How to accelerate automotive companies' transition to *intelligent manufacturing*

With the right partnerships, OEMs and tier 1s can get back on track to meet their automation goals despite ongoing disruptions.

Capgemini

Executive summary

Intelligent manufacturing is now an urgent imperative for automotive companies – both OEMs and tier 1s. Traditional manufacturing models cannot cope with trends such as electrification and mass customization. Nor can they tackle cost and efficiency pressures, or exploit the possibilities of advanced materials.

Intelligent manufacturing can address all of these challenges. However, it implies far-reaching business and technological transformation.

Automotive companies are struggling to progress this transformation at sufficient speed, in part because of the unprecedented levels of disruption currently facing the industry. Disruptors range from increased complexity arising from product proliferation to regionalization trends necessitating relocation of production. An additional, and fundamental, obstacle to transformation is the inflexibility of most companies' legacy systems.

Four steps can help companies overcome the obstacles and accelerate their journey to intelligent manufacturing. The steps are:

Rethink manufacturing strategy and processes around hyperautomation.

To maintain competitiveness, companies should aim to achieve almost fully autonomous operations within the next two decades. This hyperautomation will enhance efficiency and productivity – and also bring new flexibility.

Rapidly build the data foundation needed for the journey.

By fueling agentic AI, this foundation will facilitate autonomous decision-making, predictive insights, and real-time optimization across the shop floor, so that factories can become intelligent, adaptive ecosystems.

Master the technological enablers that bring together the digital and the physical.

Intelligent manufacturing and hyperautomation depend on combining digital technologies with machines to create adaptive processes that continuously improve efficiency, precision, and safety. Doing so requires mastery of cutting-edge technological enablers, such as AI, hyperconnectivity, and digital twins.

Create and leverage a collaborative partner ecosystem.

To succeed with a transformation of this magnitude and complexity, companies must forge links with carefully chosen partner organizations. The right strategic partner can facilitate all aspects of the transformation, and also provide access to its own ecosystem.

Capgemini is ideally positioned to support the journey to intelligent manufacturing. We are already helping leading OEMs and tier 1s to achieve Industry 5.0 readiness, integrating engineering, manufacturing, and supply chain for agility, resilience, and sustainability.

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Introduction

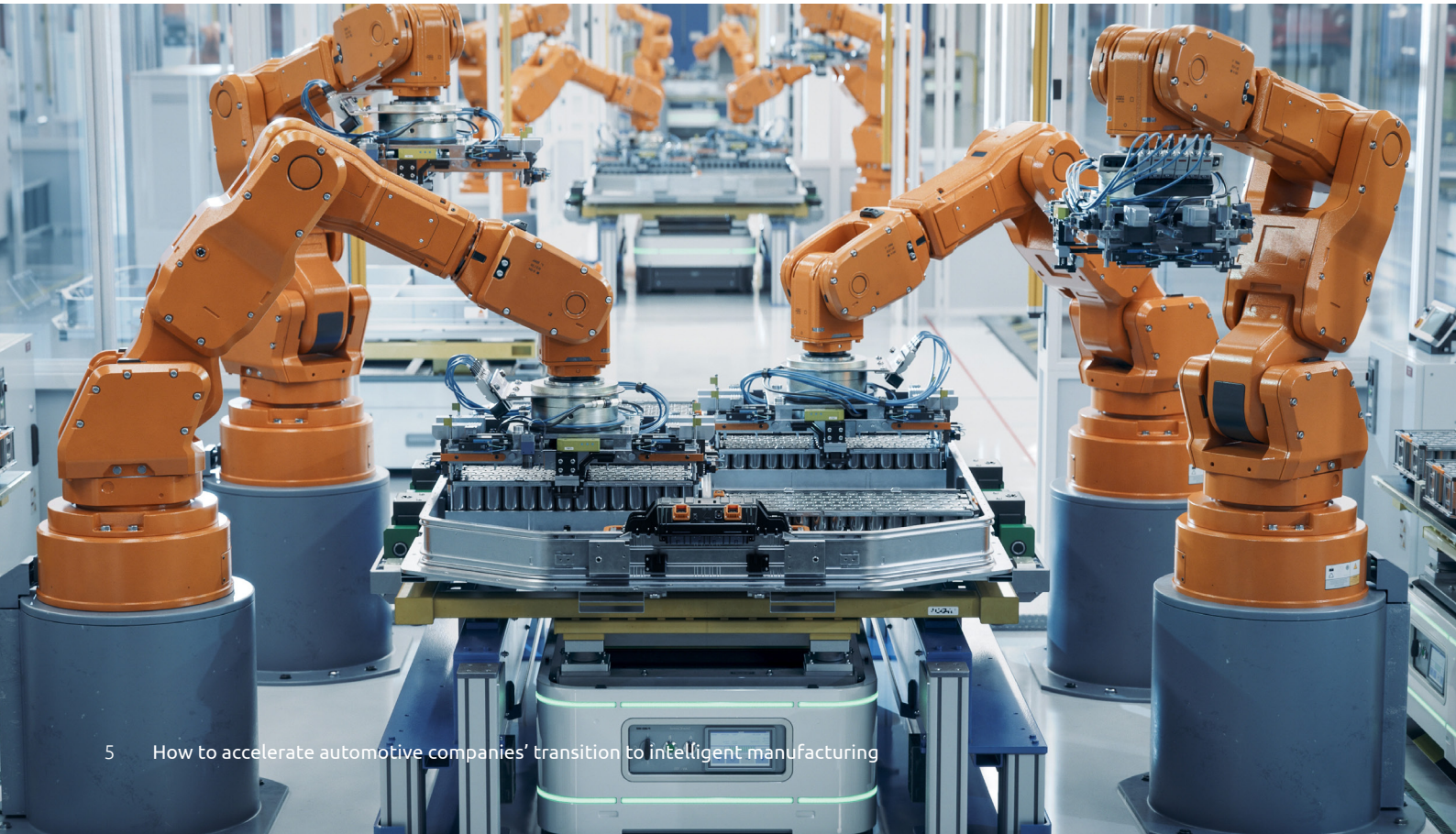
Intelligent manufacturing is now an urgent imperative for automotive companies

