The rise of the smarter, swifter, safer production employee

Future of enterprises 2nd edition

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Introduction

Contents

Accelerated by increasing globalization, manufacturing is in a constant race for productivity and efficiency. One way to bring down costs, while maintaining a high level of quality, is fully automated production, which is commonly claimed to be the future of manufacturing. But automation, in many cases, is neither easy nor profitable due to the complex nature of tasks, the need to transfer knowledge that is difficult to express or extract, and the current insufficient capabilities of automation. In addition, production employees say a large part of the tasks are still dull, dirty and even dangerous. Will manufacturing companies invest in ICT-enabled production tools to augment the capabilities of their production employees – making them smarter, swifter and safer? If taking what some call the Industry 5.0 track, what tools are most rewarding for manufacturers to invest in, and what manufacturing segments are taking the lead? Is wireless connectivity important for these tools? Is full automation a separate and competing track for manufacturers to take? What will the future of manufacturing look like, and how will manufacturing jobs change? These are some of the questions this report sets out to answer.

Methodology
Quantitative data was collected from 22 markets, through 8,657 online interviews held with respondents aged 18 and older, in Australia, Belgium, Canada, China, Colombia, France, India, Indonesia, Italy, Germany, the Kingdom of Saudi Arabia, Mexico, Portugal, Singapore, South Korea, Spain, Sweden, Taiwan, Thailand, the UK, the US and Vietnam. Of these respondents, 3,214 were decision makers in the production/manufacturing domain in companies with more than 250 employees. The remaining 5,443 respondents were production employees. These respondents are estimated to represent around 145 million of the roughly 400 million production employees active in the type of surveyed companies on included markets. The early-adopter profile of many of these respondents make them important when it comes to exploring the future of manufacturing. All manufacturing segments were included in the scope of this study. The online survey was conducted between June and September 2021. Qualitative insights were gathered through 32 telepresence interviews with decision makers, production employees, subject matter experts and academic researchers in the US, China, Colombia and Sweden. The interviews were conducted between November 2020 and March 2021.

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Ericsson Consumer & IndustryLab explore the future of technology for consumers, enterprises, and a sustainable society. We deliver world-class market research, actionable insights, and design concepts to drive innovation and sustainable business development. We provide a scientific fact-based analysis regarding environmental, social, and economic impacts and opportunities of ICT.

Our knowledge is gained from global consumer, enterprise, and sustainability research programs, including collaborations with leading customers, industry partners, universities, and research institutions. Our research programs cover in-depth studies and over 100,000 interviews with consumers, working people and decision-makers each year, in 30 countries – statistically representing the views of 1.1 billion people.

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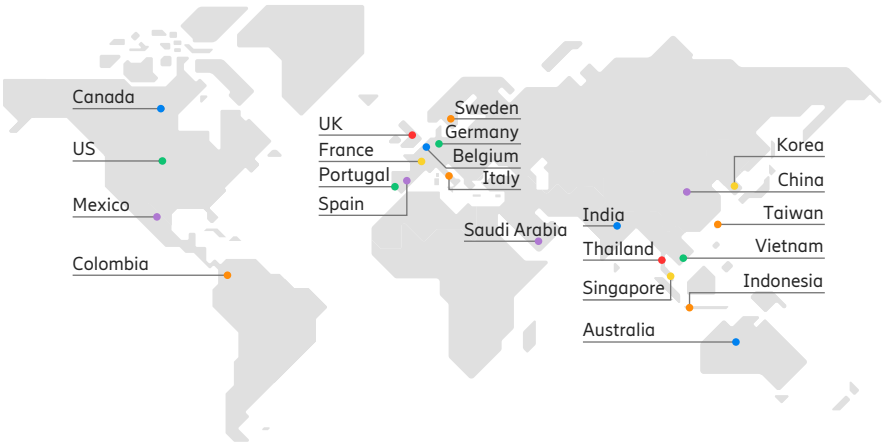
Figure 1: Coverage map

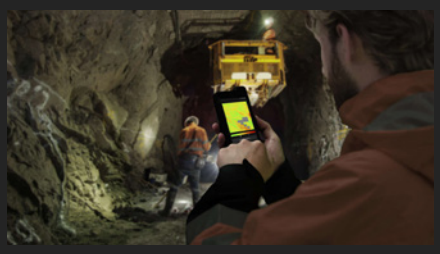


Acronyms and terminology used throughout this report

AGV	Automated guided vehicle
AI	Artificial intelligence
AMR	Autonomous mobile robot
AR	Augmented reality
ICT	Information and communications technology
ICT-enabled production tools	AR, VR, Exoskeletons and 6 other tools
Industry 5.0	New production model focused on the human/machine interaction.
IT	Information technology
PLC	A computer used to controlling manufacturing processes
STEM	Science, technology, engineering and mathematics
VR	Virtual reality

Key findings

Despite the pandemic, manufacturers are doing surprisingly well
Tough global competition means that almost 8 in 10 manufacturers are cutting costs, however they have navigated through COVID-19 so well that 69 percent say their financial performance is unchanged or has even improved.

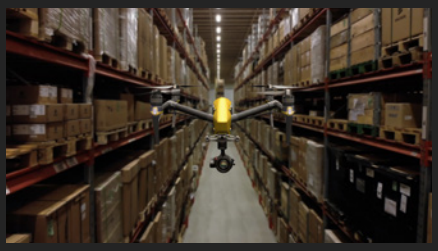


Dull, dangerous and dirty work is still a reality, regardless of what decision makers might think
While only 2 percent of decision makers are unsatisfied with how their companies work to reduce dull, dirty and dangerous work, production employees still say that 71 percent of the work is at least one of these.

A smarter, swifter, safer production employee is emerging, assisted by ICT-enabled production tools
In the next 5 years, 7 in 10 manufacturers expect to have deployed at least 5 of these production tools. 3 out of 4 manufacturers say that advanced wireless technology like 5G and Wi-Fi 6 is very important for these production tools.

Manufacturers using more ICT-enabled production tools than others are more successful in almost every dimension
Some 50 percent of tool frontrunners, using 3 or more of these tools, say they are very financially successful, which is 17 percentage points more than those with no tools at all.

