

Market Insight Report Reprint

Manufacturers forge the future with AI

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Once considered a laggard in AI adoption, the manufacturing sector has made significant headway in recent years. Expanding on our findings from 451 Research's Voice of the Enterprise: AI and Machine Learning Use Cases survey, this report takes a closer look at the growing role of AI in the manufacturing space.

451 Research

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Introduction

Once considered a laggard in AI adoption, the manufacturing sector has made significant headway in recent years. According to 451 Research's Voice of the Enterprise: AI & Machine Learning, Use Cases survey, 60% of manufacturing respondents have AI in production or proof of concept at their organization – an increase of 25% over the past two years. This surge in adoption has in part been accelerated by the pandemic, as organizations have invested in automation and computer vision technology to augment remote workers and maintain plant operations with fewer personnel on the floor. However, the ball started rolling long before COVID-19.

An underlying driver of this growth is a rise in enterprise awareness of the transformative potential that AI integration brings to a variety of manufacturing processes. Additionally, there's increasing availability of AI tools that are friendly to industry experts who lack a data science background or AI expertise. Vendors are also recognizing the potential in this space and are looking to capitalize on the developing market opportunity. In this report, we take a closer look at AI in the manufacturing sector, including findings from our most recent VotE: AI & Machine Learning, Use Cases survey.

THE 451 TAKE

Industries like manufacturing are slow to embrace change until the cost of stagnation exceeds the cost of innovation, and with the recent surge in adoption it seems we're finally beginning to reach that milestone. When the pandemic hit, manufacturers had to act quickly to maintain operations and preserve their bottom line. Despite past skepticism, AI integration has demonstrated immense value in addressing these concerns and is now seen as an investment for the future. According to our VotE: AI & Machine Learning, Use Cases survey, 87% of manufacturing respondents indicated that they have or will invest in new AI initiatives in response to COVID-19.

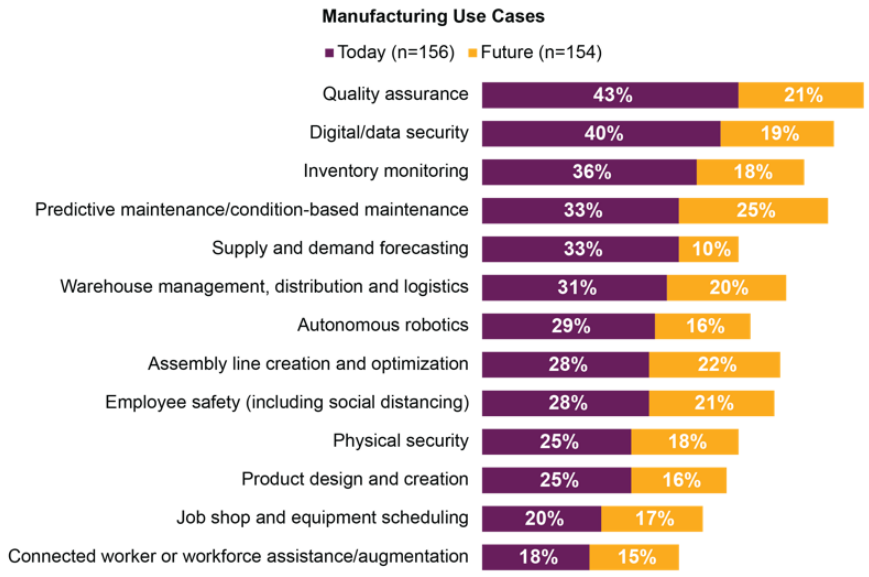
There are still some barriers to AI adoption, skill shortage being a big one. However, vendors are designing tools and platforms that target workers without AI expertise, so this will hopefully be less of a barrier as these tools become more readily available. With rigid real-time prediction needs, cloud-based AI is still not a primary deployment strategy in this sector, which means scaling can be complicated and costly – this is likely to remain a major hurdle. Despite these barriers, there is no doubt that AI will play a critical role in the manufacturing industry's future.

