quotation. The greatest benefits come from integrating entire packaging lines so that individual machines, machine-machine communications and line control and data acquisition are standardized.



**Criteria for specifying PackML**

The problem is that if it isn't broken, no one wants to spend money fixing it. So, when does it make the most sense to include PackML in your specification?

- When ordering a new packaging line
- When retrofitting an existing line
- When working in a multivendor environment
- When implementing 6 sigma or lean projects

Currently, the OMAC PackML committee has an initiative to document potential cost savings for implementing PackML simultaneously with best practices for software modularity. At least one OEE technology provider, Zarpac Performance Index, is investigating how to incorporate the cost impact of implementing OEE through PackML data interfaces (for more see Chapter 3).

## CHAPTER 5

continued

## Why PackML is good for packaging lines

### PackML World Tour

[LEARN MORE >>](#)

Learn about the World Tour.

<http://bit.ly/packml-world-tour>

### Order the standard

[ORDER TR 88.00.02 >>](#)

TR 88.00.02 is the official ISA Technical Report that provides the PackML state models, modes and tag names.

<http://bit.ly/order-packml>

## The PackML World Tour

Recently, some packaging machine builders who've implemented PackML teamed up with OMAC and PMMI to promote the business benefits of PackML to P&L stakeholders at consumer goods companies.

This has taken the form of The PackML World Tour, which began in 2010 to demonstrate the business benefits of the standard.

The Tour continues today as a function of the OMAC PackAdvantage committee. Users are invited to request a 'tour stop' at [info@omac.org](mailto:info@omac.org). Machine builders and systems integrators who've implemented PackML are invited to join OMAC as corporate members and request to participate in The PackML World Tour.

## Order the standard from ISA

TR 88.00.02 is the official ISA Technical Report that provides the PackML state models, modes and tag names. But don't expect it to be called PackML. It's an international standard that can actually be applied to any discrete control process. The other half of the standard is in progress, called ISA 88.05, and it promotes modular control architectures. ■



CHAPTER 6 - SPONSORED SECTION

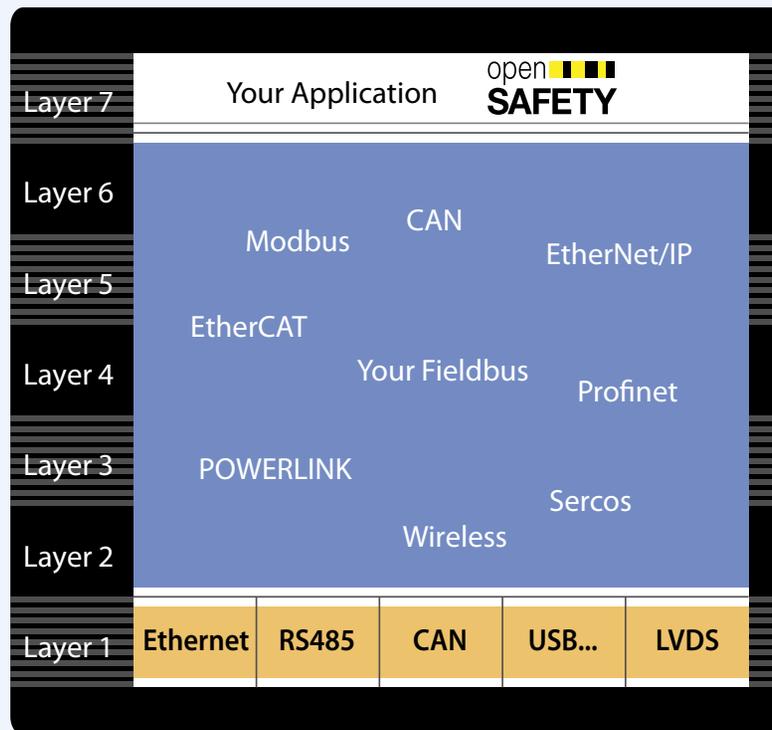
# A new standard for networked safety

*Here's how to support a single IEC recognized safety protocol extension that runs on the application layer of all your favorite fieldbuses. You'll help save a generation of unnecessary cost and complexity.*

**By Stefan Schoenegger**  
Ethernet Powerlink  
Standardization Group

**TAKE-AWAY:** Specify safety in terms of integrating the entire line, not individual machines. Integrate line control and safety over the same network, with advanced safety functionality as described in IEC 61784-3. You'll gain a new level of performance and flexibility, not just safety compliance.