The automotive industry is at a crossroads. Currently, companies are experiencing escalating complexity, with trends such as electrification and mass customization all demanding more flexible, adaptive production systems.

In addition, companies are continuing to experience acute cost and efficiency pressures; global competition and economic tightening, and geo-based regulatory measures around carbon-neutrality, are creating a need for leaner, more intelligent operations and are reshaping supply chains and production methods.

On top of that, the rapid emergence of new materials with enhanced properties is putting even more pressure on manufacturers, who must adapt their industrial frameworks to exploit the possibilities of these advanced materials.

Traditional manufacturing models, built on considerable economies of scale, are no longer sufficient to deal with these challenges. That makes intelligent manufacturing a strategic imperative for automakers today.



We suggest four technology pillars – aligned with Capgemini's manufacturing theme around IT, OT, and AI – to complement traditional approaches for the transformation of the industrial system:

Physical automation.

Although automotive has traditionally been ahead of other industries in terms of automation and robotics, there are still many opportunities for deterministic, repetitive automation. As an example, robotic density (robots per 10,000 workers) in manufacturing is around 1,200 in South Korea, 800 in Singapore, and 600 in China – but below 400 in Europe.

Extensive use of AI to support humans in operations.

The current state of the application of AI is far away from the goal of fully autonomous factories. However, trustable, explainable AI can bring immense value if used to support humans in daily tasks. For example, an AI agent – working with a robust manufacturing data foundation – can autonomously define a production plan, taking into account all the constraints on, and demands for, the production system.

Comprehensive connectivity.

Connecting machines, humans, and IT/OT systems will make it possible to exploit and deploy at scale the benefits of physical and digital automation.

Appropriate IT.

Alongside operational technology, AI, and network technology, comprehensive modern IT is required to drive efficiency and agility across the value chain. Requirements include real-time data integration, predictive insights, and digital twins.

While digitalization is a key element of intelligent manufacturing, this point of view will argue that business strategy is equally important.

By adopting a rounded approach to intelligent manufacturing that uses technology to achieve strategic objectives, automotive OEMs and tier 1s will enhance their manufacturing efficiency and agility for the long term.

Industry disruptions are impeding progress toward intelligent manufacturing

Current disruptions make it difficult to focus on transformation

To implement intelligent manufacturing successfully, manufacturers must get ready to transition to Industry 5.0, where machines, products, and people are all intelligent and all aligned – and where data brings together the physical and digital worlds.

