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Machinery Communications

The findings of a market research study that explores the trends and issues of machinery communications within the packaging machinery industry.



Machinery Communications - Trends and Challenges

**Packaging Machinery Manufacturers Institute
11911 Freedom Drive, Suite 600
Reston, VA 20190
(703) 243-8555**

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Paula Feldman, Director, Business Intelligence, PMMI**

Machinery Communications - Trends and Challenges

The Momentum Continues Towards Smarter Machines

EXECUTIVE SUMMARY

Four challenges in the advancement of machinery communications:

Standard Communication Protocol, Machine Integration

The greatest challenge in the packaging industry is integrating machines among so many fieldbus platform technologies. Legacy equipment is not easily integrated which adds to the challenge.

Improved Data Collection

Manufacturers are moving toward more efficient data intelligence – get data, store data and analyze data.

Industry Education

Another major challenge is educating both the current generation of engineers as well as those coming into the sophisticated digital electronic automation world of packaging.

Security of External Communications

Ethernet implementation is forcing a close collaboration between IT departments, the corporate office and the plant floor.

Machine communications is a prominent topic of discussion among packaging industry executives focused on maximizing uptime. Modern machine-to-machine communications, whether it is internal or external, has evolved beyond the traditional one-to-one connection. Elaborate networks connect software applications and hardware devices throughout the plant to maximize uptime and collect meaningful data to measure and optimize OEE¹ (Overall Equipment Effectiveness).

The forward looking statements in this Report regarding which technology to use, servo or mechanical and which network to install are compiled from interviews with packaging professionals who shared their knowledge and opinions. The direction of machinery communications was discussed with a focus on how the packaging industry can move forward creating smarter, more automated manufacturing plants that deliver greater operating efficiencies.

Three primary topics repeatedly touched on during the interviews:

- Cost of implementing new communications solutions,
- Educating existing staff on how to manage and maintain the technology, and
- How to overcome integration problems with legacy equipment.

Packaging professionals agree that the ultimate goal when implementing and upgrading their machinery communication solutions is maximizing uptime.

Packaging professionals say they want machinery communication solutions that:

- Prevent downtime,
- Diagnose when machine productivity slows,
- Track why slowdowns and downtime occur, and
- Instruct the machine to correct operational problems once they are diagnosed.

This report brings greater clarity to the business case for machinery communications and provides statistical analysis that supports forward-thinking trends on how to best apply the

¹ Overall Equipment Effectiveness (OEE) is the methodology for assessing process capacity and utilization of equipment and takes into account availability, efficiency/performance and quality. Sbtionline.com/glossary-of-terms

technology available in the packaging industry. Sponsored by PMMI (Packaging Machinery Manufacturers Institute), this study focuses on Machinery Communications; Trends and Challenges (referred to as the Report).

It provides insight into

- How end users want their machinery to communicate in the future,
- Why the packaging industry has been slow to embrace technology that has been available for years,
- Who is driving advancements in machine communications technology, and
- What security measures companies are taking to safeguard data as it moves between remote connections, the factory floor and the front office?

The Report presents and explores advances in internal machine communications, the challenges of machine-to-machine communications and the security concerns when data is accessible beyond the confines of the manufacturing plant.

Interviews with 63 industry professionals yielded a wide variety of opinions and viewpoints about what end users need and want in machinery communications. This Report identifies those similarities and overall trends in machinery communications. End users want communications software and hardware that brings greater efficiency to the production line and overall plant operations. Note that every company evaluates their options and makes decisions based on where their company lands on the continuum of implementing new communication technologies.

Large end users will be defined as companies with annual revenue greater than \$500 million.

Medium end users are defined as companies with annual revenue of \$100-\$400 million.

Small end users are companies with annual revenue less than \$100 million.

