One of the distractions for your manufacturing team in October is playoff baseball, especially if your hometown team is playing. Unlike the never-ending regular season, in October, fans anxiously follow every pitch, hit and out. Overseeing all that is each club’s manager. Is there any job that’s more strategic, intense and complex than managing a playoff baseball game? Every pitch, run and out is crucial. The strategy changes from moment to moment based on data: the pitch count; strike count; and the number of outs. Do you make your decision based on your data (and they have reams of data now) or your gut instinct?

Unlike managing a playoff baseball game, managing a manufacturing plant used to be simple without much in the way of strategy. Manufacturers are now faced with unprecedented strategic challenges in this Cloud-enabled, Big Data, Artificial Intelligence world. Staffing the factory floor, reducing costs, increasing efficiency and productivity and making technology choices are now exceptionally difficult, strategic challenges in the age of everything online and everything integrated.

One of the biggest strategic challenges is how to get new machines to quickly begin to pay for themselves. The automation world has grown too accepting of the idea that machine integration between vendors of different machines must be complex, laborious and difficult, requiring expensive engineers and incurring significant expense. It’s an attitude that can no longer be sustained, in a time when manufacturers face unprecedented strategic challenges in this Cloud-enabled, Big Data, Artificial Intelligence world.

The largest cost for new equipment is software integration: integration with other machines, with enterprise business systems, and with Cloud applications. Today’s integration process is time-consuming and exceedingly inefficient. Costs rise when the machine is received with a new or different vendor’s programmable controller, a new communication protocol, an unfamiliar HMI, and unique or unusual operating sequences.

Many manufacturers would like to increase the efficiency of their machines but have no data. Some have data but not enough to make a difference. Others are drowning in data with no idea how to process it. Most of all, manufacturers are hampered by the fact there are no standard mechanisms for collecting the data they need.

A FIELD OF POTENTIAL FOUL BALLS

The technology choices open to manufacturers are exploding. Is wireless a good choice? Do I choose the connectivity supported by my PLC vendor? What about Industry 4.0, is that important to me? How can our shop take advantage of AI or machine learning? What are my risk and my return for investing in Amazon AWS or Microsoft Azure Cloud services? Are better-funded competitors, with highly trained data scientists, taking
advantage of new technologies to increase their productivity and efficiency? Are those companies going to leave me behind?

And moreover, increasing regulations, obtaining reliable mechanisms of supply, setting up redundant supply chains that aren’t subject to natural disasters add more to this mix. Manufacturers today are not walking on eggshells as they strategize about these problems, they are walking through a field of potential foul balls.

**OPC UA AND PACKML = LIKE A PARTNERSHIP BETWEEN PITCHER AND CATCHER**

There is something that manufacturers should do to alleviate at least some of these problems. Manufacturers should standardize on OPC UA (Figure 1) and the Packaging Machine Language (PackML).

OPC UA, the next generation of OPC technology, is a more secure, open, flexible, and reliable mechanism for moving information between enterprise systems and the kinds of controls, monitoring devices and sensors that interact with real-world data (Figure 2).

OPC UA can be leveraged to solve some of the strategic issues facing manufacturers by implementing PackML, the standard for modeling industrial machines systems. Like a catcher calling pitches to the pitcher, PackML is an architecture that can be used to control and monitor any sort of machine. The issues addressed by the PackML standard are identical to those voiced by end users in many other industries.

The impetus for the Organization for Machine Automation and Control (OMAC) to develop PackML arose from the dissatisfaction of users and systems integrators frustrated by time, expense and laborious details of integrating control machinery into a coherent system. Integrating a capping machine from one vendor with a labeling machine from another vendor with a sterilizing machine from another is more often a nightmare. Different programming philosophies, control logic, communication protocols, controller platforms, and operational states mean that each machine requires different operational processes, training, standards and diagnostics methods. Users don’t just have a linear increase in complexity with each new packaging component; the complexity increase can be geometric.

PackML is designed to create a consistent look and feel for machinery components integrated into a system. It provides a foundation for vertical and horizontal integration of these machine components irrespective of the vendor, the control system hardware or the specific application. It provides a layer of consistency between vastly different kinds of machines.

