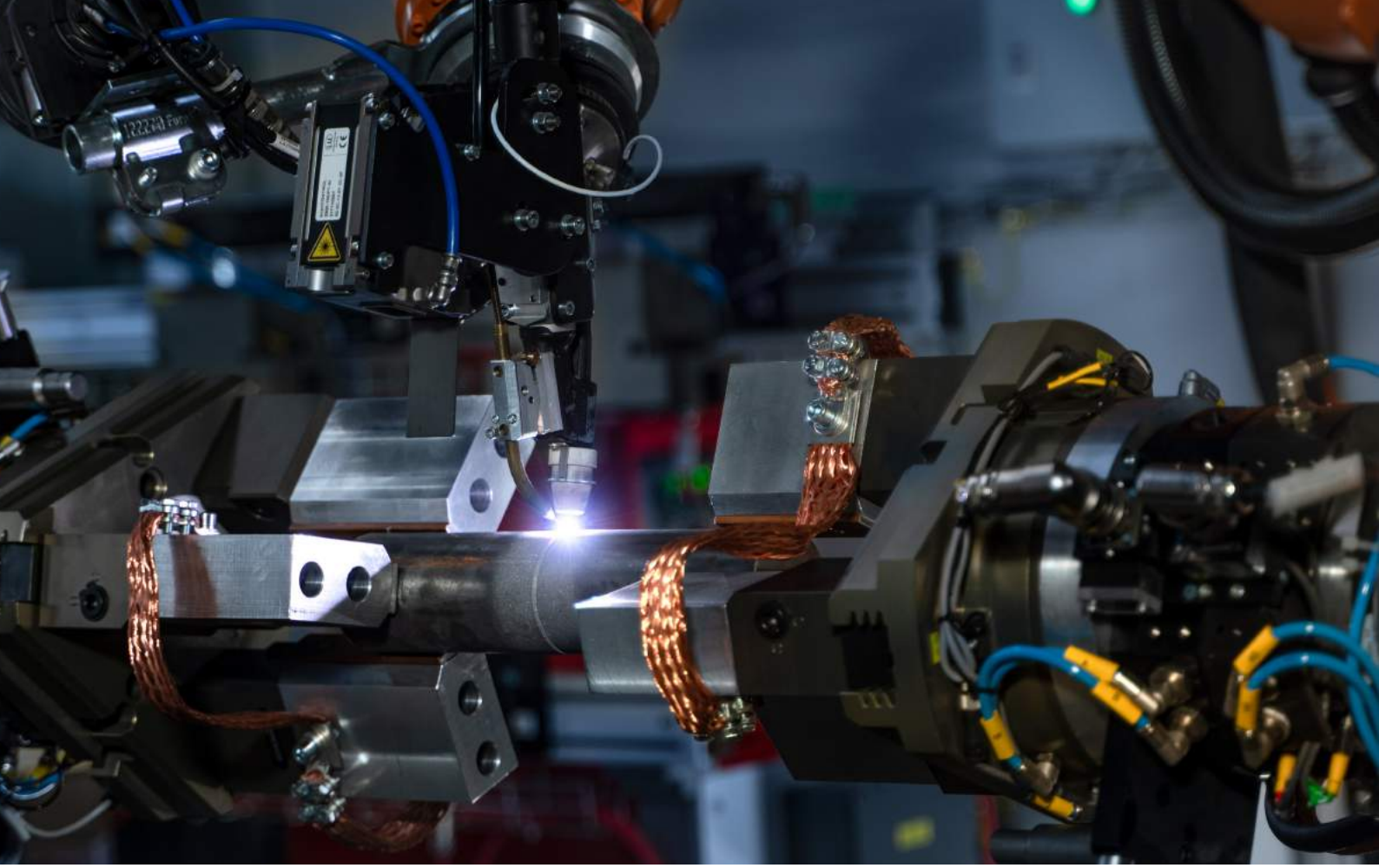
ML6

WHITEPAPER

AI in Manufacturing

Five industry use cases and the challenges manufacturers are facing today



Introduction

Today's markets are changing, as we've seen a catalyst in the number of artificial intelligence projects in the manufacturing industry, a global transformation is underway to empower manufacturing with AI. The manufacturing sector has high hopes for AI as it will be a pivotal technology to drive growth and innovation in the sector.

