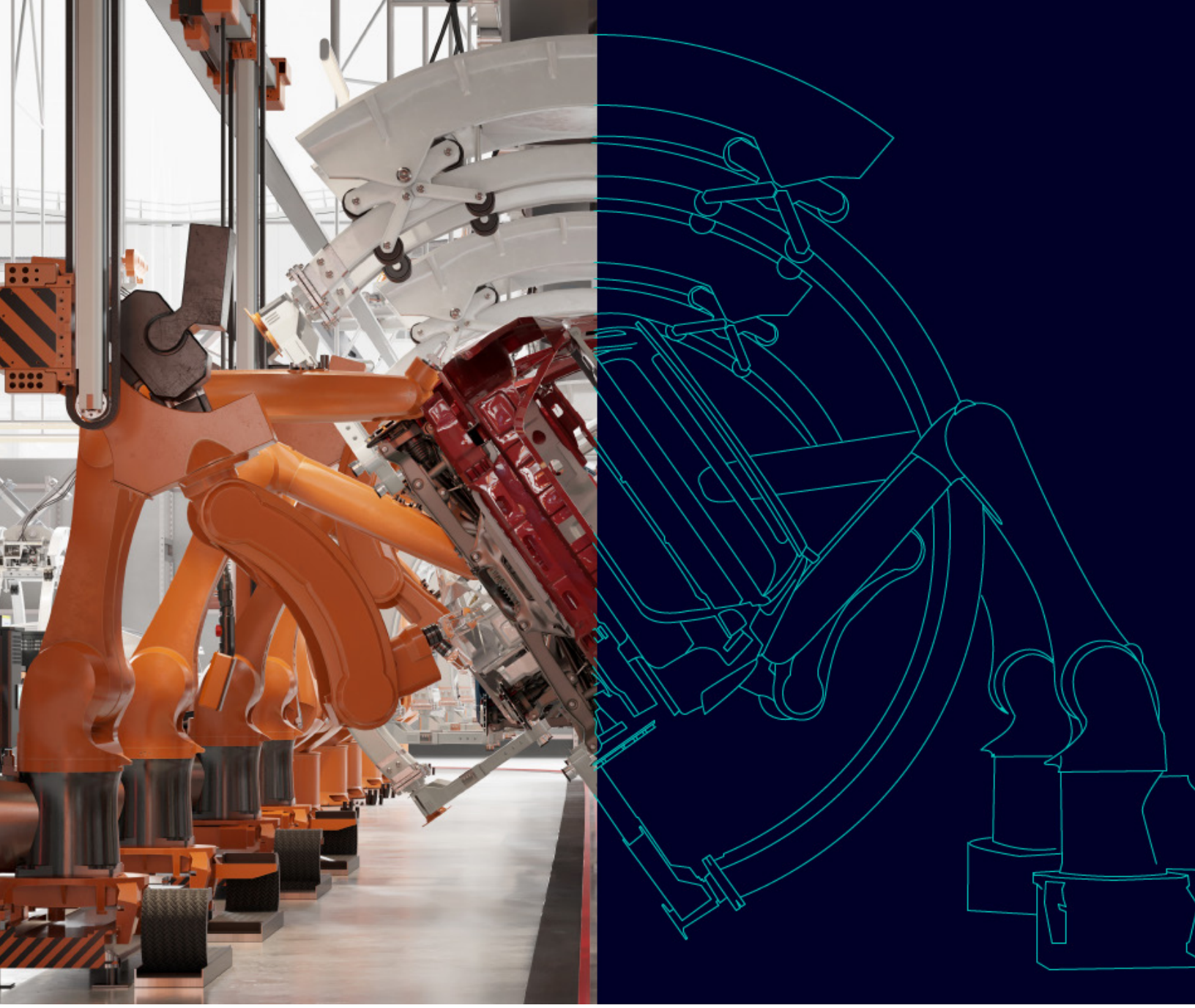

DIGITAL INDUSTRIES

Transform your plant with the next level of smart manufacturing

Drive efficiency and flexibility with intelligent automation

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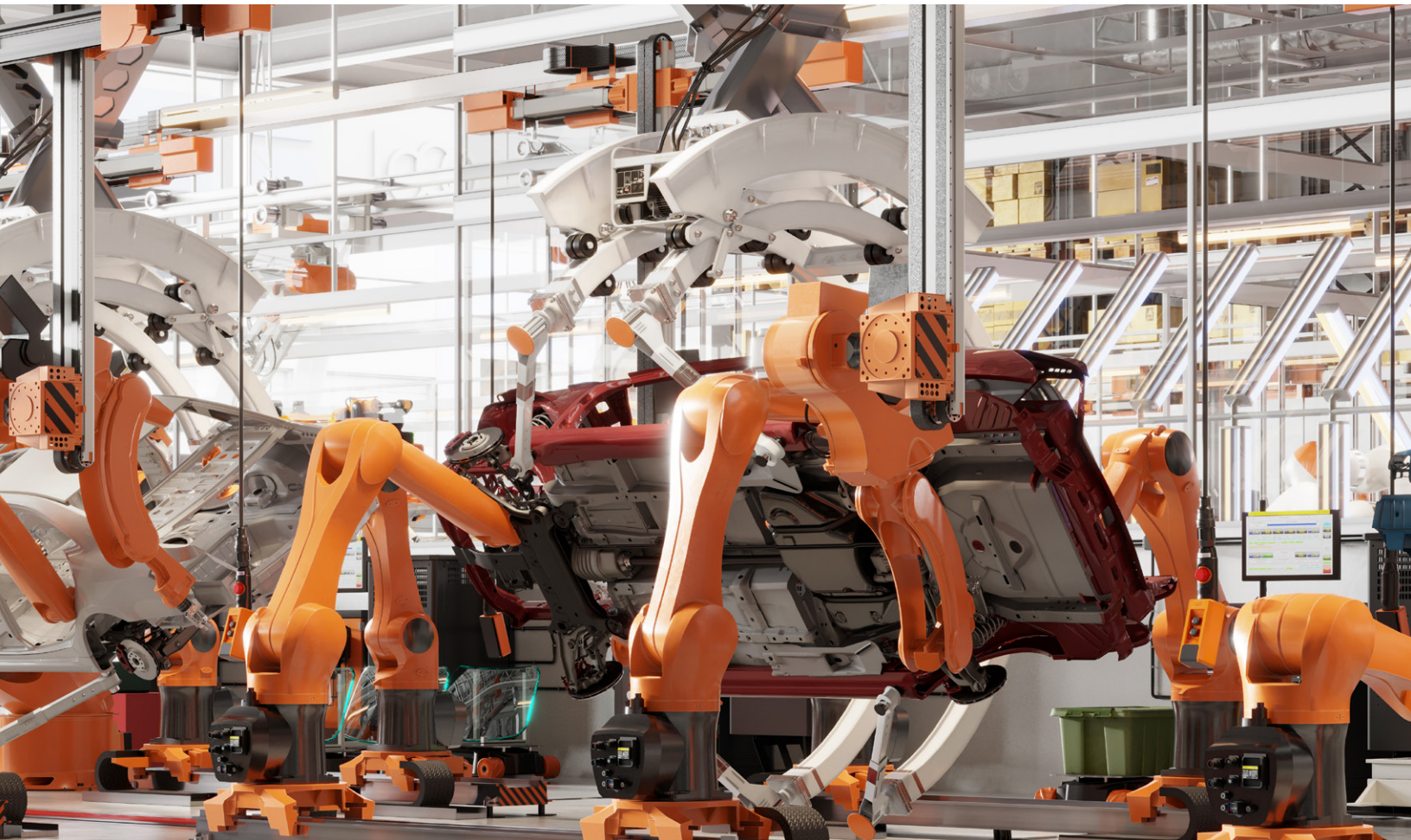
Introduction

The change in mobility is in full swing. Consumers seek greater connectivity and personalization in their cars, while governments impose aggressive sustainability targets. Automakers and suppliers are no longer asking whether there will be a switch from combustion to alternative drive systems but rather how quickly they must complete this transition and how they can execute it as smoothly as possible.