By creating a standard set of machine states (Figure 3) and a common set of control tags, PackML simplifies the control system development, reduces training and operating costs, and vastly decreases system integration labor and overall expenses.
PackML does not define the specifics of what machine operations occur in any of the machine states it defines. For example, it specifies the transitions that move a machine into Starting State or the Idle State, but it does not specify the functionality of those states. However, by having a set of common states and control tags, status tags and administration tags, the monitoring of any particular machine is identical to monitoring every other PackML machine. This lowers maintenance, support and training costs.

PackML can be compared to the generic object notation of EtherNet/IP, Profinet IO or BACnet, although its application-level functionality vastly exceeds what’s available in other systems. PackML is a standard for modeling machine behavior that provides a standard mechanism for monitoring and understanding industrial machine operation. PackML decreases the effort required to exchange data between machines and between users and machines via operator interfaces.

PackML models machine data through its state machine and the use of standard PackML Tags but does not specify how the tags get from one machine to another machine, or to an HMI. It does not specify any transports, security, encodings, interfaces or physical media. That’s where OPC UA, TCP/IP, and Ethernet come in.

OPC UA provides the secure communications so that communications to other machines and devices are authenticated (proof that the other device is true or genuine) and that users of the Pack Tags are authorized (valid permission to access those Tags). OPC UA provides the common encoding so that the PackML tags can be properly encoded and decoded.

Encodings currently include a binary encoding for performance, XML for interfacing legacy systems and JSON for more object-oriented systems. OPC UA also provides alternative transport layers like HTTPS, Web Services and others to make a very flexible system. Together, with Discovery services for identifying Server capabilities, alarming and event management, historian capabilities and more, OPC UA provides the foundation for vastly simplifying the integration of a PackML machine with other machines, controllers, HMIs, enterprise systems, and Cloud services.

**LIKE DOUBLE PLAYS ALL DAY LONG**

This improvement is illustrated in Figure 4. In this packaging system, all machines support PackML over OPC UA. Because all machines use standard PackML tags over OPC UA, it is much less complex to configure other downstream machines to properly handle faults, alarms, starts, stops and other process statuses. And HMIs can be much more easily constructed from the standard state machines and tags used by all machines.

Contrast with a situation where every machine in this system is built with a proprietary state machine, with a set of proprietary tags encoded in some binary format with its unique security mechanism. Imagine if each machine uses different tag names for state information, different tags for diagnostics, and different tag names for data values. Imagine if some of the machines use XML, while others use their own binary data encoding.
Imagine if some only use HTTPS for security while others use a certificate-based security scheme. Imagine being responsible for integrating that system. Building a system from those components would be a time and expense nightmare.

Unfortunately, in the automation world, we’ve grown too accepting of the idea that machine integration between vendors of different machines must be complex, laborious and difficult, requiring expensive engineers and incurring significant expense. With adherence to the kinds of standards described in this paper, system integration for highly connected solutions will cease being complex and expensive. Instead, it will just work.

The beauty of this approach is that it goes beyond packaging lines. These concepts are just as relevant to machinery operations in diaper and tissue converting, food, beverage, automobile production, and many other industries. The PackML concepts, tags and state machines can be used in any of these industries and more.

**LOAD UP THE BASES**

If you’re new to PackML and want more information, you can find it on the OMAC (Organization for Machine Automation and Control) website. On that website ([http://www.omac.org](http://www.omac.org)) under the workgroups tab, you’ll find the PackML specification, the Unit/Machine Implementation Guide and the PackML/OPC UA Server Companion Specification.

If you’re new to OPC UA, it’s time to get familiar with this technology. It is going to be a foundational component of manufacturing systems in the future. A good place to begin is the book, *OPC UA – Unified Architecture: The Everyman’s Guide to the Most Important Information Technology in Industrial Automation*.

It wouldn't be fair to say that OPC UA and PackML are the only two magic bullets that can solve all manufacturers strategic challenges in this Cloud-enabled, Big Data, Artificial Intelligence world. But OPC UA and PackML are proven technologies that reduce integration costs, increase productivity and vastly simplify how you get data into your enterprise or Cloud applications. Getting data we need to operate more productively and efficiently is the new job – and leveraging OPC UA and application layer architectures like PackML are going to be some of the tools you’ll need in the future!

And they’re a lot less risky than pulling that starting pitcher after those six, flawless innings.

**ABOUT THE AUTHOR**

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