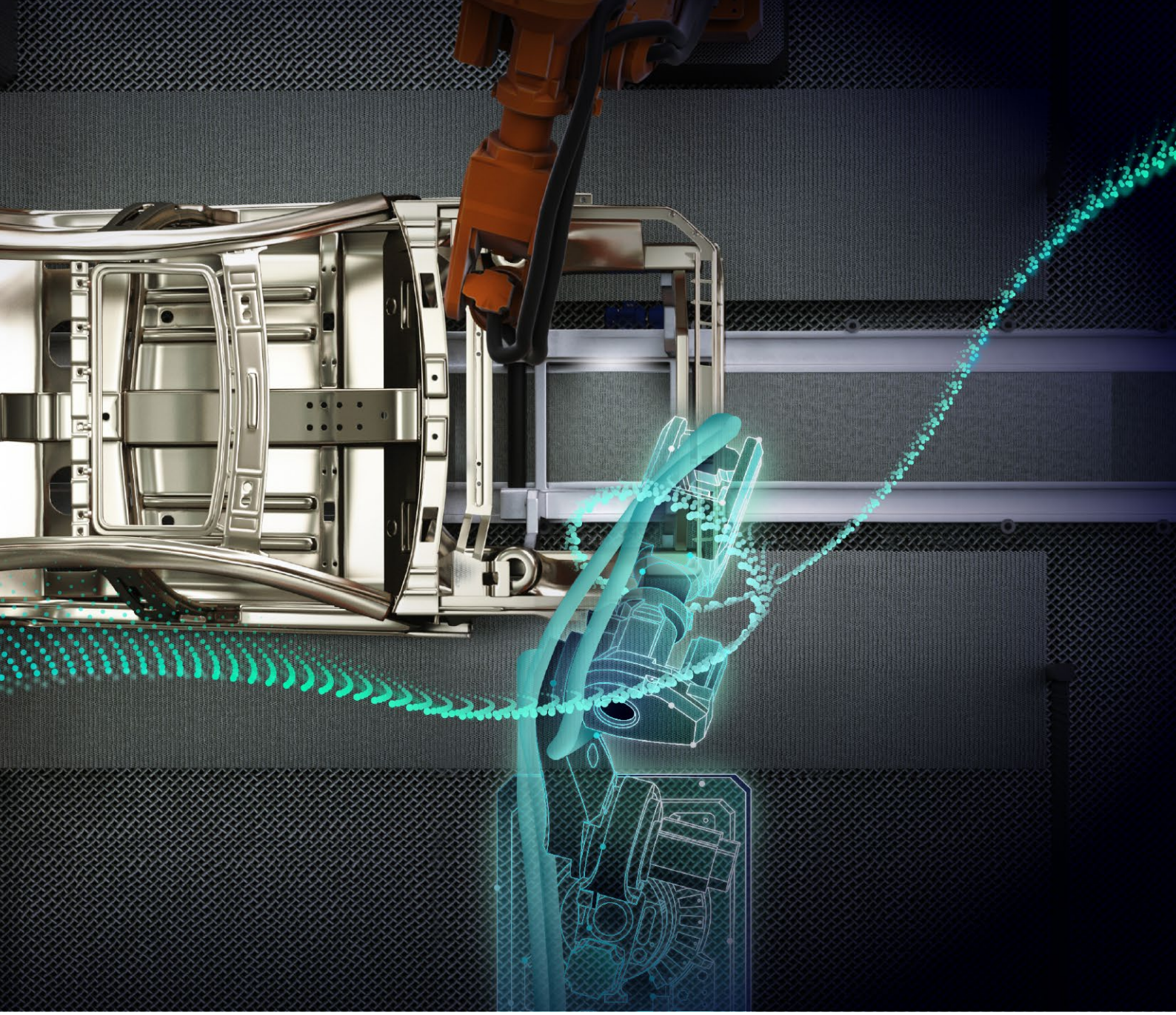


SIEMENS DIGITAL INDUSTRIES SOFTWARE

Achieve a flawless launch with a rapid plant evolution

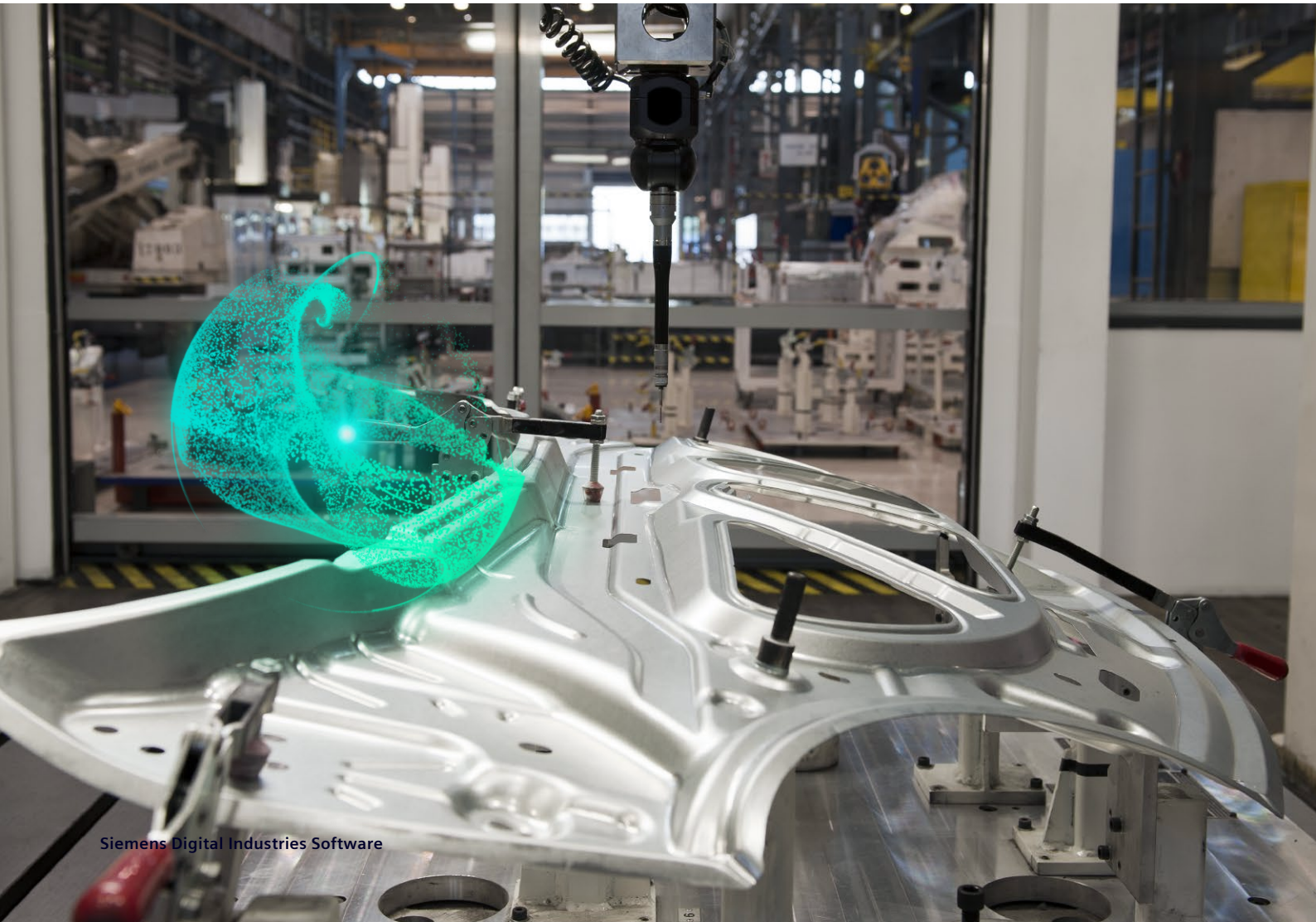
Smart manufacturing delivers the future of transportation

SIEMENS

Introduction

The change in mobility is in full swing. In addition to greater connectivity and personalization, many consumers are placing environment aspects at the center of their purchasing decisions. Today, OEMs and automotive suppliers are no longer asking whether there will be a switch from combustion to alternative drivers but rather how quickly this transition can be completed and how it can be executed 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.