AI and ML applications across the manufacturing sector

There is opportunity for AI integration at every stage in the manufacturing process – be that planning a new product, monitoring the production line, or even helping with maintenance and equipment scheduling.

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AI and Machine Learning Use Cases in Manufacturing



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Q. Which of the following best describes your organization's machine learning use case(s)? Please select all that apply.
Q. And looking ahead, which of the following machine learning use cases that your organization has not yet deployed do you plan to in the next two years? Please select all that apply.
Base: Respondents in the healthcare or life sciences industries

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Source: 451 Research's Voice of the Enterprise: AI & Machine Learning, Use Cases

Use cases for AI in manufacturing are abundant (see above figure) and widely varied from one plant to another, but there are certain applications that stand out as being particularly popular across the industry:

Quality assurance: According to 451 Research data, 43% of respondents in the manufacturing space deploy AI for quality assurance (QA). This was the top use case in 2020 and remains so in 2021. QA is a critical part of the manufacturing process – not only for maintaining consistency in products, but also for catching defects and deficiencies that could have serious safety repercussions. Rigorous QA is particularly paramount in industries such as aerospace, automotive and medical that demand a high level of parts precision and have tight engineering tolerances. One of the primary benefits of using AI for QA is detecting faults sooner in the manufacturing process. The last thing a manufacturer wants is to find out there's an issue with a product once it's left the assembly line: AI can help boost proactive detection, reducing costs incurred from recalls and defective products. Data collected from cameras, equipment and sensors on the factory floor along with product specification data can be used to train an AI model that – once deployed in a video-recognition system – can detect faults with greater speed and accuracy than a human operator alone.

Digital security: Data from our VotE: Internet of Things, Workloads & Key Projects survey suggests that more than three-quarters of manufacturers have incorporated IoT technologies into their plant operations. For all of the benefits that IoT integration brings to the manufacturing sector (i.e., real-time data collection, boosting operational efficiency, enabling AI integration), it has also brought increased digital security risk. Digital security is a popular use case for AI across all markets, so it comes as no surprise that it has become a prevalent use case in manufacturing as well (40%), especially now that the sector is growing more connected. Cyberattacks on a manufacturing plant can result in leaking of customer data and trade secrets, a shutdown of the production line, or equipment sabotage. AI systems can be trained to monitor for many types of digital security issues and save time on 'false alarms' by distinguishing between benign activities and genuine threats. A significant portion of manufacturing respondents that identify this as a major use case occupy IT roles within their organization (46%) where digital security concerns are more proximate – digital security is still a concern to those in non-IT roles (27%), but it takes a back seat to day-to-day business and operating tasks such as warehouse management (35%) and inventory monitoring (35%).

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Predictive maintenance: Predictive maintenance is another common use case for AI in the manufacturing space, and according to our data, is the fastest-growing use case over the next two years. Predictive maintenance is the tracking and monitoring of equipment condition to identify issues early on and predict equipment failure. By doing this, manufacturers can either schedule maintenance to correct issues ahead of time – extending the equipment's functional life – or order a replacement before it fails to minimize downtime. Similar to how it operates in quality assurance, AI can assist in this process as well. Models trained on historic and real-time equipment data can optimize maintenance schedules, detecting failures sooner and reducing costs from unnecessary maintenance. Failures in industrial scenarios can often occur by having a complex series of processes go wrong, rather than one thing breaking. Catching the effect that one failed process could have on a machine – and later down the manufacturing line – has the potential to prevent a complete shutdown, and leads to massive cost savings.

Opposition and barriers

The rise of automation in manufacturing – part of the ongoing technology wave known as industry 4.0 – has brought numerous benefits to the market, among them reduced labor costs, higher production rates and improved worker safety. Despite these benefits, there is still some opposition to automation and AI adoption in this sector, that being fear of the displaced worker. AI is intended to augment human workers, in some cases stepping in if a task is dangerous or repetitive. Rather than displace them, this enables workers to focus on more complex tasks, which is even more essential now with many experts retiring and few young workers stepping in to fill the gap.