By achieving Industry 5.0 readiness, OEMs and tier 1s will gain the ability to integrate engineering, manufacturing, and supply chain, thus enhancing their agility, resilience, and sustainability.

Unfortunately, however, this need has come at a time when the industry faces unprecedented challenges. These challenges include:

Regionalization trends that may necessitate relocation of production.

Changing customer demands and expectations in relation to products.

The arrival of disruptive products that increase complexity and diversity, and necessitate a faster time to market.

New sustainability needs across the value chain.

The need to adopt new technologies – for example, tier 1s may need them to serve OEM customers, while OEMs need them to compete with new digital-native competitors.

Talent shortages, particularly in relation to these newer technologies.

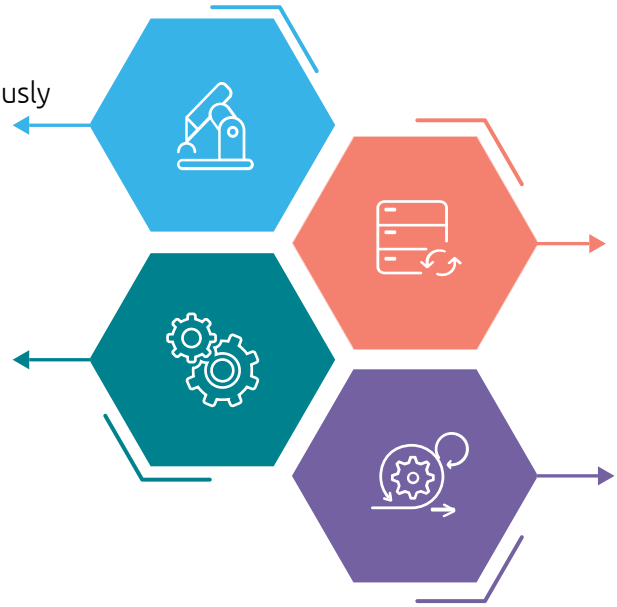
In this business context, the industry has set itself some challenging technical goals. For example:

Autonomous operations

Production systems should be able to adapt autonomously to changing process conditions, so that human expertise can be used to handle process anomalies.

Shopfloor as a data center

Software and digitalization of both products and assets requires completely new operating procedures and the handling of massive amounts of data.



Everlasting start of production (SOP)

Increasingly, each SOP event is followed by the production of different vehicle variants.

Adaptability and agility

These are vital to deal with supply chain disruptions and changing products and regulations, for instance.

Many of the current disruptions can undermine continuity within factories, with widespread and potentially catastrophic results. Interruptions to production at tier 1 suppliers affect OEMs' continuity when parts are not received on time or to spec – and OEMs themselves are of course subject to the same disruptions.

It is difficult to focus on the transformation of manufacturing while dealing with these threats to continuity. Yet automotive companies recognize that they need this transformation more than ever. That is because intelligent manufacturing will give them the agility to overcome the challenges, as well as to achieve their strategic business goals.

When it comes to costs, too, there is a similar paradox. In certain regions including Europe, a tight economic situation combined with heightened competition means many companies are operating on single-digit margins, and are focused on driving costs down.

That makes it even harder to focus on the transformation – but this same transformation is required for large-scale cost reduction.

Automakers face even more fundamental obstacles to intelligent manufacturing

So the question is how far and how fast automotive companies can progress their intelligent manufacturing journey in the face of current challenges. At present, the answer appears to be "not fast enough."

Part of the difficulty is that they tend to have a large investment in legacy platforms. On the whole, these platforms are not flexible enough to meet the needs of modern industrial programs. Importantly, they cannot provide the strong, adaptable data foundation required for these programs.

As a result, most automotive companies are currently tackling innovation in small incremental steps, instead of undertaking the rapid, wholesale transformation that the situation demands. While there have been successful small-scale projects or pilots, scaling them enterprise-wide has proved difficult.

The “HOW” part: Four steps to accelerate the journey toward intelligent manufacturing

Companies know that to win this race, they need to adopt a more radical approach – one that combines technological and business change.

The term “intelligent manufacturing” may suggest technology change, and certainly that is an important part of it. IT and OT must be integrated into a seamless source of intelligence, and modular, scalable architectures adopted to future-proof operations. Automation using both traditional and AI-powered robots is also a key strategy for enhancing efficiency.