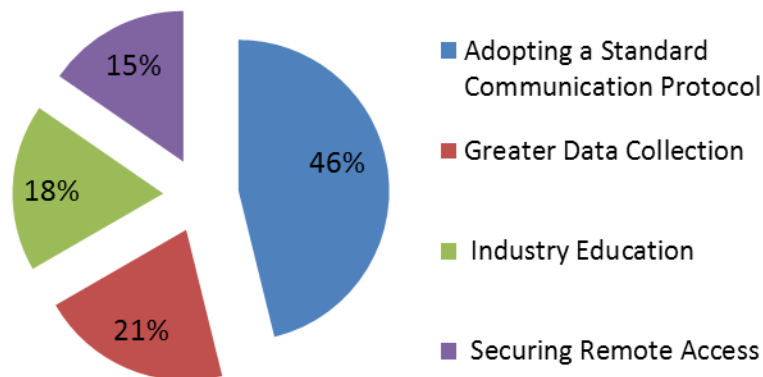
Four Challenges in the Advancement of Machinery Communications

Figure 1 illustrates the four major challenges the packaging industry is facing in the years ahead regarding advancing technology in machinery communications.

- Adopting a standard communication protocol
- Greater data collection
- Industry education
- Securing remote access

Certainly there are other topics and ideas presented further in the Report but each one stems from one of the four challenges listed.

Figure 1: Four Major Challenges in the Advancement of Machinery Communications



Each topic will be addressed more thoroughly throughout the Report.

- Δ Adopting a Standard Programming Language, page 20.
- Δ Greater Data Collection, page 29.
- Δ Industry Education, page 6 and page 24.
- Δ Securing Remote Access, page 32.

The four major challenges presented above, along with the aging workforce and fewer engineers entering the machine packaging workforce, are affecting all levels of machinery communications;

- I. **Internal machine communications** includes the controllers that operate the machines to I/O, sensors, safety systems and the motion control systems. The motion control system may include a variable frequency drive, DC drive, stepper, servo and even robots with smart switches to handle the communications between the devices.
- II. **Machine-to-machine communications (M2M)** is the different machines in a production facility that interact with each other. The challenges of M2M is selecting the right network for each application as the industry moves toward Ethernet connectivity, the continued need for collecting information and acquiring a better understanding of PackML.
- III. **External communications** refers to both the transfer of data inside the company as well as accessing information remotely. Companies continue to collect more data and upload statistics to their MES² (manufacturing execution system) systems to calculate OEE. Securing data remains a high priority internally as well as externally allowing access remotely to trouble-shoot and prevent downtime using smart communication tools - security concerns are holding back advancements.

Before discussing internal workings of the machine, machine-to-machine networks or securing external communications - often referred to as remote communications outside the machine and

² Manufacturing Execution System (MES) links the plant floor with the entire organization collecting and analyzing production information; it's the system layer between ERP and the plant floor or devices such as the PLCs that control individual machines or production lines. *Wikipedia*

outside the plant - there are some topics that relate to all three levels of machinery communications.

Driving Smarter Machines in the Future

All participants in this Report agree that an overall packaging trend affecting decisions down the entire production line is that machines are getting smarter. Smarter machines mean greater ease of use, supportability, reliability, and more portability of programming languages.