Faced with frequent line disruptions, lack of flexibility and resilience, and greater pressure on speed and delivery, manufacturers and suppliers are turning to digitalization and advanced automation to rapidly evolve their plants into intelligent production environments. This whitepaper highlights the challenges of vehicle manufacturing in today's automotive industry and the opportunities offered by the rapid evolution of the plant with a smart manufacturing solution. It intends to provide OEMs and suppliers with the guidance for the necessary transformation of production planning and processes related to the automotive plant in this changing landscape.



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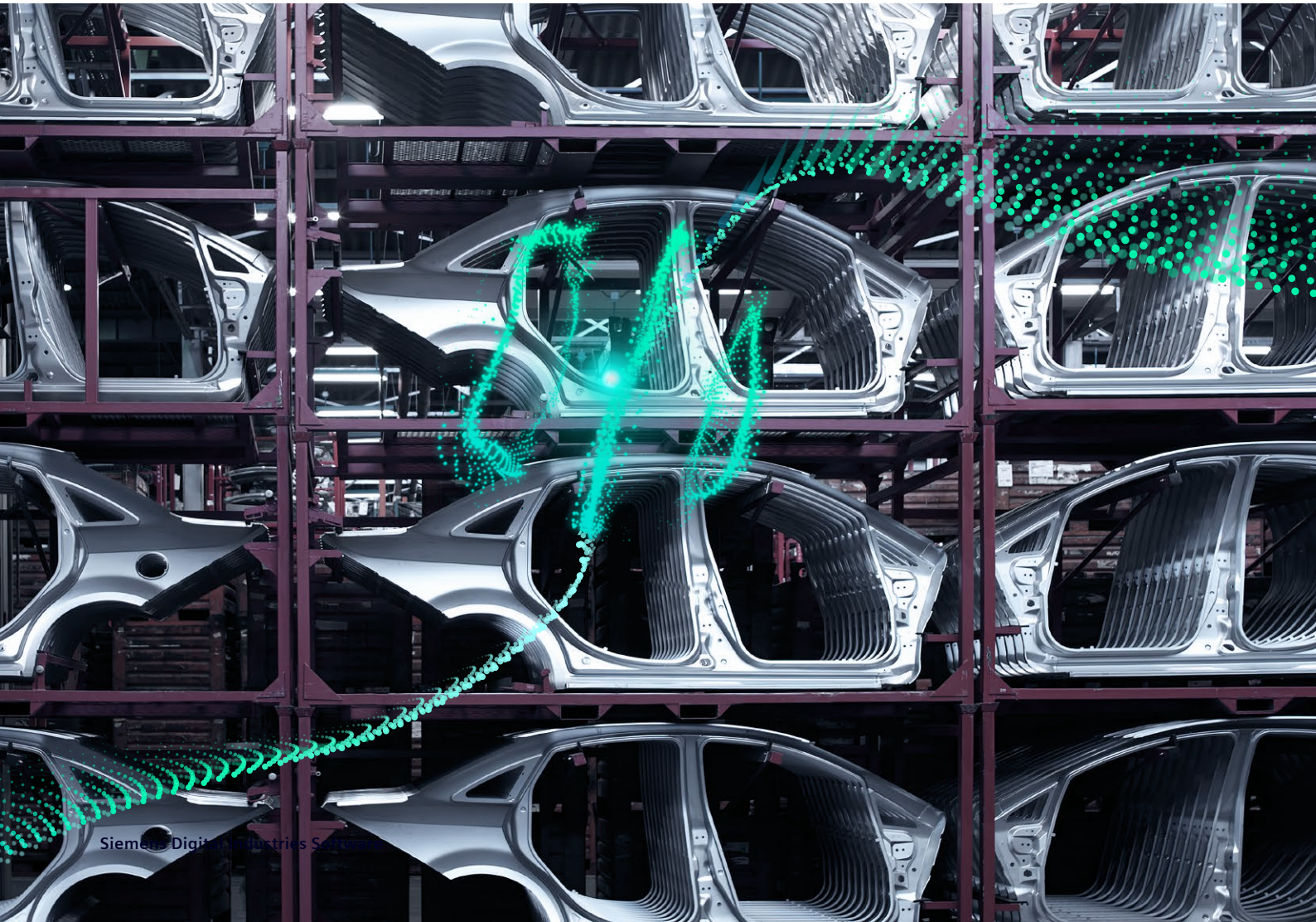