Full automation is approaching but neither decision makers nor production employees fully grasp the consequences
While almost two-thirds of the surveyed manufacturers expect to be automated to at least 80 percent within 10 years, more than half of the production employees still believe more people will be needed in similar roles by 2030, and only 1 in 5 think fewer people will be needed. Close to 9 in 10 decision makers expect AI to be used in their production processes within the next 10 years, however 3 in 4 think humans will still make at least half of all production decisions.



Production is evolving beyond the traditional factory set-up
More than half of all manufacturers believe that manufacturing as-a-service and pop-up factories will be commonplace by 2030, powered by the need for flexibility and adaptability. Just as many agree that additive manufacturing/3D printing will be an important part of their production process.

Top challenges keeping manufacturers awake at night

During the past century, manufacturing has shifted focus from mass-production to lean manufacturing, and from there to a growing focus on satisfying customers' unique needs. In more recent years, to achieve this customization, the approach has been to create small, tailor-made batches adapted to real-time needs. In fact, one in five manufacturers have already implemented efficient customization in the form of small, tailor-made batch production and are using predictions to adjust designs and volumes in real time. The problem with this is how to cut costs and increase productivity, without the economies of scale eliminated by smaller batches, or even batches of one. Nevertheless, almost 8 out of 10 manufacturers have cost-cutting targets today.

Moreover, the long life cycles – often 15–20 years for investments in machines and systems in factories – which accelerate customization, and the consequent transformation of production, have led to a heterogenous factory floor. With old machines working side by side with newer installations and IT systems, upgrading and integrating is a main challenge, especially for operations technology and IT. The vast majority of the equipment is fixed and stationary, and rearranging for a constantly changing product line can be both time consuming and costly, if even possible. A lack of standardization and harmonized data flows, in combination with paper-based processes and islands of automation are not unusual.

As facilities become digitalized, making sense of and using the large amounts of data generated by machines and processes is becoming increasingly challenging, particularly in terms of cybersecurity. Securing the data, as well as connectivity for the machines and the production process, is an additional challenge that will burden manufacturing companies increasingly in the light of accelerating cyber theft and crime.

In the wake of rising costs in many early industrialized countries, and with offshoring and the move of manufacturing to lower labor cost countries, China has gradually become the dominating manufacturing nation, with 29 percent of the world's manufacturing.[1]

Of the surveyed manufacturers, 7 in 10 say their financial performance is unchanged or has even improved since COVID-19.

7 in 10

Figure 2: Some of the main challenges within manufacturing today

[1] Statista 2019, unstats.un.org/unsd/snaama/CountryProfile

However, despite the lower labor costs, offshoring also introduces many challenges such as transport delays, quality problems, miscommunication, sensitivity to trade conflict and negative environmental effects based on increased transport.

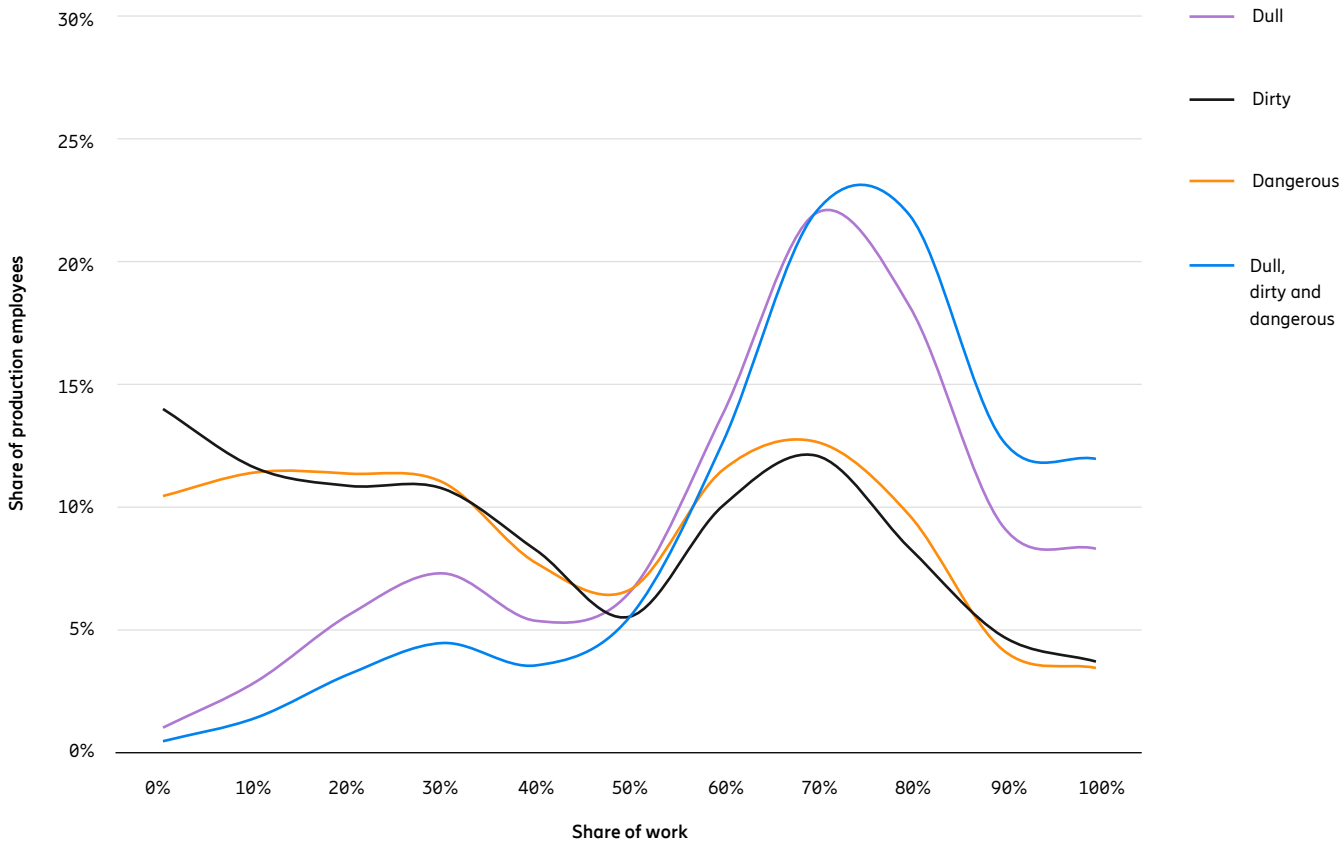
On top of this, manufacturing jobs and tasks historically consist of unhealthy work or what is often referred to as the three Ds: dull, dirty and dangerous. While only 2 percent of decision makers are unsatisfied with how their companies work to reduce dull, dirty and dangerous work, production employees still say that 71 percent of their work is at least one of these (Figure 3).

