The future of AI

Part of our Series “AI in the manufacturing industry”

Episode 5

pwc

OMC
OPEN MANUFACTURING CAMPUS

The series

Welcome to our series on the impact of artificial intelligence (AI) on the manufacturing landscape in Flanders and North Brabant, a joint project by PwC and the Open Manufacturing Campus (OMC). Our goal's to provide a comprehensive understanding of how AI's reshaping manufacturing and how it helps manufacturing companies improve their performance, innovation and sustainability, based on real-world use cases from different sectors and regions. We also share our insights and experiences on how to implement AI solutions successfully, addressing the technical, organisational and ethical challenges involved. Each whitepaper delves into a specific aspect of AI to help you gain valuable knowledge and actionable takeaways.
Throughout the series, our "AI in a nutshell" reference sheet provides the reader with an explanation on terminology and some fast facts.

This episode

This episode first explores the future of AI in manufacturing by looking at how the technology's expected to advance and how developments may impact the manufacturing environment.

In it, we address the practicalities of how to get started with AI by providing insights into prioritising use cases and what to watch out for. We also talk with Exion Hydrogen about its adoption of AI.

The future of AI

Before diving into the pragmatics on integrating AI into your operations, let's look at what to expect from AI in the future. Where does the technology go from here and how will it further impact operations?

Advancements in AI technologies

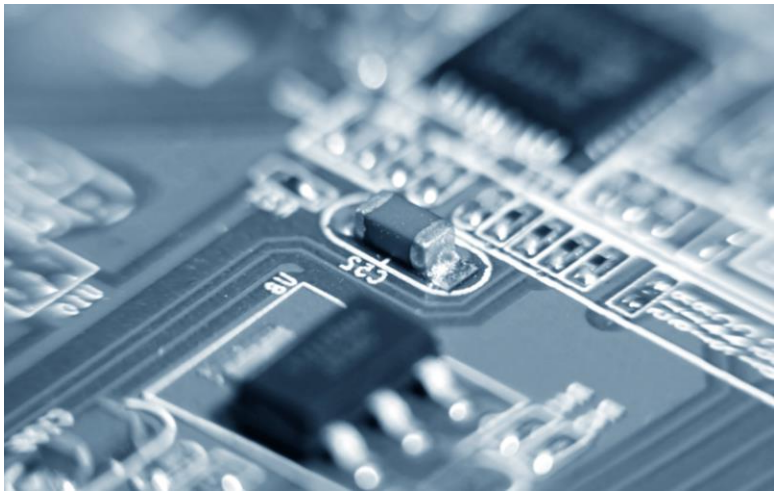
Recent advancements in AI have already reshaped the manufacturing landscape. Technologies like Natural Language Processing (NLP) and generative AI (GenAI) have allowed computers to understand human language and to create new content based on input received. These advancements have enabled various new use cases for AI in manufacturing, as discussed in our second whitepaper in this series. However, new advancements promise even greater transformations.

Unlike NLP and GenAI, which focus on language understanding and content creation, **Agentic AI** is focused on achieving specific goals. Agentic AI understands the context, autonomously makes decisions within specific parameters and executes actions. It represents an advancement in manufacturing by embedding decision making directly into machinery. For instance, it can enhance predictive maintenance systems by anticipating equipment failures (understanding the context) and scheduling repairs during planned downtime (deciding and executing), thus optimising operational efficiency and minimising costly disruptions. Agentic AI is in full development and use cases are emerging, so it won't be long until the effects ripple through to the manufacturing environment.

The ultimate goal of advancements in AI technology is to reach a stage of **Artificial General Intelligence (AGI)**. Today, this is still a theoretical concept. AGI means AI has the ability to understand, learn and apply intelligence across a broad range of tasks at a level comparable to human cognitive abilities. AGI would be capable of reasoning, problem solving and adapting to unforeseen circumstances across various domains. Unlike GenAI or Agentic AI, it wouldn't be restricted to specific tasks or domains and could autonomously pursue goals, learn new things and adapt to different environments. However, this technology is still very much in the research stage and hence far away from arriving on the shopfloor.