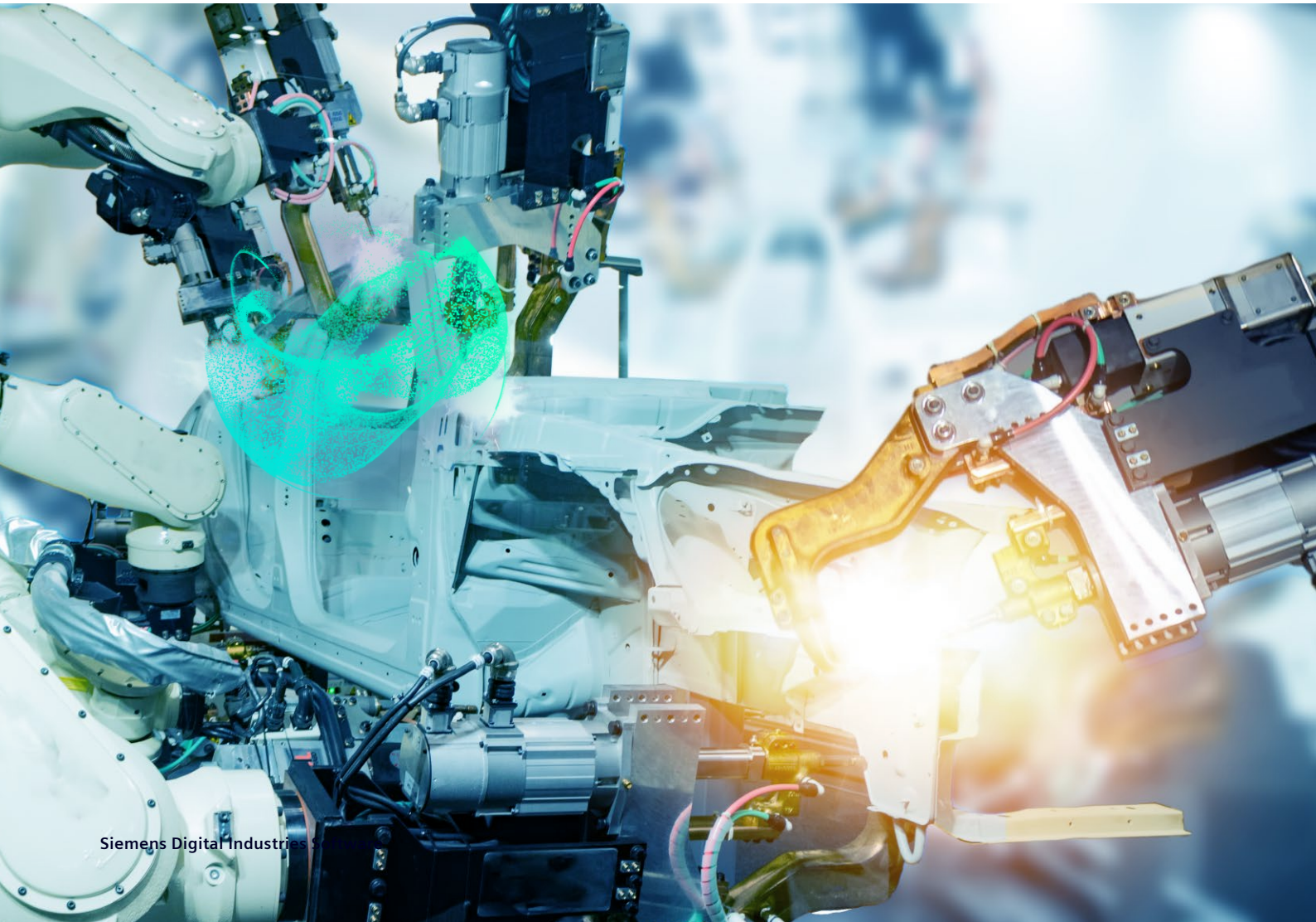
The challenges of manufacturing

According to a new study, electrification can save up to 80 percent of CO_2 emissions[1], compared to combustion engines. In the current age of climate change the industry is rapidly changing their portfolio to fully electrified powertrains as well as adding autonomous vehicles and a greater degree of personalization. Adding this complexity, however, poses major challenges for manufacturers and suppliers.

Change is coming