When it comes to wear and tear injuries, as many as 80 percent of the surveyed production employees have experienced them at their workplace. In fact, in 2020, a production employee got injured every seven seconds in the US alone.[2]

Regardless of what decision makers might think, 71 percent of the work is still either dull, dirty or dangerous,

71%

Figure 3: Share of production employees stating how much of their respective work is dull, dirty and dangerous (self-reported)



With the digitalization and automation that is happening in factories, the role of the production employee is also shifting to include more oversight and troubleshooting, rather than tasks like tendering and assembling. This requires higher creativity and analytical skills of production employees, as well as higher skills in IT, technology and software programming. For instance, 7 out of 10 production employees say they need higher skills in data analysis, thinking outside the box and programming.

Another challenge today is the large contingencies of retiring production employees, combined with insufficient interest from STEM-educated students to work in production. According to a study by Deloitte and the Manufacturing Institute, the US alone will have 2.1 million unfilled manufacturing jobs by 2030.[3]

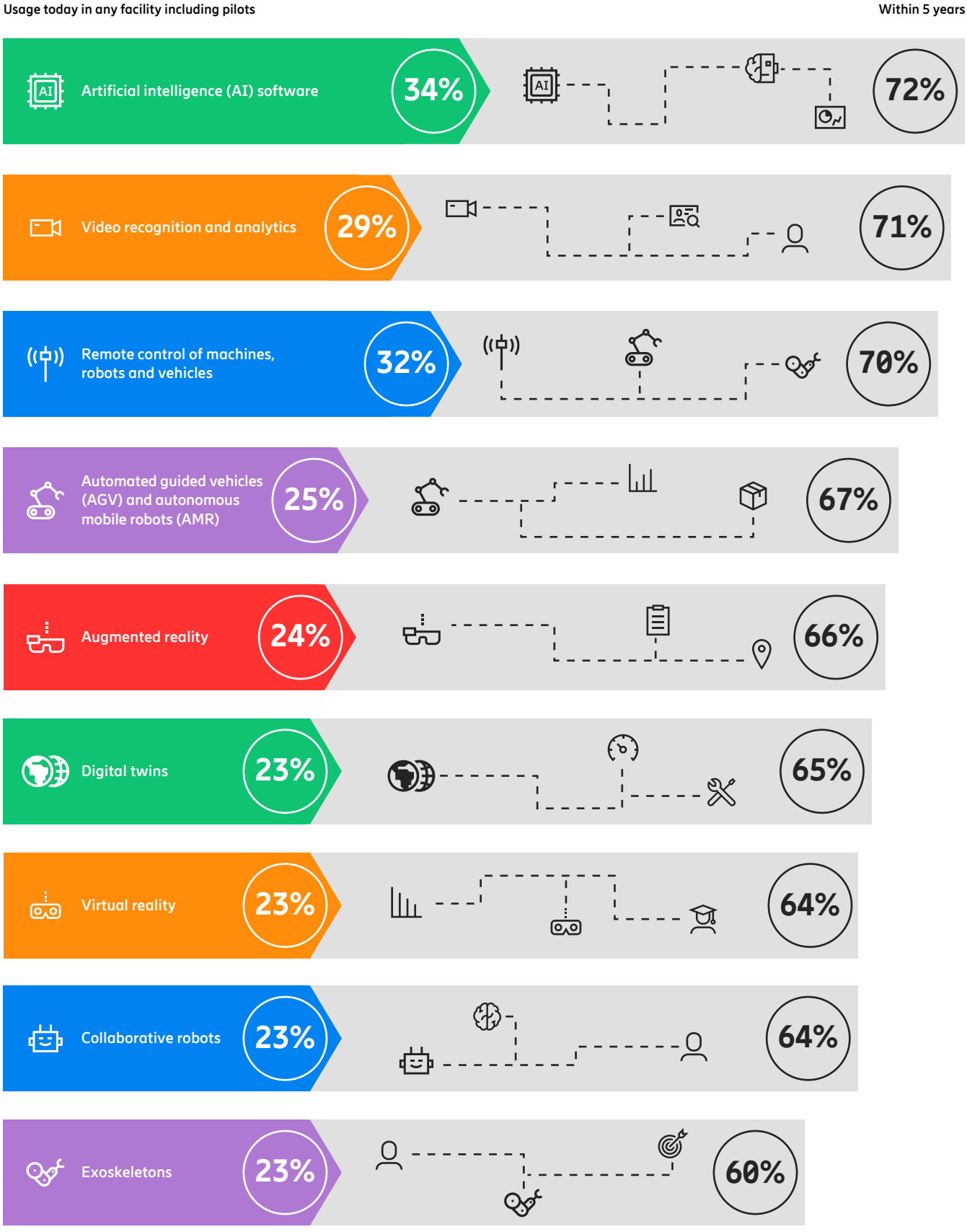
Battling global warming and environmental challenges is another important issue that calls for manufacturers to act and invest, not least to achieve environmental compliance. Of the manufacturers surveyed, 6 in 10 believe it is very important to improve environmental impacts through future investments. This is even higher for manufacturers using 3 or more tools, where the equivalent figure is 7 out of 10. Overall, when it comes to the manufacturer's choice of country in which to retain or locate future manufacturing/production facilities within the next 10 years, significantly more than half of the manufacturers rank sustainability maturity as a very important factor.

