ADVANCED CONTROL IN PRODUCTION LINES FROM SENSORS TO MES

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SMART PACKAGING HUB
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index

summary

The packaging machines global market has been estimated in approximately 43 billion Dollars in 2020 and is expected to reach 70 billion Dollars in 2030, with a 4.7% CAGR from 2021 to 2030 [1].

Pushed by a growing competition, packaging companies are constantly under pressure to optimize their service and the quality of products, as well as internal processes.

In this context, the 4.0 Industry paradigm is gradually gaining ground while the packaging industry is best placed to lead the digital transformation: not only smart packaging, but also fully automated packaging lines and the entire value chain rethought from an evolutionary perspective based on valuable data and information.

[1] See Allied Market Research, 2021

obiettivi

INTRODUCING THE BENEFITS THE 4.0 INDUSTRY PARADIGM CAN OFFER TO THE PACKAGING INDUSTRY

DEFINING PERSPECTIVES AND POINTS OF EMPHASIS OF THIS INDUSTRY

HIGHLIGHTING THE IMPORTANCE OF MEASUREMENTS WITHIN THE VALUE CHAIN, FROM SENSORS TO MES

POINTING OUT THE IMPORTANCE OF A FLEXIBLE PRODUCTION LINE

ILLUSTRATING HOW ONE CAN INCREASE SYNCHRONICITY AND PERFORMANCE OF A PACKAGING PRODUCTION LINE

Introduction

In a Smart Factory, production machines are interconnected; thanks to a continued exchange of data, also production and logistic processes are closely related. Hence, everything can be checked and monitored remotely in an integrated and optimized way.

Furthermore, while extracting valuable information from collected data, machines can learn from past events, improving the performance as far as flexibility and reliability are concerned.

Finally, in an evolving perspecitve, through predictive maintenance strategies, that leverage data and data analysis, one can detect any abnormalities, implement corrective measures, automatically send alarms to the staff involved, asking for action on their part. This would help them cut unplanned downtime and stops.

The Packaging Industry is 4.0

In the packaging industry, the Smart Factory implements extremely flexible production lines, offering a continuous operation, while eliminating downtime for washing, format change and maintenance. Furthermore, this kind of lines makes small print runs, or even unique packaging sustainable.

This ensures a very quick response to a market demand, while generating an unquestionable competitive advantage.

In addition, just to give an example, this flexibility is an opportunity to take care of taste trends, using packaging to carry out an original, smart marketing campaign, even in terms of customization.

The packaging as such becomes connected and smart: it is trackable in real time along the value chain and can supply information on origin and quality of the contents.

Thereby, manufacturers can meet the growing demand of transparency, as well as improve the product or quickly detect the cause of problems, e.g. concerning raw materials or the supply chain, in case of claims.

OUTLOOK AND POINTS OF EMPHASIS

Packaging machines play a basic role in ensuring product safety along the entire supply chain.

Major applications cover a wide range of segments, from food and beverage to health, cosmetics and other consumer goods, as well as number of industries where packaging has become essential.

In the last few years, filling machines have been the prevailing machines on the packaging machines general market. They are mainly in use in the food and beverage in-

dustry to fill bottles or sachets: according to weight and size of the product to be filled into, their precision degree varies appropriately.

Presently, the demand of packaging machines is driven mainly by a growing demand of consumer goods, by the increased application of automated packaging machines and by the development of energy efficient machines. Another key factor is a growing demand of packaging robots.

In the last decade, the development of packaging technology has enjoyed a significant growth. Collaterally, packaging has become an essential process before offering the consumers a final product. In fact, the packaging machine is the most delicate point of the production line, where the bulk product gets in touch with its container/package. In this context, the machine as such is a strategic step for all those processes involving tracing of products as well as synchronising of factory orders.

In the near future, cleaning and sterilizing machines are expected to enjoy the quickest growth rate, with a 7.3% CAGR until 2027. As regards the Food & Beverage segment, that has been leading the packaging machines market in 2020-21, a 5.1% CAGR is expected until 2030, with the Asia-Pacific region steadily growing together with the LAMEA area (Latin America, Middle East and Africa), while North America and Europe remain mature markets, hence with a lower growth.

As regards Italy, the market of Italian packaging machines manufacturers generated a turnover over the pre-Covid crisis level, with in excess of 8 billion Euro, 8% more than in 2020. (Source: UCIMA [2], 2021).

In particular, in 2021 the domestic market grew by 18%, by an absolute value of 2 billion Euro. Export, a historical strong point of this industry, contributed totally 6.4 billion Euro, +5% compared to the previous year.

However, rising costs of raw materials, components, transport and energy, with a +30%

[2] Italian Packaging Machinery Manufacturers Association

overall burden on production costs, weighs on recovery in 2022; on the other hand, UCIMA considers it the major point of emphasis to be monitored.

FROM SENSORS TO MES: THE IMPORTANCE OF MEASURING

In Smart Manufacturing, facilities, workers, systems, and finished products are equipped with sensors to detect location, status, activity. Data collected, that are the real engine of the smart factory, is analyzed to improve production capacity, efficiency, safety and operation continuity. Finally, the whole factory is connected to the rest of the logistic-productive system and to customers through cloud platforms: product usage data is used in the after-sale service and to develop new products and services.

Though initially the emergence of Industry 4.0 technologies seemed to replace MES (Manufacturing Execution System), an already fully developed technology, in fact, in the background, it plays an ever more and more central role in this new environment.

MES connects the ERP (Enterprise Resource Planning) management software to the machines (actually to SCADA/PLCs) operating in the different sections of a factory, thus optimizing the productivity.

