SIEMENS IT/OT INTEGRATION OPTIMIZES PRODUCTIVITY AND COMPETITIVENESS

For Greater Transparency and Efficiency

Smart order management to provide more flexibility and less paper in production

SIEMENS

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Executive Summary

Integration of information technologies (IT) and operational technologies (OT) is playing a decisive role on the path towards digital transformation. It determines the extent to which industries remain competitive and future-proof. As a core foundation for further digitalization of factories and production facilities, it is paving the way to Smart Factory concepts and all the advantages they promise.

Most business already know about the need to connect IT and OT. Around 76% of businesses surveyed by a Forrester survey in 2022 confirmed this awareness. However, only 36% are actively pursuing IT/OT convergence, establishing a key advantage for themselves in their markets. ERP and MES/MOM and automation systems must all be capable of sharing information to guarantee flexible production processes. Closer and closer integration of these two areas greater sharing of data mean that businesses can design more efficient processes, producing higher quality and generating added value by using data correctly.

Industrial businesses that successfully integrate IT and OT as part of their digitalization process profit in many respects, with the four most important factors being cost reduction, sustainability, improving overall plant effectiveness and quality improvement. The food and beverage industry is a perfect example of just how important these outcomes have already been for many manufacturers: current consumer trends such as healthier, more sustainable food, an increase in food safety regulation and ever smaller and more customized product ranges mean greater process complexity and higher costs. A successful IT/OT integration offers the appropriate solution, improving transparency, efficiency and flexibility, and often determines which projects become established in the market in the short term and go on to last the course.

It is relatively simple to get into IT/OT integration using the tried-and-tested technologies available today, releasing latent potential in the value chains even in the short term, for example in the execution of production orders (order execution). Smart integration of IT and OT allows companies to significantly increase their productivity and, for example, meet the challenge of introducing paperless production flexibly and without significant downtimes. Digitized order management reduces the time and effort that have to be devoted to data entry as well as the complexity of documentation and enables transparent processes from procurement to production. All relevant data is displayed digitally during order execution via an IT/OT connection and is available at all times. This increases flexibility and sustainability, while the susceptibility to errors is significantly reduced due to the elimination of paper and manual inputs. Simply introducing IT/OT integration for order execution therefore means that numerous benefits of Industry 4.0 smart-factory concepts can be realized in a short space of time.

INTRODUCTION

IT-OT Integration: The key to digital transformation

IT/OT integration – the integration of information technology (IT) and operational technology (OT) – is an essential step on the way to a company's digital transformation. Because wherever automation, edge computing, 5G or data security are involved, IT and OT converge. And the more closely the two areas are linked via their respective systems, and the better the functions for sharing and exchanging information, the more effectively this data can be used. This can increase the efficiency of processes, reduce error rates and downtime, and improve the quality of the respective product. By connecting the shop floor with the higher-level data structures, IT/OT integration forms the central foundation for the further digitization of factories and production lines en route to smart factory concepts, therefore also for long-term future viability and competitiveness.

Fit for a silo-free future

For a long time, many companies viewed their IT and OT departments in isolation, with different tasks, priorities and resources. Only in a few industries has integration been actively pursued, according to recent survey data from Forrester in 2022: For example, around 67% of the companies surveyed had not yet established any IT/OT integration solutions in their own companies, or had only partially embarked on the journey.[1] While 76% saw IT and OT integration as a top priority for their organization, only 36% had recorded any progress on implementation, and have no plans to increase or accelerate their efforts to date.[2] The greatest efforts were focused on standardizing automation, retrofitting sensors to existing products, and investing in autonomous systems. According to a study by the consulting firm Mieschke Hoffmann und Peter, this reluctance might stem from companies' widespread lack of faith in a quick return on investment (ROI) and thus in the profitability of integration projects.[3] Despite this belief, a look at the technical options shows that entry into IT/OT integration is possible from various starting points with little effort, in order to release dormant potential in the value chain. As a long-term investment in digital transformation, modern integration solutions also make a significant contribution to strengthening important future factors such as flexibility, productivity, efficiency and, not least, the ecological and economic sustainability of companies.