System capability and robustness in high-tech components, software know-how, and globally connected development centers are challenging requirements that manufacturers will face in the future.

For the industry, the change in mobility offers many opportunities and major challenges. After all, they must adapt to completely new functions, components, and systems. This is especially true as the next generation of cars require 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-and this exploding diversity can easily become confusing in the plant.



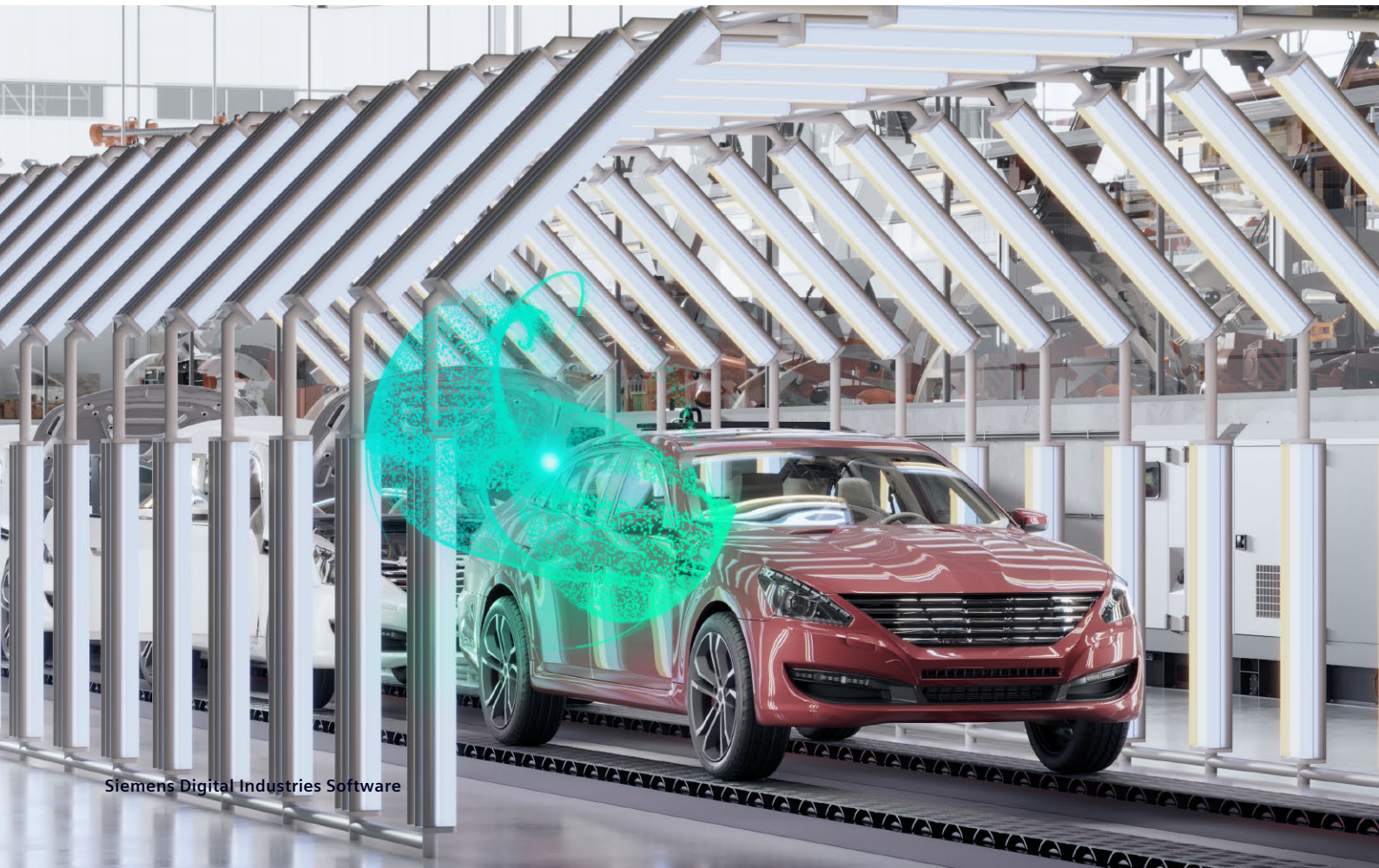
A successful launch begins with early collaboration