This white paper focuses on providing insights into the most attractive use cases and solutions that artificial intelligence can offer within manufacturing and production processes.

AI in manufacturing use cases

USE CASE 1

Quality control

To ensure consistent output/throughput without sacrificing the quality of the product, fast and reliable quality inspections are needed. Artificial intelligence proves to be a very powerful tool in the execution of those. In any production process, the product must meet certain quality standards. In order to guarantee this quality, checks are needed during the process and/or at the end of the process. Nowadays, we notice that this is still often done manually by people, by eye or by a manual action.

Artificial intelligence, specifically a computer vision solution either on static images or on often fast moving video, can provide the means to remove these manual actions. These types of solutions increase the accuracy and speed of the inspection process, as well as offer the ability to evolve from a sample check to a full control of quality control during and/or at the end of the production process. At the same time it improves the job content of the workers by reducing or eliminating repetitive work.

USE CASE 2

Smart Machines : Production process steering

Smart or intelligent machines are becoming increasingly important in executing the existing production process, by actively steering the existing - often older - production machines. Training machine learning algorithms on computer vision techniques and/or data from sensors allows to build AI solutions which can determine whether the production process is running smoothly, and if not correcting the settings of the production hence complementing the operator function.
What is important during these processes is the realisation of a fully continuous process. For this reason, we always work with a fallback method, an alternative solution when the Ai solution fails or problems occur and the circuit is thus interrupted. Such a fallback option ensures that the production process is never interrupted and there is no loss of production, at the same time it also ensures the continuous feedback data collection to continue training the AI algorithms.

Automating the steering of production machines increases the efficiency, quality and flexibility in capacity.

USE CASE 3

Production process optimization

AI can also be used to understand existing processes and help find potential improvements.
By real-time monitoring, alerting, simulation of process characteristics and environment conditions using cameras & sensors, we build insights in the performance of the production and processes, and potential issues and root causes of issues. These insights can then be used to define and implement changes to the processes and/or the process execution. The ambitioned value of these process improvements include: increase yield and reduce raw material consumption, improve energy efficiency, and reduce waste & emission; as well as for example improve safety.

What we are trying to achieve while optimising the existing processes is that by better planning the processing of raw materials, water consumption, energy consumption and CO2 emissions, not only the cost efficiency is optimised but also the ESG factors - Environmental, Societal and Governance - the three central factors in measuring the sustainability of a company, are taken into account and positively assessed.

Learn how we optimised the wine bottling process of Accolade Wines here.

USE CASE 4

Dynamic production planning

Making planning decisions across multiple production lines can be a time-consuming and even a gut feeling based exercise In order to make maximum use of the available production capacity, it is essential to optimise the planning of the production lines , across product variants and different packaging variants, taking into account production process characteristics (and uncertainties in those), switching ties and costs, as well as demand forecasts. The implementation of an AI powered digital twin, allows to do visual and interactive scenario analysis and impact simulation,

It hence provides insights into which product or product variant should be scheduled on which production line and what the optimal duration of the production run should be; aiming for maximum relevant production within the existing product capacity.

The complexity in creating this kind of AI solutions lies in determining the relevant parameters (fixed or stochastic), and the best suited digital twin representation which allows for easy and flexible use.

USE CASE 5

Predictive maintenance

A well-known challenge within manufacturing is to keep machine downtime as low as possible, especially unplanned downtime due to breakdowns or urgent replacements. The goal is to limit these and preferably predict and plan them, so that the number of unpredictable incidents are reduced to almost zero and frequency and timing of planned maintenance is optimised. In addition, the machine or / component lifetime can be optimised and replacement decisions can be supported.

