SIEMENS
Ingenuity for life

Customization in the Food and Beverage Industry.

Spotlight on the digital twin

Whether cheese tea, Waterdrop or turmeric latte, the global food and beverage industry is constantly introducing new refreshing drinks to the market. Time and time again consumers follow current trends, and the variety of flavors and product variants has never been greater. Consumers desire more and more customized food items, and at no additional cost if possible.

This does not necessarily mean tailored products for individual purchasers. Instead, it involves production of smaller product batches that address various market niches. Examples are special offers for health-conscious consumers, certain ethnic and religious groups and regional or seasonal demands.

New recipes for your success on the market

As a business director for a beverage manufacturer or a technical director for a machine or system builder, you face increasing pressure towards greater flexibility. Fast changing trends, the growing mobility of the population and the desire for more sustainability and less sugar call for new recipes. What's more, you want to quickly respond to consumer requests and have more flexible filling operations and customized packaging.

Other contributing factors are the stringent requirements for food safety, the requirement for traceability of individual production steps and raw materials and the steps needed to prevent resource waste. With all of this, the food and beverage industry and machine and system builders supplying global markets face a number of new challenges when planning and designing production processes. With the help of the digital twin and other Digital Enterprise solutions, these challenges can be successfully overcome.

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Customized large-scale production in the digital enterprise

In this white paper, you will learn how you can use a variety of new digital technologies to optimize your business processes, better meet new requirements and cost-effectively produce customized products for specific customers in a large-scale production environment of Industry 4.0. Big Data analyses, the Internet of Things (IoT) and artificial intelligence (AI) are changing the future of the food and beverage industry as much as 3D printing, cloud and edge computing and new forms of robots. Digital twins – the central topic of this white paper – are an essential basis for achieving comprehensive digitalization in the digital enterprise.

The food and beverage industry is under massive cost pressure. That is why it must lower production costs as much as possible. Currently, 80% of its production is for the mass market, where volumes are high and margins are very low.

Three-fold twin: Product, production, performance

Integrated, consistent digitalization of the entire value chain extends from the design of the product to its production and its service and marketing. Its representation as a digital twin makes customized large-scale production possible.

Well on the way to the digital enterprise

Under the label "Digital Enterprise", Siemens has developed three application areas for use of digital twins: the product, the production of the product and the performance of the production.

With our automation and digitalization solutions for the food and beverage industry, you achieve sustainable competitive advantages through faster time-to-market as well as greater flexibility and efficiency and higher quality. Our solutions offer you new possibilities for value creation, innovative business models and forward-looking forms of cooperation.

Linking the virtual and real production worlds

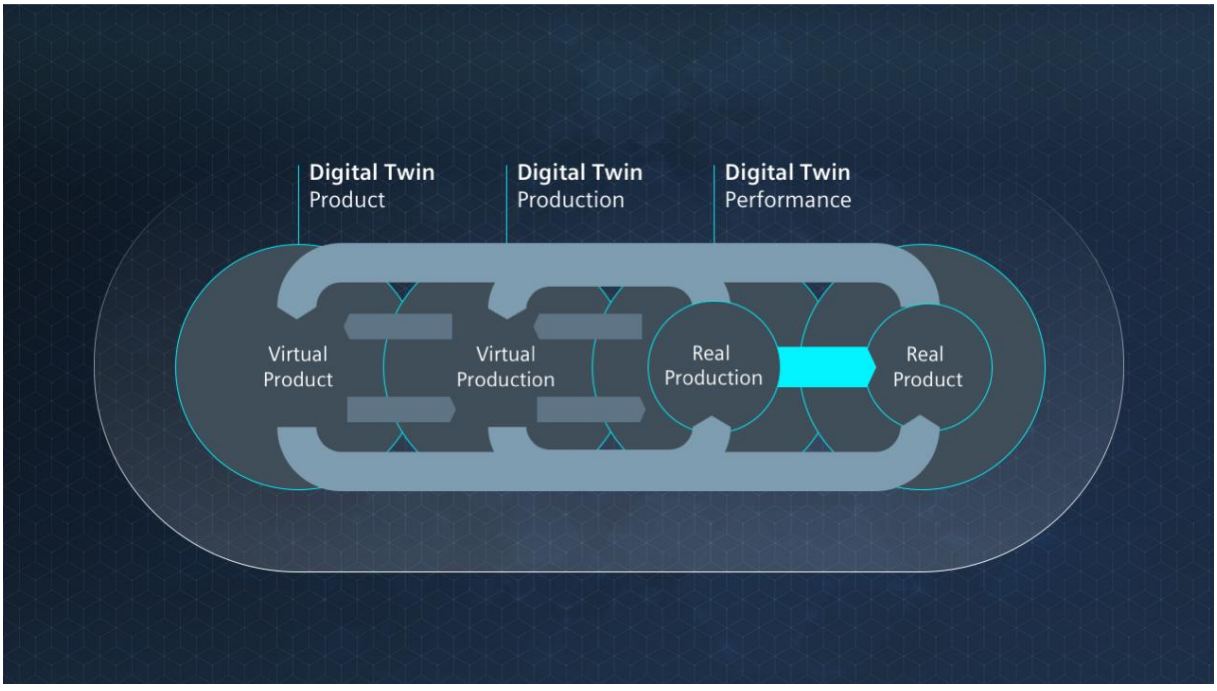
The Digital Enterprise offer from Siemens lays the technical foundations for implementing a comprehensive concept. It connects the virtual and real production worlds along the entire value chain based on well-founded industry knowledge and unsurpassed expertise in the areas of electrification, automation and digitalization. You can design and optimize products, machines and systems using simulation solutions and the digital twin, before these are employed in the real world. You then use the resulting data for continuous improvement of processes and products. The virtual representation accompanies the entire lifecycle and improves your efficiency at all levels.