[1] See: Forrester, IT OT integration as lever for digital transformation IT OT Integration: A Forrester Consulting thought leadership paper commissioned by Siemens, June 2022, https://contentpath.siemens.com/ot-it/71?utm_source=website#page=1, 07.18.2023
[2] See: Forrester, IT OT integration as lever for digital transformation IT OT Integration: A Forrester Consulting thought leadership paper commissioned by Siemens, June 2022, https://contentpath.siemens.com/ot-it/71?utm_source=website#page=1, 07.18.2023
[3] See: Mieschke Hoffmann und Peter, MHPStudie Industrie 4.0 Barometer 2023, https://www.mhp.com/de/insights/was-wir-denken/industrie-40-barometer-2023#c4436, 07.18.2023

More efficiency in data sharing and -analysis

Pressure is rising on many manufacturers, for example in the food and beverage sector: current consumer trends such as healthier, more sustainable food, an increase in food safety regulation and ever smaller and more customized product ranges mean greater process complexity and higher costs. “The benefits of Industry 4.0 have gone from being a ‘nice to have’ to an uncompromising competitive factor in the sector,” insists Christian Gerke, IT/OT Senior Consultant at Siemens AG. Accordingly, the digitalization of the food and beverage industry is already relatively advanced, for example using automated ovens or processing machinery. According to the Global Food and Beverage Industry Trends Report, around 75% of food and beverage companies have continued or ramped up their investment in digital technologies. Among these, the most important areas to be improved through digital technologies are supply chain operations (51%), data collection (38%) and better business analytics (37%).[4] Nevertheless, in many places the integration of IT and OT necessary to convert existing data streams into value creation on a lasting basis is a missing link. For example, industry experts assume that about 98% of German breweries carry out their entire process control using standalone solutions that do not have an integrated Manufacturing Execution System (MES).[5] Although intelligent control systems are in use in most existing plants today, only a few are connected in such a way that they can efficiently exchange data with each other and analyze it systematically. Yet process control systems such as Braumat have been available for many years, enabling easy entry into integration without the need for costly new development or hardware upgrades.

How things can be different is demonstrated, for example, in the chemical, pharmaceutical and automotive industries, where IT/OT systems are usually already highly integrated. Numerous companies already rely on integrated control systems and have been able not only to digitize their processes, but also to optimize them significantly and sustainably. Prime examples of successful process optimization include the 120 Siemens factories worldwide. Productivity at the Siemens Electronics production site in Amberg, for example, has increased 13-fold since the start of production in 1990. This is a leap in efficiency that has yet to be achieved in many companies and industries and is becoming increasingly urgent against the backdrop of current global challenges. Today, thanks to the successful integration of IT and OT, Siemens Electronics in Amberg retools around 350 times for 1,200 different products every day.

The integration of information technology on the top floor with operations technology on the shop floor makes it possible to connect smart data via IoT (Internet of Things) applications from all parts of production, thereby supporting real-time decisions, optimizing processes and minimizing risks. The combination of IT and OT data creates transparency in both areas and helps common goals to be pursued and achieved across departments. IT/OT integration therefore lets companies streamline workflows and eliminate bottlenecks through data exchange. This enables production to operate more flexibly, efficiently and sustainably, for example by shortening cycles, reducing costs, eliminating quality losses and environmental impact.

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[4] See Aptean, Global Food and Beverage Industry Trends Report 2020: Assessing the growing impact of digital technologies as new priorities take center stage for the global food & beverage industry, https://lp.aptean.com/rs/181-TRF-125/images/Aptean-Global-2020-Food-Beverage-Trends-Report.pdf?aliId=eyJpIjoiSzUxVGZ5bjY5YzhSNEo2WCIsInQiOiJCa3NrcE0xd1ZzeTR1bEhXWnZ3ZlRBPT0ifQ%253D%253D, 07.18.2023

[5] Source: Siemens

INFORMATION

The benefits of IT/OT integration at a glance

Speed:

- Bottlenecks in production can be quickly identified and eased.
- Important decisions can be made in real time thanks to connectivity between IT and OT.
- Customer orders can be fulfilled with less effort by linking all data together.