A key challenge in building Predictive Maintenance Machine Learning solutions is the identification of the root causes of failures, and the indicators of how to spot them. And that often in a context where there is limited historic fail data. Combining expert industry knowledge with machine learning based analysis of large datasets is key to tackling this challenge.

Once that is done, a ML model can be trained to detect early indications of potential issues, before they actually occur.

The challenges manufacturers are facing today when transforming with AI

Based on our extensive experience in the industry, we've identified five key challenges and common pitfalls manufacturers face when transforming their business with AI. Tackling these challenges is fundamental to bring AI solutions into production and generate substantial actual business value.

Using the AI solutions on the factory floor with fast response times.

Most AI projects are tightly coupled with the actual machinery (either for data collection or to actually steer machinery). The high speed at which manufacturing processes are executed creates challenging requirements on the acceptable latency of AI solutions when used in practice. This results in the need to run the solutions not only on the cloud but 'on edge', using local computing devices installed on the production machines. This means that typical AI projects in manufacturing are at the boundary between IT & OT and therefore requires a very wide skill set to implement successfully.

Data bootstrapping problem

AI projects require data to create and train models and to solve the problem at hand. With more data comes better models and results. Unfortunately at the start of the project there is typically not a lot of data available, resulting in less performant models and solutions. Specific care needs to be given on how to solve this constraint to get started while ensuring the collection of more data to realise more performant models. Depending on the problem a different strategy can be useful. One of the strategies can be to have some less data intensive fallbacks available that can take over from the model in situations where there is not enough data to train a performant model.

Knowledge distillation from personnel into the AI model.

It is critical to actively involve experts with solid insights in the characteristics and behaviour of the manufacturing processes in the development of the AI solution; to ensure a better speed in building working solutions, as well as to get to good accuracy. This expert involvement makes sure that the right trade-offs can be made and that the AI solution can build on top of the existing knowledge instead of trying to replicate it. Therefore it's important to allocate enough time for these experts and that there is a common language to facilitate discussions.

Keeping up to date with the State-Of-The-Art.

There is a fast pace of innovation in AI, meaning that what is currently State of the Art, might be outdated in a few months. The integration with machinery and the fact that the models are running on edge, limits the room for experimentation since there is typically not a lot of "test" production lines to test new models on. By investing in AI solutions, the goal is typically to also leverage these model improvements over time. Therefore it's important to have a strategy to allow for easy experimentation eg. by allowing experimentation on historic data in the cloud.

Continuous improvement and data drift.

AI systems are trained on data and the assumption that this historic data is a good representation of the future situation. However this assumption is typically not 100% correct and the system and thereby also the data might change over time, this is called data/model drift. It's important that the AI solution is able to pick up and flag these changes so that the models can be retrained on new representative data. Some example triggers for change: changes in actual products that are made in the production line or wear of the actual machinery that might affect the typical inputs of the AI system.

ML6 as your AI Partner

We work with our clients on the core of their business, the parts of their business/ activities that are crucial from them, that make them unique, and that they see as their engine of strategic positioning and value creation. Because that is where we believe our ML6 specialisation to build solutions tailored to the use case and the client has its best fit.

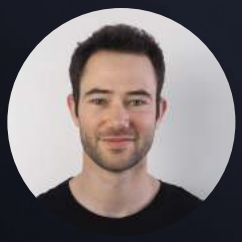
We actively work together with our clients to define how AI can play a role in that core and what value it can bring as a digital transformation tool.
Our way of working centres around our belief in innovating together with our clients, focusing on maximising knowledge transfer and client skill building - if they wish to do so.

By doing so, we actually intentionally avoid a vendor lock-in for our clients, and at the same time work together with them to see where we can play a valuable role for them.

Thank you for reading!

More information can be found on ml6.eu

Feel free to schedule a meeting with our industry expert, Arne to unlock business value for your project:



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