In the mid 1990's, the automation world faced a phenomenon known as 'fieldbus wars.' In the absence of a single, internationally recognized industrial network standard, various automation suppliers filled the void with their own digital networks, which we live with today – EtherNet/IP, DeviceNet, Modbus, Profibus, Profinet, Ethernet Powerlink and many more.



Then, there appeared to be hope for standardization with the rise of industrial Ethernet around the turn of this century. Unfortunately, all that happened was the migration of the surviving fieldbus application layer protocols to Ethernet cables.

Today's major network development is safety. Even now, safety circuits on packaging machines are still largely hardwired devices – complex to install and troubleshoot, with limited functionality. Then came the safety PLC, but cost largely kept builders of



## CHAPTER 6 - SPONSORED SECTION

continued

## A new standard for networked safety

### Request for conformance sample language

DOWNLOAD  
REQUEST >>

Download this Request for Conformance sample language and append to your User Requirements Specification to get your suppliers on board with openSAFETY.

<http://bit.ly/opensafety-conformance>

individual, isolated machines from adopting the programmable technology.

Now, the same network that controls the machine — or even the entire packaging line — can provide communications for safety processors, safety devices, safety I/O modules and safe drives.

So this time around, there's no need for 'fieldbus wars.' There is a single IEC approved standard, in the public domain, that can run as an open protocol on the application layer of your network of choice. The advantages are huge and benefit the entire packaging community – users of machinery, device manufacturers and machine builders – who must otherwise learn and support multiple safety networks.

The standard, called [openSAFETY](#), is available from the Ethernet Powerlink Standardization Group ([EPSPG](#)). In addition to Ethernet Powerlink, EPSPG has implemented fully functional openSAFETY solutions based on Modbus TCP, EtherNet/IP, Profinet and SERCOS III, which will likely lead to rapid growth of the [SIL3](#) certified safety protocol.

openSAFETY is certified according to [IEC 61508](#), the protocol has been approved by national IEC committees representing over two dozen countries around the world, and has been released for international standardization in [IEC 61784-3 FSCP 13](#).



## CHAPTER 6 - SPONSORED SECTION

continued

## A new standard for networked safety

**Video: why Nestlé wants an open protocol for safety such as openSAFETY**



This video, shot during a panel discussion at the interpack trade show, covers many trends in packaging, including the need for an open safety protocol.

<http://bit.ly/nestle-video>

## Benefits of specifying modern safety technology

In the past, an e-stop meant dropping out the power, which generates wear and tear on both the electrical and mechanical systems. It also meant the machine stopped at whatever point in the cycle it was in when the power went out.

With integrated safety systems now available, drives can come to a stop under control, without a full machine shutdown. That allows various kinds of stops to be made, ranging from completion of the last cycle to a fast but gentle idle. The machine or production line does not need to be re-homed and jams can be avoided.

With intelligent, decentralized and integrated safety technology, it is also possible to respond more rapidly than ever and provide safety without necessarily shutting off electrical power and stopping the production process. Various safety processors may also perform safe configuration management, safe parameter management and safe application processing functions – central to the range of machine safety concepts.

## What do specifiers need to do?

Early adopters who want first mover advantage by implementing an openSAFETY-based safety solution with their existing data communication system should download and append language similar to the supplied Request for Conformance language to their electrical specification.