Sustainable operation:

- Reduction of the CO2 footprint through optimization in production and sustainable use of resources.

Quality improvement:

- Consistent data management enables complete traceability.
- Calculation of KPIs, for example quality rate, to compare and optimize equipment.
- Creation of a complete genealogy including production and process data, which allows all of the relevant data sources to be connected for specific products.

More flexibility:

- Update orders and respond quickly to production stoppages with rapid rescheduling.

Efficiency:

- Continuous analysis of real-time machine data to optimize cycle times.
- Paperless manufacturing processes provide the error-proofing and real-time visibility needed to produce consistent product quality every time.

Competitiveness and future viability

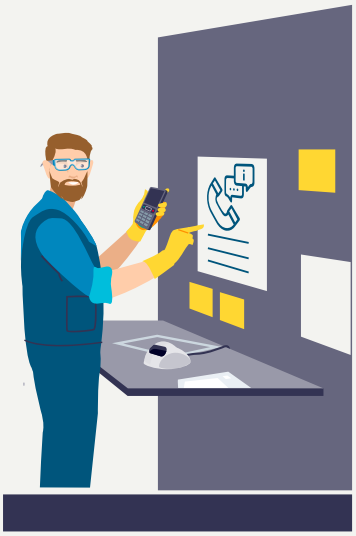
Flexible production with smart order execution

An analysis of the different production processes in many companies makes it clear that even today paper and manual processes often still dominate. In the execution of production orders, for example, the order data is printed out and pinned to a high-level board. At the production machines, the target settings are also configured manually, while the actual values are entered manually on the order slip, and the data is transferred manually to the ERP. If there are changes to the order data, these must be printed out again, filled in again by hand and re-attached to existing sheets. This process is not only very time-consuming, but also highly error-prone. The high use of paper in operations, there is an increased risk of low-quality data and a lack of timeliness, more confusion, and missing paperwork. The lack of the correct documentation, errors in processing and the resulting use of out-of-date information can even result in an incorrect product batch as a consequence. In paper-based processes, any information obtained in the production process cannot be fed back for further processing. This creates both process gaps and gaps in the optimization of production processes. “Companies that approach us at Siemens for an

integration solution want more transparency, flexibility, a simplification of their processes and consequently an increase in efficiency," explains Christian Gerke. "Or to put it another way: They want to get away from a lack of oversight, time-intensive working, and the error-prone nature of their manufacturing processes."

Through the intelligent integration of IT and OT, companies can increase their production speed and introduce paperless production. Digitized order management reduces the time and effort that have to be devoted to data entry as well as the complexity of documentation, and enables transparent processes from procurement to production. The use of digital displays and dashboards, on which the necessary data can be viewed immediately, increases flexibility and sustainability. At the same time, the elimination of paper and manual input reduces the susceptibility to errors. With digitized order execution, all relevant data is displayed digitally and is available at all times. The connectivity between IT and OT allows target parameters to be transferred directly to the machinery. And the actual production values are also transferred directly to the digital production order thanks to the exchange of data from OT to IT. This gives companies detailed digital insights, for example about the contents of specific containers, the material that was used and its quality, the target quantity required and the time frame for production. Staying with the brewery example, 'extract loss' plays a major role in the efficiency of the production processes. Digital order execution allows brewers to plan their recipes and capacities, and to keep an eye on the quality and quantities of the raw materials used as well as the quality of their end and intermediate products.

