OMRON

Transforming semiconductor and electronics manufacturing, encouraging disruptive innovation with flexible production

Industry trends and strategies for success

White paper | February 2020

automation.omron.com

Introduction

The need for continuous innovation characterizes consumer electronics and semiconductor manufacturing perhaps more than any other industry. The market is always hungry for the next exciting tech gadget, and with each new product release comes a host of options for customization. Individual customers want items with their favorite colors, just the right amount of memory, and whatever features they prize the most. Semiconductor manufacturers see a need to produce processors with varying speeds and power requirements so that they can be incorporated into tablets, phones and all sorts of different device formats.

To meet the needs of the market while retaining the ability to rapidly innovate, semiconductor and electronics manufacturers are increasingly relying on a flexible manufacturing strategy. This white paper discusses several strategies for ensuring the efficiency, throughput and transparency of flexible manufacturing systems for device makers and electronics. Topics include:

- Using software to manage new products and traceability
- Keeping flexible systems efficient with automation technology
- Adding more variability with vision-guided robotics
- Leveraging data to optimize complex processes (i.e. interaction / SECS/GEM compliance)

OMRON

OMRON

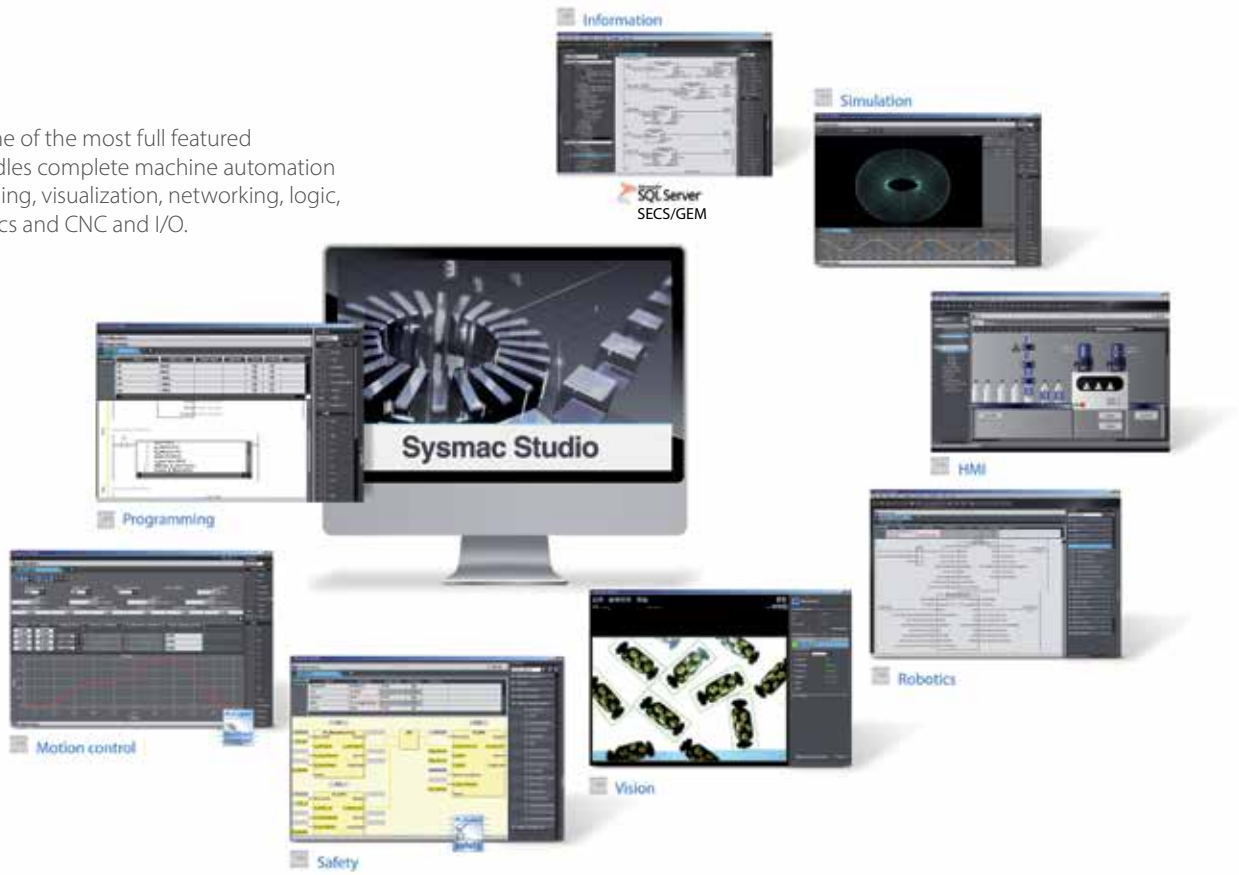
Contents

To enhance innovation, the right software can help with ramping up new products

The need for innovation drives a lot of flexible manufacturing needs in semiconductor and electronics. Companies are continuously working on the next iteration of their most popular products, as they know that competitors are constantly striving to be more innovative. While doing so, they recognize the importance of keeping previous versions of their products available to satisfy customers who prefer those. This is a major driver for implementing a flexible manufacturing strategy.

Omron's hardware solutions that are based on its Sysmac Platform automate semiconductor tools and equipment while integrating seamlessly with the manufacturing execution system (MES) through flexible communication interfaces that include EtherNet/IP, OPC-UA and SQL. Sysmac Studio software helps customers design, maintain and troubleshoot flexible production equipment in a single integrated development environment (IDE) that dramatically reduces engineering time. Using Sysmac Studio, manufacturers can employ IEC 61131-3 PLC programming languages and capitalize on easy simulation features to make their design work easier.

Sysmac Studio software also has a version control option that makes it much easier to innovate new functionality while ensuring that any upgrades to the basic product line are shared across all versions. With the scale of development and workload of continuous program modifications, Sysmac's GIT-based version control system helps multiple developer teams work in parallel and efficiently manage projects. The version control capability also helps create modular software assets that can be repeatedly used across projects.



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.

Automation keeps flexible systems efficient