However, what is also needed is a business transformation. Automotive leaders must, for example, invest in workforce upskilling to bridge the digital skills gap. And the company needs to embed metrics into every process to ensure it meets its strategic objectives.

By adopting a holistic approach that emphasizes both business and technology transformation, companies can streamline their intelligent manufacturing.

We have identified four specific actions that can accelerate the transformation and ensure its goals are achieved. With these actions, companies can achieve the speed of change that they need, while acquiring the agility to deal with disruption and maintain continuity.

1.

Rethink manufacturing strategy and processes around hyperautomation

We believe companies should aim to achieve almost fully autonomous operations within the next one or two decades. This is the only way to maintain competitiveness in the rapidly changing environment.

This goal will be achieved through hyperautomation, where automation tools are combined with AI and humans to widen the scope of automation. Traditional automation mostly applies to repetitive, mundane tasks. Hyperautomation goes much further, leveraging technology to automatically discover, analyze, design, automate, measure, monitor, and adjust.

The benefits of hyperautomation include not only enhanced efficiency and productivity, but also enhanced flexibility. A hyperautomated factory is much better able to respond to changing business requirements.

The Core-Context framework is an excellent approach to defining what activity is core – i.e. brings a lasting competitive advantage – versus what is context. This approach repurposes the resources of the company to invest in the future core and exploit the current one, offloading key resources from managing the context. This will allow automakers to invest in what will have a significant impact, saving them from overinvesting. (For more information, please read our Innovation Mandate[1], which explains how Capgemini uses the Core-Context framework.)

2.

Rapidly build the data foundation needed for the journey

Modern manufacturing processes only work well with a strong data foundation. Most automakers know that this is something they lack. In the past, the limited data management capabilities of legacy systems have often frustrated their attempts at innovation.

Successful transformation depends on introducing appropriate techniques and technologies for storing, managing, and using data securely and safely.

Key elements of the data foundation will include:

- **Manufacturing data management**
- **Plant connectivity**
- **Hybrid edge-to-cloud manufacturing platform**
- **Data governance framework**

A robust manufacturing data foundation is the fuel that powers agentic AI. Thus, it enables autonomous decision-making, predictive insights, and real-time optimization across the shop floor. Together, data and AI can transform factories into intelligent, adaptive ecosystems.

[1]https://www.capgemini.com/insights/research-library/the-engineering-leaders-innovation-mandate/

3.

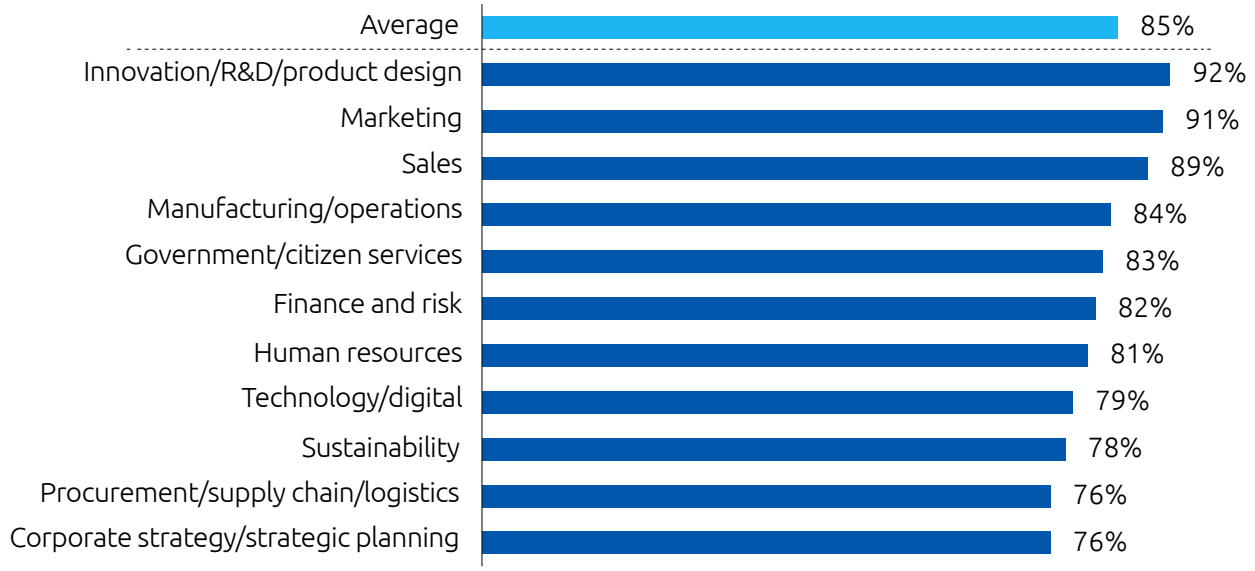
Master the technological enablers that bring together the digital and the physical