Dark/Lights-out factories

Lights out factories are manufacturing facilities that operate fully autonomously without human intervention, typically in complete darkness as no human presence is required. AI plays a critical role in realising this vision by enhancing robotic capabilities and enabling autonomous decision making. Furthermore, AI's ability to integrate with IoT (internet of things) devices allows for real-time monitoring and adjustments. As AI technology advances, the efficiency and reliability of lights-out factories will increase, making them a viable solution for the future of manufacturing. .



Skill shifts concerning labour shortages

The integration of AI and automation in the manufacturing industry is creating a shift in resource demand. On the one hand, there's an increasing need for workers skilled in AI oversight and maintenance, as well as complementary roles that require human creativity and problem solving. As highlighted in the previous whitepaper, organisations must invest in a comprehensive workforce strategy to address labour shortages in tech-savvy roles and secure a smooth transition. On the other hand, AI could serve as a critical solution to Europe's labour shortage, particularly in blue-collar industries. By automating repetitive and physically demanding tasks, AI can help sustain economic growth while allowing human workers to focus on higher-value roles. Managing this shift in labour requirements will become even more pressing as AI technology advances.

Business reinvention

According to PwC's 28th Annual Global CEO Survey, 53% of Belgian CEOs believe their companies won't be viable beyond the next decade without reinvention. As highlighted in our second whitepaper, AI can be a key driver of business reinvention. Today, we already see this in how AI enables mass customisation without sacrificing efficiency and in how AI facilitates a "Product-as-a-Service" (PaaS) model, providing continuous support and maintenance that generates steady revenue streams. As AI capabilities advance, manufacturers will spot more and more opportunities to disrupt their offerings and reinvent the way they do business.

Increasing efficiency and accessibility of AI systems

A final trend is the increase in efficiency and accessibility in both hardware and software. As AI techniques continue to develop, such advancements are making these technologies more feasible for a broader range of applications. A prime example is DeepSeek, which showcases how innovative techniques are reducing the energy intensity involved in training AI models.

For many applications, particularly those involving language models, the primary costs are not in model training, but in inferencing – the process of using the trained model to deliver responses or perform tasks. This is where Small Language Models (SLMs) demonstrate their value. SLMs are optimised for specific tasks, allowing them to run efficiently on local, modest hardware, such as Raspberry Pi or Arduino. Unlike general-purpose models like GPT-4 or Claude, SLMs are fine-tuned to excel in singular tasks, making them highly effective for industry-specific applications.

As hardware and software continue to advance in efficiency, we expect AI to become more accessible and impactful across the industry.

How to get started

Whether AI evolves at its current pace, with the potential to reshape industries, or whether we see a slowdown where manufacturers focus solely on selected high-value use cases, the topic remains strategic and should be on the agenda of every CEO in the manufacturing world. While the hype around AI is likely to cool down somewhat in the future, the urgency for companies to do something with this technology remains undiminished.

Strategic alignment

Recent advancements in AI have already Getting started with AI requires consideration of both long- and short-term goals. In the long term, you should consider how you'll incorporate AI into your organisation's strategy. Remember, current AI tools are simply that: Tools. They allow you to fulfil a specific business need. But AI has the potential to be a transformative or even disruptive technology. Following in the footsteps of the printing press, electricity, transistors and the internet, AI can reinvent business processes and redefine business models. As a business leader, you need to take a stance: How will this technology reshape your industry? Do you want to be a leader or a follower in its adoption? The answer to that question and the reasons why will be unique to every organisation. Having this long-term vision and translating it into a clear strategic framework will allow you to make better tactical decisions in the short term. Additionally, translating this strategic framework into a case for change for each individual project is crucial in your change management approach. More on that in our previous whitepaper.

If you don't already have a good understanding of how AI can improve your processes, start by identifying pain points in your operations and assessing how AI can:

- Make them more efficient
- Deliver higher-quality output
- Enable greater customisation.

Define a few pilot projects to test your assumptions against your long-term vision, to ensure strategic alignment. Choose your pilots well, considering short-term impact and technical feasibility. You might also identify some low-hanging fruit to fast track production.