Finally, and in contrast to the challenges mentioned above, 7 in 10 of the surveyed manufacturers say their financial performance has remained unchanged or even improved, despite the lack of supply chain resilience in the global turmoil that COVID-19 has caused. In fact, more than 40 percent of the surveyed manufacturers consider themselves to be very successful.

[2] www.nsc.org/nsc-membership/injury-facts
[3] US Manufacturing Skills Gap Could Leave As Many As 2.1 Million Jobs Unfilled By 2030, Deloitte and The Manufacturing Institute Study Finds – Press release | Deloitte US

Use of ICT-enabled production tools is thriving

Figure 4



Making production employees smarter, swifter and safer

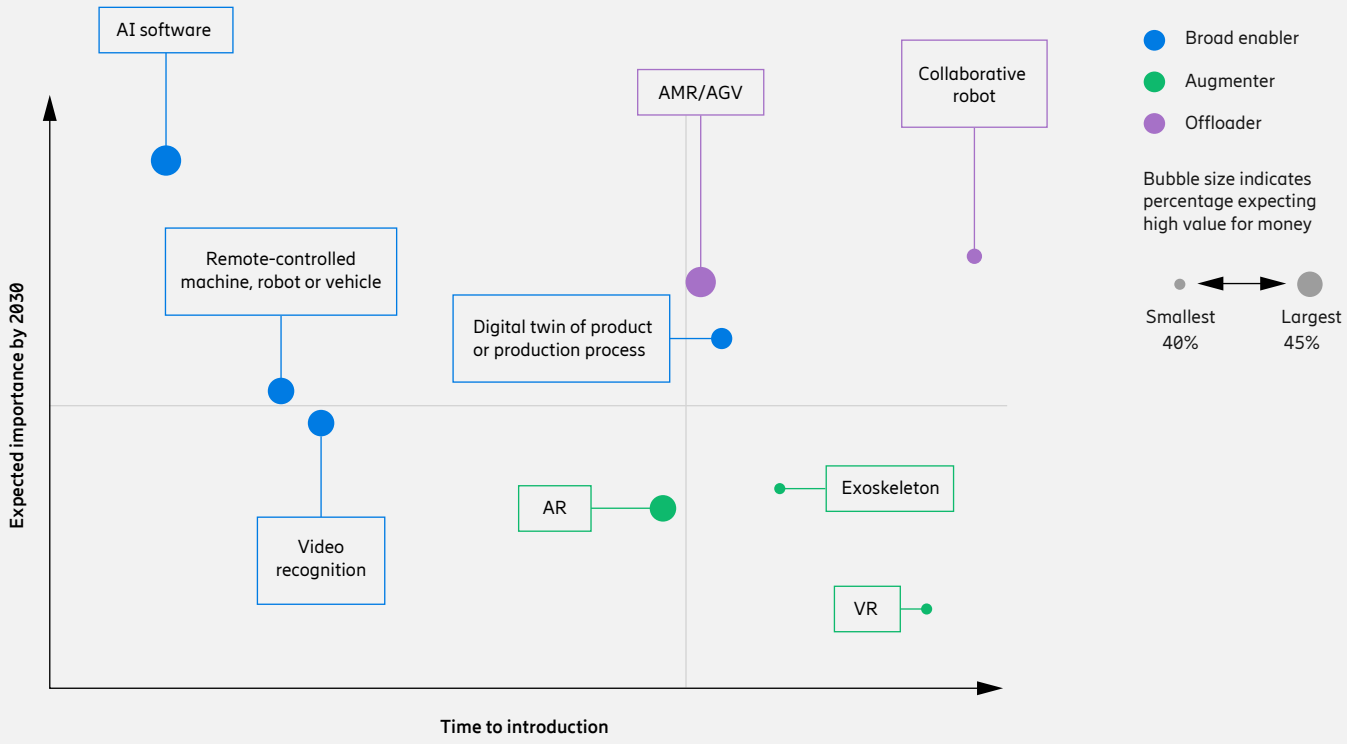
ICT-enabled production tools becoming mainstream

Although the surveyed decision makers agree that factories will be fully automated eventually, a number of tools and technologies that enhance the production employees' capabilities to work smarter, faster, safer and with higher strength and endurance can help manufacturers master this new production ecosystem now. In this study, nine ICT-enabled tools and technologies (see Figure 4) which could become more powerful when enabled by wireless connectivity, have been examined based on their expected importance and value to manufacturers.

As the infographic suggests, some of these tools are already used to some extent, while others are just emerging. Nevertheless, these nine tools are becoming mainstream within manufacturing. In fact, roughly 70 percent of the manufacturers expect to have implemented at least 5 of the 9 tools within the next 5 years.

Figure 5 plots the order that manufacturers expect to introduce the tools (x-axis) against the expected and relative importance of the tools in 2030 (y-axis). The relative value for money is represented by the size of the tool's bubble on the chart. Three groupings of tools based on their nature are visible in this chart, showing relative differences in expected time of introduction and importance, which have been enlarged to highlight differences in this chart.

Figure 5: Relative importance by 2030, time-to-introduction of tools and value for money



Broad enablers are versatile

On the left side of Figure 5, four tools – AI software, video recognition, remote control and digital twins – have a broad application area across several industries. These tools are equally valuable to manufacturers, production employees and the future of automation. Three of them will impact the market in the near term, while digital twins, which is the least known, is expected to have a mid-term impact.

As manufacturing companies become increasingly connected to their production assets and generate huge amounts of new data, it is unsurprising that AI software is the most well-known and most deployed tool across production systems. In certain environments, the speed, quality and even safety of the workstation could be negatively impacted by the capability of the production employee to make time-critical decisions. For situations such as these, 88 percent of production employees say that they would be interested in a personal AI assistant to support with tasks such as quality control, calculations, estimates, data handling and processing.

Video recognition offers relatively low-cost high-definition video cameras that can be used across any industry to provide tracking, counting and surveillance functionality. Video recognition can cost-efficiently reduce dull tasks, such as visual quality inspection on a production line, or be combined with drone inspection or a surveillance system to trigger actions like ordering or alarms. The functionality can also replace the need for separate tracking systems.

