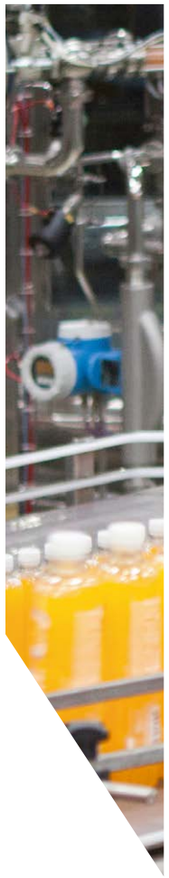
Packaging 4.0

Enabling operational excellence

PERFECTION IN AUTOMATION
A MEMBER OF THE ABB GROUP



Executive summary

Industry 4.0 and the Industrial Internet of Things (IIoT) promise to reduce total cost of ownership (TCO) by making machinery easier to operate and maintain. Mass customization requires highly modular machines to enable automatic adaptation of production to real-time demand.

Widespread adoption of PackML and OPC UA ensures operational consistency between all the machines in a multivendor packaging line – for a substantial boost in overall equipment effectiveness (OEE).

Integrated condition monitoring and direct web connectivity down to the sensor level will serve big data analytics and enable auto-diagnostics. Complemented by augmented reality technology, access to comprehensive diagnostics via standard web technology enables total productive maintenance (TPM). The result is improved production with zero defects, zero breakdowns and zero accidents.

Key findings

OEE

56%

of companies expect to increase efficiency by more than 20% over the next 5 years.

TCO

43%

of companies expect to lower costs by more than 20% over the next 5 years.

TPM

61%

of companies will use big data analytics within 5 years for more efficient maintenance.

Source: PwC Industry 4.0 report

Contributors

OpX Leadership Network – Moving Operational Excellence Forward

UCIMA

PMMI – The Association for Packaging and Processing Technologies

GEPPIA

OMAC – The Organization for Machine Automation and Control

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PPMA – Processing & Packaging Machinery Association

TCO
TPM
OEE
PACKAGING
4.0

Introduction

Industry 4.0 and the smart factory concept enable operational excellence

Packaging 4.0

In pursuit of the smart, connected factory of the future, Industry 4.0 embraces automation, communication and manufacturing technologies – paving the way for a new industrial revolution.

With the revolution will come heightened levels of networking and integration between companies in value networks. This type of collaborative partnership relies on interoperability, transparency and decentralized intelligence to ensure operational consistency throughout a multivendor environment. Maximum productivity and extensive product customization under mass production conditions are central goals of Industry 4.0.

