White Paper

Improving Communication and Efficiency

Using PackTags in Product Inspection

Contents

METTLER TOLEDO

1. Introduction

Of all the factors which can have an effect on the efficiency of a production process, communication is one of the most crucial. The modern-day production facility relies on various pieces of equipment working in concert to process, package and deliver a product as quickly and efficiently as possible.

In addition, manufactures needed a way to measure the performance of their production line. Measuring equipment efficiency is a simple enough task, but collecting all that information and putting it into a format that can be easily exported to a central location required extensive work. Each system would potentially use a different protocol in order to communicate with a central server, necessitating the implementation of custom code to pull information to a central location. This white paper explores the ways in which technology and communications languages have evolved in order to address industry-wide challenges.

2. The Creation of OMAC

To address the issue of equipment communications, a group of automation professionals came together and created a standardized communication language that would allow for open and easy communication between packaging equipment and line controls. The group formed in 1994 under the name of the Open Modular Architecture Controls User's Group with a mission to bring production equipment manufacturers together "to address issues that confront global manufacturing today" ("About OMAC," OMAC.org, http://www.omac.org/about-omac/). Later, the name was changed to the Organization for Machine Automation Control (OMAC). Chief among the issues OMAC intended to address was the need for an open communications platform for production equipment. The organization is divided into two working groups, each addressing a particular part of the manufacturing process.

The OMAC Manufacturing Workgroup's (OMW) main focus is on the creation of automation guidelines, best practices and the development of international manufacturing standards. These guidelines and practices are meant to encourage the proliferation of more machine automation choices for end-users and Original Equipment Manufacturers (OEMs). Creating a greater number of options drives the development of a greater emphasis on interoperability, ensuring that end-users can select the best equipment available without having to worry about whether or not everything will communicate with one another.

The second working group is the OMAC Packaging Workgroup (OPW), which like the Manufacturing Workgroup focuses on improving automation guidelines and standards, but focuses specifically on packaging machinery rather than manufacturing machinery. Ultimately the goal is to improve flexibility, capabilities and system integration ability. The OPW's primary contribution toward this goal was the development of a new communications language and data structure known as PackML (short for Packaging Machine Language).

3. What is PackML?

The core purpose of PackML is to create a common look and feel for both the organization and transmission of machine data. This facilitates the rapid integration of production equipment into a production environment, as systems can easily communicate with one another.

The structure of a PackML system is represented by a flow diagram separating system 'states' into distinct sections. For example, a series of data and functions based around idling are all sectioned into the Idle state, which has links to the Execute state, which in turn links to the Suspending, Holding, or Completing state. These standard definitions for machine states and operational flow ensure that not only do other systems know where to look for particular pieces of data, but the look and feel of the system operation will also follow this standardized operational flow. This flow is an extension of the ISA S88 Part 1 State Model concept, which is a previously developed set of guidelines for automation software developed by the International Society of Automation.

The PackML subcommittee used this structure to develop a data mapping and naming standard known as PackTags; this is the primary requirement for software developed under PackML guidelines. In fact, that OMAC's guidelines for PackML implementation only require PackTags support – use of the state model for program structure is optional. From the OMAC website:

"In this approach, only the PackTags data mapping into the existing OEM or end user program is used to gain the benefit of horizontal and vertical line integration. Use this approach when the minimal changes are desired to the existing software or if the other benefits of modular programming and the PackML mode/state manager are not easily realized." ("PackML Download," OMAC.org, http://www.omac.org/content/packml).

PackML an OMAC standard

OMAC.org

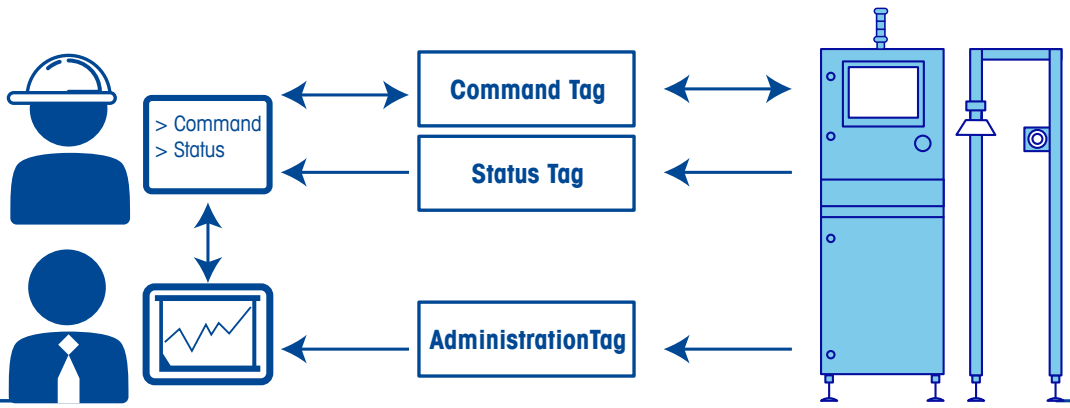
"The OMAC Packaging Workgroup (OPW) Executive Committee oversees the direction of the OPW and its sub-groups and approves all of the recommendations that come out of the OPW sub-groups. The OPW Executive Committee is made up of 3 users, 2 technology providers, and 2 machine builders. Members are expected to represent their industry group (user, technology provider, or machine builder) in providing input and direction to the committee. OPW Executive Committee positions are for two year term," from the OMAC Packaging Workgroup webpage at http://omac.org/workgroups/packaging-workgroup/