Current situation



- Order data is printed out – and changes again
- Target parameters input manually on the production machines
- Actual values recorded manually on the order slip
- Data transferred manually to the ERP

Desired situation

- Problems on the shop floor need to be evident and transparent –
  Order data displayed in digital format on a screen
- Target parameters need to be uploaded directly to the machinery when known
- Actual values are returned directly from the machine to the digital production order

Complete IT/OT integration in four months

An IT/OT integration project can basically be divided into three major phases, which, according to Christian Gerke's many years of experience, follow a clearly structured and plannable course: "In the first phase, we deal with the definition of the project requirements, before we implement the defined integration modules in the second phase. At this point we then already start operating with the new solution." This also marks the beginning of the third and longest phase, the "plausibility check". In this phase, all equipment and networks are continuously reviewed and optimized to ensure flawless and highly efficient operation on a permanent basis. "It is absolute crucial for us that we don't abandon our customers once the technical implementation is complete, but ensure that the opportunities offered by digital methods can also be exploited," Gerke clarifies. Siemens estimates a horizon of three to four months for phases one and two. Phase three can run for up to eight months, depending on the industry and product. "In many cases, we don't build from scratch, but work with existing assets whose individual components are harmonized and tested. Likewise, we would ideally like to go through the production cycles once in their entirety – and some products, especially in the case of food, are subject to seasonal factors. A brewing process takes time, regardless of what type of beer I'm producing," says Werner Hasenschwanz, Technical Account Manager Breweries at Siemens AG.

From manual data registration to continuous real-time communication

The following example of a project with the brewery Hofbräu München illustrates perfectly how IT/OT integration works. The aim was to permanently monitor the production process and make it traceable. For this purpose, the equipment in the brewery was updated and connected, and the data transparency of the processes was increased. Powerful industrial communication networks with standardized interfaces and integrated IT/OT are the prerequisites for this.

At Hofbräu München, the brewmaster must be able to fully observe the entire production process from start to finish and make it traceable. In the past, doing this was possible but required a lot of experience and recording of data manually on paper; today it is no longer an option. The more frequent changes in the brewing processes for different types of beer – from Hofbräu Original to Dunkel and Weisse to Maibock, Oktoberfestbier or alcohol-free and Pure – make automated production a necessity. It enables Hofbräu München to ensure consistently high quality. By digitizing beer production and linking IT and OT at Hofbräu, the brewery wants to track processes retrospectively and in real time, as well as tap into important parameters for future production. Information such as the quantity of the different additives required, the energy consumption, the temperature reached during the brewing process or the resulting extract have a direct impact on the quality of the beer and must be changed quickly if necessary. In addition to the brewmaster, the quality control laboratory also needs this information, as does the bottling operation and the maintenance department. At the same time, processes such as order management will be made more efficient and clearer. End-to-end communication via standardized interfaces and integration of IT and OT are indispensable in achieving this. The brewery will gain new insights into all of its production processes, letting it derive optimization measures, and leverage potential savings; it really is the only option. Hofbräu München's previous decentralized infrastructure consisted not only of an outdated production network but also of completely discrete, isolated solutions. For example, the bottling shed, the brewhouse, and the fermentation, yeast, and

storage cellars had systems that did not allow data to be exchanged beyond their own network boundaries. Pooling of the data streams and data sharing between IT and OT is essential for the brewery.
On the path to digital beer production, Siemens first conducted an inventory, the Industrial Networks Health Check. This involved reviewing the existing networks, identifying previous performance weaknesses and determining individual requirements. Subsequently Siemens collaborated with the brewer to develop a network design tailored to Hofbräu München, install the wiring and components, integrate various safety components and the Braumat process control system, and carry out the step-by-step commissioning. The Braumat process control system offers an easy way into IT/OT integration. Braumat makes it easy to implement order management and ensure full transparency, even without having to implement an MES. The process control system records all the necessary process data and displays it clearly. With its new network technology and integration of IT and OT, Siemens ensures that all steps from malt intake to beer bottling to the execution of production orders can now be documented at any time.