## CHAPTER 6 - SPONSORED SECTION

continued

### A new standard for networked safety

#### Download the safety protocol

**DOWNLOAD THE PROTOCOL** >>

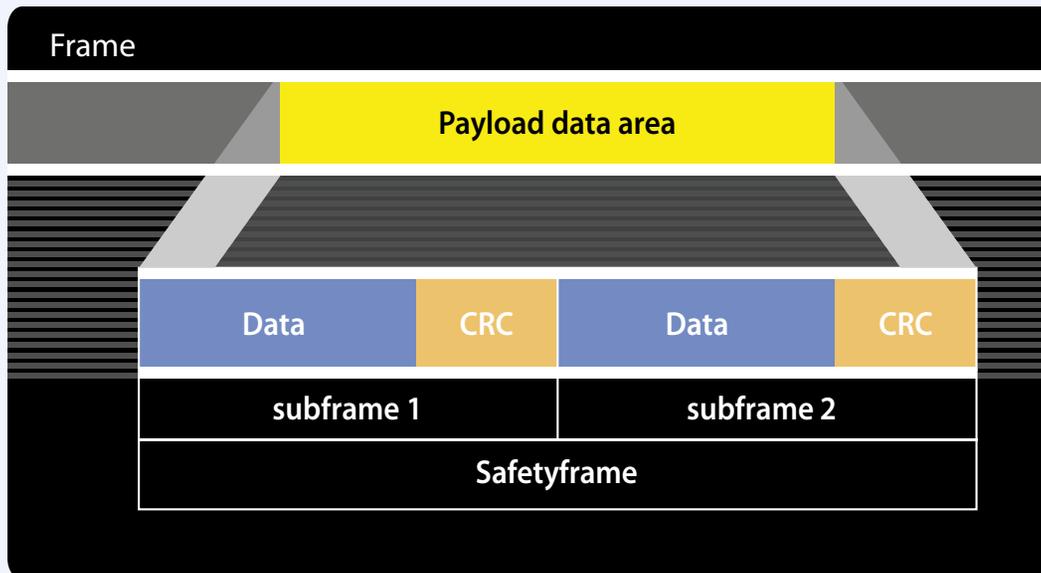
Download the openSAFETY protocol free of charge.

<http://bit.ly/opensafety-download>

The Request for Conformance states that priority consideration will be given to accepted suppliers that (1) integrate the openSAFETY protocol on the application layer of their bus system, and (2) direct their device supply divisions and third party suppliers to develop compliant networked safety devices.

When these requests start coming from a growing number of customers, the commercial equation becomes simple. Demand drives supply and drives down implementation costs.

It's also advisable to join EPSG and publicly support openSAFETY as a number of European companies have already done. The faster, louder and more numerous the support for standards, the faster they are realized.



#### openSAFETY - how it works

Technical assistance can be requested from EPSG. Since openSAFETY is also [TÜV-certified](#), the basis for implementing safe data transfer capability is provided for free and is readily accessible.

openSAFETY provides data transfer definitions, high level configuration services and encapsulation of safety-relevant data into an extremely flexible telegram format.



## CHAPTER 6 - SPONSORED SECTION

continued

### A new standard for networked safety

**Voice your support for openSAFETY**

**SUPPORT openSAFETY >>**

Join the supporters of openSAFETY and be heard!

<http://bit.ly/support-opensafety>

**openSAFETY on Wikipedia**

**LEARN MORE >>**

Read about openSAFETY here.

<http://bit.ly/opensafety-wikipedia>

Faults	Preventive/corrective measures					
	Time stamp	Time monitoring	Identifier	CRC protection	Redundancy with cross-checks	Distinct frame structures
Duplication	Blue					
Loss		Green				
Insertion			Cyan			
Incorrect sequence	Blue					
Delay	Blue	Green				
Distortion				Blue	Yellow	
Mix-up of standard and Safety Frames						Green

openSAFETY uses a frame with a uniform format for payload data transfer, configuration and time synchronization. Frame length is simply contingent on the amount of data to be transferred. The safety nodes on the network automatically recognize the content, so frame types and lengths do not have to be configured.



## CHAPTER 6 - SPONSORED SECTION

continued

## A new standard for networked safety

### Safety consortium defines openSAFETY as standard

LEARN MORE >>

DDASCA, a safety consortium, whose members include the parent company of Airbus and the French National Railway, has adopted openSAFETY, according to a report by *Industrial Ethernet magazine*.