Remote control of machines, robots and vehicles is a versatile tool that production employees rank highly for reducing dirty work (65 percent) and keeping them out of harm's way (68 percent), on top of higher efficiency and quality. One of the leading examples is the mining industry, where the use of remote control for underground vehicles is growing rapidly. This allows work to continue quickly after blasting and gives operators a safe, comfortable working environment.

Digital twins of products and production processes can reduce planning, testing, and even mitigate the consequences of faulty products or processes by running simulations of, for example, production processes. As it was the tool that manufacturers were least aware of, it's possible its modest ranking of importance will increase as knowledge on how to build and use this software-based tool grows.

Augmenters improve senses

In the bottom half of Figure 5, one group of tools, including AR, VR and exoskeletons improve production employees' senses. These augmenters are expected to be widely introduced further down the line and may have been awarded lower scores in terms of importance because manufacturing focus over time is shifting towards automation. **AR** can visualize a mix of data with reality to provide: a better understanding of what an employee is seeing, easy to follow instructions, increased understanding, immersive training and interactions, improved safety and more. For example, it is used for giving instructions in complicated assembly procedures and one of its most valuable features according to production employees is that it leaves their hands free to work.

AR wearables will benefit greatly from the ongoing shift towards placing more of the computing in the network using advanced wireless networks. This will likely improve the available functionality as well as the battery size and life, which in turn will make them lighter and more physically attractive for users. Some of these are aspects – functionality (66 percent), comfort (62 percent) and battery life (58 percent) – that production employees using AR (but also VR) equipment are satisfied with already today.

Of the surveyed manufacturers, 7 out of 10 will have deployed 5 or more production tools enabled by advanced wireless connectivity like 5G within 5 years.

7 out of 10

"You can write a whole essay about some features of a product, or you can show it in 15 seconds – that is the power of AR glasses."

Production employee, Estonia

Exoskeletons and **VR** are given relatively lower scores for their expected importance by 2030 and are expected to impact the market later. The two share a relatively narrow area of application, but also score lower for different reasons:

- Exoskeletons can, through their support of body parts like hands, arms, or even full body suits, provide production employees with more strength, precision and endurance. However, according to production employees in the survey, they still face issues with features of "comfort" and "ability to move freely", which are important for overall satisfaction according to manufacturers.
- VR can visualize data and drawings in 3D for new perspectives and better understanding, immersive training, online meetings and much more. However, its application area is highly restricted because employees are not focused on the real surroundings when using them. In addition, it also shares the same challenges as AR in terms of comfort and functionality.

Offloaders redistribute work

Finally, on the right-hand side of Figure 5, offloaders, such as AGVs/AMRs and collaborative robots, help redistribute production employees' work, but also represent major steps towards automation. While they achieved high scores for importance, they are expected to reach mass adoption later in time due to their dependency on the overall digital maturity of the production line and automation technology.

AGVs and **AMRs** transport goods and spare parts, offloading production employees as well as optimizing their time by reassuring stocks of components and parts are always at the needed level. AMRs can even navigate based on maps and sensors, and steer clear of blocking objects. There are many ways for AGV/AMR systems to navigate today, but with control and navigation supported by positioning and wireless communication, the speeds

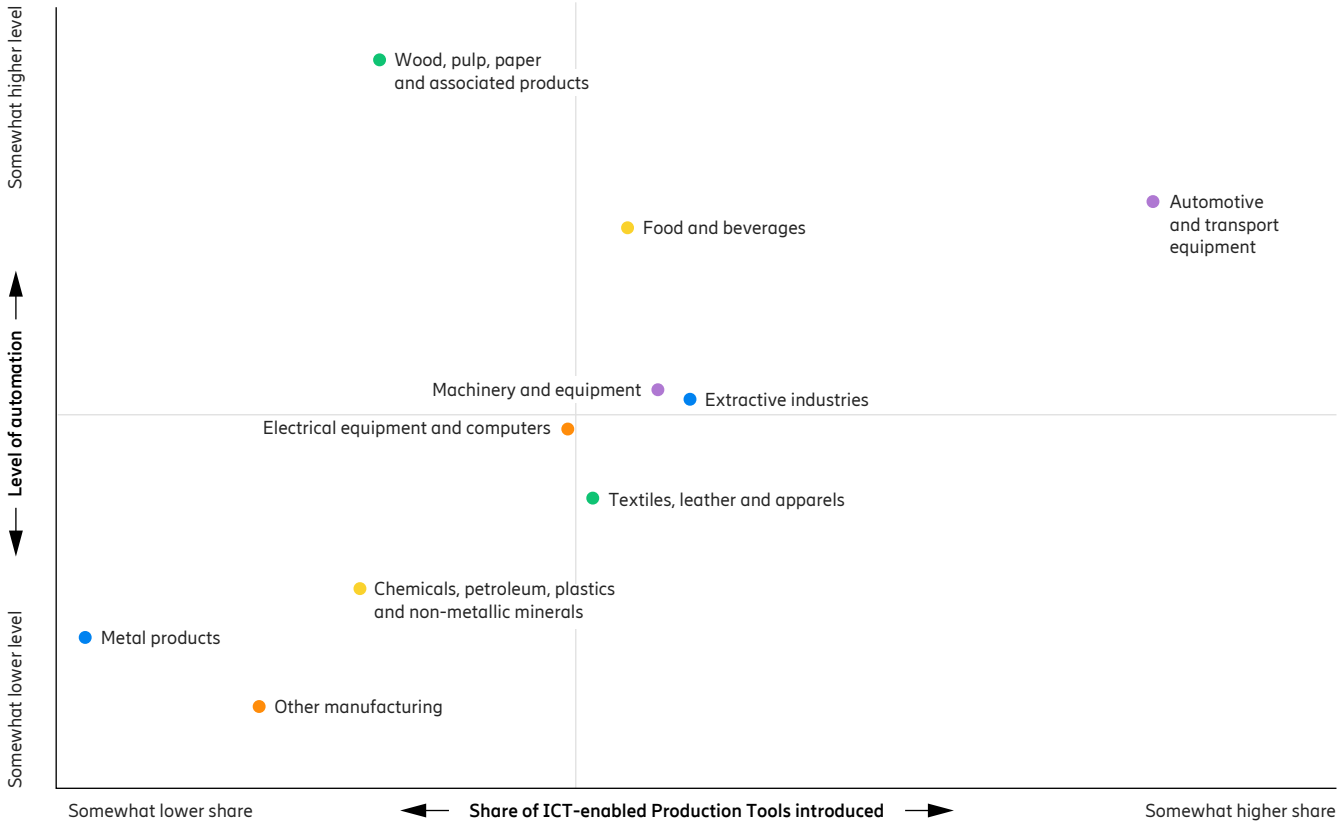
"I believe we evaluated 15 to 20 percent cost savings using AGVs."