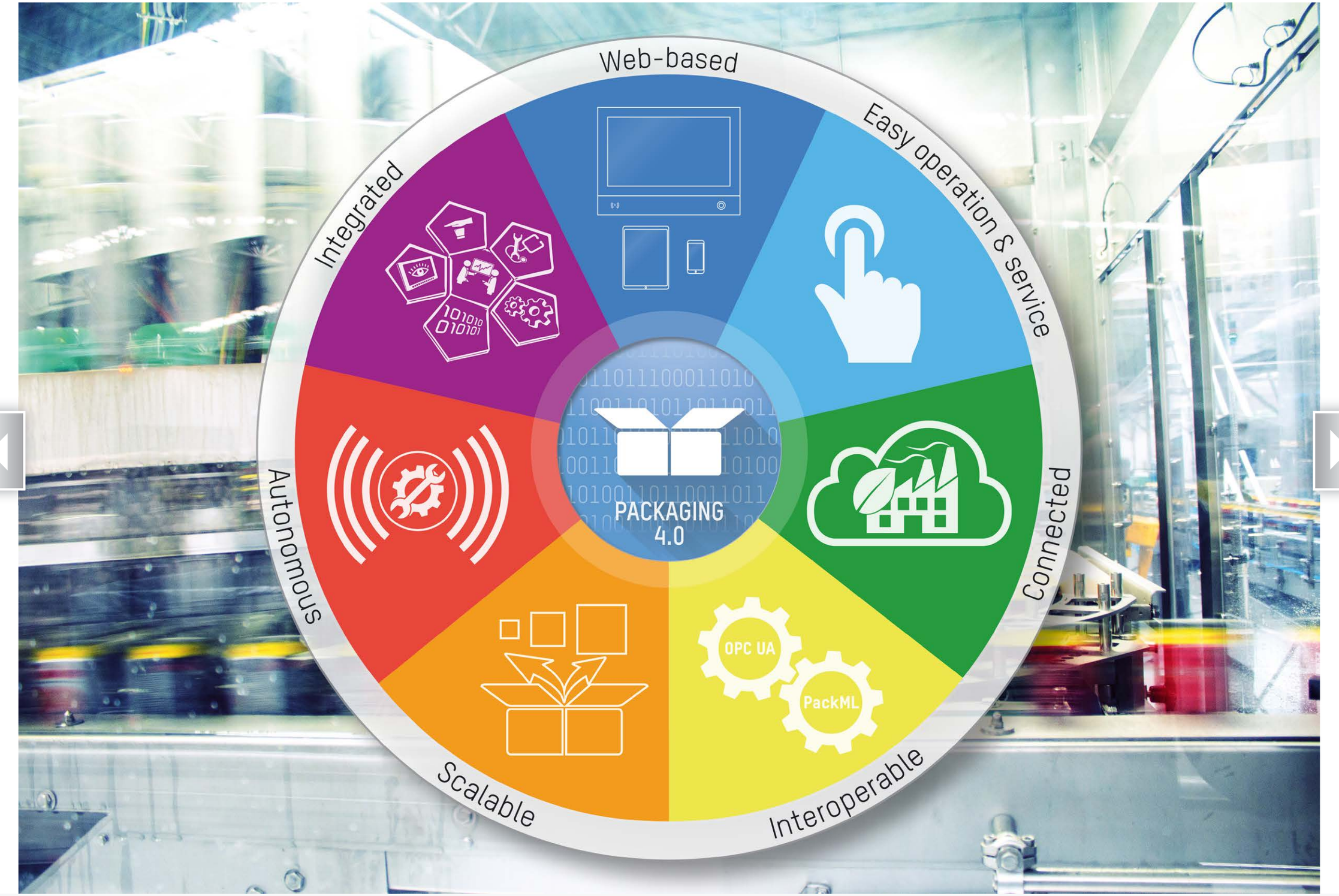
In many ways, the highly innovative packaging industry already operates according to these principles. Some filling and packaging lines are already producing products with personalized recipes (personalized medicine, custom-blended perfume) and customized containers.

Operational excellence

A number of emerging initiatives and metrics are aimed at facilitating operational excellence within smart factories. This paper focuses on the three with the greatest impact on operational excellence:

- Overall equipment effectiveness (OEE)
- Total cost of ownership (TCO)
- Total productive maintenance (TPM)

The packaging community plays an essential role in achieving operational excellence. This paper will highlight the leading international associations representing this community, reviewing current trends in the packaging industry and sharing their vision for its future.


Web-based
Easy operation & service
Connected
Interoperable
Scalable
Autonomous
Integrated
PACKAGING
4.0
OPC UA
PackML

Overall equipment effectiveness

As a key component of the Industry 4.0 business model, collaborative partnership pushes for a single set of common standards. This not only provides consistency within packaging lines, but also enables operational efficiency and facilitates the computation of key performance indicators.

Modular software technologies reduce the development time for new machines and allow easy management of machine options and variants. This minimizes changeover times and enables mass customization.

Overall equipment effectiveness

Modular application (mapp) technology increases machine availability

As a key performance indicator, overall equipment effectiveness (OEE) provides reliable information regarding the actual production efficiency of a packaging line. It breaks the performance of a manufacturing unit into three measurable components: availability, performance and quality.

Interoperability standards

PackML gives all the machines that make up a packaging line a common look and feel and ensures operational consistency. It helps to calculate and improve OEE on the machine and line level by more easily identifying the root causes of production inefficiency.

OPC® Unified Architecture

PackML an OMAC standard

The modularity and consistency of PackML, together with the OPC UA interoperability standard, will enable self-optimization and self-configuration of production lines and facilities.

Easy options management

OEMs now have a much easier way of managing the many variants of their machines. New modular software technologies conveniently allow changes to the configuration and software at runtime, which accelerates changeover and boosts productivity. Dedicated software components (such as mapp OEE) permit automatic collection of production data and provide OEE functionality without any programming.

Integrated safety

Integrated safety is a top priority for Industry 4.0. Safety strategies will be designed for open, collaborative subsystems belonging to different manufacturers and operators. Use of open and integrated safety technology will significantly increase line availability and reduce stoppages.