<http://bit.ly/ddasca-opensafety>

### Automatic safe parameter distribution

One highlight of openSAFETY is the automatic safe distribution of parameters: the protocol enables storing of all configuration details for safety applications, such as light curtains, in the safety controller. If a device is exchanged, the safety controller automatically and safely loads the stored configuration onto the swapped application. Users do not need to manually configure the new node when they replace a safety device.

### No faults go undetected

openSAFETY uses checksum procedures to perpetually examine whether transferred data content is incomplete. It constantly monitors the data transfer rate. Due to extremely short cycle times, failures are detected almost without delay.

The table shows what types of transmission errors may occur and explains the mechanisms openSAFETY uses to identify or prevent these faults.

### Structure of an openSAFETY frame

openSAFETY duplicates the frame to be transferred and conjoins the two identical frames into one openSAFETY frame. Hence, the openSAFETY frame consists of two subframes with identical content.



## CHAPTER 6 - SPONSORED SECTION

continued

## A new standard for networked safety

**ARC analyst reports on openSAFETY from European automation trade show**

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David Humphrey reports on openSAFETY as one of the 'big trends' at the 2011 SPS/IPC/Drives show.

<http://bit.ly/arc-opensafety>

Each subframe is provided with an individual checksum as a safeguard. The receiver compares the identical content of the two subframes. The probability that the same data is changed or destroyed in two such subframes is extremely low, and even lower as the frame length increases.

That said, even in such an extremely unlikely case, the checksums still serve as a corrective action. The special format of openSAFETY frames, with their two subframes and their own individual checksums, also makes "masquerades" extremely unlikely to occur, and precludes any erroneous processing of a masked standard message.

### The openSAFETY network

An openSAFETY network may contain up to 1023 safety domains, with up to 1023 nodes or devices permitted within each of these. Safety domains can extend over different and non-homogeneous networks, and can integrate safety nodes that are scattered throughout these into one domain. Safe and unsafe devices can be operated within one domain.

Gateways allow for communication between different safety domains. openSAFETY enables users to enforce hierarchical separations as well as to establish separate safety zones on a network. Therefore, service can be performed in one zone while production in other zones carries on uninterrupted. In every domain, a Safety Configuration Manager (SCM) is responsible for continuous monitoring of all safety nodes. ■



## CHAPTER 7 - SPONSORED SECTION

# Seven simple solutions for designing on-machine 'help' systems

*The time has come to make HMI more effective self-learning tools. Consider hiring a computer graphics intern or recent graduate to define your requirements using established best practices for User Centered Design.*

**By Joe Faust**

**B&R Industrial Automation  
Packaging Solutions Group**

**TAKE AWAY:** Interactive on-machine help systems still need to follow 7 fundamentals regardless of their sophistication.

The future of operator interfaces will clearly follow the consumer market with intuitive, interactive help systems using video and animation, and even soon-to-be-introduced industrial HMI touch panels with multi-finger gestures.

However, the industrial present, for the most part, consists of limited freedom of design due to touch screen construction and a range of stop-gap documentation methods due to the relatively high cost and low functionality of both the HMI hardware and software.

As a result, operators try to find work instructions scrolling through a pdf document of the print manual on a 6" screen. Perhaps there are additional photos or even a PowerPoint® show. But with a limited Windows™ CE operating system or simply no budget for the machine builder to develop more effective systems, this is too often the reality.

This reality is beginning to change with the introduction of higher performance, lower cost industrial PCs, some benefiting from Intel Atom® processors, others from powerful dual or even Intel® Core™ i class processors. It's no problem for these machines to run Windows™ XP Embedded or even Windows™ 7 and support a full range of graphical tools.



## CHAPTER 7 - SPONSORED SECTION

continued

### Seven simple solutions for designing on-machine 'help' systems

The ultimate in on-machine help systems: immersive, 3D animation.

Photo courtesy of [Product Animations, Inc.](http://Product Animations, Inc.)

But let's stand back for a moment. Regardless of how sophisticated or straightforward your help system, the fundamentals don't change. Here are seven simple rules to make every help system more effective.

True, they're broken every day. But they shouldn't be.