A versatile tool in the field of digitalization

You can also use the digital twin for 100% energy transparency. These days, this is essential for optimal energy management and is an increasingly important factor for your competitiveness. With MindSphere, the Siemens cloud-based open operating system for the Internet of Things (IoT), you continuously acquire and analyze performance and maintenance data of your production equipment and whole production lines.

This increases plant availability and enables needs-based maintenance planning. The open platform also paves the way to new business models, cross-location analyses and incorporation of external companies (e.g. suppliers or customers).

The three-fold digital twin is thus a versatile tool in the field of digitalization and is uniquely capable of helping you design and optimize all of your processes proactively, efficiently and sustainably.



Product design: The recipe for market success

Fast-changing trends are forcing companies in the food and beverage industry to react more and more quickly to the fast-changing tastes and preferences of consumers.

Meanwhile, growing competition within the industry demands a faster time to market for new products and for additional variants of existing established products.

Easy run-through of many variants

If you want to change the standard recipe for a milkshake, for example, you can use the digital twin of a product to run through various raw materials, taking into account their quality, composition, nutritional value and other details, as well as costs.

What does a different fruit variety mean for the production process? How does changing the quantity of ingredients affect the viscosity? Does the filling process need to be changed? What constraints need to be observed within the plant? These questions and many more can now be quickly answered in the simulation.

With the **Siemens SIMATIC IT R&D Suite**, you can try out different recipe options virtually on the computer in order to test them for customer appeal, feasibility, efficiency and profitability.

The recipes stored in the digital twin can be easily adapted for specific regions and seasons or modified to meet new trends and customer needs. An automatic check is also made to determine if the new product meets all legal requirements.

An attractive package is half the battle

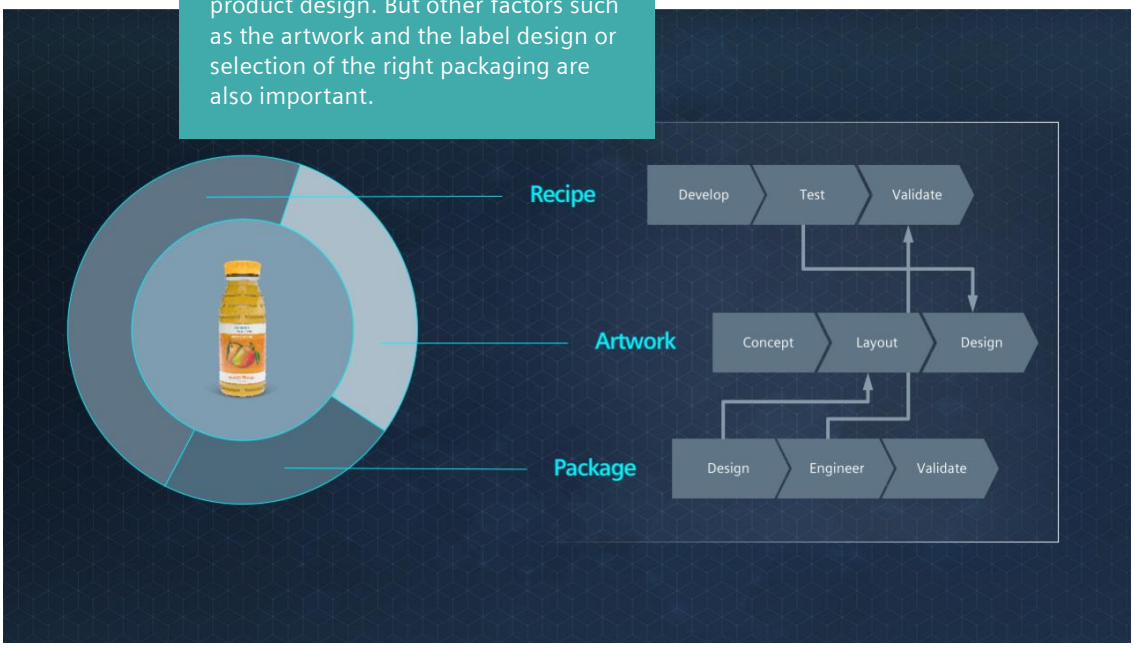
Another important element of development – especially for known markets – is the package design. The choice of a certain material, the shape and color of the bottle, carton or can and the label design significantly affects a beverage's success on the market.

With the Siemens NX solution, you can create the digital twin of your product package, simulate its behavior under various conditions and subject it to a load test on the computer.

The flexible, integrated and powerful NX software enables you to provide better products more quickly and efficiently. It offers the next generation of design, simulation and production solutions, allowing companies to make optimal use of the digital twin.

NX supports all aspects of product development – from conception to engineering and production. The software provides you with an integrated toolset that coordinates all disciplines, preserves data integrity and the design idea and standardizes the overall process.

The recipe plays a major role in the product design. But other factors such as the artwork and the label design or selection of the right packaging are also important.



AMWAY: New energy from a colorful can

The globally active direct sales company AMWAY has food items such as energy drinks and protein bars in its product lineup. For faster time-to-market of new products, AMWAY relies on Siemens Teamcenter. "While product specifications were previously managed in a document structure that required time-intensive manual maintenance, we now have a single digital database," said Patrice Gausselin, Director for Research and Development Strategy and Business Operations at AMWAY.