Total cost of ownership

The total cost of ownership (TCO) for a piece of equipment or other asset involves much more than simply its initial cost. The TCO accounts for all the costs over the asset's entire lifecycle – from installation and deployment to operation and energy consumption to maintenance and upgrades.

Although implementation of Industry 4.0 does require short-term investment, in return it generates long-term savings through increased efficiency and optimized energy consumption. To achieve the goal of mass customization at mass-production costs, machine design has to be highly modular and flexible to enable automatic adaptation of production to real-time demand.

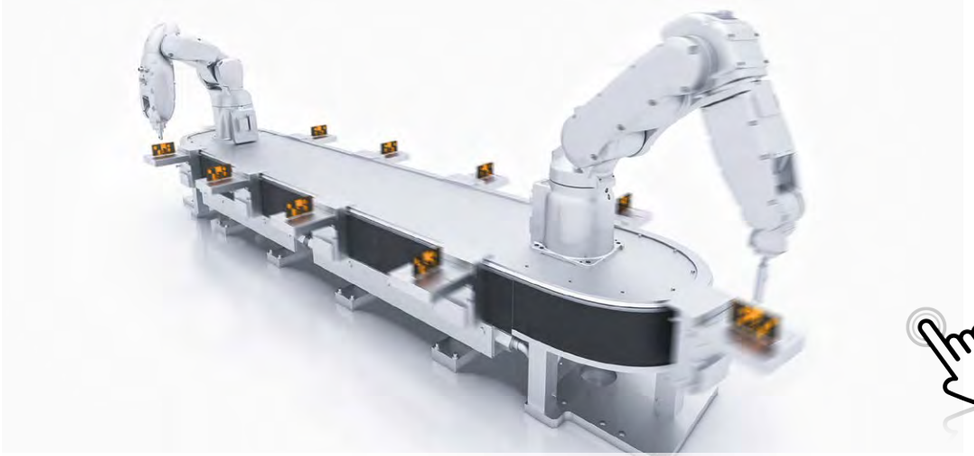
Total cost of ownership

A TCO analysis will often shed light on very large differences between purchase price and total lifecycle costs – especially in the case of packaging lines, which typically have very long service life.

Flexibility in production

A new generation of service-friendly intelligent transport technology combines optimized productivity and flexibility with industrial-grade reliability to ensure maximum uptime and minimum maintenance. With independent control of multiple movers, such highly dynamic conveyor systems increase the production rate of packaging lines and make format changes faster and easier than ever.

Assembly lines also benefit from this new transport technology. Low-latency, hard real-time synchronization with all types of servo axes – including CNC and robotic systems – guarantees high-precision, high-quality production output.



Next-generation industrial transport technology for optimum productivity and minimum maintenance costs

Mass customization

Industry 4.0 promises high levels of product customization at costs similar to mass production, allowing manufacturers to focus on differentiation with more personalized products. Mass customization needs fast production changeovers performed by non-specialist operators, so a highly modular machine design is essential.

Energy efficiency

With energy prices endlessly on the rise, machines are being equipped with embedded energy monitoring features to help optimize consumption. Energy metering modules incorporated into the control system provide access to real-time energy consumption data for a production facility. Centralized acquisition of operating and process data allows for online performance monitoring and optimization.

Total productive maintenance

Integrated condition monitoring capabilities and big data analytics enable auto-diagnostics. Direct web connectivity down to the sensor level allows machines to autonomously ask operators to perform maintenance tasks.

Production, maintenance and engineering teams of machine builders and end users have easy access to key indicators and full diagnostics via standard web technologies.

Total productive maintenance

Web-based technologies eliminate the need for dedicated maintenance software

The total productive maintenance (TPM) concept was first applied in Japan in the 60s to maximize plant and equipment efficiency and optimize the lifecycle costs of production equipment. The idea was to get production operators involved in maintaining their own equipment. The decade-old practice of preventive maintenance was combined with autonomous maintenance – giving rise to productive maintenance.

Zero tolerance

TPM has since become a globally accepted approach to industrial equipment maintenance. Many industries rely on this model to achieve maximum equipment effectiveness and, ultimately, improved production with zero defects, zero breakdowns and zero accidents.

