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Strategies for boosting flexibility in packaging

How to succeed amid changing customer needs and an insatiable demand for variety

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Introduction

The combination of global development, a larger number of people in the workforce and an increasingly health-conscious consumer base has created a demand for mass customization and the ability to offer a wide variety of serving sizes and niche products (a phenomenon known as SKU proliferation). Big data is helping manufacturers gather more customer data, and this data can be used to drive changes in production.

To successfully compete in this environment, food and beverage manufacturers are embracing flexible packaging strategies. Industrial flexible manufacturing can mean many things, but the overarching goal is to respond effectively to changing consumer needs and manage multiple related product types.

Specifically, food and beverage manufacturers can take advantage of flexible manufacturing arrangements to do any of the following:

- Produce a variety of products on the same machines
- Produce the same products on different machines
- Efficiently accommodate product design changes

To be flexible, a manufacturing system must be able to automatically identify different production units to perform the correct operation, efficiently send changeover instructions to computer-controlled production machines, and quickly change between physical arrangements of fixtures, tools and other working units.

This white paper will give some background on flexible manufacturing in the food and beverage packaging industry and discuss several strategies for making the most of a flexible system.

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Key drivers of flexible manufacturing in food and beverage packaging

The bulk of today's customization and thus the leading factor in SKU proliferation is driven by the needs of the consumer. Manufacturers are responding to an increasingly diverse and demanding consumer base by investing in new machinery and new lines to make varying packaging formats and portion sizes readily available. Growing consumer health consciousness combined with increasingly busy lifestyles is spurring demand for convenience foods, single-serve portions and completely new recipes.

Like the food industry, the beverage industry in North America and Western Europe is heavily influenced by trends such as portion size. Smaller-size cans and bottles provide variety for the consumer and also enables manufacturers to compete with cheaper alternatives without devaluing the brand. Beverage companies are also constantly seeking to improve the grip styles on beverage packaging, which often demands highly specialized machinery.

Aside from consumers, major retailers like Walmart are putting pressure on manufacturers to meet stringent pricing demands through increased productivity and efficiency. These retailers have enormous purchasing power, and they are able to squeeze profits from their suppliers by forcing them to compete with one another for a limited number of coveted opportunities and precious shelf space in stores. Due to this pressure, food and beverage processors and packagers are investing in flexible machines and increased automation in order to reduce production costs.

What are the characteristics of a flexible line?

A flexible production line can do one or more of the following:

- Automatically identify different production units to perform the correct operation
- Efficiently send changeover instructions to computer-controlled production machines
- Quickly change between physical arrangements of fixtures, tools and other working units
- Interface with material requirements planning (MRP) systems that use supply chain data to predict consumer purchasing trends

The trade-offs of flexibility

A well-known and widely praised example of the use of flexibility in the packaging of food and beverages is Coca-Cola's "Share a Coke" campaign that began in 2011 and continues to the present day. Using flexible labelling and printing machines at the production stage, Coca-Cola was able to label its bottles and cans with all sorts of different common names and relevant terms like "friends" and "family." Whimsical and fun, the campaign served its purpose well by delighting customers and significantly increasing Coca-Cola's share of the beverage industry.

Other examples of flexibility have a more practical purpose, such as providing a wide range of sizes and combinations of the same products without needing to build several different lines. In fact, the practice of running several different packaging sizes on the same production line is quite common, particularly in the snack food arena. For instance, manufacturers often adapt existing equipment to special sizes depending on the time of year, such as a new family-size variety pack for the Fourth of July.

Having an entire line dedicated to a single SKU has traditionally been the best way to maximize throughput and overall equipment effectiveness (OEE), but it doesn't allow a company to be as responsive to the needs of its consumer base. It's up to manufacturers to determine what's in their best interest. Boosting the flexibility of a facility requires a compromise to some extent on drivers like throughput and OEE because constant product changeover can reduce machine speeds. Flexibility can also have an impact on quality because greater product changeover means more likelihood of uncaught errors without the inclusion of a robust traceability system.

That said, flexible manufacturing ultimately helps with time-to-market when consumer demands are diverse and unpredictable. It may prevent manufacturers from producing unsellable quantities of products or letting lines sit idle for costly periods of time. It also saves plant space and reduces overall capital expenditure. When designed intelligently, the benefits and cost savings of a flexible system far outweigh the initial challenges.