4. Implementing PackML

OMAC outlines two options for the implementation of PackML in system software. The first recommended option is to design and build the software using the S88:Make2Pack modular and state machine template. This ensures the software is structured in a way that makes PackTags implementation and troubleshooting easy, and OMAC provides a set of detailed instructions and a comprehensive help file to aid with the creation of the software.

The drawback of this approach, of course, is that it requires building a completely new piece of software. OMAC explicitly advises against modifying existing code to fit S88:Make2Pack as it will be far too time-consuming to reorganize an existing codebase and result in too many potential problems during development and testing to make it worthwhile. For companies which have already developed their own robust control or inspection software, there needs to be another option.

In this case, OMAC advises developers only implement the PackTags data mapping structure. This allows for the full benefits of PackML's horizontal and vertical line integration capabilities without needing to change the structure of the existing program. While this does mean the benefits of using the S88:Make2Pack structure are lost, a developer making this decision will have likely already created an efficient program which would be needlessly disrupted by the implementation of such a structure. Should the developers believe the time and effort of building a new piece of software is worth it, then they are free to do so. The state model structure is not the heart of PackML's benefits. The most important goal of PackML is the increased ease of communication between equipment on the production line, and that comes from PackTags.



PackTags provide the communication between the system and allow for line level control, as well as administrative oversight for review of production efficiency. Using these central communication tools, production teams are able to review all production systems in the same way, regardless of the original equipment manufacturer.

5. What are PackTags?

PackTags are a set of unified data naming structures. This standardization of format allows for information to be transmitted and received by the system to and from other equipment. These tags are divided into three main categories: Command Tags, Status Tags, and Administration Tags. Each tag may be further defined by a mode which allows designers to adjust the states, state commands and state transitions.

Command Tags

Command Tags are the way that other equipment is able to interact with the system. This includes the ability to stop or start the system, alter the speed of any integrated conveyors, and change the system's inspection parameters or profile. For a vision inspection system, this could range from inputting a new lot number to changing the entire product label profile.

Status Tags

Status Tags allow other systems to see what the system is currently doing and how well it is performing—or if there has been a problem. Primarily this means describing the mode the system is currently set to: so in the case of a vision inspection system or other piece of product inspection equipment, it would inform users whether or not the system was currently in inspection mode, or if it is in bypass mode. The status tags would also include an indication as to what the status of a current process is (stopped, aborting, executing, holding, suspending, etc.) or how fast the system is running, expressed in parts per minute (ppm) passing through the system.

What is OEE?

OEE is an industry standard method for measuring and quantifying the performance of production line equipment. This is expressed as the ratio of actual output divided by the maximum capable output. For an inspection system, the OEE calculations focus on the number of products processed versus the total number of products, and also the ratio of good products versus total products.

Administration Tags

Administration tags provide information to high-level systems such as a central control or central monitoring station. This information includes critical information such as alarms or alerts due to a system issue. Other status information including total time spent in a particular state or mode and total system uptime is also displayed, along with how long it has been since the last system restart. Most importantly, information about the Overall Equipment Effectiveness (OEE) is communicated by administration tags.

These various tags provide the theoretical framework for an effective system of communication, but the complete suite of standard PackTags makes a few assumptions about the system. In particular, it is somewhat weighted toward the use of equipment which is producing goods rather than inspecting goods. In particular the measurement of system performance is generally concerned with goods produced, which is measured by the number of products passing through a system. A better way of measuring the performance of a product inspection system is to compare the time spent available versus the time spent in a faulted state—which is not measurable with one of the existing PackTags. Adding this functionality to a system which does not break with the PackTags requires the creation of supplemental tags.

Supplemental PackTags

Creating a supplemental PackTag is accomplished easily enough: the naming structure for a PackTag involves several parts: the unit name, the category (Command, Status, Administration), the State, and the name of the tag itself. So for example, a tag meant to show the time at which an alarm occurred would have the name structure UnitName. Admin.Alarm[#].DateTime.