However, as they try to add new products to their line-ups, they discover that their current production facilities are not efficient or flexible enough to deliver the next generation of vehicles quickly, reliably, and profitably. Whether they choose to build new plants or update current ones to accommodate electric vehicle (EV) production, they need to focus on speed and cost-efficiency to meet the required timing and make the best use of capital.

This white paper highlights the challenges of vehicle manufacturing in today's automotive industry and the benefits of adopting the next generation of smart manufacturing solutions to evolve production facilities quickly. It intends to guide automakers and suppliers as they transform their operations to keep up with this changing landscape.



The challenges of manufacturing

To satisfy government mandates and meet consumer demands, manufacturers must expedite the addition of EVs to their portfolios alongside ADAS (advanced driver assistance systems) features and customized options. Transitioning production to include EVs alongside traditional vehicles poses unique manufacturing challenges.

Automakers must adapt their operations and retrain workers to accommodate new components, heavier vehicles, and new functions and processes. This is especially true as the next generation of cars requires innovations for powertrains and batteries and additional areas like software, heating, and cooling. The cross-domain interaction increases the already large number of design variants, which can become confusing for the plant and affect quality and cost. In this environment, manufacturers will succeed only with upfront planning for flexible operations that can accommodate multiple configurations on the same line without compromising quality or delivery.

Extended collaboration

Under pressure to add electric vehicles to their line-ups quickly, manufacturers face the prospect of managing multiple new product launches in shorter timelines. Launching the next generation of vehicles while maintaining current production is challenging as it forces manufacturers to develop new operations while trying to protect quality and profitability across all programs.

OEMs, emerging manufacturers, and suppliers must adopt strategies to plan and design processes quickly, manage design changes efficiently, and react rapidly to market changes. By taking a collaborative approach that integrates product and process development, the manufacturing team can gain early access to engineering data so that they can plan, optimize, and validate operations concurrently with product design. This connectedness enables the reuse of best practices and efficient resource management for continuous improvement. Ultimately, the integration of data extends across all shops from the onset of engineering to production. By pairing it with the right intelligent tools and technologies, it can facilitate IT (informational technology) and OT (operational technology) convergence to drive significant production improvements.

Advanced automation

Although the internal combustion engine is considered a phase-out model, it will probably continue to dominate the road scene for the next 20 to 30 years. Experts even believe worldwide sales could continue growing and may not peak until 2030.[1] While the eventual transition to electric and hybrid vehicles seems inevitable, it will take place gradually. As a result, automotive companies need flexible automation and innovative assembly concepts for all types of drive systems.

No one wants to sacrifice well-functioning products and equipment, but it is equally important not to miss out on an opportunity to be a leader in the future of mobility. Some companies are designing and building new greenfield facilities to accommodate EV production, while others are taking a brownfield approach by adding or adjusting production lines in established manufacturing sites. Because every manufacturer has different parameters and needs, it is difficult to determine the right path. At first, building new intelligent manufacturing facilities may seem more straightforward, but the costs can be prohibitive. Experts estimate that building a new plant from the ground up can cost manufacturers as much as $1.3 billion, while a brownfield approach averages between $4 and $7.4 million.[2]

Automakers who choose to adapt current facilities over building new ones find that updating legacy equipment to add flexibility and predictability is the key to success. Over 70% of automotive manufacturers have begun incorporating smart manufacturing technologies[3], but many have not yet realized the full power of the data they produce. Siemens' next-level automation prioritizes standardized design supporting multiple applications alongside disruptive technologies like the digital twin, software-defined control, artificial intelligence (AI), and auto code generation. By embracing smart manufacturing and intelligent automation, manufacturers can rapidly benefit from connected production processes and equipment without the extraordinary cost of building a greenfield facility.

Cost-efficiency and sustainability

Increasing regulations, additional competition, and the advancement of technologies mean that the automotive landscape is changing rapidly. The continued need for profitability makes it critical to optimize costs now while also investing in the next generation of manufacturing. Maximizing profitability with an eye on the future is a matter of improving overall efficiency through standardization, modularity, continuous improvement, and the reimagining of plant automation.