Decision maker, US

– and thereby efficiency– could increase without compromising safety.

On the far end of the mass introduction timeline are **collaborative robots**, or cobots, which are capable of safely interacting with humans and learning tasks without safety zones or cages. This technology is expected to penetrate the market a bit later. They are very flexible and can easily be reprogrammed and moved between workstations to take on new tasks. When looking at drivers for satisfaction, surveyed manufacturers are unsatisfied with important capabilities like the maneuvering skills and the length of reach of cobots. These aspects likely need to be improved for widespread adoption of this technology.

Figure 6: Relative position of manufacturing segments in terms of their level of automation and use of ICT-enabled production tools

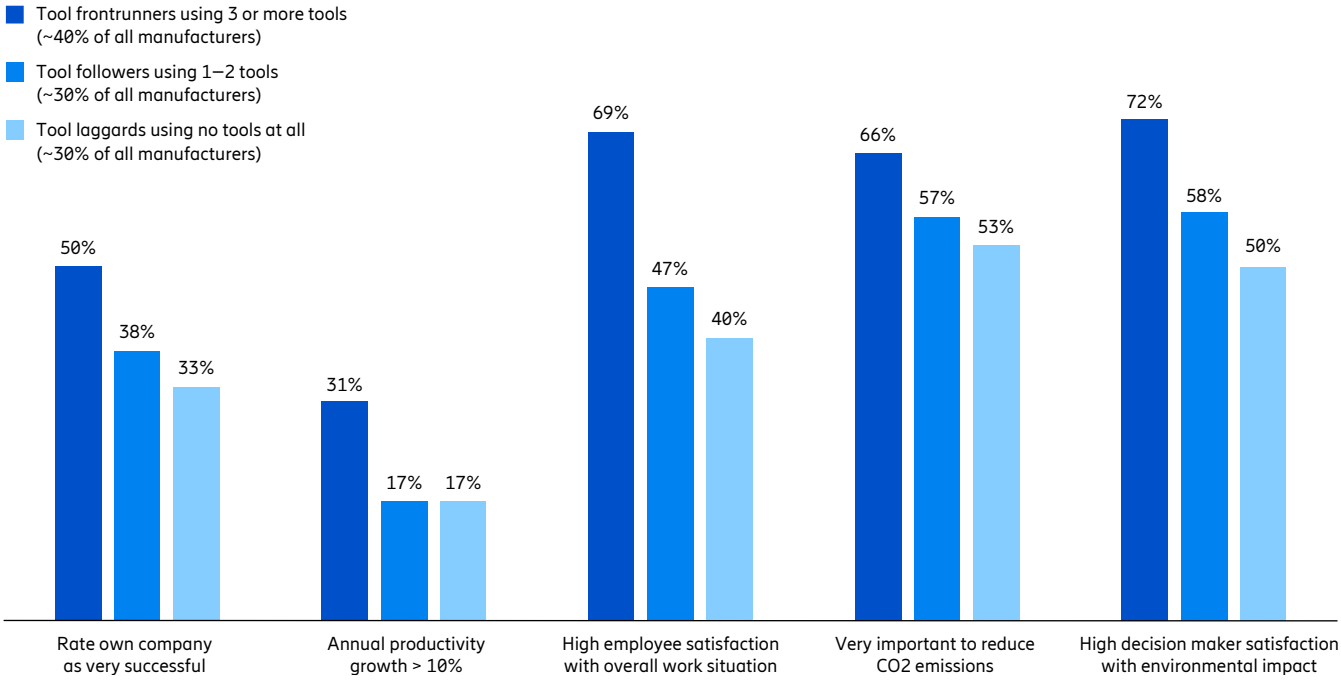


Not all industry segments are the same
Turning the perspective to manufacturing segments, and the differences in how tools are used, one segment is faster in implementing more tools than others and ranks higher in its level of automation. Automotive has always been a driving segment, in terms of facility, process design and development for the whole manufacturing industry.

This is because of the high-volume, high-value product throughput of the goods produced. In the automotive and transport segment, ICT-enabled production tools have already been implemented to a high degree. Given their process-oriented production, wood, pulp and paper products on the other hand have a very high level of automation. Metal products rank lower than other industries, both in terms of tool adoption and automatization.

Tool frontrunners are more progressive, including in environmental action
In this report, the surveyed manufacturers have been divided into three groups, based on their current use of the nine ICT-enabled production tools. Tool frontrunners are manufacturers that have implemented three or more tools, tool followers have one or two tools, and tool laggards have no tools at all. Tool frontrunners constitute approximately 40 percent of the surveyed businesses and typically have a higher level of automation.

Figure 7: Comparison between frontrunners, followers and laggards with regards to the ICT-enabled production tools



When comparing tool frontrunners with the other groups, it becomes obvious that they are more progressive than tool laggards in many areas including productivity growth, financial success, internal overall work satisfaction and also leading in environmental actions (see Figure 7). The share of production tool frontrunners that have fully renewable energy-powered production is 45 percent higher than the average for the surveyed companies, and two-thirds of the of the frontrunners say it is very important to reduce CO2 emissions, compared to 6 out of 10 on average.