Faster time-to-market for new products

The result has been greater efficiency and significantly shorter cycle times. Numerous independent systems that inevitably led to data silos were able to be replaced. Data analyses have now become much simpler, and on this basis the manufacturer can more quickly implement product modifications such as new flavors for its energy drinks in their colorful cans.

"The constant updates of labels, ingredients and global registrations necessitated by strict regulations are also no longer a problem," explained Todd Slater, Manager for Global Research & Development at AMWAY. That is because by documenting all product properties in a single software solution, there is no need to reenter data after product changes or new product introductions.

Identifying opportunities for efficiency improvements

Previously hidden opportunities for efficiency improvements can also be identified with the help of PLM software. Synergy effects between various product groups are one example. With Teamcenter NX, AMWAY has become a more agile company that is now "getting it right the first time." Now, for example, when the direct sales company develops a new protein bar, it can immediately access all existing related product information.

Here, the "single source of truth" concept of Siemens ensures there is a single information archive where all necessary information resides. At the same time, it eliminates redundant work and closes the loop from suppliers, ingredients and recipes to quality control and logistics.

Click: The complete user report can be downloaded here.

Customized labels for consumers

Thanks to the Digital Asset Libraries in Teamcenter, designers always work with up-to-date layouts. As a result, they can concentrate on creating an attractive design. The time-consuming approval processes of the past have been simplified, and the risk of publishing incorrect labels minimized.

The ingredients stored in the digital twin of the product can be automatically transferred to the label while ensuring compliance with legal requirements. You can easily implement customized labels or label designs for smaller customer groups or even individual consumers – for example, as part of marketing campaigns.

When there are product variants, existing templates for the package design can be reused and linked to the product history. This simplifies the process and reduces effort, thereby enabling faster and more transparent production of variants.

Production: The machine in the spotlight

Machines and systems are essential components of the value chain in the food and beverage industry. They are indispensable for efficient and safe production of high-quality food items.

As an original equipment manufacturer (OEM), you not only save time and money by using digital technologies in developing new machines and systems. You are also able to more quickly and effectively meet the demand of food producers for more flexible production systems.

With its comprehensive Digital Enterprise offer, Siemens supports you on your way to a digital enterprise. For this it integrates the world of **Totally Integrated Automation** (TIA) with **Product Lifecycle Management** (PLM) software.

Parallel instead of serial development

The planning and development of a machine today generally involves three disciplines whose work is largely carried out sequentially: mechanical design, electrical planning and automation engineering. Three teams of experts from different departments often work in self-contained IT environments with barriers that allow little or no data to pass through.

To accelerate time-to-market, Siemens offers machine and system builders various software tools for integrated engineering, which enable real collaboration between the various development disciplines within the company by relying on a single database.

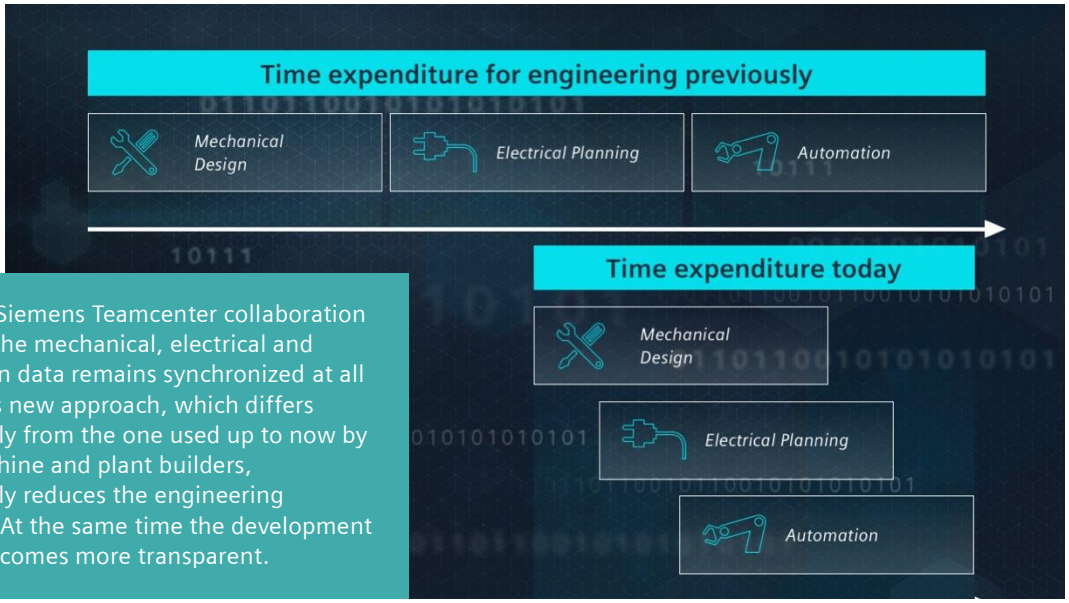
The mechanical machine model produced from 3D drawings in the **Siemens NX** CAD system is automatically expanded using the **Automation Designer** tool to include the electrical and automation components. At the same time, the Teamcenter collaboration platform ensures that the mechanical, electrical and automation data is always synchronized. That is because all data is centrally stored and is always available up-to-date to all employees involved.

Uncovering design errors at an early stage

While supporting you in optimizing your work processes, Siemens also helps you gear your machine concepts towards greater flexibility. On the one hand, using the digital twin to simulate a complete machine allows you to optimize it. On the other hand, however, you can also use simulation to ensure that steps to increase flexibility will not have an adverse effect on efficiency.