Standardization builds the foundation

From development to launch to production, automotive manufacturing is hugely complex. While most automakers are embracing automation to reduce complexity, challenges often arise from diverse hardware and software, leading to increased manual workload and inefficiencies. Countermeasures must be taken early by leveraging existing systems and implementing unified interfaces to reduce costs and enhance efficiency. Siemens understands that standardization is indispensable to the evolution of the plant. With a robust data management backbone that leverages standardized automation libraries, manufacturers can get assembly lines up faster and ensure that all production processes run seamlessly. Additionally, Siemens offers flexible components and solutions tailored to specific needs to improve shop floor management, reduce inefficiencies and costs, and facilitate a smoother digital transformation.

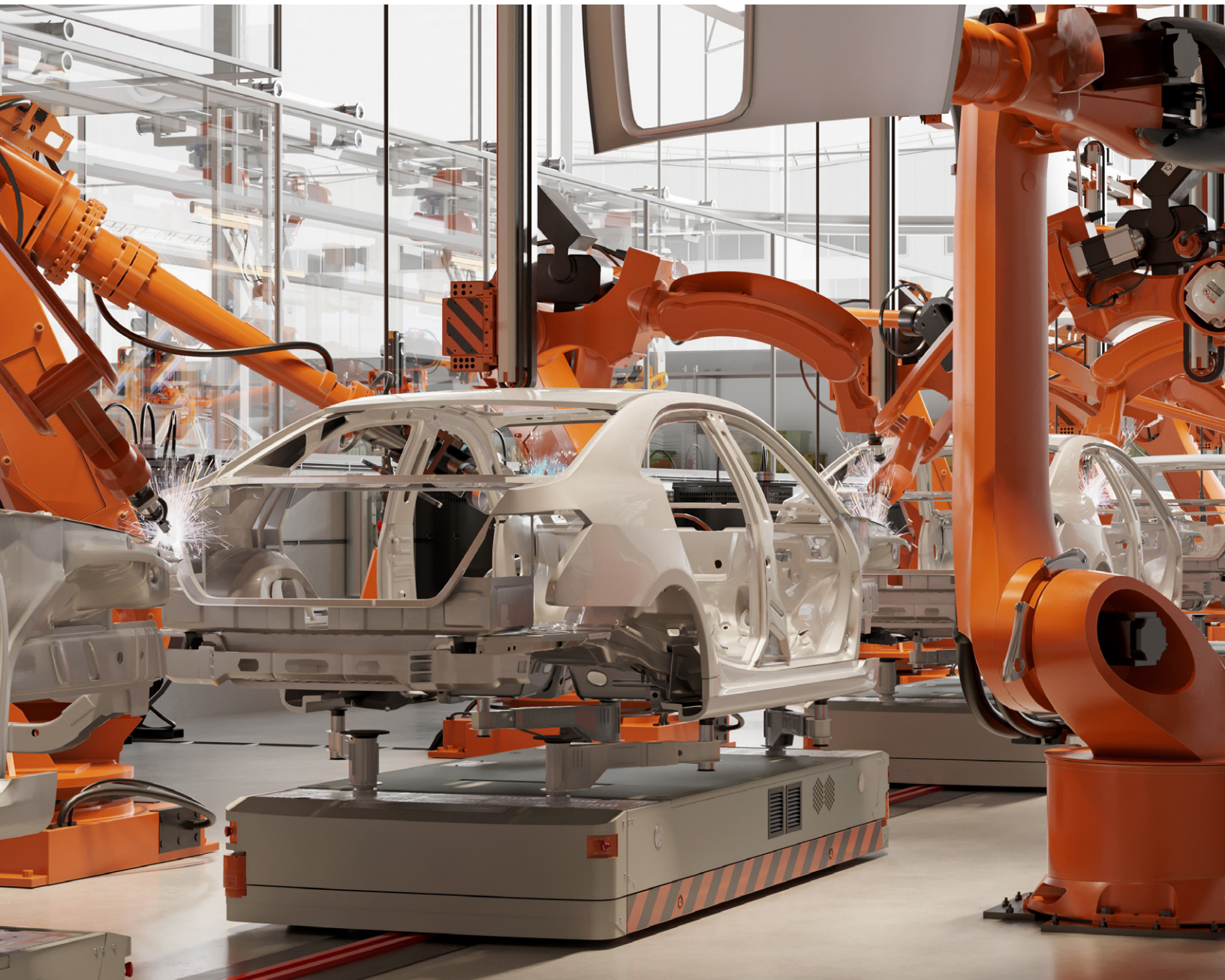
Reduce waste and improve quality

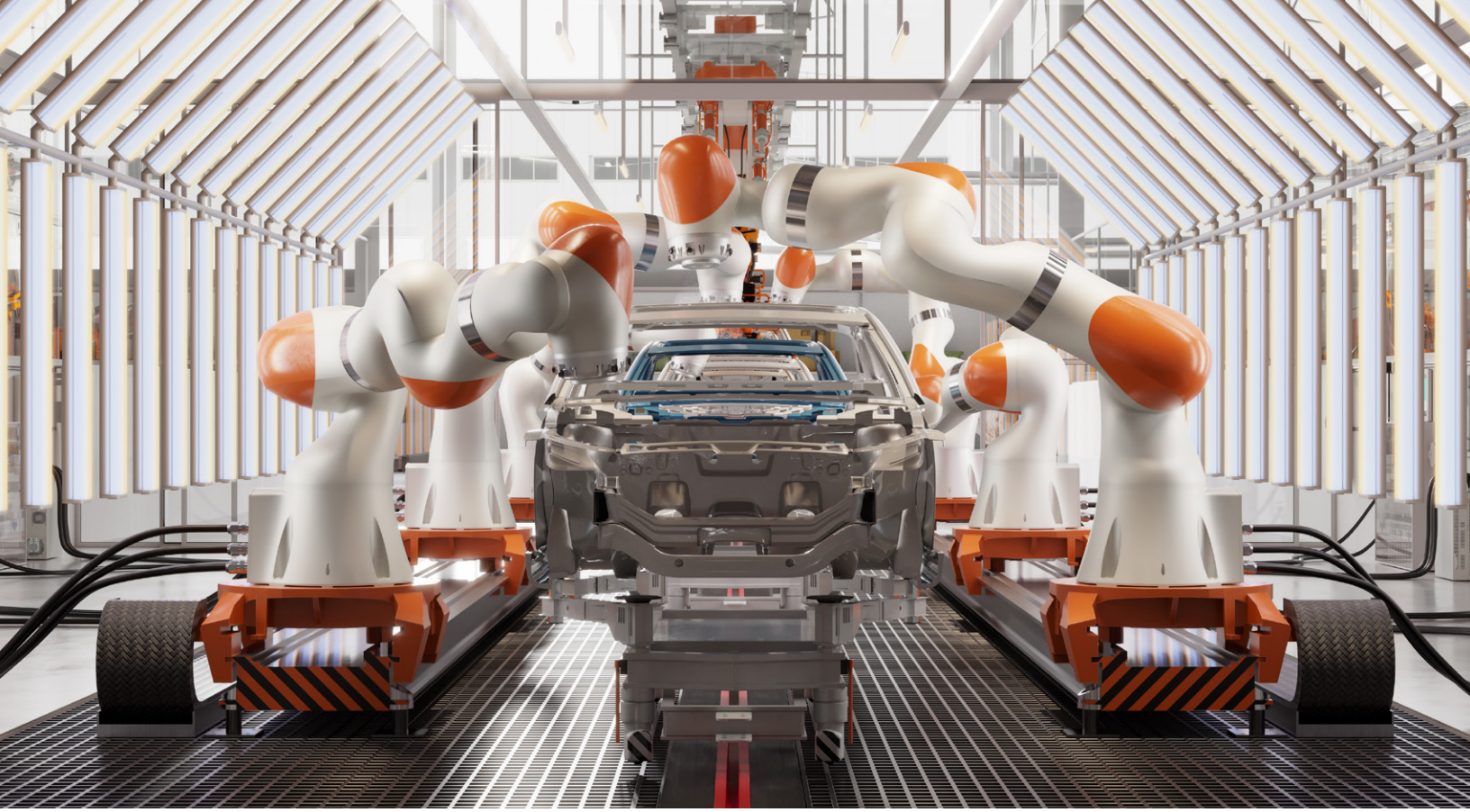
Today's automakers must not only deliver sustainable products but also use sustainable manufacturing processes. Alongside standardization and advanced automation, manufacturing facilities can use AI technologies, edge devices, and an industrial internet of things (IIoT) platform to connect IT and OT, monitor processes and productivity, and predict operational performance in real-time. Back-feeding data and information can create a continuous loop of process improvement and energy efficiency to identify inconsistencies, optimize usage, and reduce carbon emissions associated with energy consumption.