The skills gap is the main barrier
Both decision makers and production employees generally rank drawbacks as low for all tools. About 30 percent of the decision makers and production employees rank "difficult and time-consuming to learn", "complicated to use" and "immature technology" as the most important drawbacks. For almost every drawback, an almost equal number of decision makers and production employees disagree with these being drawbacks at all for each tool. A barrier that both decision makers and production employees agree upon relates to the skills gap that will grow as more tools and technologies are introduced.

The very nature of the job will typically change from, for instance, assembling and tendering to supervising and troubleshooting, which typically means interpreting large amounts of data and deriving insights. Consequently, 7 out of 10 manufacturers say they will not only require higher, or much higher, programming skills but also creative problem solving, critical thinking and entrepreneurial thinking in 2030. Furthermore, almost 8 out of 10 manufacturers say that lifelong learning will be necessary in order to keep up with a fast-changing environment.

On the road to full automation

Automation in manufacturing is the use of equipment to automate systems or production processes, such as material handling processes and assembling. This is done with the purpose of replacing human action and manual activities by using mechanized equipment and logical programming commands.

Although ICT tools, as described in the previous chapter, can reduce some of the dull, dirty and dangerous tasks, automation is seen as the ultimate solution. As mentioned previously, tool frontrunners with their mature attitude to digitalization are often highly automated too. Manufacturers believe that in the long term automating all elements of work is going to be possible and economically viable. Machines and robots are ultimately better suited to perform dull, dirty and dangerous tasks day-to-day with the exact same quality, and are even able to reinvent and optimize the processes for doing so.

In fact, almost two-thirds say their companies will be automated to at least 80 percent in the next 10 years. Only 3 percent believe they will never have a fully autonomous production.

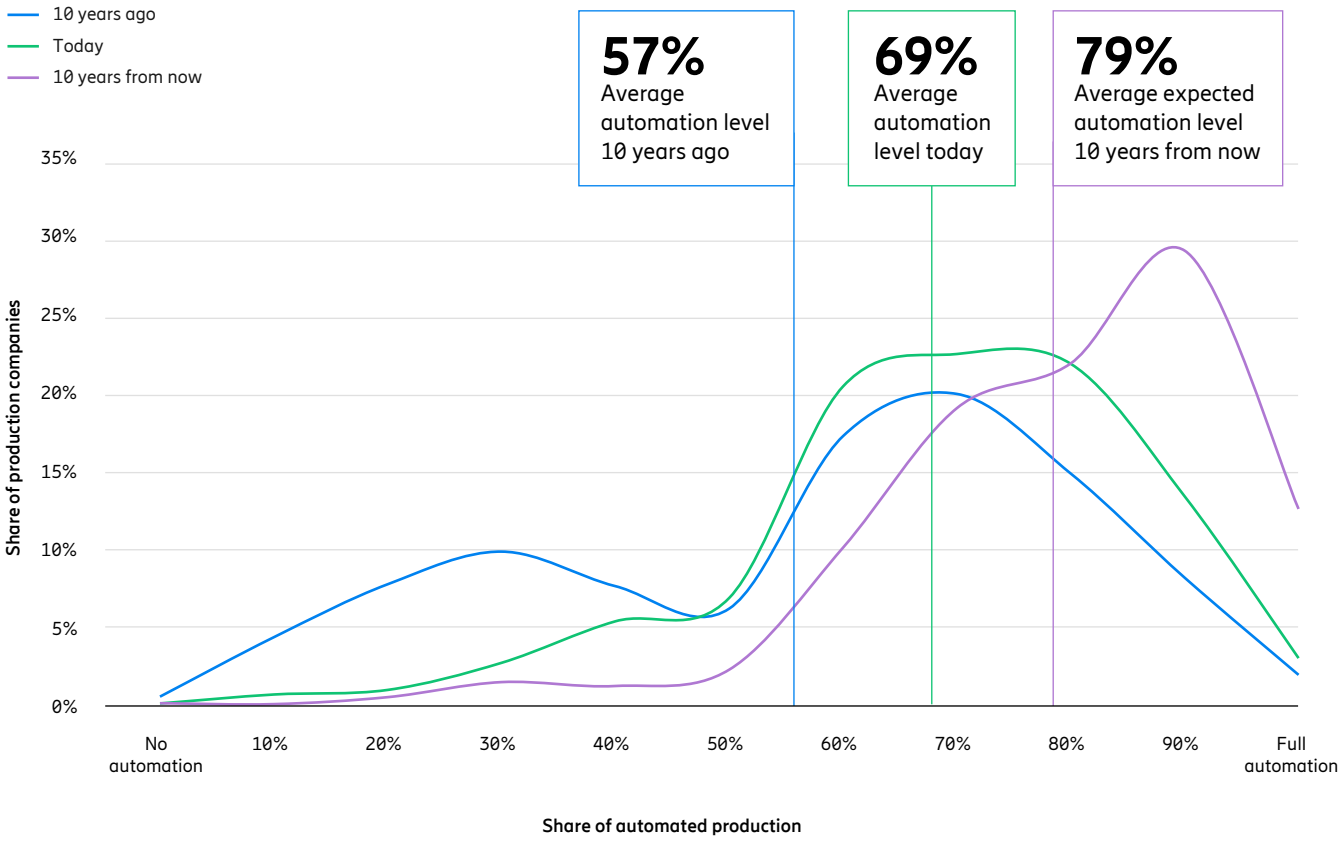
Drivers for automation

No less than 75 percent of decision makers agree that automation has increased the speed of production, 68 percent believe that it has led to, or will lead to, reduced costs, and 71 percent believe that it has reduced dangerous tasks that carry the risk of accidents and wear-and-tear injuries. Continuously declining robot prices and rising labor costs are also improving the business case for automation. Machines and robots are regarded as being stable, as they can perform tasks with a high and consistent quality of output 24 hours a day, 7 days a week. Tasks that are especially suitable for automation include the earlier mentioned the earlier mentioned three Ds.

"Before, we nearly had 450 operators on the line; 3 years later, we've reduced this by nearly 40 percent because of robots and cobots."

Decision maker, China

Figure 8: Share of decision makers stating the automation level for their respective production companies 10 years ago, today and in 10 years (self-reported)



The road to automation

Manufacturers say that the road towards full automation consists of many steps that need to be taken, and that there is no magic formula that allows them to transform to an Industry 4.0 or 5.0 factory straight away.