If you are involved in the design, sales or support of machinery you can start by writing the seven one-liners on the white board. Assemble your team and ask them what these statements mean to them.



If you are a machinery buyer, specifier or maintainer, consider lifting these seven rules word-for-word and adding them to your user requirements specification. That was easy, wasn't it?

### 1. The help system should be context sensitive

That is, it should never just be a document to page through. And yet, many help systems are just that. Based on HMI screen content, pressing the 'help' button should open the help system to the appropriate information.



## CHAPTER 7 - SPONSORED SECTION

continued

## Seven simple solutions for designing on-machine 'help' systems

### Download these seven steps

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WORD DOCUMENT >>

Download a Word document containing these steps so that you can integrate this language into your user requirements specification.

<http://bit.ly/help-systems>

One scenario would be, based on the alarm that's currently active, the help button should open the help system to the appropriate solution tree or procedure to remedy the situation.

The OMAC PackML alarm tags provide an existing means to standardize and organize alarms and response.

Another scenario would be, if no alarms are active, the help system should open up to an overview description of the screen that is currently active.

Every screen must provide clear navigation to the help system. In a potential downtime situation, the operator should not have to figure out how to access the help system.

## 2. It must be multi-lingual

The help system should present information in the language of the operator. In the case where the HMI is multilingual, the help system should automatically select the same language as the machine operating screens. No additional user intervention should be required.

## 3. It must be audience-specific

Based on the "user class" of the person at the machine, the information presented to the user should be appropriate. Information pertinent to other user classes is a distraction and should not be presented. That is to say, if a user is logged into the HMI as an "operator". The



## CHAPTER 7 - SPONSORED SECTION

continued

## Seven simple solutions for designing on-machine 'help' systems

help system should display only tasks he or she can perform or information pertinent to their duties. Don't present information on tasks that only a "maintenance" user can perform.

The user class may be interpreted as a security level in some applications.

### **4. The system should allow help information to appear on multiple display devices**

The display devices may be multiple HMIs on the same machine. They may also be different hardware platforms, such as PCs, tablets and smart phones.

Each display device should be capable of navigating the help system independently. Two people navigating through a help system, on separate devices, should not interfere with each other.

Machine mounted display devices should take into consideration the viewing angle of the user. An example of this would be: If an operator is standing at the HMI and the product flow through the machine is left to right, the diagrams on the HMI should depict the machine with product flow also left to right. This is a concern when HMIs are located on both sides of a machine and when machines are installed on left and right legs of a line. Mobile display devices present the same concern.



## CHAPTER 7 - SPONSORED SECTION

continued

## Seven simple solutions for designing on-machine 'help' systems

### 5. It should have the ability to be hosted locally or remotely

A single centralized help system information repository should be maintained. This is to avoid conflicting or incomplete information in disparate systems.

For non-networked environments, the help system should be capable of running 'stand alone' on the machine for which it is intended. For networked environments, the system should be capable of being hosted on a central server.

No content changes or application changes should be required to support these two environments.

### 6. Help system content should be developed utilizing qualified technical writers

Control engineers should not be utilized to develop help system content. Instead, they should be used as a resource to technical writers during system development and testing.

Control system resources used by the Help System should be limited, thus limiting impact on control system performance. This also minimizes chances of a control system change affecting the help system information viability.



## CHAPTER 7 - SPONSORED SECTION

continued

Seven simple solutions  
for designing on-  
machine 'help' systems

## 7. Help system content must reflect the requirements of the machine's risk assessment

The risk reduction methods prescribed in the machine's risk assessment must be described in the help system. If the help system directs the user to perform a task that has particular hazards, care must be taken to indicate those hazards in the help system. This is particularly true when the help system is taking the place of a printed manual. ■

*The author, Joe Faust, has extensive experience as an electrical engineering manager in the packaging machinery industry, including the development of groundbreaking servo machines and the development of PackML-based control software.*



## CHAPTER 7 - SPONSORED SECTION

continued

Seven simple solutions for designing on-machine 'help' systems

For on-machine help, sophisticated doesn't mean complex. It means *simple*

By **John Kowal**, B&R Industrial Automation, Packaging Solutions Group

Believe it or not, a panelist at a recent PMMI conference stated that his company still has manufacturing plants in the United States that don't allow servo packaging machinery. An ongoing discussion on the LinkedIn Packaging Machinery Group debates servo versus mechanical machines, with posts coming from emerging economies saying they are not equipped to handle servos.