[CTA: PwC GenAI Inspiration Session - Get inspired by GenAI use cases from your own industry and others]

If you're tackling a specific problem to address a particular short-term need, chances are the biggest return on investment (ROI) comes from not using AI at all. Implementing AI comes with its own set of challenges, from infrastructure to governance, so the first question to challenge your AI use case should be: Can we do this simpler, using traditional automation solutions?

Prioritising AI use cases

When prioritising your use cases or evaluating a proof of concept (PoC), make sure not to judge use cases only by their ability to wow people. Incorporate evaluation criteria to determine how well the case will work at scale and how easily you can industrialise the solution from both a technical and cultural viewpoint.

Evaluation criteria	Bad	Acceptable	Good
Data availability	Limited or insufficient data	Adequate data, room for enhancement	High-quality, ample data
ROI potential	Ambiguous or marginal	Potential but uncertain	Clear and demonstrable
Strategic alignment	No clear alignment or conflict	Partial alignment, potential exploration	Direct alignment with goals
Scalability	Not scalable or highly situational	Scalable with modifications	Easily scalable across operations
Expertise and resources	Lacking necessary skills entirely	Expertise can be developed or outsourced	In-house expertise available
Cultural adoption	Significant resistance to change	Mixed views, needs change management	Culture supportive of innovation

Based on these criteria, here's how we classify use cases:

- **Green Zone:** Scoring 'good' on at least four out of six criteria. High potential value and feasibility.
  Strategic alignment and clear ROI, such as predictive maintenance or quality control.
- **Red Zone:** Scoring 'bad' on three or more criteria. High risk or complexity with low impact. Issues may include limited data availability or significant cultural resistance.
- **Gray Zone:** Use cases that don't score predominantly good or bad, but are often on the threshold of what's acceptable. These are cases that require further exploration. They may have some strategic alignment or partial data availability and could be promising, but need extra validation before commitment.

While these criteria hold true for any technological change, AI comes with its own pitfalls which you should plan for in advance:

- **Predictability:** Getting reproducible results is essential in manufacturing processes, but traditionally hard for AI systems. They require guardrails and evaluations to secure qualitative and predictable in- and outputs.
- **Performance:** Left untouched, AI systems will see performance degradation over time. Tackling this requires a regular feed of new data points to retrain the system.
- **Trust:** Every change requires change management, but with AI systems it's also a matter of building trust through transparency, thinking about the 'human in the loop' and gaining a foundational understanding of the capabilities and limitations of such systems.

Call to action: Accelerating innovation via 'Sprints'

Breaking the data paradox with synthetic data

You may find that you're collecting an abundance of data in one area, produced by many different systems, and that real signals are being buried in the noise. Or, you may find that data points are scarce. Bringing together data with high enough volume and quality to power your AI systems can be a challenge. It requires a large upfront investment in data infrastructure without any certainty of a return, which is often enough to stop any pilot project dead in its tracks before it even kicks off.

Synthetic data can fill the gaps by providing large volumes of simulated data, making sure that AI systems have sufficient material to learn from without the need for an extensive and potentially expensive data infrastructure. Synthetic data can accelerate the development and testing of AI systems during their PoC phase, where rapid iteration is necessary to demonstrate value and feasibility.

Using synthetic data has other advantages in a manufacturing context too:

1. **Data privacy and security:** As synthetic data doesn't correspond to real individuals or entities, it mitigates privacy and security concerns, allowing organisations to share and collaborate without risking sensitive information leakage.
2. **Scenario testing:** Synthetic data can be used to simulate rare or extreme conditions that might be difficult to observe in real-world data, thus enhancing the robustness of AI models against various operational scenarios.

Your AI action plan

Here are four no-regret moves you can start with today.