The trend toward the next generation of mobility solutions is irreversible. New technologies and changing customer needs are forcing car manufacturers and suppliers to reposition themselves as soon as possible to retain market share. Market researchers believe that the tipping point to electric vehicles could be reached as soon as 2024[2]. Those who want to master the future of mobility successfully must deliver faster results with fewer resources to bring products to market faster.

Under pressure to add vehicles to their line-ups quickly, manufacturers are facing 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.

OEMs, emerging manufacturers, and suppliers need to adopt strategies that allow them to plan and design processes quickly and manage design changes efficiently throughout production. By taking a collaborative approach that integrates mechanical design with electrical, controls, and software engineering, the manufacturing team gains early access to engineering data so that production processes can be planned, optimized, and validated during product design.

With a digital backbone of data, everyone builds their plans leveraging a single source of collaboration accessible to all stakeholders and downstream processes to ensure information is always up to date. When problems do occur, this connectedness also offers the ability to trace the root of the problem quickly and efficiently.



Modernizing plant 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 that worldwide sales could continue to grow and may not peak until 2030[3]. At the same time, however, demand for environmentally-friendly alternatives is growing rapidly and with it the need for electric drive components used in EVs and hybrid vehicles. What is certain is that the transition from internal combustion to electric vehicles will take place gradually. As a result, automotive companies need flexible and innovate assembly concepts for all types of drive systems.

Finding the right balance

But how can these be implemented? After all, no one wants to sacrifice well-functioning products and equipment. On the other hand, it is equally important not to miss an opportunity to be a leader in the change in mobility. Some companies are designing and building brand new production facilities (greenfield), while others are building additional production lines in established manufacturing sites (brownfield). Because every manufacturer has different parameters and needs, it is difficult to determine the right way forward. At first, it may seem easier to set up new production lines in intelligent manufacturing facilities, but this usually involves much higher costs. Experts estimate that building a completely new plant would cost car manufacturers up to $1.3 billion, while the cost of a brownfield setup falls between $4 and $7.4 million.[4] A strategic smart manufacturing plan that includes updating legacy equipment with smart sensors and software to take advantage of advanced technologies like AI, ML, and the IIoT enables actional production insights and analysis without the extraordinary cost of building a greenfield facility.