Intelligent manufacturing and hyperautomation depend on combining digital technologies such as AI with machines to create adaptive processes that continuously improve efficiency, precision, and safety. Before an automotive company can achieve this, it has to have mastery of certain technological enablers, of which AI, hyperconnectivity, and digital twins are the most significant.

AI, including real-time analytics

Capgemini research suggests that manufacturers believe AI – and particularly agentic AI – will play a major part in their companies' future. For example, a recent CRI report reveals that 84% of organizations expect that in the next three to five years, AI agents will collaborate to handle one or more complete business processes in manufacturing/operations.

Percentage of organizations who agree with the statement: "In the next 3-5 years, AI agents will collaborate to handle one or more complete business processes in my business function"[2]



[2]https://www.capgemini.com/insights/research-library/generative-ai-in-organizations-2025/

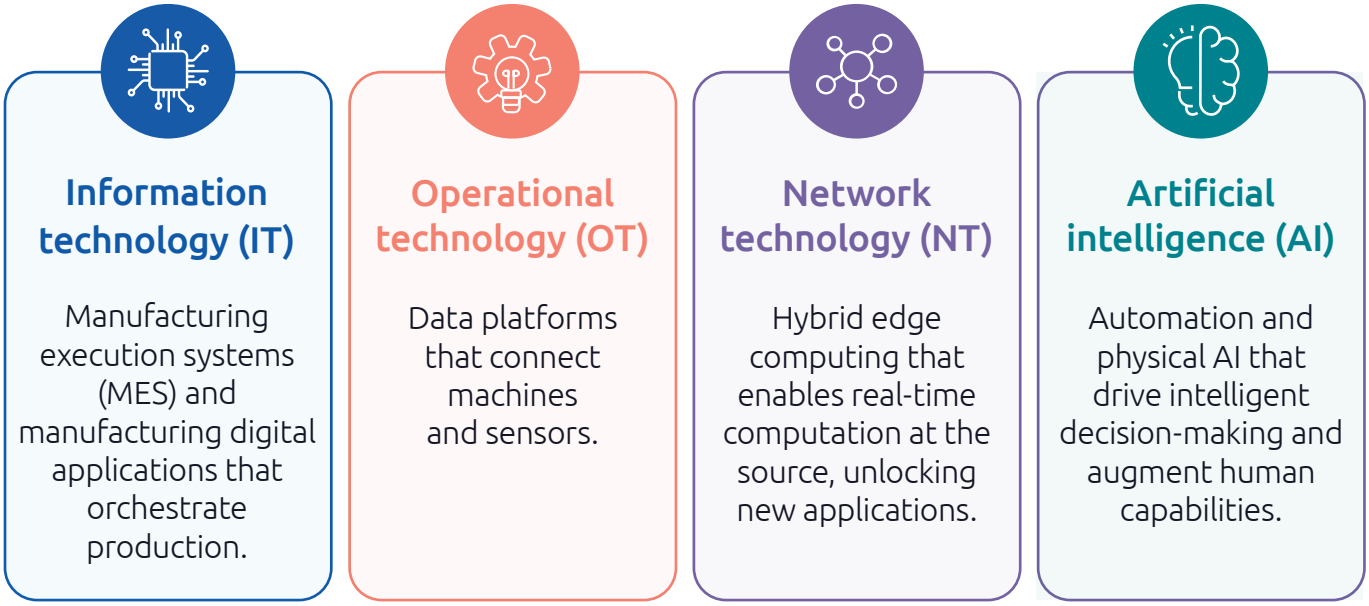
We share this expectation. In Capgemini's view[3], AI – including emerging forms such as agentic AI – can help to address many of the automotive industry's hardest manufacturing challenges.