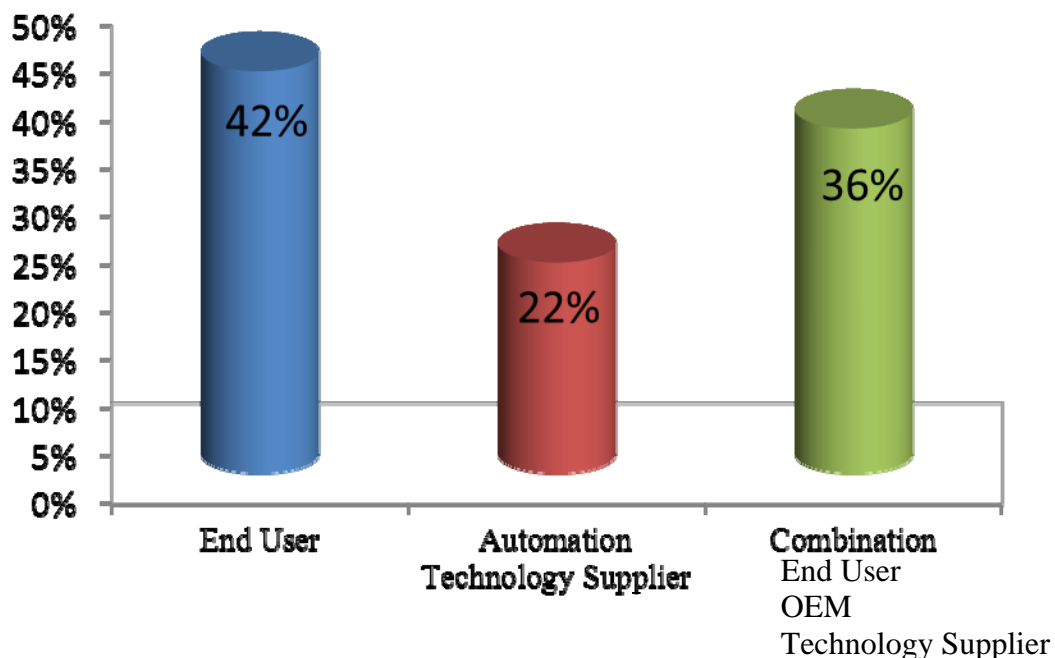
Figure 2 indicates that end users are responsible for driving technology advancements in the packaging industry.

42% of the participants in this Report perceive end users are driving technology advancements in machine communications due to their need to achieve OEE and the continuous need to achieve uptime, reduce cost and remain innovative.

22% Look to the automation technology suppliers as the drivers behind new technology that will help them stay competitive by introducing advanced functionality to the packaging industry.

The OEM was not cited as being the sole driver, however the remaining 36% of packaging professionals stated it's a combination of; end users, automation technology suppliers and OEMs working together to bring advanced technology to the packaging industry; a partnership that is well underway.

Figure 2: Who is Driving Technology Advancements in the Packaging Industry?



Industry Collaboration

In some interviews, end users spent more time raising questions about the translation of data protocols between vendors than providing answers about the future direction of this trend. A frequent question is will the demand to achieve integrated communications cause suppliers to abandon their proprietary single process focus and work towards designing solutions that bring more synergistic intelligence to the manufacturing floor?

Several end user manufacturers say the maze of solutions in machine communications and integration in the packaging industry is occurring due to the competition between suppliers. End users also mentioned the escalating costs of supporting so many technologies.

The Market Development Director of Packaging at an automation technology supplier asks, “Can an industry standardization, which is needed to drive the entire line of communications, be developed that does not tie end users to a single supplier?”

The Controls Manager at one of the leading CPG companies wants OEMs to focus more on innovation and accelerate their expertise in state-of-the-art technology; delivering more flexible and capable packaging machinery and focus less on what’s good for their particular market position. In other words, he wants the OEMs to put the needs of the end user first.

The Director of Automation Systems at a Canadian systems integrator echoed similar sentiments when it came to integration issues. He stated, “OEMs focus on their process or machine and not on the big picture of connectivity”. He went on to add that end users need to continue to create the market demand for integrated-ready machines but that the end users must then understand their demand for integrated-ready machines comes at a premium.

A significant number of participants say suppliers are doing a good job of opening communication codes between vendors, which suggests the collaboration between vendors that end users are asking for is occurring.

Educating Engineers is a Continued Concern

There is a very real hurdle facing the packaging industry when it comes to the skilled labor needed to maintain machinery and troubleshoot problems. First, many existing machine engineers are not fully trained in operating and maintaining the emerging generation of machine communications technology. In the past, engineers have been more familiar with mechanical functionality and not as familiar with servo programming, network experience and advanced controls technologies.