To this end, the **Mechatronics Concept Designer** simulation software is used to "pair" the 3D drawing of a machine with its behavior model. The simulation software uses the definition of the kinematics of all moving parts for this. The product to be produced together will all its physical properties, such as weight, center of gravity, friction factors and motion control, can also be embedded in this simulation.

The connection to a virtual programmable logic controller (PLC) lays the foundation for a virtual commissioning. Using the Siemens **PLCSIM Advanced** solution and virtual commissioning, you can uncover any design errors at an early stage in the development process and correct them before the first prototype is actually built. The virtual controllers created in this way can be used for comprehensive function simulation and will allow faster validation even for complex machines.



Using the Siemens Teamcenter collaboration platform, the mechanical, electrical and automation data remains synchronized at all times. This new approach, which differs significantly from the one used up to now by many machine and plant builders, significantly reduces the engineering overhead. At the same time the development process becomes more transparent.

Krones: Faster development of new beverage bottles

Krones AG in the Bavarian town of Neutraubling not only supplies beverage filling and packing systems to its customers but also supports them by jointly planning and developing the right bottles, cans and specially-shaped containers for their products.

To reduce the development times for PET bottles and thereby give customers a competitive advantage, the machine and system builder wanted to use precise simulation models to gain a deeper understanding of the product properties desired by its industrial customers. The motivation is that manufacturers require ever shorter time-to-market for new beverages and need optimized packaging for this.

Simulation tools for different tasks

After having used numerous simulation tools of various manufacturers in the past, the engineers at Krones are now relying on uniform tools from the Siemens PLM software portfolio (NX CAD, NX CAE and NX Nastran) for simulation of the PET bottles throughout the process.

It is now also possible to simulate the production behavior for different wall thicknesses in the blow-molding machine, the thermal behavior, the material flow and the motion behavior in the production line using the Siemens NX tools. Likewise, the structural loading of bottles in the case of top load filling or the behavior of filled and stacked bottles on transport pallets can be simulated.

A few days instead of three to four weeks

Arno Haner, Head of PET Packaging Design at Krones: "NX is the preferred and probably the only environment available on the market that scales simulation data from expert analysis up to the developer community." The ultimate goal at Krones is to reduce the development time for a new bottle from the typical three to four weeks in the past down to three to four days.

Progress toward this goal has already been made. For example, the top-load filling process for newly developed PET bottles can now be simulated much faster – with a time savings of 75 percent. A virtual modeling process for a package taking four to eight hours in the past now takes only one hour thanks to Siemens NX.

Virtual commissioning instead of trial and error

With the digital twin, virtual commissioning of individual machines as well as complete production line is possible. As a result of this, downtimes during initial commissioning or after a reconfiguration are kept to a minimum.

By connecting the dynamized machine model to the PLC simulation software, a virtual representation of the real PLC including the automation program emerges with the help of PLCSIM Advanced.

The controller cannot tell the difference between it and the real machine, because the behavior models of the sensors and actuators can also be realistically simulated using the SIMIT software. This allows the functionality of the machine to be tested, validated and optimized in advance, thereby minimizing the risks during real commissioning.

The digital twin also enables joint development of new business models between machine builders and food producers. OEMs can sell their machines in the future together with a digital twin.

This will allow their customers to adapt existing products to changing market conditions or to introduce completely new products in a significantly less time.

Additional services can also be offered based on the digital twin. Examples include training offers, fast reconfiguring services for existing machines and even the specification of new systems. In addition to lower costs, faster commissioning and improved time-to-market, the end customers of machines and systems will gain additional advantages.

Maximize productivity from the first day

The ability to detect and eliminate errors during the design phase results in higher quality and less downtime for systems developed in this way.

The extensive simulation possibilities enable better utilization during actual operation. This helps to prevent overcapacity and undercapacity, protect the machine through optimized operating speeds and guarantee proper maintenance.

Unplanned and costly production outages can be significantly reduced. And last but not least, comprehensive instruction and training of your machine operators can take place before the real commissioning. As a result, maximum productivity can begin from the first day.

Production: All eyes on the system

With the digital production twin, the creation and modification of complete filling and packing systems can also be greatly accelerated and the impacts of introducing new or modified products on the production process can be simulated. For example, you can prevent possible bottlenecks and optimize the production process well in advance.

It is also very easy for all the disciplines involved in a project to create a shared data model through use of a single data platform. Processes that previously had to be performed sequentially can now take place largely in parallel and will be digitally merged. As a result, you gain similar advantages at the system level as for individual machines: time and cost savings, higher quality and greater transparency.

Parallel engineering of mechanics, electrics and automation

When engineering a conventional process plant in the food industry – for example, in a dairy or for a soft drink manufacturer – developers typically begin with process flow diagrams – an abstract representation of the overall production process. Objects are defined, flows are placed and their routing is determined. These models can then be refined in the form of piping and instrumentation diagrams (P&IDs).

The basic engineering for process plants once again involves the three disciplines: mechanical design, electrical planning and automation engineering.

