

Artificial intelligence (AI) in the manufacturing industry

- Artificial intelligence (AI) will prove transformative in the manufacturing industry, across a very broad range of functions.
- Some implementation aspects are more straightforward than others, and we know that human factors must be carefully considered.
- The research team of Professor Dr-Ing. habil. Sascha Stowasser at the Institute for Applied Industrial Engineering and Ergonomics (ifaa) in Germany is evaluating progress, with a view to learning how advice may be offered.

Artificial intelligence (AI) is here. Its benefits seem limitless, helping us to be more effective in every aspect of our lives and work. So, how do we plan to optimise the use of AI in critical areas? Manufacturing underpins the developed world, and we need to ensure AI plays a central role in its advancement. We should harness AI applications in manufacturing to maximise both business advantages and employee benefits. AI can significantly improve manufacturing functions like process automation, robotics, scheduling, and quality control. And it is an industry with a wide range of human involvements, thus requiring very careful consideration for employee engagement and technology interaction.

Professor Dr-Ing. habil. Sascha Stowasser and his team of 40 researchers at the Institute for Applied Industrial Engineering and Ergonomics (ifaa) in Germany are studying the implementation of AI in manufacturing. Their research aims to further develop labour science approaches to support companies with their challenges. The current challenges include the introduction of AI-supported systems in the context of quality management and knowledge management. The important aspects of human-centred work design are the key focus for a range of applications.

Big opportunities – some examples

AI excels at visual object and feature recognition and interpretation (fully self-driving cars are almost here!). Manufacturing can produce components with visual defects, thus having AI run the 'first pass' at spotting these is advantageous. Soon, we may see most companies using this to enhance quality management. But one of the remarkable features of AI is its ability to identify correlations, learn patterns, and see connections that the human brain can't.

AI could learn about the complex processes in a manufacturing environment to produce novel insights and innovations; intelligent process automation will be transformative in terms of throughput, efficiency, and safety. Equally, large amounts of data may be processed so that AI not only predicts potential machine failures but

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can ensure the necessary maintenance is scheduled optimally. And the important role of robots could be extended if sensors – such as those for sight, touch, and audio – were used to help robots learn through human imitation for tasks that are excessively repetitive, complex, or dangerous.

Scheduling personnel duties and shifts efficiently can be challenging for management. Applying AI here will lead to smart use of human resources and could

assist with personnel buy-in. Likewise, AI could identify opportunities for knowledge management in humans and generate effective pathways for the development of skills and expertise.