Deriving maximum value from technology

While most automakers recognize that smart manufacturing requires updated technologies and equipment, it will be those extracting the data and then using it to take corrective action, completing a loop of communication, who succeed.

A manufacturing execution system (MES) operates at the core of manufacturing systems which are substantially enhanced with smart manufacturing. By taking control of plant operations, the MES acts as the fundamental bridge between the enterprise business systems (ERP), the product lifecycle management (PLM) system, and the quality management system (QMS) to make sure that materials are available when and where they are needed to keep the assembly lines running.

Increasing plant 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, multi-systems engineering, continuous improvement, and the reimagining of plant automation. Facing these challenges, seventy percent of OEMs have already established smart manufacturing initiatives in their plants and 44% of suppliers have plans to begin digitalizing their plants in the next 5 years.[5]

Standardization builds the foundation

Why are standards so important? Manufacturing a vehicle requires that thousands of parts are designed and produced within extremely tight tolerances if they are going to fit and function together. From concept to launch to production, automotive manufacturing is extremely complex. Without standardization, parts may not fit together, ultimately causing avoidable delays and quality issues. Countermeasures must be taken at an early stage. To increase the efficiency, agility and flexibility of manufacturing processes, intelligent automation, solutions must be universal from the controls and drive systems to peripheral dices and sensors. Standardization is indispensable to the evolution of the plant. A strong data management backbone, support by advancements in connectivity, leverages standardized automation libraries to get assembly lines up faster and ensure that all production processes run seamlessly. This not only reduces manual effort but also opens enormous savings potential. Experience has shown that automotive manufacturing costs can be reduced by up to half on average through standardization. Manufacturing costs are reduced, the commissioning of new equipment is accelerated, production lines are scalable worldwide, and operating parameters can be uniformly controlled.

Reduce waste and improve quality

The evolution of the plant must not only include the ability to produce sustainable products but also utilize sustainable processes. After standardization and strategic equipment modernization, manufacturing can use an IoT platform to monitor processes and productivity, feeding data and information to back-enable a continuous loop of process improvement and energy efficiency. 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. This cycle ensures that the quality of the product is constantly improving.

Siemens' comprehensive digital twins for the automotive industry

A holistic approach is needed to connect previously separated engineering processes and achieve the production flexibility required to be able 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, digital twins can demonstrate the impact of design changes before implementation. This early access to information helps eliminate bottlenecks and offers important insights for performance and efficiency improvement. In this way, digital twins reduce development time and improve quality.

Smart manufacturing begins with rapid plant evolution

The rapid evolution of the automotive plant includes multiple components: a collaborative data management backbone that leverages standardized automation libraries; technologies like AI, ML, and the IIoT; intelligent intralogistics to increase line flexibility; a comprehensive digital twin to enable virtual commissioning and closed loop communication; and, a multilayer approach to cybersecurity that provides all round, deep protection.

Siemens' smart manufacturing solutions are open and scalable, enabling the evolution of an assembly line or an entire plant by upgrading and modernizing existing equipment without building a brand new facility.

Case Study: BAIC BJEV

Smarter manufacturing through digitalization

As a leader of 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 in the market.

"We hope to strengthen the brand effect, improve product quality, and produce vehicles that can better meet market needs," says 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 digitalized plant.

Qingdao Industrial Base covers an area of more than 1,600 acres and has continued rapid development since the start of production in 2015.

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 create a virtual simulation of the production processes, enabling the necessary debugging and problem resolution before the physical manufacturing line was physically commissioned.

> 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: 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 at the same time.

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

But space for the new construction was seriously limited by the existing buildings. Building upward was, therefore, the order of the day. But 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.

To achieve the necessary flexibility, Porsche decided against fixed conveyor belts 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 next 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, itlt 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 access all parts with ease.

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.

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

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 the battery and two axles.