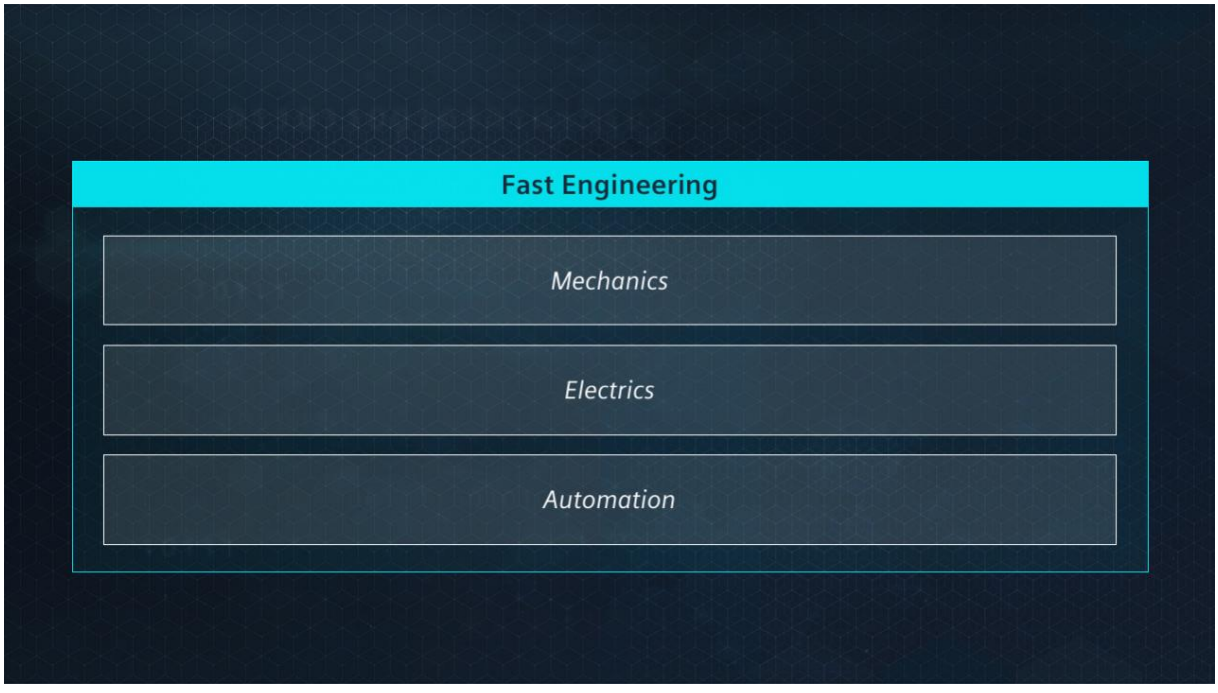
To increase your overall efficiency and perform various work steps in parallel, you can make use of the Siemens **AmeSim** simulation environment for the mechanical design to start. Here, the piping, vessels and pumps can be automatically sized based on the desired output quantity.

The corresponding diagrams for implementing the mechanics, electrics and automation are generated from the P&IDs with the help of the uniform **Siemens COMOS** data platform. With this integrated engineering tool, all the departments involved within the company access the same project-relevant data pool, thereby guaranteeing consistent data management.

Uniform quality worldwide through mixer simulation

A detailed simulation using the Star CCM+ software can be performed for specific system components that are critical for success, e.g. a mixer. The simulation results are then fed back to the basic overall simulation so that non-critical components can be adapted there accordingly.

In the beverage industry, the mixer is often a key element of production. Here, the individual ingredients are added, mixed and processed in various steps until the desired customer favorite is produced. By using the digital twin of the mixer during the development phase, you can go a long way towards ensuring the consistent quality of your products made at different factories with different raw materials.



Global soft drink manufacturer: revolution in the syrup room

The syrup room with its variety of raw materials to be mixed in exact quantities is the core of the beverage production process – whether for production of soft drinks, sparkling fruit juice, still fruit juice, mixed alcoholic beverages or energy drinks.

The automation system in the syrup room of a global soft drink manufacturer in the USA was based on many individual components and was outdated. The goal was to quickly replace it with an integrated and efficient solution capable of lasting 30 years and optimized to the overall process in the syrup room.

Siemens as general contractor with a complete solution

The beverage manufacturer selected Siemens as the general contractor for all automation services including plant design, electrical, hardware and software installation as well as project management, program development and support. The complete offer also included commissioning support, training and an on-site spare parts warehouse.

The fixed wiring between the switch panels was removed in the course of the complete redesign as were the pneumatic power units. Replacement of all control panels and the networks was also part of the project. Three existing monitoring systems were replaced with a single monitoring system that allows secure remote access to the whole platform.

30% lower costs overall

Personnel no longer need special IT expertise. The system provides program logic, transparent diagnostics and a single combined communication network. After the ahead-of-schedule changeover, production was able to resume immediately and to continue problem-free. The utilized design and system platform can be scaled at any time and can be reproduced for other factories of the manufacturer. Hardware costs of Siemens were about 40% less than those of comparable solutions. Overall, a total savings of 30% was able to be achieved.

Click: The complete case study can be downloaded here.

Mixers are often sized according to the volume needed, but other questions also have to be answered, such as: What blade shape is needed to achieve perfect mixing? How does the shape affect energy consumption?

To answer these questions and to simulate different variants, Star CCM+ supports computational fluid dynamics (CFD). This mathematical computation of the fluid dynamics analyzes how a change in the blade geometry, e.g. angle, or blade count affects the mixing process and its result.

Run through hundreds of variants at the press of a button

With the help of Heeds, a Siemens parametric simulation engine, you can run through hundreds of variants at the push of a button in order to identify the best solution – without compromising the homogeneous mixing of your product. Obviously, this mixing must be optimal in any scenario.

As more and more system data from all disciplines is added to the data pool, the digital system twin gradually emerges.

At the press of a button, you send all automation-relevant data from **COMOS** to other interfaces or the **SIMATIC PCS 7** process control system and the **Totally Integrated Automation Portal (TIA Portal)**, which generates the automation program (semi-)automatically.