Does it seem shocking that this is going on two *decades* after the introduction of servos to packaging machinery? And a good sixty years after the introduction of the NC (numerical control) machine tool technology that ushered the servo concept into manufacturing?

Thanks to environmental regulations, there is not a purely mechanical farm tractor, truck, car, locomotive or lawn mower for sale in or export from the Western world. Computers are embedded in virtually every new car, yet these cars manage to operate in the most remote parts of the world.



## CHAPTER 7 - SPONSORED SECTION

continued

## Seven simple solutions for designing on-machine 'help' systems

### Progress means de-skilling technology for the world

Perhaps it is not the greater availability of mechanical versus electronics and software maintenance skills that should dictate the design of our packaging machinery. Instead, like cars, we should make the front ends of packaging machines much more accessible *without* special skills.

If we do this, we will accomplish far more than simply solving the chronic shortage of skilled labor. That's because all of the benefits of what we term mechatronic designs are as valid in Africa as in the EU – greater efficiency, simplified changeover, traceability, energy conservation and safety to name a few.

As an industry, we are taking steps in the right direction. Take Nestlé's watershed announcement that it will support the OMAC Packaging Guidelines in its global packaging operations. In so doing, this food giant sets the direction toward standardized machine control processes that apply across the world.

### Shift focus from the controller to the HMI

Start the simplification process by restricting access to machine control source code. Instead, specify more sophisticated expectations for HMI – so that troubleshooting and simple parameter changes can take place at the operator panel within specified limits.



## CHAPTER 7 - SPONSORED SECTION

continued

## Seven simple solutions for designing on-machine 'help' systems



**KHS wins Red Dot award with customized HMI**

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Functionality and best practices in HMI design bring clear advantages of less machine downtime, faster product changeovers and shorter training times for system operators.

<http://bit.ly/khs-hmi>

Yes, make that code *inaccessible* to first line maintenance staff...while you add a more sophisticated layer of interactive software to the HMI that operators and techs will *automatically* see when a limit is approached.

Just as an automotive technician plugs into the car's diagnostic computer or a copy machine indicates how to clear a jam, we actually need *more* sophisticated software to simplify operation and maintenance.

For example, recipe management will simplify setup changes. Selecting changes in packaging materials, sizes, speeds, fill volume or weight from a menu also protects the machine and program from unnecessary and unauthorized adjustments.

Consider using a control platform that uses compiled code. Compiled code prevents people from 'tinkering' with machine control programs. There has been a legacy of PLC programs that are readily accessible to front line maintenance techs. The irresistible urge when troubleshooting is to get in the program and see if changing something will make the problem go away.

For example, increasing the dwell time for a heat seal bar may make the problem go away initially because it *masks* the root cause. But ultimately addressing the symptom instead of the cause may lead to increased degradation of performance, increased energy consumption, and perhaps a catastrophic failure down the road.



## CHAPTER 7 - SPONSORED SECTION

continued

## Seven simple solutions for designing on-machine 'help' systems

It also doesn't hurt that compiled code, together with mechatronic design, are potent protections from those who would steal intellectual property.

### **Multinationals need to address the lowest common denominator**

In most of Africa, manufacturers are simply not going to find the skills needed any time soon. In Vietnam, you face new language barriers on the plant floor, even if you have just translated your software for the Chinese market.

And it's an uphill battle to entice a new generation to become automation technicians, either in North America or among the aging populations of Europe and Asia.

Instead, shouldn't we be investing in animated, immersive, interactive, graphical interfaces for our machinery? Shouldn't we be engaging machine builders, automation suppliers and our educational system to make this happen now?

### **A new rule of thumb: usability or heuristics**

*Every aspect of troubleshooting should be accessible from the operator panel with a minimum clicks or touches.* It should not be necessary to refer to tiny pdf files to troubleshoot a machine.