In Industry 4.0, where IT systems communicate with Operational Technologies (OT) through a continuous flow of data, MES is the point of convergence and orchestration of different data sources; it allows integrating and coordinating various activities relating to materials, orders, production, deliveries, human and mechanical resources.

Furthermore, while collecting, saving and making production data available when needed, it becomes more and more essential when operating on cloud infrastructures that make it more difficult to maintain control over the exact location of data.

Hence, for packaging machines it is essential to be designed applying methods and platforms that can offer interconnection to company MES.

Integration should be set up from the very start to enable those changes in production processes that can happen any time and that require great flexibility and speed in implementation.

The OEE (Overall Equipment Effectiveness) calculation and management platform, formerly recognized as the main indicator of a machine production efficiency, and end point of integration of a line, is now the basic line of more and more advanced systems, set up to implement a steadily increasing digitization of the different steps of the supply chain.

Automation and Flexibility in Production Lines

The pandemic crisis pushed number of industries to quickly convert production systems and redesign logistic channels.

For example: the Food & Beverage sector saw a sharp decline of products intended for the Ho.Re.Ca (Hotellerie-Restaurant-Café) channel, consequently pushing it to re-convert dedicated installations to be able to meet the increased demand from mass retailing and the logistic channel of online sales and home delivery.

In fact, generally speaking, companies that were able to re-convert their production gained a great competitive advantage.

The most significant impact on a streamlined and efficient factory in the Food & Beverage industry certainly comes from packaging, where a possible redesign of

the production line and interconnection with the management network are basic requirements to track products and implement a quick and efficient format or product switch within the line.

Furthermore, due to a continued development towards a sustainable environment, packaging systems must be flexible and quickly field-configurable, because customized packaging is going to be re-considered every few months.

In order to obtain a quick format change, integration between hardware and software is simplified by the use of modular platforms where single modules are interconnected and quickly programmable; once the correct parameters for a specific application have been identified, suffice to select the suitable set of parameters.

RECORDING PROCESS VARIABLES TO INCREASE EFFICIENCY

Regardless of the type of product, almost every manufacturer is actually data-driven, that is with long- term strategies heavily influenced by data; the packaging industry is no exception.

Exact, accurate, reliable and prompt information is necessary to be competitive on the market; in fact, the equivalence between data and value of an enterprise is a fundamental pillar of the Digital Economy.

From refining to processing of raw materials to packaging of final products, by means of data analysis one can introduce changes along the production line and cut operation costs, to get rid of waste and inefficiencies.

The range and size of process variables becomes the key to implement predictive maintenance strategies, tracking of variables that can influence a product quality, forecast and optimization of production as a whole. Such strategies concern also the lifecycle of a single product, the supply chain management (from demand forecast to the warehouse), up to the implementation of an Enterprise management, that enables businesses to face the challenge of global development, even in terms of sustainability.

ZACMI: SYNCHRONISING MACHINES IN 4.0 PRODUCTION LINES

Today, Zacmi established in 1954, is a leading manufacturer of filling and seaming machines, with in excess of 2,500 units installed in the world and a total turnover of approximately 30 million Euro. Always innovation oriented, the company boasts 47 patents, some of them still valid. Focused on the food industry since 1965, they started in the early 1980's to expand to international markets, now a priority of the company, to the extent that in 2019 they opened officially Zacmi North America in Anderson, Indiana.

As regards Industry 4.0, Zacmi manufactures primary packaging lines for all kinds of container.

Intended for customers ranging from smaller businesses to big corporate companies, Zacmi lines are flexible and automatic, and, as mentioned above, they ensure a fully synchronized production processes thanks to 4.0 MES. For example, in UK they recently implemented a production line that can quickly change its configuration to be able to continue operating even while washing part of the line.

Thanks to measurements taken at each step of the production process, when needed, Zacmi lines can track the filling process up to a single container.

Of course, measurements are essential to improve efficiency as a whole and optimize production in a complex environment, where various machines, even of different make, and have to work synchronously. For such an application, Zacmi offers specialized service and advice. They operate both in a standard way where, based upon number of cases observed, they apply basic stardard configurations, or customized solutions, if that is the case.

Among Zacmi solutions, they offer platforms to manage centrally the operation of various machines, enabling the remote operator and improving the efficiency of the machines involved.

Taken as a whole, they estimate that, given the initial efficiency of a cluster of ma-

chines of approximately 50-60%, some basic measures, as mentioned above, can quickly reach 80% to exceed even 95% with customized solutions. All that, even with number of machines in the production line: a full synchronization is always a priority for Zacmi.

Efforts, measurements and fitting are the main directions of Zacmi solutions. In particular, thanks to the use of data, they define the priorities for intervention based on the following classification:

- Operator safety (ensured from the very start)
- Product quality (implemented within a customization process to obtain exactly the packaging customers want)
- Efficiency and preservation of machinery (analysis of common downtime causes and strengthening of efficiency levels through continued measurements and dedicated customization).

Conclusions

Industry 4.0 is often referred to as a future vision of manufacture under which, thanks to digital technologies, manufacturing businesses will increase competitiveness and efficiency through interconnection and cooperation of its resources (physical assets, people, information), both in house or distributed along the value chain.

Data is the engine of digital transformation: collecting, analysing, using data for number of optimization actions and for a greater flexibility obtain real economic savings while improving competitiveness. We have seen it in the case of the packaging industry, among other excellent achievements of Italian manufacture.

Keypoints

- A growing demand in the last few years has made packaging more and more connected and smart
- The packaging industry is a key player of the 4.0 pattern thanks to flexible production lines and the recently central role of MES
- Integration, synchronization and measurements are critical to face the market challenge
- Zacmi, thanks to an innovative and highly specialised approach, can increase up to 95% the efficiency of a packaging production line