1. **Reflect on your long-term vision for AI** Imagine an automated future where AI's deeply ingrained in every facet of your manufacturing process, driving innovation, efficiency and customisation to unprecedented heights. How will you use the transformative potential of AI to pivot your company toward this future?
2. **Identify current pain points that AI could help address:** Manufacturing faces pain points like inefficient resource allocation, inconsistent quality control and rigid production processes. AI offers a promising solution to these issues, enabling smart systems to optimise operations, predict maintenance needs and adapt to market demands with agility. Identify the areas in your organisation where AI systems can have the biggest impact.
3. **Prioritise your use cases based on impact and feasibility:** Focus on initiatives that promise significant ROI and align well with your strategic objectives and available resources. Start by deploying AI for high-priority solutions, such as predictive maintenance, which not only offers a significant impact, but is also practical to implement with existing technology.
4. **Start small, scale fast:** Begin with small, achievable AI projects that pave the way for rapid scalability. Learning from initial trials and quickly iterating them will make sure that AI solutions are well-integrated and scalable across your operations, enabling your company to scale fast while minimising risk.

Once you've achieved some successful use cases, connecting them across your system landscape (such as ERP systems) can elevate the potential of AI even further. At this phase, collaborating with the ecosystem of AI players (as highlighted in our third whitepaper) will be even more crucial.

Cases

To close off our series on AI in Manufacturing, we had an insightful discussion with Exion Hydrogen about its experience with AI adoption. How does it leverage AI and what challenges did it run into?

Tell us more about Exion Hydrogen.

At Exion Hydrogen, we're dedicated to producing reliable water electrolysers for hydrogen production. Our research and development (R&D) and business development activities are based at the OMC campus in Turnhout and our production operations are located in Poland.

What motivated Exion Hydrogen to explore AI?

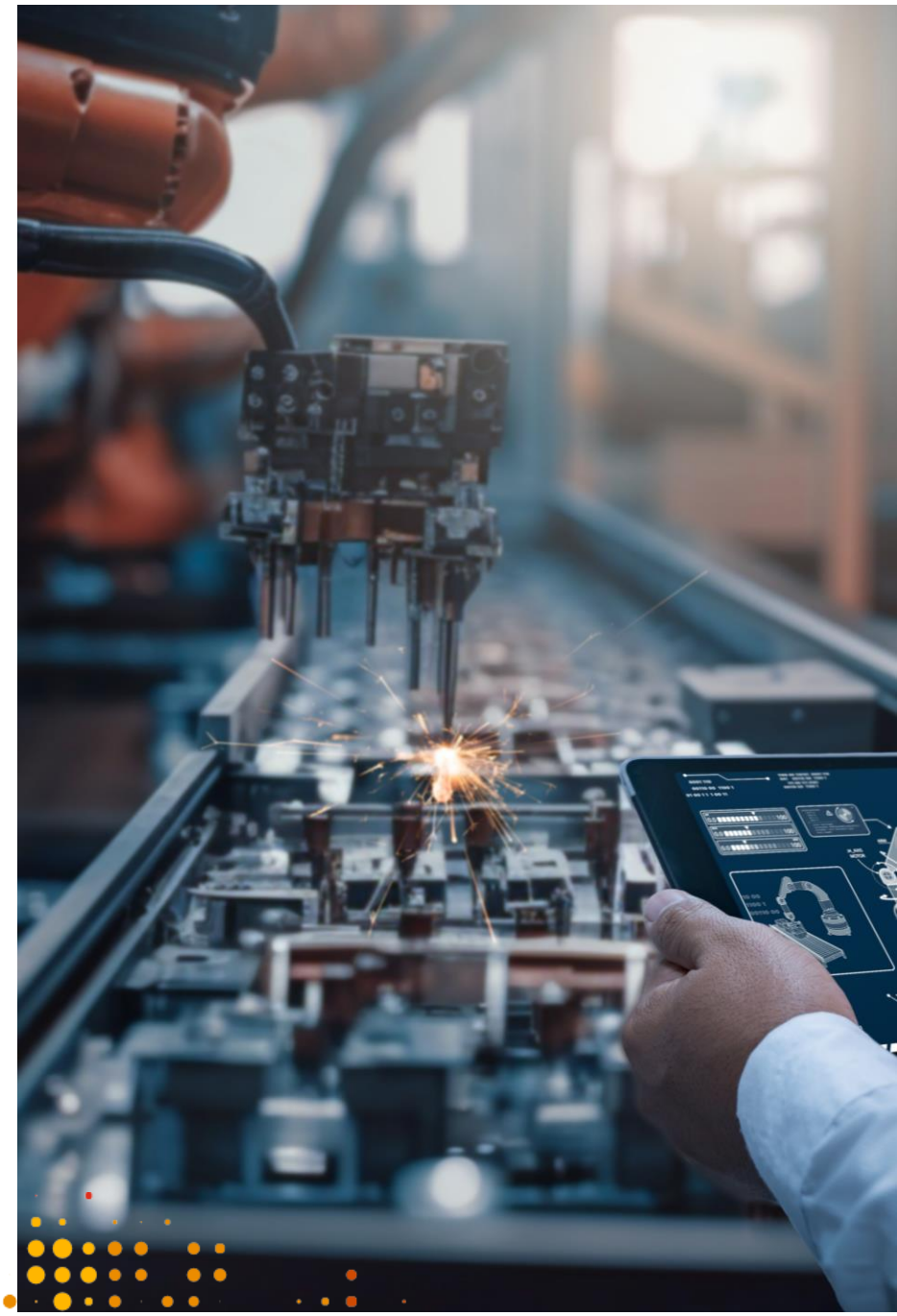
As a small company, we can't afford to be early adopters in areas outside our specialisation in electrolysers. However, we understand that AI's becoming essential, and we want to make sure that we're riding the wave rather than being left behind. We see the potential it can bring to our day-to-day work.