## CHAPTER 7 - SPONSORED SECTION

continued

## Seven simple solutions for designing on-machine 'help' systems

There is a simple term for this kind of best practice in the mainstream computing world: usability. There are specialists in usability or heuristics in the tech world, so it would be relatively straightforward for packagers to define higher standards for those control panel screens and calculate the ROI.

There are even applicable standards. ISO 9241 Part 11 defines usability and ISO 13407 provides a degree of guidance for designing usability into an interactive system exhibiting User Centered Design.

Perhaps the time has come to consider hiring a computer graphics intern or graduate to develop your next generation HMI specification. ■

*John Kowal serves on the OMAC and PMMI boards and moderates the popular Packaging Machinery group on LinkedIn.*

## CHAPTER 8

# 12 topics for effective support agreements

Doing business with a new machinery or controls provider is a long term commitment for both parties. Yet, it can be straightforward and trouble-free when clear expectations are established up front.



Increasingly, Global 2000 companies are requesting corporate support agreements that define mutual expectations and what those resources will cost. These include software licenses, training, spare parts availability, technical service and repair.

Depending on corporate policy, end users may benefit from well-defined quotations that classify whether the costs can be capitalized or expensed should the expenditure extend the life of the capital assets.

Establishing these agreements provides a comfort zone for customers who wish to gain the benefits of new technologies, new suppliers, or established suppliers in new regions of the world. This is especially important as the automation technology content of machinery increases.

Post-sales support approaches vary greatly. Some automation suppliers charge for services such as phone support, and for annual software licenses whether or not the customer seeks

# INTERNATIONAL TRENDS IN PACKAGING

Technology by **THE INNOVATORS**



Every 3 years, the world packaging community comes to interpack to glimpse the future. Hear what a panel of visionaries hosted by B&R at interpack had to say about sustainability, demographics, product integrity, innovation, standards and more.

## CHAPTER 8

continued

### 12 topics for effective support agreements

to upgrade to a new version. Other suppliers may waive subsequent annual licenses, make them optional, and/or charge nominal fees in order to retain or win the business.

Change parts and end-of-arm tooling are a fact of life, and despite the costs, the range of available capabilities of new machine designs may compare favorably to the previous generation of less flexible machinery. Tool-less change parts and servo automation of format changes can also reduce changeover time, labor and parts cost.

Support agreement topics for packagers to address with their suppliers include:

#### 1. Global site support

Establishes capabilities, response times and costs for providing on-site after-sale support at end user sites. The suppliers may offer remote diagnostic services and tools that provide a fast, cost-effective resolution as an

## CHAPTER 8

continued

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## 12 topics for effective support agreements

alternative to traveling to the site. Work closely with IT security to address any concerns with remote network access. Utilize the suppliers' global presence. Communicate your expectation that local support can be called upon wherever the equipment will be installed.

### 2. Training

Training is a two-way street. It is a time commitment on the part of the customer. It is also an investment on the part of the supplier, even though training costs are subsidized by course fees. Lack of customer commitment to training is one of the most oft-cited reasons by suppliers for inefficiencies, both at startup and in ongoing operation.

Some machine builders provide PMMI Certified Trainers, which provides assurance of consistent training, documentation and testing methodologies. PMMI also maintains a Training Community of Practice, a valuable resource for training managers.

Typically, at least a portion of machinery training must take place on the equipment in the production environment. However, automation training can take place largely in the supplier's classroom, away from the distractions of the trainee's workplace.

Some automation suppliers and machinery builders are working to simplify interfaces and provide interactive help tools (see Chapter 7) to reduce training requirements for their customers.

## CHAPTER 8

continued

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## 12 topics for effective support agreements

### 3. Spare parts availability

On a case-by-case basis, the customer and suppliers should agree on a recommended spares package based on experience, specifics of the plant environment, estimated machine utilization, and location relative to supplier stocks.

Some agreements allow the customer to return unused spares in their original packaging after a specified time period, providing peace of mind until the system has proven its reliability.