Did you know?

Coca-Cola's "Share a Coke" campaign started in Australia in 2011 and has since been rolled out to more than 100 countries. The beverage manufacturer used flexible labelling and printing machinery to customize individual bottles with more than a thousand different names. This famous example of mass customization significantly increased Coca-Cola's share of the beverage industry.

Designing for modularity

As manufacturers seek to implement complete packaging lines that incorporate several functions – from molding to filling to labeling – from a single supplier, machine builders are trending towards modular designs. Modular machinery from a single supplier helps food and beverage companies prepare for the requirements that the increased variety of packaging styles and materials will likely bring in the near future.

Modularity is essential for flexible manufacturing because it can be practically impossible to predict the future requirements of production line machinery. As manufacturers move forward with capital investment plans, they can save significant amounts of money by upgrading or changing specific components of a modular line rather than paying a higher cost for an entirely new line. Because modularity can extend down to the individual sub-assemblies within a machine, these sub-assemblies can be swapped out to accommodate many product variations with ease.

A modular line may have the same up-front cost as a non-modular one, but because machines or even sub-assemblies can be swapped and rotated amongst many lines, the overall cost is lower. Modularity provides significant lifetime savings by eliminating additional capital investment as product throughput demands change. Furthermore, failure in one area of a modular line will not require the whole line to be shut down because parts and even machines are interchangeable.

Making existing equipment adaptable

Many of the drivers affecting food and beverage packaging lead into the need for flexible machinery that enables product variation without significant changeover time. There are many things manufacturers can do to make existing machines more flexible. For example, they can automatically change the positioning of the guide-rails on a line that produces – for example – bottle sizes ranging from eight ounces to one liter. As the different bottle sizes are selected by the MRP system to come down the line, guide-rails and deflectors self-adjust. Vision and sensing equipment can then detect each size and prompt the line to verify the change and react accordingly.

Omron's HMI recipe handling features make it easy to reprogram equipment to change guide-rails and other aspects of machinery depending on what SKU is coming down the line. When a recipe change is needed, an operator can simply touch a few buttons on the HMI to send a signal to a machine automation controller and prompt the line to automatically adjust to the new parameters. This level of automatic adaptability can increase the number of individual SKUs that a company can package by a factor of ten or more, and there's no need to fully reinvest in capital equipment every time the requirements change.

The Omron Sysmac NA Series HMI enables faster, more efficient control and monitoring - and a more natural, proactive relationship between operator and machine. The design has been based on real applications and customer requirements, a future-proofed, scalable platform that will evolve with their ever-changing needs, allowing real time reaction to events. As part of the system family, the NA Series is fully aware of the total machine.

Employing robotics – vision-guided and collaborative

The packaging industry has dramatically increased its use of robotics over the past decade – in primary and secondary applications as well as end-of-line applications. Because robots themselves are becoming easier to integrate into flexible applications, manufacturers can easily use them to handle different product shapes and sizes, including delicate items. In fact, the International Federation of Robotics (IFR) has predicted 15% annual growth in robotics through the end of 2019.

Did you know?

The International Federation of Robotics has predicted an annual growth of 15% through 2019 for the use of robotics in the packaging industry.

In addition to maximizing flexibility, robots help with the following:

- Increase throughput rates
- Improve precision and consistency
- Minimize scrap and waste
- Reduce repetitive injuries and improve overall safety

The power of robots in packaging comes from the fact that they are reusable, re-deployable assets that can change their programs on the fly. By helping to increase line changes and product changes, they are a key component of overall flexible manufacturing solutions, particularly when paired with a vision system that allows them to automatically detect changes in their environment as well as products coming down the line.

One robotic solution in particular that has a tremendous impact on flexibility is the collaborative robot – for example, Omron's new TM Series robot. Collaborative robots are highly adaptable to changing environments, and they are easy to teach new tasks. They also help prevent workers from repetitive injuries that could result from making the same movements over and over again. Collaborative robots can be added to work spaces with a minimal impact on floorspace since guarding is unnecessary.