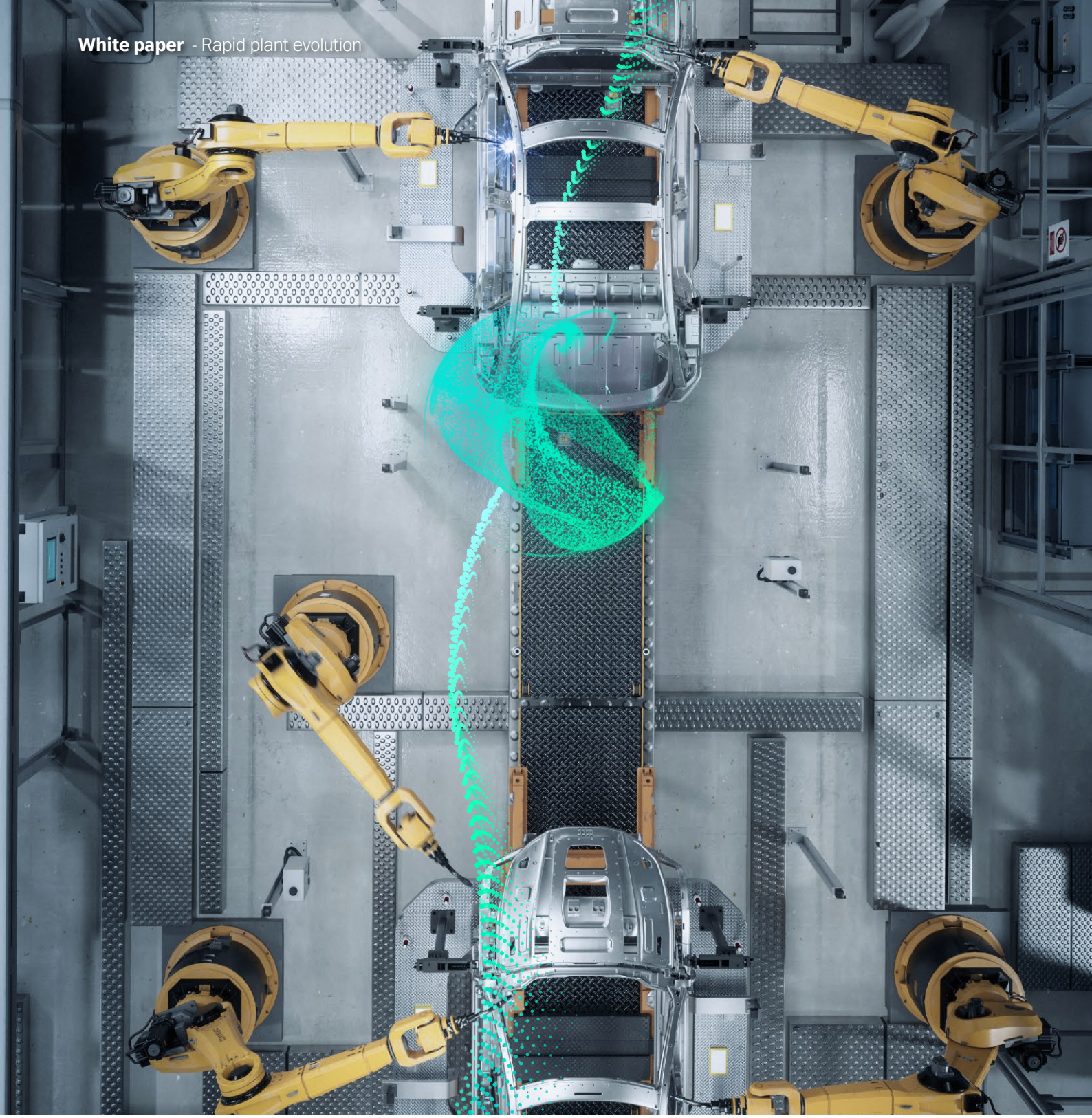
The aim is to simplify and align production lines consolidating electronic controls and reducing the number of microprocessors.

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

> 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***



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