61% of end users participating in this Report say they look to the OEM or automation technology supplier to educate them on the advances and operations of smarter machines in the future. This point is more fully discussed later in the Report, page 24.

“More robotics are being used in areas where there is an increased incidence of worker injury and where repetitive processes can be performed through automation” says the Controls Technician at a leading pet food company.

According to the Controls Technician automating routine tasks is not a substitute for the shortage of skilled electricians needed for troubleshooting. Most electricians have been around for 30-40 years and don’t understand a function block which is expected to be a major challenge when adopting new technology. “Finding qualified personnel is difficult,” he adds.

The existing generation of maintenance engineers is familiar with the legacy equipment, but they will begin retiring in a few years.

That poses a problem for the industry, because fewer maintenance engineers are entering the workforce.

Furthermore, maintenance engineers entering the industry are unfamiliar with how to operate legacy systems. Hence they have little, if any, knowledge about how to integrate legacy systems utilizing the latest machinery communications technology. The challenge continues at end users since companies are hanging on to legacy equipment longer.

The situation has created a conundrum, according to the Director of Engineering at a subsidiary of a Top 20

food company. Finding qualified new personnel to operate and maintain legacy systems is getting tougher as fewer machine engineers enter the industry and existing engineers are inadequately trained on the new, smart motion technology and advanced communications the industry is implementing.

The Motion Product Manager at an automation technology supplier believes the greatest hurdle facing the packaging industry in the next three to five years is educating the end user manufacturer about what's possible to improve OEE and how to utilize the flexibility of equipment to its greatest potential.

Does the solution lie in packaging companies sponsoring more engineering internships, scholarships, or mentor programs? Should the industry be offering training through social communications such as blogging, Twitter, web sharing or more? These are questions that need further discussion and exploration outside the scope of this Report. Some of the systems integrators participating in this Report say they are looking to the leading technology automation suppliers to take responsibility for educating end users just as they educate the OEMs.

Without question there is a gap from the conventional means of education to the new information technology sweeping all aspects of business. How the packaging leaders embrace the challenge of attracting new engineers and communicate the fast-paced changes and technology advancements to existing engineers will directly affect their competitive advantage in the industry.

Ethernet

Ethernet is a cable-based local area networking technology developed in the 1970s. Ethernet cables consist of standard wires and connectors and are commonly used to physically connect computers to the Internet. The TCP/IP (Transmission Control Protocol/Internet Protocol) is the primary standard over Ethernet cables. The TCP governs the rules of how different devices talk to each other. The IP is how the message gets routed from place to place or in the packaging automation world from device to device.

Wireless Ethernet connectivity, while technologically available, remains in the future for many packaging end users until frequency interference is eliminated to ensure operator safety

84% of packaging professionals participating in this Report said they either use an Ethernet-based fieldbus to communicate with their controllers, HMI, PLC/PAC, sensors and vision equipment or are planning to do so in the near future. Serial ports with connections like RS485, RS232 and RS245, still hold their place for point-to-point communications. Communications to the motion system is most frequently handled through a version of SERCOS.

The different types of fieldbus protocols are discussed in more detail in the section Machine to Machine Communications beginning on page 17 and listed in Appendix C on page 38-39.

Standardization

The importance of designing systems to be compatible with machine technology that is already in place is critical. The Controls Engineer at a Top 10 snack food company said, “The direction right now as our first choice is Ethernet for I/O, HMIs and VFDs.” Although they have standardized on one supplier, he indicates they would be open to alternatives as long as those alternatives meet specific functionality requirements.

51% of end users in the food, beverage, pharma and CPG companies represented in this Report have standardized on one supplier versus several for ease of support, maintenance, parts availability and training.

The OEM is responsible for delivering cost reductions in machine design, manufacturing, programming development and installation. Subsequently, 43% of OEMs interviewed for this Report respond to their customers’ demands and are also standardizing on a single supplier for their machine control.