In addition to saving considerable time when developing and planning, you can also use the **SIMIT simulation system** and the **SIMATIC S7-PLCSIM Advanced** virtual controller to thoroughly test the automation functions and the process control virtually – against the virtual plant model built in **AmeSim**.

with the help of this **virtual commissioning** errors can be corrected at an early stage. The properties and behavior of sensors and actuators and other process components are also taken into account here.

The 3D visualization of a brownfield plant made possible by COMOS Walkinside is used not only for planning and monitoring. Rather, it can also be used for training and operating purposes. For example, maintenance and repair tasks can be planned, simulated, and executed efficiently. The basis for this is the 3D engineering data from the basic and detailed engineering phases

Digital twin for existing plants as well

For new greenfield factories, a digital twin can be realized from the outset today. But one can also be created for existing brownfield plants.

To do so, a 3D model is built with photographs of the plant, taken by a drone for example, or ideally by a laser scan. This is made possible by the **ContextCapture** reality modeling software from Bentley (a Siemens partner) and the powerful 3D visualization with **COMOS Walkinside**. This navigable three-dimensional model can be used later to train maintenance and service personnel, for example.

If a new line is to be integrated in an existing system or a production line is being redesigned, you can build a virtual model of the complete filling and packing system based on scan data of the existing environment and 3D models of new machines.

With the **Siemens NX Line Designer,** you then specify and optimize, for example, the layout of the new line in interaction with the actual space conditions – or compare the virtual model with the real conditions.

Testing and optimizing complete production lines

Not only can you simulate production lines based on the digital twin but also material flows, logistics, use of robots, human interaction in the production process and, finally, the output quantity of the expected production.

Here, Siemens provide you with the comprehensive **TECNOMATIX** software platform, which can be used for process definition to simulation to checking of the actual production, and which, like hardly any other solution, stands for the digital factory.

For example, **TECNOMATIX Plant Simulation** allows whole production lines to be simulated and bottlenecks and overcapacity to be avoided. Still, the digital twin offers even more advantages: For one thing, it is used to train operating personnel, for example, by simulating maintenance operations, error situations simulated and practicing correct behavior in extreme situations.

Another important aspect is its use for remote maintenance and error analysis and correction. It also supports the use of augmented reality (AR) by operators and maintenance mechanics. For example, wearing smart glasses that display additional information in the employee's field of vision increases the quality and efficiency of work while making it easier.

Plant documentation is updated automatically

You also benefit in a major way from the digital twin during the operating phase. For example, through continuous monitoring of mechanical assets, it is possible to significantly increase the safety and availability of your system.

Understanding the condition of your assets also enables intelligent management of service and maintenance measures and reduction of unplanned stoppages to a minimum.

Changes to the plant after maintenance work or replacement of a component are directly taken into account in the digital twin. All affected documents and diagrams are also automatically updated so that you always have access to up-to-date plant documentation.

Performance: Continuous improvement

Wherever automated processes are used in production in the food and beverage industry, a large amount of data accrues. This happens over years or even decades, depending on the lifetime of the plant. These enormous quantities of Big Data are only the raw material, however, from Big Data, you must generate Smart Data with added value. The digital twin performance – the sum of all measures needed, for example, to create more transparency in food production or quality assurance – represents just that.

Avoiding recalls with consistent quality assurance

In Germany, food recalls have risen by over 50% in the last five years. This is not because produced foods and beverages have lower quality, but rather because manufacturers proactively inform consumers more often nowadays.

To avoid this situation altogether, the continuous checking of running production is an important aspect of quality in food production. Siemens supports you in this with its **R&D Suite** – both for offline testing using random samples and for at-line testing or fully automatic in-line testing directly in the system.

he second important aspect of quality is seamless traceability in each segment of the delivery chain, i.e. Track & Trace. For this reason, the Manufacturing Operations Management (MOM) of Siemens is able to use data from production in a way that produces the full material genealogy.

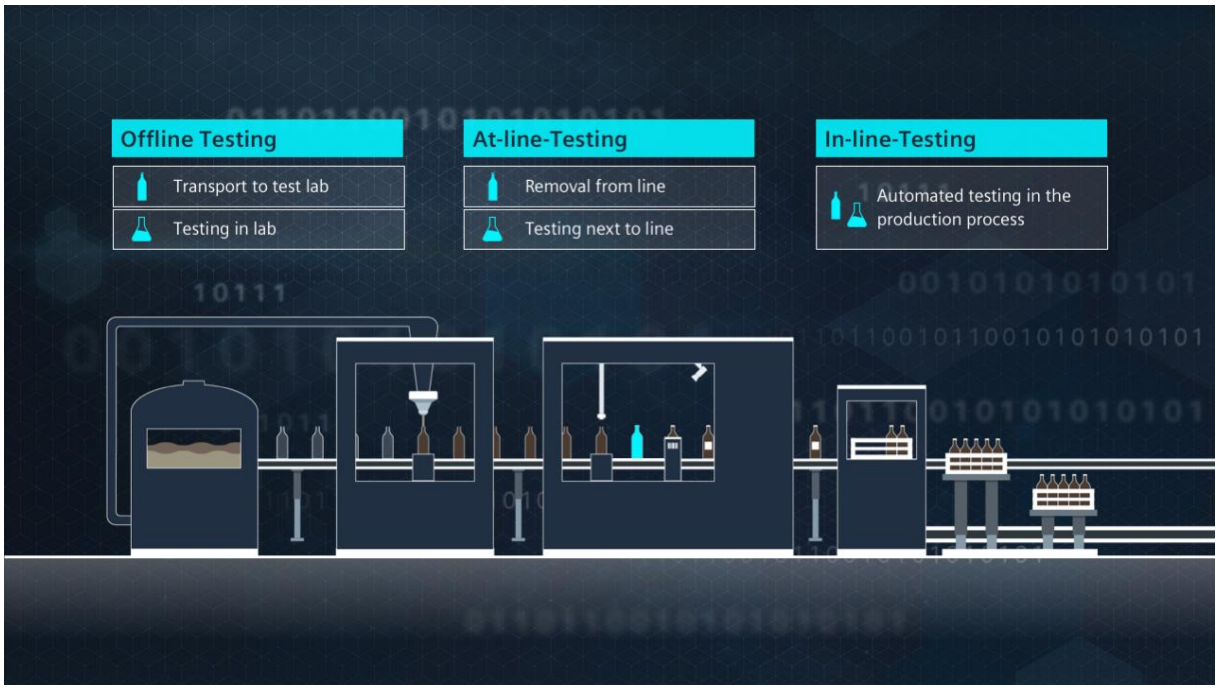
Blockchain technology and cloud storage secure the traceability