Everything from one source

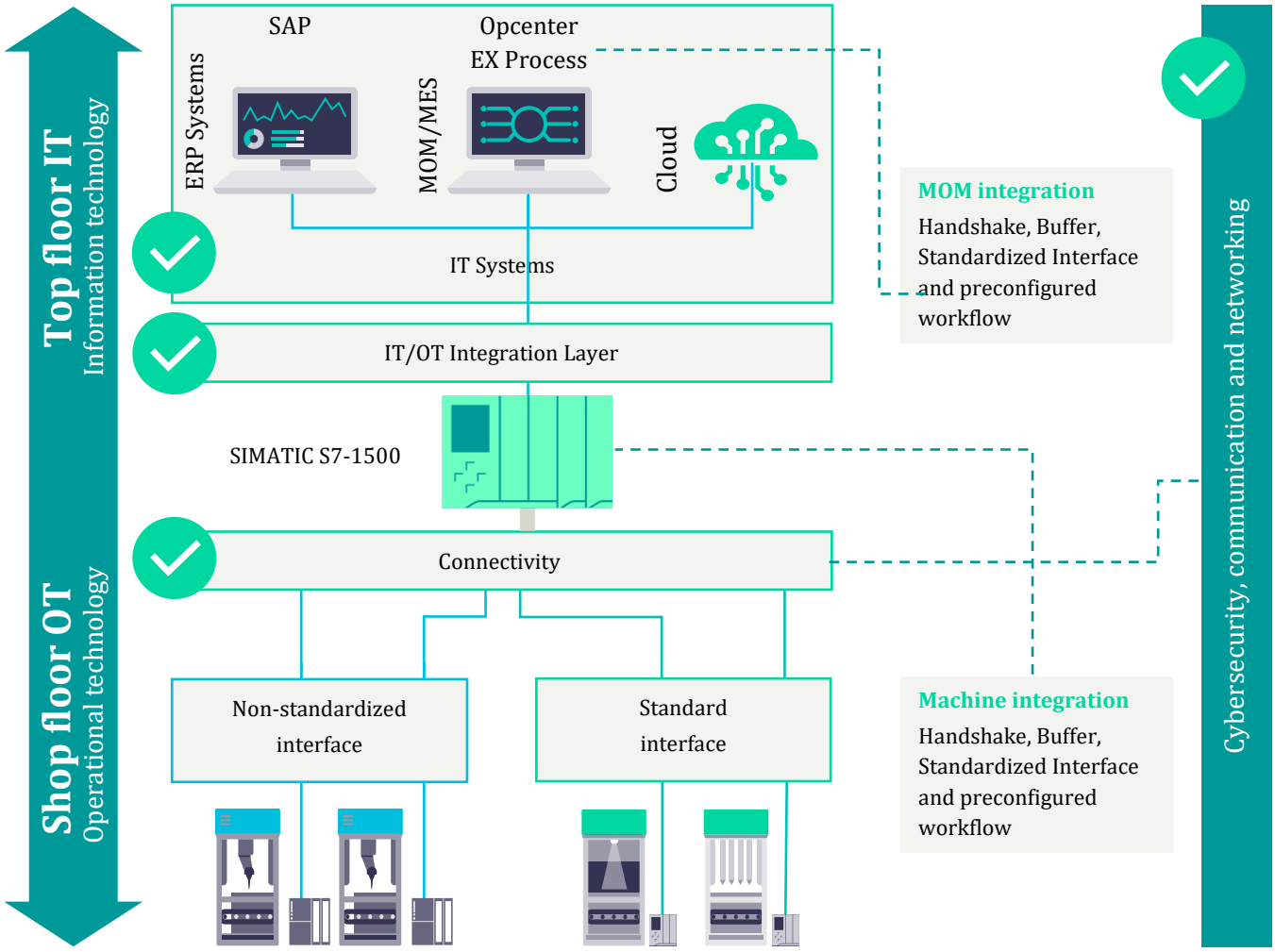
For flexible production with smart order management, Siemens offers an end-to-end solution for connecting manufacturing to the IT system and comprehensive MES functions with Opcenter Execution to meet the specific requirements of different industries. All options are based on standards that allow different solutions to be combined. This guarantees the consistent exchange of information in production. At Siemens, customers receive all the necessary building blocks for IT/OT integration from a single source: holistic and scalable. Both the hardware comprising different components and the software and cloud connectivity are included in the planning and solution proposals. Siemens is open to all technologies and offers integration solutions for hardware and software components from different suppliers.