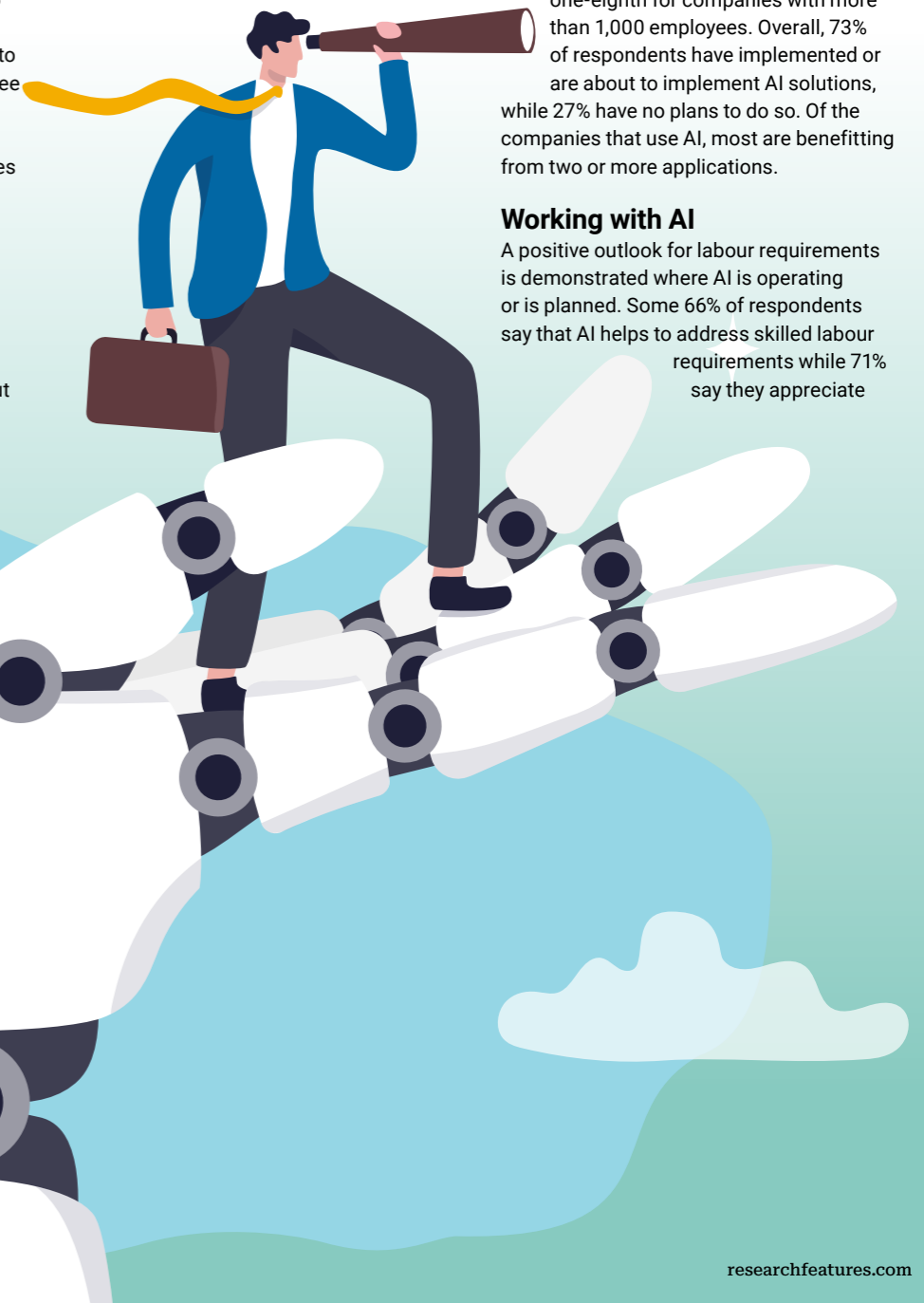
The implementation outlook

The team surveyed a range of manufacturing businesses to help understand the benefits and challenges for AI adoption. Participants from various positions (just under half had no managerial role) in 459 organisations answered an online questionnaire. Small- to medium-sized companies accounted for 46% of the sample, while 26% of respondents worked at businesses with more than 1,000 employees.

Interestingly, the survey reveals that AI is not a priority for small businesses. Nearly two-thirds of companies with fewer than 50 employees have no plans to implement AI solutions, whereas this figure drops to one-eighth for companies with more than 1,000 employees. Overall, 73% of respondents have implemented or are about to implement AI solutions, while 27% have no plans to do so. Of the companies that use AI, most are benefitting from two or more applications.

Working with AI

A positive outlook for labour requirements is demonstrated where AI is operating or is planned. Some 66% of respondents say that AI helps to address skilled labour requirements while 71% say they appreciate





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the potential to enhance operations and efficiencies. A slightly lower proportion of just over 50% are positive about the ability to enrich working practices, provide more interesting roles, and to help with knowledge management.

Overall, the research suggests a generally positive attitude towards the impact of AI in the workplace. More than half of the respondents agree that increases in productivity, competitive innovation, and the extension of employee learning, wellbeing, and autonomy will be seen as beneficial outcomes. The survey also identifies that 60% of those using (or planning to use) AI are concerned about a shortage of AI expertise. And employee 'fear' of AI is seen as a problem by 52% of respondents.