In what areas are you already capturing this potential?

First, we have a company account for ChatGPT, which we use for various purposes (e.g. overcoming writer's block in marketing activities, translation of code from R to Python and creation of Mermaid syntax for first drafts of process flows). Additionally, we're exploring its use in generating mechanical drawings and developing a chatbot for our knowledge base. Beyond ChatGPT, we use classical AI for the categorisation of event logs.

You already have some nice use cases. What challenges are you facing in expanding your AI usage beyond these areas?

Navigating the overwhelming ecosystem of AI providers and identifying trustworthy partners and durable tools is challenging given the fast-changing landscape. We don't have the scale to dedicate employees to exploring AI implementations, so use cases are mainly driven by individual needs. Today, identifying use cases in a structured manner is difficult and we're still learning how to effectively integrate AI into our core activities.



The technology's advancing fast. Which advancements are you looking forward to for future use?

We see a lot of potential in using AI for drafting piping and instrumentation diagrams (P&IDs) and electrical schemes. So far, the technology isn't mature enough, but we see many companies working on this. A good solution would be of great value to us. We also see opportunities in the cleaning and organising of unstructured data, in first-line customer support and in securing consistency across documents. As AI tools continue to improve, we hope to expand their usage within the organisation.

Sounds promising! Any lessons learned you'll be taking on that journey?

The experiences we've had so far have taught us several lessons that we'll leverage in the future:

- **Balancing AI with critical thinking:** With ChatGPT, we experienced how difficult it is to assess the trustworthiness of an output. There's no body language to assess the confidence of our conversation partner. Hence, critical thinking's key in handling the outputs of an AI tool.
- **AI doesn't solve all:** The more complex a request to a language learning model (LLM), the more time's needed to finetune the prompt and clean and adjust the output. There are times when we spend more time on completing a task with the aid of ChatGPT than we would've with the traditional way of working.
- **Resource requirement:** Just like any other technology implementation, structured AI implementation requires time and resources. For now, we're mostly waiting to see which tools come out on top and are worth investing in. Until then, we're focusing on our main mission: To create a new generation of safe, reliable and scalable on-site hydrogen solutions.

Closing

In conclusion, the future of AI in manufacturing has the potential to have an immense impact. From the realisation of fully autonomous lights-out factories to driving significant shifts in labour requirements. But this requires business reinvention and the increased efficiency and accessibility of AI systems. For manufacturers looking to get started with AI, it's crucial to align strategic goals with practical use cases, prioritise based on impact and feasibility and start with small, scalable projects. The journey of AI adoption, as shared by Exion Hydrogen, highlights both the opportunities and challenges faced by companies in integrating AI into their operations.

Vincent Schollaart

Industrial Manufacturing Lead and Director at PwC Belgium

Geert Krekel

Business Development Manager of OMC

Michiel De Keyzer

Director Technology Consulting and GenAI expert at PwC Belgium