Data from the US Bureau of Labor statistics in May shows current job openings in the manufacturing sector are at their highest level in more than 20 years. Human feedback and expertise is critical to the model-training process. Even after training, there is still need for oversight and approval. AI predictions aren't prefect – it's ultimately up to the human operator to interpret AI outputs and decide the best course of action. AI won't be replacing years of tribal knowledge anytime soon.

According to 451 Research data, although 59% of enterprises in the manufacturing space deploy cloud-based AI tools in some capacity, only 38% choose it as their primary AI strategy – less than any other industry. Historically, there has been a lack of trust around putting data in the cloud, but even as that eases up, there are some technical limitations – certain manufacturing processes like QA require precise real-time predictions, and even the smallest delay or connectivity issue when sending data to endpoint devices makes this unattainable.

These types of applications – which make up the bulk of use cases in manufacturing – necessitate local AI deployment, often on edge equipment and devices. One in five manufacturers identify scalability as a major barrier to AI adoption – a barrier that can largely be addressed via cloud deployment. However, the reliance on local and embedded AI means that manufacturers miss out on many of the benefits that cloud AI brings.

At 28%, skill shortage remains a primary barrier to AI adoption in the manufacturing sector (the second highest), but this is significantly lower than in years past. This could suggest that manufacturing organizations are more readily hiring or training workers with AI expertise, but data scientists are still in short supply and hiring new workers can be costly. A more likely scenario is that AI tools are becoming easier to use by those without data science skills, therefore lowering the 'skill' barrier to entry. Vendors are creating low-code/no-code AI tools and adding explainability features that make their platforms more accessible to nontechnical users. There has been a push recently toward tools that allow engineers (not the software variety) to deploy the simulation tools with which they are familiar to build and train models by breaking down complex process into constituent parts and using them to guide the AI-driven application, although it's early days in that space.

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Vendors targeting manufacturing

For some time, vendors have been tailoring their AI tools and products to specific industry demands. While the technology itself may be omni-purpose, the algorithms are not. A model trained on medical terminology that's invaluable to a healthcare provider would be mostly useless to an automotive manufacturer. So, with demand for AI integration picking up in the manufacturing space, vendors are increasingly targeting this vertical.

Naturally, many of the major cloud providers already have their skin in the game. At AWS's annual re:Invent in 2020, the company announced several industrial machine learning use cases. Among them are Lookout for Vision, which uses computer vision for fault detection, and Amazon Monitron, which uses a sensor to collect equipment data for predictive maintenance.

Microsoft Azure is well established in the manufacturing segment and has partnerships with vendors such as BlueYonder, PTC, ABB and SAP. It is also pushing into the autonomous systems space – a key part of the pursuit of so-called industry 4.0. Such systems don't start out being autonomous, of course – they need to be trained by human experts, which is where the aforementioned tools for manufacturing engineers to use come in.

Recently, Google Cloud has gotten more involved in the manufacturing sector. In April, the company announced a partnership with industrial manufacturer Siemens that will integrate Google Cloud's AI technology with Siemens' industrial automation portfolio. Google Cloud has been somewhat absent in this market compared with other cloud suppliers like AWS and Microsoft Azure, but this partnership opens a lot of doors for the provider, and presents an opportunity for Siemens to enhance its MindSphere platform, particularly its efforts to develop a full-circle digital twin.

There's a raft of smaller AI vendors that focus on the manufacturing sector either predominantly or as one of their two or three key target industries. Many deploy computer vision for workplace safety, visual inspection for anomalies in production lines, and other use cases. Companies like Chooch AI, Drishti and Noodle.ai are in this category. Meanwhile, other firms such as DarwinAI, DataProphet and Secondmind have manufacturing in their sights for other forms of AI-driven analytics. C3.ai, which went public in November, is going hard after the manufacturing space, notably with its predictive maintenance application.

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