Closely related to this closed-loop manufacturing process is closed-loop quality, which focuses on improving the quality of the product across the entire lifecycle. Closed-loop quality is a constant evaluation of the quality of the product, feeding the extracted information back into the production and design processes to make the product more manufacturable and drive continuous improvement of product quality. This cycle ensures that the quality of the product is constantly improving.

The comprehensive digital twin

A holistic approach is needed to connect previously separated engineering processes and achieve the production flexibility required to add new products to current portfolios rapidly and profitably. Siemens is the only company that provides products and solutions for all aspects of manufacturing. By incorporating multi-system engineering, data analysis, and machine learning capabilities, a comprehensive cloud-based digital twin powered by AWS can demonstrate the impact of design changes before implementation. This access to information helps eliminate bottlenecks and offers essential insights into performance, energy usage, and efficiency of production processes. In this way, the digital twin reduces start-up time, improves quality, reduces carbon footprints, and helps manufacturers achieve production targets.





A digital enabled workforce

Automotive plants face workforce challenges due to shortages of skilled operators and technicians. To address this, Siemens helps automakers leverage immersive technologies for worker training and support. Virtual maintenance training utilizes 3D data and hands-on exercises to simulate real-world scenarios, ensuring relevant learning and skill application. Role-specific, interactive training monitored through cloud-based platforms enhances standardization and effectiveness. Remote assistance for operations and maintenance offers location-independent troubleshooting and expert support, minimizing unplanned downtime. This comprehensive service connects people and technology through audio/video communication and device access, ensuring swift problem resolution. These digital training methods are essential for upskilling workers, enhancing safety, and improving efficiency.

Drive a rapid factory transformation with Siemens

Siemens Smart Manufacturing solutions enable a rapid factory transformation that encompasses several critical elements to help automakers succeed:

- **A collaborative data management backbone that maximizes reuse and efficiency**
- **The convergence of IT and OT with technologies like AI, ML, IIoT, and an edge eco-system**
- **Advanced automation that emphasizes standardization and flexibility**
- **A comprehensive cloud-based digital twin for virtual planning and closed-loop improvement**
- **A digital enabled workforce to boost upskilling, safety, and cross-training**

Siemens solutions, curated specifically for the automotive industry, are open and scalable, enabling the evolution of an assembly line or an entire plant by upgrading and leveraging existing equipment without the cost of building from the ground up.

> *In partnership with Siemens, we benefit from their solutions and the added value, including standardized agile development and a digital mindset."*
>
> *Liu Weixia, Digitalization, Process and IT Director, BAIC BJEV*

Case Study: BAIC BJEV

Smarter manufacturing through digitalization

As a leader in China's electric vehicle industry, BAIC BJEV sold 158,000 vehicles in 2018 and has been the sales champion of China's EV market for six consecutive years.

However, there are still hurdles, including decreasing subsidies and growing competition. The company needed to devise a strategy to develop a middle- and high-level market to maintain its leadership position.

> *We hope to strengthen the brand effect, improve product quality, and produce vehicles that can better meet market needs,"*
>
> *Wang Qingzhou, General Manager Qingdao Industrial Base of BAIC BJEV.*

These goals could only be achieved by continuously improving research, manufacturing, and management capabilities.

Siemens' integrated hardware and software solutions, specifically designed for the automotive industry, have helped BAIC BJEV build the group's first mass production base for new-energy vehicles in Qingdao and laid a solid foundation for building a digitalized plant.

Qingdao Industrial Base covers an area of more than 1,600 acres and has continued rapid development since the start of production.

The EC and EX series models are produced here, where the complete production process occurs, from iron sheets to the finished product.

During the construction phase of the production line, Siemens helped BAIC BJEV build a digital twin of the plant, including individual machines, work cells, and assembly lines.