The goal of any flexible manufacturing system is to increase production and reduce downtime while responding promptly to changes in market demands. If a production line is dedicated to a single product and consumers stop purchasing that product, the line won't be making any money for the company unless it can be easily repurposed.

One of the key requirements of flexible production lines is to automate the process of identifying which product is being run at any given time. The MES can ensure that works-in-progress undergo the appropriate sequences of steps by leveraging traceability information. Key traceability technologies that help with line optimization include high-resolution laser markers for placing tiny barcodes on space-constrained printed circuit boards (PCBs), components or enclosures; barcode readers and verifiers that are optimized for capturing data from these small codes; and RFID solutions that can flexibly store traceability information in a way that can be easily updated. Anything having to do with data flow is especially important, since traceability generates huge amounts of data, and this can slow down the production cycle if not managed properly.

Omron's NJ-SQL controller helps manufacturers in the semiconductor and consumer electronics industries manage traceability data and other key information such as measurements and timestamps. This controller boosts flexibility by making it possible for low-level machines to communicate work-in-progress location and status information to higher-level computers. Since the controller has client software for SQL databases, the average programmer can easily understand the software since SQL connectivity is also programmed using IEC 61131-3 languages.

The NJ-SQL is designed to directly transfer traceability information – as well as quality-related production data like screw torque and tolerance measurements – to a SQL database without hampering machine control performance thanks to embedded SQL clients. By making secure data transfer easily available at the machine level, the controller helps manufacturers get the information they need to make significant productivity improvements to their lines. In addition to the NJ-SQL, Omron provides several other ways to communicate traceability data to the MES, including OPC-UA and Ethernet/IP.

The Sysmac NJ501 Machine Automation Controller (MAC); a completely redesigned hardware platform with a powerful Intel® Atom™ processor, proven for harsh environments. This architecture allows the NJ-Series to be adaptable and scalable. This ultra-compact market leading technology provides ultimate flexibility without compromising reliability and robustness.

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.

Vision combined with robotics makes it easy to add more variability

Designing flexibility into a production line used to mean that a line couldn't be automated to the degree that single-purpose lines could be. Today's technology has evolved to the point where manufacturers can produce a greater variety of products while keeping the level of automation high. In particular, the combination of machine vision with robotics can significantly enhance throughput and increase quality in a flexible environment by fully automating the process of dealing with varying products coming down the line.

Robots are reusable, re-deployable assets that can change their programs quickly and efficiently to enable line and product changes. When paired with vision, they become a complete solution for flexible manufacturing. Robotic equipment is particularly useful for the final assembly, test and packaging (FATP) stages in consumer electronics manufacturing.