A decentralized system that can acquire data anywhere in the world in a manipulation-proof manner is needed to establish complete traceability in the food and beverage industry. At the same time, manufacturers should be able to offer all involved partners insight into the data – at least the portion of the data affecting them directly.

Siemens is working on developing a solution for this using cloud and blockchain technology. The open, cloud-based IoT operating system **MindSphere** enables data from machines and systems distributed around the world to be consolidated in a single data lake. The blockchain records all transactions in a verifiable manner, and regardless of whether they involve transport of goods to a container ship or a step in the production process.

The ability to collect, process and make available data – also known as connectivity – is the foundation for this. Yet, this solution is not readily possible today in many industrial enterprises.

That is because many production operations are still being automated in isolation without the possibility for data exchange. Furthermore, older machines in a plant often have no communication interfaces or the installed components are very heterogeneous and do not understand each other.



Cheese dairy in Altendorf: Schwyzer and Mutschli at the push of a button

The new cheese dairy in the Swiss town of Altendorf, which produces a variety of cheeses as well as traditional regional specialties like Schwyzer, Mutschli and yoghurt, used the Siemens **TIA Portal** Engineering Framework for complete engineering up to and including drive technology.

Its main advantage, according to Florian Rüegg from the Altendorf automation specialists Solinaut, is that everything is integrated into a single project: "You don't need to save your data seven times and reopen seven programs." He sees the diagnostic functions and the ability to link tags as particularly helpful. "Everything is stored in a project folder, so there is no need to jump back and forth between different versions."

Processing eight million liters of milk a year with two people

The cheese dairy in Altendorf is also relying on Totally Integrated Automation for the hardware components in the production so that automation components interact in one efficient overall solution. Now, up to eight million liters of milk a year can be processed into cheese in the new plant. The quantity of raw material is automatically measured at the time of delivery. Only two people are needed to control the next processing steps in the dairy.

After a transition phase, a smooth changeover of the plant to closed-loop control took place, eliminating many actions that previously had to be performed by hand. "With the new system, the time expenditure has been cut in half. We often complete the job with two people by noon," said Dairy Head Erich Keller. We are also saving energy. For example, the heat from the cleaning wastewater can be used to heat up the milk before it flows into the vat.

Click: The complete case study can be downloaded here

Better communication with OMAC and Weihenstephan

That is why standards for data exchange across production operations have been developed in recent years in the food and beverage industry. Examples include OMAC from the Organization for Machine Automation and Control and "Weihenstephan" (WS). Standardized interfaces for machine data acquisition connect filling or packing machines with higher-level systems such as the MOM.

In this way, cumbersome transfers between controllers can be reduced or eliminated altogether allowing for higher production rates and better coordination. Standardized interfaces also lay the foundation for easy and consistent interpretation of event data in controllers. This data is of particular importance for analysis because it can reveal and lead to subsequent elimination of efficiency weaknesses.

Siemens participated in the development of these standards and today also supplies corresponding libraries together with its automation products. These make the standards easier to use in practice in machine building and by plant owners.

The standards are also undergoing further development. For example, the communication of our hardware is currently being converted to OPC UA (Open Platform Communications Unified Architecture).

This collection of standards for communication and data exchange in the industrial automation field describes the transport as well as the interfaces and semantics of machine-to-machine data.

The complete architecture is designed as service-oriented architecture and enables data exchange between the machine level and higher-level systems via a standardized protocol.

Clear display of key performance indicators on the dashboard

A typical use case is the setup of a line monitoring system for a filling line. Systems that use these standards acquire all data from the machine that is needed to generate comprehensive performance indicators for the line – for example, overall equipment efficiency (OEE), asset intensity, etc.

As an owner, you can have individual machine data elements, such as counter values, alarms and real-time machine status, clearly displayed on a dashboard and translated into understandable performance indicators for line operators.

Through this real-time analysis, they are then able to use line balancing algorithms in the filling line in such a way as to avoid micro stops, for example.

Meanwhile there is a whole series of intelligent applications based on standardized data and the digital performance twin.

Not all data has to be sent to the cloud

It is not necessary to send all data to the cloud for this. Instead, with the help of edge computing, a certain amount of pre-processing is possible directly on the shop floor.

Our Siemens Industrial Edge digitalization platform closes the gap between conventional local data processing and cloud computing.