Siemens uses Opcenter Execution as the Manufacturing Operation Management (MOM) and Manufacturing Execution System (MES). It captures the massive and growing stream of data generated every day in production. At the same time, it processes the data by collecting it and passing it on in a meaningful way to the downstream manufacturing areas and to the upstream enterprise systems. In addition, the Siemens MES simplifies change management by establishing the links between technical and production-related change and work orders, as well as handling all materials, components and processes affected by the changes. Opcenter Execution is therefore designed to control growing product lines and ensure seamless, transparent tracking of production.

For process control, Siemens relies on the Simatic portfolio, a Siemens product family that has been successfully established in the market for many years as a core element of automation solutions. It is modular in design and highly scalable in functionality. The Simatic S7-1500 controller automates complete production plants as well as plants with the highest demands in terms of performance, flexibility and connectivity. For IT/OT integration, Simatic S7-1500 offers large memory capacity as well as state-of-the-art communication for networking IT and OT interfaces. The biggest benefits are faster production cycles and higher production output. The greater memory enables larger projects, modular machine designs and the capture/storage of more data, cycle-independent separate tasks for communication and improved safety concepts.

Siemens uses tools such as WinCC Unified to provide flexible access to production data for operating and monitoring the plant and for data exchange with various IT applications. The integration platform links data from production with data from the IT world via robust and open interfaces and combines them in a uniform operating concept.

Flexible Production with Order Execution
Proven end-to-end solution



Sample structure of an integrated IT/OT solution for smart order management with PLC, SIMATIC S7-1500 and Opcenter Execution

OUTLOOK

Long-term competitiveness

For successful IT/OT integration, companies need standardized solutions, uniform systems from a single source and, ideally, machines with the right communication links. Collaboration between IT and OT departments has a very important role to play here: It not only forms the foundation but is the key ingredient for successful and sustainable IT/OT integration in companies. “As consultants we provide companies with access to the necessary skills and expertise to support their digital transformation journey and IT/OT integration. In doing so, we always speak our customers’ language, adapting our approach to the industry, technical requirements, and the manufacturers at hand,” explains Christian Gerke. Depending on the application, whether order execution, track and trace, or energy management, the link between OT and IT pays off in a variety of competitive advantages and sets the course for a successful future. At the same time, IT/OT integration gives companies the opportunity to build up the necessary expertise for digitization within the organization and to break out of old, entrenched structures. “In focusing on technology, businesses forget that people are just as important to successful

integration. Companies lack trained personnel with expertise in integration to take responsibility for continued support. The new digitalization approaches help counter the prevailing demographic change and current shortage of skilled workers, as they create new and complex positions," explains Christian Gerke. Some 47% of Forrester survey respondents have already done this, investing in specialized roles that span both IT and OT and ensure close collaboration between the areas.[6]

INFORMATION

Siemens components for smart order execution

For data acquisition and processing: The Opcenter Execution MOM/MES

- Data acquisition
- Order management
- Data processing
- Control of growing product lines
- Seamless product tracking / track and trace
- Transparency

For connecting the IT interfaces to the OT interfaces: WinCC V7/V8, Unified, Open Architecture

- State of the art communication
- Large memory
- Networking of IT and OT interfaces

Flexible access and data exchange: WinCC Unified

- Integration platform
- Flexible access to production data
- Data exchange with various IT applications
- Summary in uniform operating concept

[6] See: Forrester, IT OT integration as lever for digital transformation IT OT Integration: A Forrester Consulting thought leadership paper commissioned by Siemens, June 2022, https://contentpath.siemens.com/ot-it/71?utm_source=website#page=1, 07.18.2023