### 4. Product repair

Uptime is the key for the user, while failure analysis is key for the supplier. But root cause analysis is just as important for users, since component failures are just as likely to be induced by operational issues as by product flaws.

Spares and repairs for critical wear parts should be coordinated so that a component can be quickly changed out and repair does not impact return of the machinery to service. Modular design and attributes of the control system can help minimize change-out times and should be considered during the purchase process.

In the specification (Chapter 2), consider requiring condition monitoring of factors such as torque, energy consumption, vibration, temperature, service intervals, and cycle-based criteria such as B10 bearing life. These capabilities are increasingly standard options in control systems. However, unless specified in the URS, they are not likely to appear in the lowest cost bid.

## CHAPTER 8

continued

## 12 topics for effective support agreements

### 5. Software license fees

Automation software license fees have become a topic among users, as discounted licenses often offered by new suppliers don't obviate the need to keep licenses for the installed base up to date. These are two separate issues.

License costs should reflect the very real cost of ongoing maintenance and development of software products. In general, they should be reasonable and reflect the value they add.

Standards-based software generally offer lower license costs than proprietary software. Software licenses are typically negotiated with the automation suppliers by both users and machine builders.

### 6. Technical support fees

Like software licenses, machine builders and users may negotiate the scope and costs of technical support and maintenance services based on prevailing trends. Technical support should also reflect the value added.

A distinction should be made between expected product support and budgeting for engineering or systems integration services that may be outsourced to assist in specific projects.

## CHAPTER 8

continued

## 12 topics for effective support agreements

### 7. Additional engineering services

Ranging from proprietary modification of new machinery to line integration to retrofits, there are many good reasons to include rates and project management processes for engineering services into a support agreement.

### 8. Long term protection from product obsolescence

Continued availability and scheduled cost increases are both critical aspects of control product obsolescence.

For machine components, parts are generally available unless the OEM goes out of business, and even then, third parties often make a business out of replicating parts for machines 40+ years old.

For controls, however, technological advances can cause relatively early obsolescence. The machine builder or user should investigate the control supplier's record for supporting products after ten years in production, which should be at least an additional ten years, without significant increases in price.

Sometimes, control suppliers use large price increases to dissuade customers from continuing to purchase older products. This practice pits the retrofit cost against replacement parts costs. Online auction sites have become an opportunistic channel for sourcing legacy components, both new and used. Caveat emptor.

## CHAPTER 8

continued

## 12 topics for effective support agreements

### 9. Support for international standards

Various chapters in this guide cite international standards, specifically Chapters 2, 5 and 6. By tying support for these standards into the support agreement, the maximum number of potential suppliers can compete for your business without overburdening your organization.

In the OMAC Packaging Workgroup, adhering to these standards is referred to as a 'win-win-win' situation, meaning it's good for the entire community of packagers, machinery builders and automation technology providers.

The standards referred to in this specifying guide are not intended to impact any supplier's legitimate competitive advantages. They are meant instead to reduce the difficulty of overcoming incompatibilities between functions that are generally available from all suppliers in the marketplace – such as machine communications.

### 10. Documentation

Define your requirements for operating, maintenance and spare parts manuals. Also, include electrical specifications (e.g. schematics) and program backups.

## CHAPTER 8

continued

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## 12 topics for effective support agreements

### 11. Prioritization

Define criteria for prioritizing an issue. For example, a Level 1 issue is something that causes a stop in production. The contract would call for the OEM to respond to a Level 1 issue in a certain time frame. A Level 3 issue may be an inoperable failure, but a workaround is available. The associated time frame would be longer. Support levels are negotiable, but should be defined up front.

### 12. Intellectual property rights

The issue revolves around who owns the intellectual property if the end user develops an innovation for their process and has the OEM implement it. This most often becomes an issue when modifications are made after the equipment is installed. There is no right or wrong answer, but should be negotiated and declared up front.

As with any working agreement, not every contingency can be anticipated. But it benefits both parties to set clear mutual expectations in the form of a contract, particularly when new technology, a new supplier or a new customers are concerned. Support agreements also protect both parties long after the individuals originally involved with the project are no longer involved. ■

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