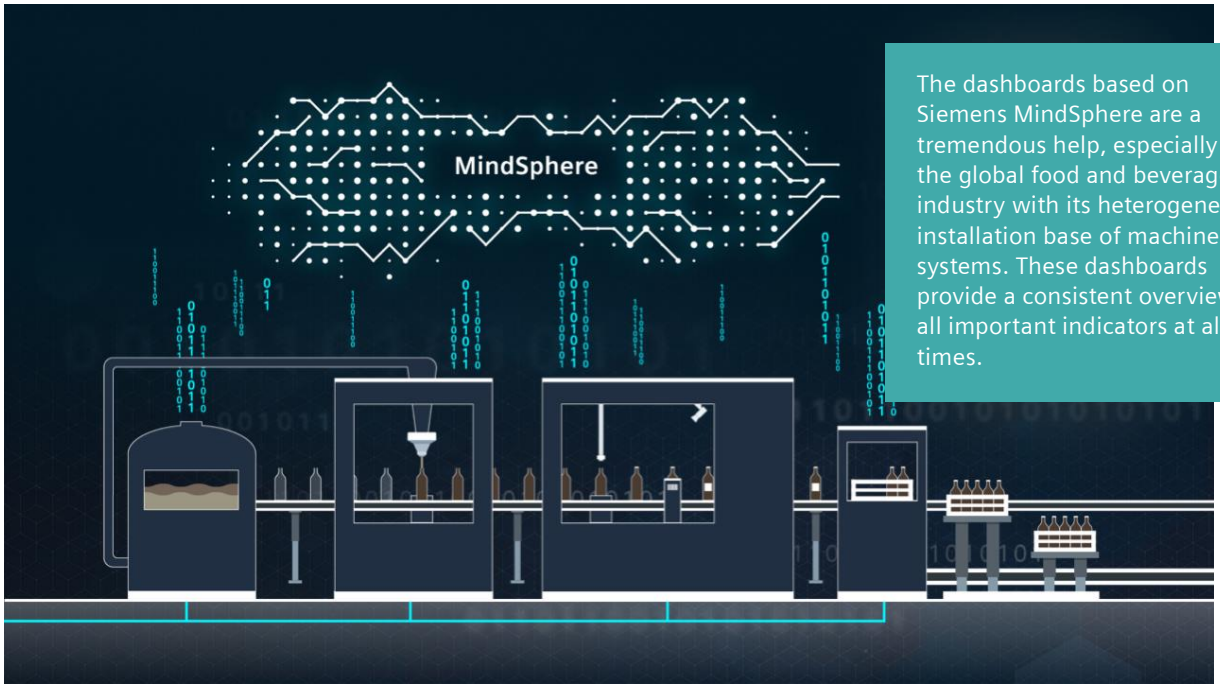
With this platform you can collect, pre-compress and make available all relevant data before it is sent to the MindSphere cloud in a consolidated form for analysis. We also support you in subsequently furnishing your existing brownfield plants with the necessary intelligence.

Using MindSphere-based dashboards, you can then more effectively compare factories around the world producing identical products.

This opens up new paths to greater transparency and higher productivity for the food and beverage industry in particular, because of its heterogeneous installed base.

We also help machine and plant builders make better use of the data they accrue using **MindSphere**. For example, they can offer predictive, preventive and corrective maintenance concepts as well as innovative energy and environmental services.

The more such services are built on the digital database of all preceding process steps, the better they can be integrated and utilized.



The dashboards based on Siemens MindSphere are a tremendous help, especially for the global food and beverage industry with its heterogeneous installation base of machines and systems. These dashboards provide a consistent overview of all important indicators at all times.

Terms and abbreviations

Asset Intensity	Performance indicator for the effectiveness of an asset of a company relative to other market participants in an industry.
Digital Twin	Digital twins are virtual representations of the product, production or performance along the entire value chain that enable seamless linking of the individual process steps. Use of digital twins can consistently lead to greater efficiency, minimize error rates, shorten development times and open up new business opportunities.
Edge Computing	Edge computing differs from cloud computing in that data is processed or stored decentrally, or "at the edge" of the network. This allows resources to be (temporarily/partially) Saved/processed locally (on the end device/during operation), while making use of the advantages of the cloud.
IoT (Internet of Things)	The Internet of Things stands for the increasing networking between and among smart objects and of smart objects with the Internet. All kinds of objects including everyday objects and machines are equipped with processors and embedded sensors so that they can communicate with one another via a network.
AI	The objective of artificial intelligence is to automate intelligent behavior as well as machine learning of IT systems in ambiguous environments so that these IT systems can solve problems or optimize processes on their own.
MOM	Manufacturing Operations Management (MOM) is a comprehensive manufacturing management system that enables complete insight into production processes at all times. As an enhanced Manufacturing Execution System (MES), a MOM system consolidates and optimizes all production processes.
OMAC standard	Standard of the Organization for Machine Automation and Control for data exchange across production operations in the food and beverage industry, for example for communication of filling or packing machines with the MES.
OPC UA	Open Platform Communications Unified Architecture is a collection of standards for communication and data exchange in the industrial automation field and describes the transport as well as the interfaces and semantics of machine-to-machine data. The complete architecture is designed as service-oriented architecture and enables data exchange between the machine level and higher-level systems via a standardized protocol.
Overall Equipment Efficiency	Performance indicator for the overall equipment efficiency or a measure for the added value of a production line.
Right First Time	Error-free production starting at the initial commissioning of a production line.
Time-to-market	Interval between product development and placement of the product on the market, during which costs are incurred but no revenues are generated.
Weihenstephan Standards (WS)	The Weihenstephan standards were based on a research project in the brewing industry. An industry user group consisting of machine builders, IT providers, controller manufacturers and end-users defined joint standards for data acquisition from beverage filling and packing systems.

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