Big data analytics

Industry 4.0 makes it possible to aggregate data from all sources (operational data, production scheduling, condition monitoring, historical data). Predictive asset analytics turn this massive volume of data into proactive measures and help identify the right maintenance strategy to get the most out of every asset.

Web services as standard

Smart machines connected to web services are able to request maintenance actions autonomously. Operator interfaces take advantage of technologies based on web standards and do not require dedicated software. Auto-generated diagnostics are integrated in machines and available on any device with a standard web browser.

Augmented reality

Augmented reality makes it easier for operators to obtain information in real time and provides hands-free web access to repair manuals or supplier help centers.

Packaging trade associations

Leading international packaging associations share their visions for how Industry 4.0 and the IIoT will shape the evolution of the packaging industry.

Glen Long
Senior Vice President, PMMI - USA

OpX Leadership Network

This multinational community of manufacturing, engineering and operations professionals is dedicated to operational excellence – leveraging the resources of PMMI, The Association for Packaging and Processing Technologies. As the definitions of Packaging 4.0 are established, they will set new benchmarks for operational efficiency. While OpX defines metrics, Packaging 4.0 will define performance expectations.

"Packaging 4.0 will set new benchmarks for operational excellence"

Total Cost of Ownership Solutions Group

This is a framework for understanding total acquisition and operating costs that factor into the true cost of running machinery, from design and application through maintenance and environmental concerns.

Packaging 4.0 promises to reduce TCO by making machinery easier to operate and maintain, more connected to operations management and performance measurement systems, and able to adapt more flexibly to changing CPG market imperatives.

Operational Reliability Solutions Group

Packaging 4.0 will enable a new scale of OEE optimization and bring uniform measurement to multivendor environments. Technologies such as predictive maintenance, remote/onboard diagnostics, mechatronic streamlining and networked safety will boost reliability.

Combined, the attributes of Packaging 4.0 will lead to packaging and processing lines that experience fewer unplanned stoppages.

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Winfried Batzke
Managing Director, Deutsches Verpackungsinstitut - Germany

Digital revolution

The effects of the digital revolution and the Internet of Things (IoT) can already be seen throughout the packaging industry. This influence will grow as the IoT itself matures. After all, packaging is an essential link between value chain participants as well as an interface between brands, retailers and consumers.

"Smart packaging machines will allow mass personalization and just-in-time manufacturing"

Smart packaging

Active, intelligent, networked packaging can help monitor packaged goods and display or even regulate key conditions such as temperature and humidity. It can also facilitate compliance with medication prescriptions, display shelf life, make traceability more transparent and accessible, check inventory levels and trigger re-orders.

Smart packaging and smart labels can steer the entire packaging process. IoT trends such as mass personalization and just-in-time manufacturing rely on packaging as a key player in the process. In the smart factory, packaging can play the role of carrying the semantic product memory.

For packaging to reach its full IoT potential, there must first be a secure, reliable and accepted means of collecting and sharing data and resources up and down the entire value chain.

The overall tendency is clear, however, and has been for years. A product and its packaging are increasingly being perceived and treated as a single unit. As the IoT takes shape, this trend will only continue to gain traction.

Jean-Marc Doré
President, GEPPIA Packaging Trade Association - France

New possibilities for the entire packaging line

Product marketing requires frequent and even continual packaging innovation. In this context, machine builders need to make their machines more modular and flexible, which demands continuous investments in both hardware and software. Equipping machines with the latest automation technologies helps achieve a fast ROI.

Packaging 4.0 will have a strong impact on end-of-line machines. This equipment will no longer work as standalone units. Instead, it will be tightly connected to upstream machines. The emergence of advanced and integrated safe motion and robotics concepts will allow further integration of end-of-line equipment and open up new possibilities for the entire packaging line.

"Users have come to expect production with almost zero defects."

Zero-defect production

End users require OEE optimization and expect production with almost zero defects, regardless of machine type or configuration. Predictive maintenance allows early issue detection and preemptive actions, making it a helpful tool for preventing breakdowns, improving equipment efficiency and raising quality. Since the new internet communication tools make it easier to collect and integrate information from many machines, applying predictive maintenance to entire packaging lines has become easier.

Constant innovation

Finally, the strength of the packaging industry is and must be its exceptional ability to respond to ever-changing applications and constraints. The constant push and pull between consumer expectations and distributor constraints make our profession among the most dynamic and innovative you can find.