The TM Series Collaborative Robot boasts an easy-to-use manual teaching feature that allows operators to safely hand-guide the robotic arm through a sequence of actions. Because the hand-guiding mechanism makes it possible to teach new tasks without turning to a robot programming expert, the robot empowers operators to optimize their workflow and helps keep adaptive lines running smoothly and efficiently. The manual teaching feature of collaborative robots can be combined with vision to find and identify works-in-progress. In the past, most robots didn't use vision, so they needed to be told exactly where to go. Vision allows for more variability with less input from operators.

Omron's new FHV7 Series Vision System uses an innovative lighting technology that catches tiny defects and subtle color changes that might escape the human eye. Ideal for plant managers and system integrators dealing with increasing amounts of

Using data connectivity and traceability technologies to support more automation

image information, the FH Series features high-speed, high-resolution compact cameras with a wide field of view in addition to advanced image processing algorithms and high-capacity storage. Another powerful vision solution is the HAWK MV-4000 smart camera, a unique technology that boasts near-PC processing speeds in a compact and ruggedized casing. It offers a complete vision, code reading and verification toolset and comes fully accessorized with lenses, lights, cables and mounts.

As manufacturers integrate more automation into their machines to increase throughput, operability and flexibility, the importance of traceability, record-keeping and industrial communications increases as well. When a greater range of automation components – from servo-driven actuators to machine vision to remote monitoring – are incorporated into a system, these technologies demand better data tracking and communication between individual machines or between the machine level and the enterprise level.

To send product changeover data electronically and ensure that the correct products are being run, it's important to employ technologies that assist with data flow. Omron's NJ-SQL controller is an excellent example of a solution that allows low-level machines to tell the higher-level computers where each work-in-progress is located at a given point in time. The controller's built-in SQL client ensures that the average programmer would be able to troubleshoot issues and restore connections to the database whenever the flexible system needs restructuring.

Omron's high-performance barcode readers are also a key component of an asset tracking and traceability solution. The MicroHAWK family of compact, industry-ready barcode readers is designed to fit seamlessly into a variety of applications and accurately capture data from damaged codes as well as pristine ones. Omron has ensured that the MicroHAWKs connect easily to the SQL processor so that asset tracking solutions can be quick to set up.

Omron's MicroHAWK series of industrial barcode readers enhance traceability and flexible manufacturing with best-in-class liquid lens autofocus technology, including new long range functionality, and high-performance X-Mode decoding algorithms.

Omron's TM series robots help companies produce a high mix and low volume of products, as well as harness the true potential of human resources.

Omron's NJ101 SQL Client CPUs are designed to address basic industrial controller applications in a wide variety of industries including: automotive, semiconductor, infrastructure, and food and beverage packaging.

Visualizing the process and emulating new packaging applications

When planning out a flexible manufacturing application, thorough visualization is essential. Omron has several options for visualizing and emulating packaging applications. One in particular, called PackExpert, provides an advanced emulator that allows engineers to easily program multiple robots in a single system to meet specific design criteria. In a wizard-style format, an engineer can set up an entire robot system without explicitly programming it. This gives machine and system designers more flexibility by making it possible to dynamically change the products being made.

Omron's Sysmac Studio platform includes a simulator that runs a virtual PLC so manufacturers can see how a program will work in a virtual environment. This saves significant amounts of time and effort optimizing the actual application once it's fully up and running. Omron also has a partnership with Indusoft, a company that makes an extremely flexible data manipulation and visualization package and allows Omron's architecture to communicate with multiple devices.

Omron's Sysmac Studio is one of the most full featured automation IDEs which handles complete machine automation including: information handling, visualization, networking, logic, motion, safety, vision, robotics and CNC and I/O.

Summary

In order to offer a wide variety of products and respond quickly to changes in consumer preference, food and beverage manufacturers can take advantage of a number of intelligent design strategies and automated solutions to enhance flexibility. By designing for modularity, increasing the adaptability of existing equipment, employing vision-guided and collaborative robotics and embracing advanced technologies for connectivity and traceability, manufacturers can increase throughput rates, minimize waste and ensure consistent quality while retaining the ability to perform product changeovers whenever business analytics indicate that a change would be advantageous.

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