Collaborative robots are an especially powerful flexible manufacturing solution, as they can be easily retrained on new tasks and can work in conjunction with humans without requiring special safety precautions. The manual teaching feature on collaborative robots – such as Omron's new TM Series robot – can be combined with machine vision technology to locate and identify parts and follow the correct steps for each work-in-progress category. Because vision-guided collaborative robots can adapt quickly to changing environments and new requirements, they help keep adaptive lines moving at full productivity.

Omron offers several powerful yet compact smart cameras and vision systems that reflect the significant advancements in today's machine vision technology. These cameras can perform a wide range of tasks, including locating objects through pattern recognition, counting objects, detecting color and verifying that machine-readable data and human-readable data on an item match. Omron's extensive vision portfolio includes the versatile FH series that provides high-speed, high-precision inspection and measurement functionality within a compact, easily programmable system. Other vision options include the tiny, embeddable MicroHAWK smart cameras and the rugged and powerful HAWK MV-4000 that can reach near-PC processing speeds.

Today's technology has evolved to the point where manufacturers can produce a greater variety of products while keeping the level of automation high.

Omron HAWK MV-4000 camera is designed to rival PC-based systems in many industrial applications.

Optimizing complex processes requires more data, and machine learning to process it

When a production line is dedicated to a single product, basic traceability data can point unequivocally to the source of bottlenecks and potential signs of machine failure. With flexible production lines, on the other hand, the complexity of the system typically exceeds the point where people can keep track of bottlenecks and optimize machine uptime using manual calculations and traceability information. There are simply too many parameters to consider when trying to optimize flexible lines and determine when a piece of equipment is likely to break down.

Mechanical components generally have a predictable lifespan associated with them, and it's crucial for manufacturers to have a good idea of when they might break down in order to avoid downtime and – even more importantly – hazardous situations. For a safety circuit, for instance, manufacturers perform mean-time-between-failure calculations to predict when they're going to fail. If the equipment's configuration is altered – as is done frequently in flexible manufacturing systems – the calculations need to be updated. This is time-consuming, and it only provides rudimentary predictive maintenance information at best.

In many cases, optimizing flexible lines is only possible with increasing amounts of data and specialized machine learning solutions that can monitor machine function constantly and crunch the numbers automatically. Omron's AI Controller "listens" to manufacturing equipment while it's running normally and determines what constitutes normal machine behavior. If any of the hundreds of parameters detected by the machine learning algorithms could signal abnormal behavior, the system sounds an alarm to indicate a problem and point to the likely cause. In effect, this is a strategy not just for predictive maintenance, but for fully-fledged preventive maintenance.

If any anomalies are indicated by a specific combination of the hundreds of transformed variables that the machine learning algorithms monitor, the controller can programmatically change the operation to an alternative run mode that avoids costly equipment damage or product quality issues. Since artificial intelligence is responsible for determining that something isn't quite right, it can pick up on subtle cues that might elude even the most experienced operator on less flexible production lines. This helps ensure that, no matter how complex a flexible system is, it's possible to figure out that something isn't functioning well before it breaks – and manufacturers can feel comfortable adding complexity to the system without hindering their ability to perform predictive maintenance.

Summary

Through effective management of new product iterations with software and boosting efficiency through automation, device makers can offer innovative new products while maintaining consumer satisfaction. Variation in products also becomes easier to manage through the use of vision-guided robotics – particularly collaborative robots combined with machine vision smart cameras – and AI-powered solutions for automated data crunching.

References

1. Hooper, Trey for Pannam. (2018). The 7 Biggest Trends and Challenges in the Electronics Manufacturing Industry in 2017. Retrieved December 14, 2018 from https://www.pannam.com/blog/top-trends-and-challenges-in-electronics-manufacturing/.
2. Wimmer, Christoph for Microscan. (2017). 3 Ways To Make Your Factory Smarter With IIoT. Retrieved December 14, 2018 from https://files.microscan.com/resources/3%20Ways%20To%20Make%20Your%20Factory%20Smarter%20With%20IIoT%20ATX%20 2018%20Final.pdf.

OMRON

Omron Automation | 800.556.6766 | automation.omron.com

U78I-E-01

Sensing | Control | Safety | Vision | Motion | Robotics