UCIMA
Italian Packaging Machinery Manufacturers Association

Enrico Aureli
President, UCIMA - Italy

Cutting-edge technological solutions

The Italian Packaging Machinery Manufacturing Association has assumed a leadership position on the global market by offering cutting-edge technological solutions tailored to the needs of individual customers.

An evolution, not a revolution

Italian companies have always shown an ability to anticipate the needs of the market and for years have offered their customers machinery and technology capable of catering to concepts such as Industry 4.0 and smart industry.

This means that Industry 4.0 is not a new idea for our companies. There is always room for improvement and we will do everything we can to offer our members opportunities to address the issue.

"Supply Chain 4.0 is the Italian approach to smart industry"

Supply chain 4.0

We also believe that the Italian approach must extend to the entire supply chain involved in the creation of a machine, transforming it into Supply Chain 4.0. It is a concept of integration and close cooperation between all players that contribute to the production of our machines: sub-suppliers, component suppliers and partners.

Culture and technology

Our goal is to encourage our supply chains to embrace these opportunities in terms of technology and communication so as to optimize the process of bringing innovations to market.

PPMA
Processing & Packaging Machinery Association

Dr. Andrew Mint
Chief Executive Officer, PPMA - UK

Membership embracing Industry 4.0

The Internet of Things is quickly changing the way manufacturers operate, bringing real opportunity to achieve new heights of operational innovation as well as operational excellence. We see our 450 member organisations developing Industry 4.0 technologies to enable manufacturers to have full visibility of operations and allow them to be responsive to information about raw materials, inventory, quality, waste, outputs and customer demands. This, in turn, ensures that opportunities for improvement are highlighted and action taken to save both money and time. Also delivered, of course, are improvements in customer satisfaction and supplier relations.

"The Internet of Things is bringing real opportunity for improvement"

Smart factories make machinery autonomous

Interconnectivity is the key component in the Industry 4.0 world. We see our members not only developing the technology that allows machines to talk to each other, but also talk to other departments at a plant and also suppliers. The result of all this greater communication is smart factories in which machinery is increasingly autonomous and able to manage its own service and maintenance requirements, and adapt instantly to new production requirements.

Industry 4.0 is not just a 'big boys' toy

It is not just large multinationals that will benefit from Industry 4.0 enabled technology, especially in overall equipment effectiveness (OEE) strategies. To date, OEE has often been the preserve of larger companies but will soon enough be within reach of all. SMEs will be able to form seamless links with their machine builders and technical services suppliers.

OMAC
The Organization for Machine Automation and Control

John Kowal
OMAC board of directors - USA

OMAC
Formed in 1994, OMAC brings together OEMs and their suppliers to develop consensus guidelines to increase operational efficiency in packaging and manufacturing.

PackML
PackML defines states, modes and tag naming conventions for machinery, standardizing the state model and data acquisition for any type of discrete manufacturing, regardless of the machine builder or control platform. PackML gives you apples-to-apples on how machines are running, making it much easier to collect production data, do OEE, diagnostics, and perform line control.

OMAC and OPC Foundation are cooperating on a companion specification that will provide OPC UA communications for PackML data. This will enable seamless communication and a uniform look and feel across multi-vendor packaging lines.

"OMAC PackSpec: At last, a universal User Requirements Specification"

PackSpec
Universally dreaded, packaging machinery specifications are hard for packagers to keep up to date. OEMs spend a lot of engineering dollars reviewing and seeking exceptions, and automation providers object to arbitrary product specifications.

That's why OMAC has developed PackSpec Version 1.0, a universal user requirements specification that calls out not just the OMAC Packaging Guidelines, but everything from EHS (Environment, Health and Safety) to commissioning and training.

Version 2.0, in the works now, will feature a readily modified template, making it easier than ever to make yours a 'PackSpec machine'.

OPC UA and PackML provide seamless communication and a uniform look and feel across multi-vendor packaging lines.

AUTOMATION THAT MAKES PACKAGING MORE PRODUCTIVE

www.br-automation.com/Packaging

B&R
Industrial Automation GmbH

B&R Strasse 1
5142 Eggelsberg, Austria

t +43 7748 6586-0
f +43 7748 6586-26

office@br-automation.com
www.br-automation.com

Your local contact
www.br-automation.com/contact

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