This is a fast-moving area which needs careful tracking. For example, liquid neural networks (LNNs) are a promising area of innovation. LNNs are easy to train, use fewer computing resources than large language models, and produce accurate, explainable results.

By bringing AI to physical systems – robots, machines, support processes – manufacturers can significantly increase the performance and adaptability of those processes, improving efficiency and agility.

Hyperconnectivity

To bring together the physical and digital worlds, as required for hyperautomation, it is necessary to ensure full connectivity across all the different types of data and assets:



An intelligent edge-to-cloud platform, combining data and information from all sources, allows the deployment at scale of applications where machines work together to drive real-time decisions and continuous improvement.

By ensuring connectivity through the full spectrum of computing from edge to cloud, automakers can take full advantage of the benefits of both approaches. These benefits include real-time execution, data security, an isolated mode of operations with very limited traffic to the cloud for the edge approach, and computing power and visibility from the cloud.

[3]https://www.capgemini.com/insights/expert-perspectives/what-are-liquid-neural-networks-and-why-should-you-care/

Digital twins

Building a model of a production facility, and continuously updating it with real-time data, opens up a whole range of possibilities.

For example:

Process optimization:

With digital twins, it is easy to model the effects of a proposed change before making that change in the factory, or to compare the effects of different proposed changes to find out which is most effective. This makes process optimization less risky and more cost-effective.

Facilitating human-machine collaboration:

Digital twins make it clear how assets work, and provide a framework for pooling of information. This paves the way for joint working between humans and machines.

Safeguarding processes against disruption:

Automakers can simulate the effect of different disruptions on manufacturing processes and assess the costs and benefits of different preemptive measures.

Validation:

Digital twins are increasingly being used to validate solutions such as robotic cells prior to deployment.

Data management:

Digital twins should be an integral part of the data foundation, bringing together data from multiple sources into a single integrated, authoritative, and easily understood view. This data view can be used by both humans and AI to drive informed decisions.

Implemented appropriately, a digital twin can be a strategic enabler of transformation. Capgemini has deployed “enterprise digital twins” that provide clients with total visibility of a company’s operations.

4.

Create and leverage a collaborative partner ecosystem

The transformation of manufacturing is far too big a task for any one company to undertake. Automakers must embrace ecosystem working, forging links with organizations that can accelerate transformation safely and securely.

While this may sound easier said than done, the right choice of strategic partner can greatly facilitate the process, not least because the partner should be willing to share its own ecosystem.

Selection of the partner ecosystem is a key aspect of rethinking the manufacturing system. The automaker must identify which capabilities and assets are present within the company and which must be obtained outside. The Core-Context framework[4] referred to earlier is an invaluable tool for defining which partners are needed according to the status of a process.

[4]https://www.capgemini.com/insights/research-library/the-engineering-leaders-innovation-mandate/

Why work with Capgemini on intelligent manufacturing?

Capgemini is ready to help you "make it real" by getting your transformation program back on track. We understand your industry and the change that it needs. Our accelerators can make it happen at the right pace.

It is not just that we have the skills, assets, capabilities, and global reach to help you implement intelligent manufacturing. We can also provide you with the partners you need to incorporate into your ecosystem, because we already partner with them. For example:

SIEMENS

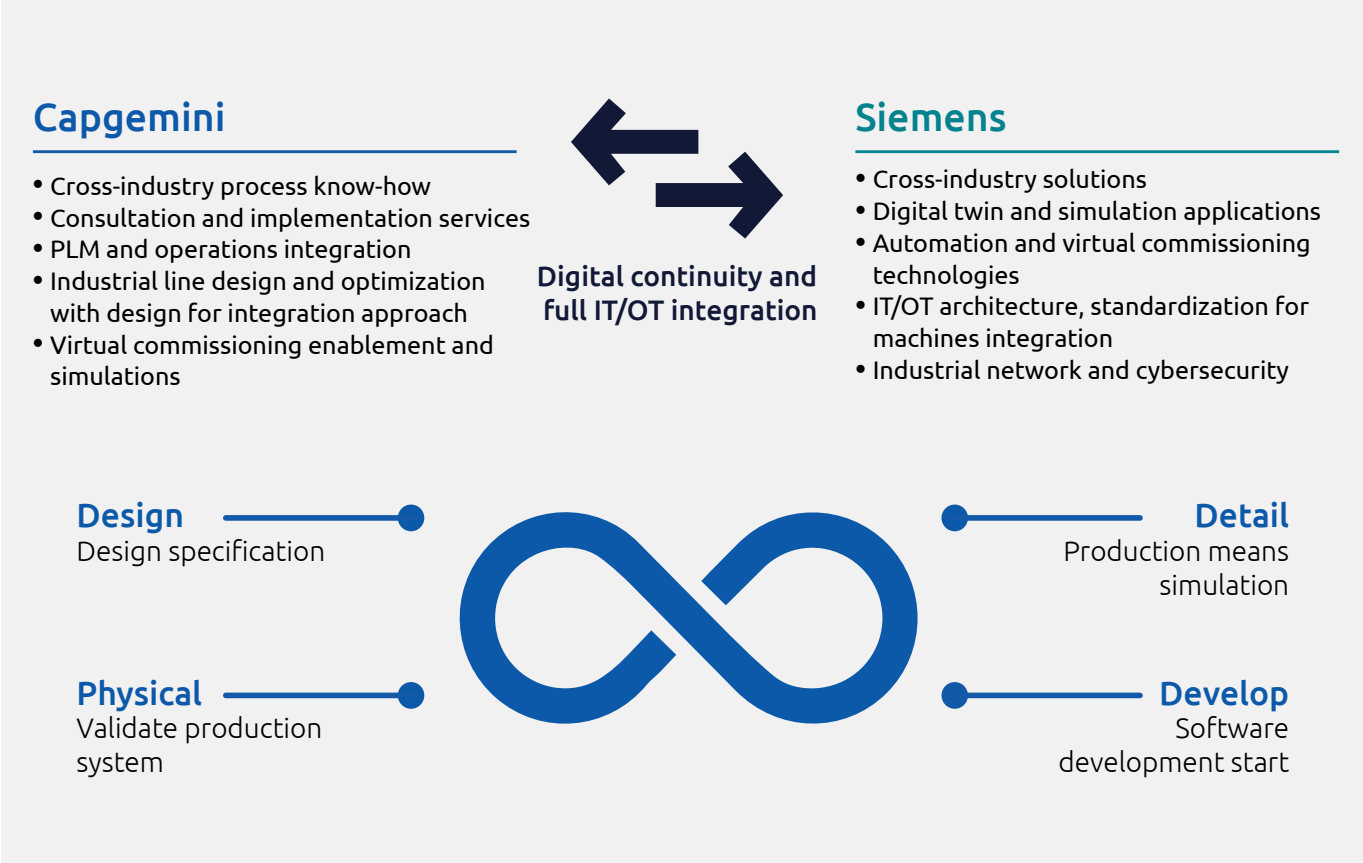
Our partnership is designed to empower industries for the next era of manufacturing. Together, we will provide comprehensive AI-native assets for product engineering, manufacturing, and operations. This will enable automakers to bridge the gap between the business promise of technology and industrial reality, becoming more flexible, scalable, resilient, and sustainable.

databricks

This partnership focuses on manufacturing data management. We use Databricks' Unity Catalog to simplify the task of data management and enhance security across data and AI assets. It ensures consistent data governance and compliance, making it easier to manage and secure your data.

A recent addition to this longstanding relationship is our sovereign technology partnership, designed to enable European organizations to innovate securely and independently, with the control needed to protect sensitive data and critical operations.

The following figure summarizes a current collaboration with our partner Siemens.



Our many other partners include all the major hyperscalers, as well as data players and data consortia such as Catena-X.

Our flagship offer, Intelligent Manufacturing Services for Automotive by Capgemini, positions OEMs and tier 1 suppliers to achieve Industry 5.0 readiness. With it, clients are already integrating engineering, manufacturing, and supply chain for agility, resilience, and sustainability.

Work with us on manufacturing transformation, and suddenly the mountain that needs to be climbed will look less high.

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About Capgemini

Capgemini is an AI-powered global business and technology transformation partner, delivering tangible business value. We imagine the future of organizations and make it real with AI, technology and people. With our strong heritage of nearly 60 years, we are a responsible and diverse group of 420,000 team members in more than 50 countries. We deliver end-to-end services and solutions with our deep industry expertise and strong partner ecosystem, leveraging our capabilities across strategy, technology, design, engineering and business operations. The Group reported 2024 global revenues of €22.1 billion.

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