By using this naming structure to create a supplemental PackTag, other systems can access information above and beyond the data delivered by standard PackTags without needing to build a workaround to deal with a different data structure. Bear in mind the development of PackTags initially focused on production equipment, not inspection equipment. As a result, there are some statistics which simply do not have a spot in the standard PackTags structure—but because of the template-based nature of PackML, any supplemental PackTags fit neatly into the existing structure.

6. Accessing the Data

The core concept behind PackTags is ease of communication between systems, but PackTags are a data structure and not a communications protocol. This section briefly discusses a few of the available options for systems communication: OPC, Ethernet/IP, Modbus and ProfiNet.

6.1 OPC

OPC is a series of open connectivity standards for industrial automation and is primarily used to send information to PC-based supervisory control systems. OPC servers are able to expose the full range of PackTags and access the most possible information from them. The downside to OPC UA is that it is a newer communications protocol which may not be widely used, and it can be expensive to implement.

6.2 Ethernet/IP

Ethernet/IP is less specialized, but is a more widely-used communication standard. In a manufacturing setting it is generally used for PLC communications, but it is also capable of transmitting PackTags information. Unfortunately Ethernet connections have comparatively less bandwidth than other methods and may not be able to make use of the full capabilities of PackTags as a result.

6.3 Modbus

Modbus is a serial communications protocol which was originally created for communication with PLCs. Since its creation it has expanded its capabilities to include communication for other production systems including communication with a supervisory control system. The disadvantage of Modbus is in its age. Modbus was developed in the late 1970s and there is a limit to what the inbuilt capabilities can handle. Utilizing PackTags will likely require custom code, adding cost to system implementation.

6.4 Profinet

Profinet is a method of communications utilizing industrial ethernet and is used to facilitate communication between all industrial equipment. It is also fully compatible with normal "office" ethernet/IP networks, meaning it features a greater connectivity than other methods of communication. Much like OPC, Profinet has the necessary bandwidth to quickly allow for utilization of the full range of PackTag capabilities.

7. More Data Means Stronger Documentation

Improving communication between production equipment is one of the larger benefits of utilizing PackTags, but another benefit lies with the amount of easily-accessible data that a PackML system can provide.

Many industries, particularly the food production and pharmaceutical industry, place a great emphasis on the proper observation and documentation of various procedures aimed at increasing consumer safety. This is beneficial to both consumers and producers, as consumers know the products they buy are produced safely and producers have a clear demonstration of their due diligence.

The data which PackTags define is, thanks to the standardized structure of the tags, easy to access and convert into useful statistical displays which in turn can be used to spot issues in the production process and make corrections as necessary. These statistics also provide an important window into the performance of the quality control process, aiding in the formation of more effective policies. The data collected using PackTags can be used as an argument for making changes to improve cost-effectiveness by helping to break down the precise costs of a particular production process.

8. Conclusion

Simply put, streamlining data collection and distribution is what makes PackML so beneficial to manufacturers, particularly when it comes to product inspection equipment. The usefulness of product inspection equipment does not end with recall prevention; the ability to conduct analysis of production processes is one of the strongest arguments for implementing automated product inspection. The use of a unified communications protocol allows for easy access and exporting of production data from all equipment on the production line much easier.

PackML is the industry standard for manufacturers who wish to have their equipment communicate with one another, and OMAC is constantly working to push new revisions and improve the effectiveness of the PackTags system. The ability to easily create custom tags that integrate into the existing PackML structure Working with an experienced equipment provider who works closely with OMAC (or better still, is a member of OMAC) will ensure integration of inspection equipment into your production environment is a painless process.

Further Information about Product Inspection

Free Technical Guide

Make an Informed Decision

METTLER TOLEDO has published a range of authoritative product inspection guides covering Checkweighing, Vision Inspection, Metal Detection and X-ray Inspection technologies. The guides enable you to select the right product inspection equipment for your production line. They offer support in installing an all-encompassing product inspection program and provide advice to help you in achieving compliance with standards, regulations and legislation.

Register today for your free copy: **www.mt.com/pi-guide**

About Mettler-Toledo Product Inspection:

The Product Inspection Division of METTLER TOLEDO is a leader in the field of automated inspection technology. Our solutions increase process efficiency for manufacturers while supporting compliance with industry standards and regulations. Our systems also deliver improved product quality which helps to protect the welfare of consumers and reputation of manufacturers.

Metal Detection

X-ray Inspection

Checkweighing

Vision Inspection

Disclaimer:

Information contained in this publication is provided "as is" and without warranty. METTLER TOLEDO disclaims all warranties, express or implied, and makes no warranty regarding the accuracy or applicability of the information contained in this publication, and is therefore explicitly not responsible for any damage, injury or death resulting from the use of or reliance on the information.

www.mt.com/civision

For more information

Mettler-Toledo CI-Vision
2640-A White Oak Circle
Aurora, IL 60502
Tel: +1 (630) 446-7700
Fax +1 (630) 446-7710
E-mail: info.ci-vision@mt.com