Virtual commissioning technology was used to simulate the production processes, enabling the necessary debugging and problem resolution before the physical manufacturing line was commissioned.

Case Study: Porsche

A flexible production line brings two worlds together

Developing a new production line at the main Porsche plant in Zuffenhausen was a unique challenge. The production facility for the new Taycan eCar was constructed within the existing plant in the shortest possible time despite other car lines running simultaneously.

For Porsche, the main plant at Zuffenshausen represents tradition. That's where the move toward electromobility begins with the Porsche Taycan.

Space for the new construction was seriously limited by the existing buildings. Building upward was, therefore, the order of the day. However, there are also height restrictions for buildings in Zuffenshausen to minimize the impact on airflow in Stuttgart.

The result is a unique manufacturing concept that makes the most of every level and doesn't waste any space.

Porsche decided against fixed conveyor belts to achieve the necessary flexibility and opted for a highly flexible system involving autonomous guided vehicles (AGVs). They used Siemens technology to map operating cycles to actual needs, like stopping an AGV from performing automated tasks and then speeding it up to move to the following processing system.

Conveyor technology solutions from Siemens are used throughout the vehicle assembly process.

In addition to the automated guided vehicles and the door conveyor system, lift hangers are used to ensure ergonomic working conditions.

These enable the car bodies to be rotated 110 degrees in both directions so that employees can easily access all parts.

Case study: Volkswagen

Setting new standards in automotive production

In partnership with Siemens, Volkswagen has developed the standard for the coming generation of electric vehicles across VASS, the four major VW brands in the volume segment-Volkswagen, Audi, SEAT, and SKODA.

The VASS standard, which includes automation solutions for hardware, software, and visualization libraries, forms a building block system for the mass production of different vehicle models.

With the standard, the manufacturer offers a modular system for flexible production and creates a standardized basis for further digitalization of production.

A very high degree of automation has been achieved using Siemens technology, including the TIA Portal, Simatic controllers, HMI (human-machine interface) panels, and industrial PCs.

Clear installation guidelines help shorten commissioning and ramp-up time for a successful launch. Pre-configured interfaces make systems user-friendly for operators to improve training and knowledge transfer.

Maintenance and troubleshooting also become easier, and continuous optimization can be applied across the whole system.

Volkswagen's electric vehicles will be based on the Modular Electric Drive Matrix (MEB), which consists of a battery and two axles.

The aim is to simplify and align production lines, consolidate electronic controls, and reduce the number of microprocessors.

For the first time, the four VW group brands now have a common electric vehicle platform, which provides the foundation for taking electric vehicles into series production.

Volkswagen's ID.3 is just the beginning. By 2022, the four carmakers plan to offer 27 total MEB-based vehicle models covering a wide range of applications.

Volkswagen expects the broadest possible dissemination of its new technology for electric cars and the associated economies of scale to reduce the cost of its transition to electromobility significantly.

"With the VASS standard, we enable mass production of different models in the same line. At the same time, we are creating a uniform basis for further digitalization of production."

Thomas Zembok, Head of Manufacturing Automation & Digital Production, Volkswagen AG

Siemens Digital Industries

Americas: +1 314 264 8499

EMEA: +44 (0) 1276 413200

Asia-Pacific: +852 2230 3333

About Siemens Digital Industries:

Siemens Digital Industries (DI) is a leading innovator in automation and digitalization, empowering organizations of all sizes to transform their operations and create sustainable products for the future. Through its Digital Enterprise portfolio, DI offers a comprehensive suite of software, hardware, and services that facilitate the seamless integration and digitization of the entire value chain, customized to meet the unique needs of each industry. Siemens Xcelerator business platform provides a unified environment for organizations to leverage the full potential of DI's solutions, including its robust digital twin technology. DI assists organizations of all sizes in their digital transformation journey, utilizing software, hardware, and services from the Siemens Xcelerator business platform. In partnership with its customers, DI accelerates transformation, helping them achieve greater productivity, flexibility, and sustainability. For more information on Siemens Smart Manufacturing for Automotive, visit siemens.com/automotive-smart-manufacturing or follow us on LinkedIn and X.

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