The key areas

Given the focus of the questionnaire, it is no surprise where AI is being used or planned – manufacturing, logistics and warehouse, and assembly are identified as the high-gain areas. Functions such as corporate management and marketing are somewhat disregarded. This to be expected when the most highlighted AI technologies in use or planned are image and sound processing, along with pattern recognition. High on the list are also action planning and optimisation. The least-cited technologies of intent analysis and emotion recognition are yet to be prioritised.

The way forward

There are signs that the implementation of AI is positive, and it appears to be reasonably well understood in the workplace.

For successful implementation, AI technical expertise in leadership is of key importance as is the need to carefully manage the balance between AI potential and employee needs.

The high-gain opportunities are being realised, though the larger companies are significantly more advanced. There is a level of discomfort however, in that 40% of all respondents (including those with no plans for AI) said they were concerned about the use of AI in general. Only 33% said they had no concerns, which leaves a significant 27% as unclear or undecided.

The survey reveals that for successful implementation, AI technical expertise in leadership is of key importance as is the need to carefully manage the balance between AI potential and employee needs. It is acknowledged that AI will bring profound advantage and change, and in a manufacturing environment, it's clear we're at an early stage. Like any transformation, employee confidence and buy-in is critical. It will be important to identify methods to foster strong employee relations in the AI roadmap, and to ensure confidence in leadership.



Personal response

What are your main concerns regarding the status of AI implementation in the manufacturing industry?

There are various AI applications that support work in indirect areas. Systems for work in direct areas have so far been customised developments or are still under development. The challenge here is that processes in direct areas are very specific. They are difficult to support with standard solutions and therefore, usually require adaptations to the company-specific framework conditions. This in turn generates effort and costs for companies. On the other hand, companies are currently still finding it difficult to assess the benefits and added value of AI.

AI, in some respects, will soon be 'done for us' – in that third-party software and hardware solutions are starting to have AI built-in, even without our knowledge. How can your research account for this in the future?

These are processes that are probably common in these comparatively early stages of development. They make an important contribution to increasing acceptance of the technology. Corresponding studies are still pending. They also help to concretise discussions, for example, about regulatory measures at various levels of legislation and at company level. Practical characterisation approaches for AI systems are needed to develop generalisable introduction processes for the various classes of AI systems. This should be part of future research activities.

We might assume that the adoption of AI is ultimately a given, and rather the challenge in the coming years may well be the

acceleration and proliferation of AI. It could be somewhat difficult to manage – what are your thoughts?

The introduction of AI is a basic prerequisite for remaining competitive in high-wage countries in Europe and America in the coming years and decades. AI also offers an answer to the ever-increasing shortage of skilled labour. It will therefore be a matter of course to work with AI-supported systems in the future. At present, however, there are still great fears about the use of AI. These are based, for example, in the context of data protection issues and in dealing with automated (incorrect) decisions or in uncertainties regarding the economic benefits of introducing AI. The aim here is to inform and motivate people to use AI.

Is the scope of your future research to include quantitative measures of gains – for example specific cost savings and similar measures?

The question of the economic benefits of AI systems is asked by many companies, especially small- and medium-sized ones. While these considerations are important, they are certainly not exhaustive. The introduction of AI can and should not only improve companies' KPIs. The design approaches should be chosen in such a way that added value is achieved for both the company and its employees. Improvements on the employee side cannot always be monetised, but they do contribute to employee retention and employer attractiveness. Ultimately, however, these targets will become increasingly important in the coming years to maintain production and secure prosperity.

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Bio

Professor Dr-Ing. habil. Sascha Stowasser has headed the ifaa – Institute for Applied Industrial Engineering and Ergonomics since 2008. He conducts intensive research into the work of the future, examining not only technical but also organisational and cultural issues relating to changes in the world of work.

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Further reading

(2024) ifaa study: Artificial intelligence in manufacturing companies. [online] ifaa. www.arbeitswissenschaft.net/angebote-produkte/studien/kwh-ue-alf-ai-study-results [Accessed 25/06/2024]