The first step to automation is the ability to collect data, process it and make decisions. Only then will manufacturers have the insight into operational performance across both equipment and staff to automate processes and drive greater efficiency across the shop floor. Manufacturers with a high level of automation have also typically adopted several of the ICT production tools mentioned in the previous chapter. As shown in Figure 8, the average automation level has increased from 57 percent 10 years ago, to 69 percent today, and is expected to increase to 79 percent in the next decade.

Barriers for automation

Among decision makers, the most significant barriers to automation concern the high perceived costs, with existing machines and tools being too expensive to be replaced. Production employees, on the other hand, highlight barriers such as tasks that are difficult to automate since they require creative and social skills, involve difficult decisions or a high amount of knowledge that is hard to program, write down or verbalize.

The tasks that would be the hardest to automate, according to production employees, are the ones that currently require precision coordination between hands and the human senses (for example, touch and sight), something that is seen by 41 percent. Fixing mistakes/abnormalities (38 percent) and creative thinking (37 percent) are also seen as difficult to automate.

As automated systems are complex, many companies are also starting to see an increasing need for costly maintenance and repairs, with rising in-house service personnel and competence as a result. These might be aspects that are underestimated initially.

Automation reaching white-collar production employees

Blue-collar employess are not the only people that will be affected by automation. Jobs that require a high amount of creative thinking, judgement and human interaction are next in line, as automation begins to move towards white-collar work.

Generative design is an emerging area, leveraging AI and machine learning to quickly generate the best design alternatives that humans can't derive from customer requirements. Half of the decision makers believe AI powered generative design will be widely deployed before 2030.

So far, blue-collar jobs have been transforming into white-collar jobs, slowing down the reduction of the workforce within manufacturing. Digitalization and automation has enabled a shift of low-skilled manual jobs in production facilities around the world into more process- and surveillance-oriented jobs. However, the question is whether this exchange of jobs has run its course, and whether a decline in the total number of production staff is now nearing?

At the same time, previously cognitive and intellectually complex tasks have become simplified thanks to advancements in user interfaces, smart AI assistants and auto-generated code. This may lead to a situation where employees with a lower education might be able to perform tasks that previously required a software engineer or a specialist. Several of the interviewed experts agreed that it can be difficult to find the right competence and software engineers, something that could further fuel the automation of more qualified jobs.

> "Since robots are very sophisticated, we need technical people to repair them, to maintain them."
>
> **Decision maker, China**

Advanced wireless connectivity a cornerstone

Manufacturing has a history of using Industrial Ethernet and Fieldbus fixed technologies to provide connectivity. However, there is a growing need to quickly and cost-efficiently rearrange production, and flexibly connect thousands of sensors, vehicles, machines and ICT-enabled production tools. Because of this, wireless connectivity in production facilities – both indoors and outdoors – is becoming increasingly important. In fact, 3 out of 4 manufacturers say that advanced wireless technology like 5G and Wi-Fi 6 is very important for production tools.

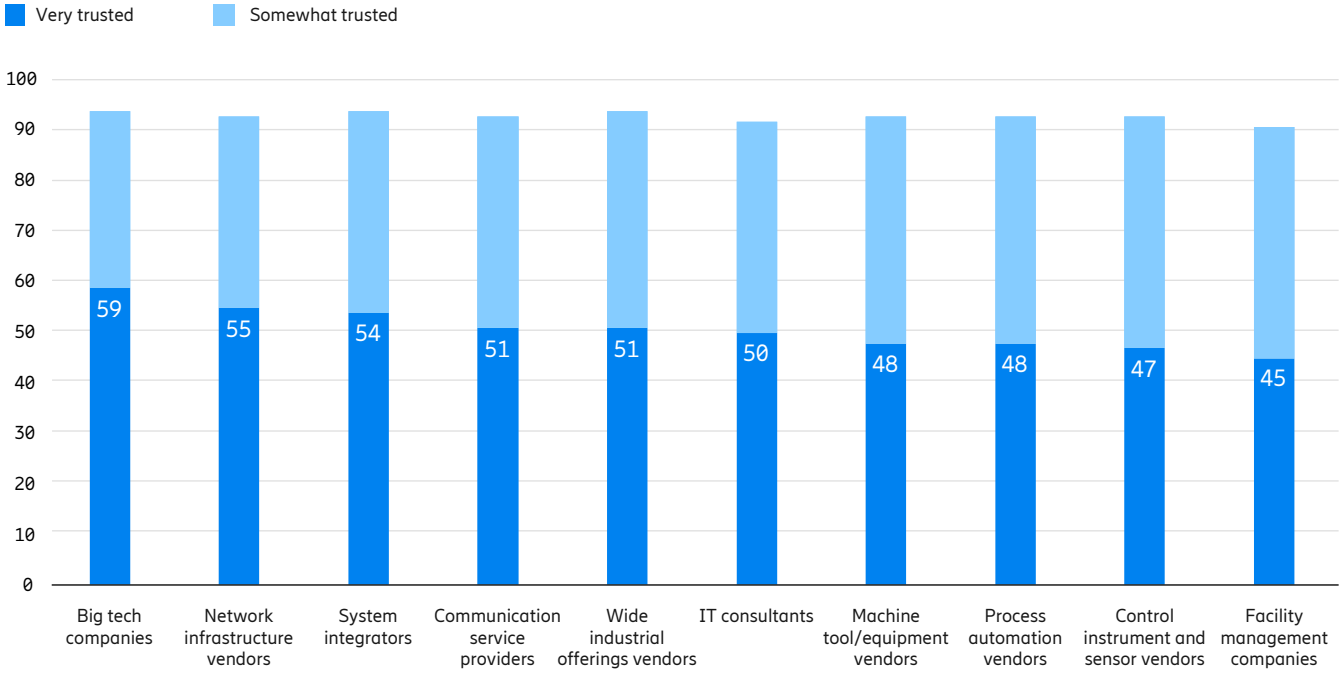
Since production will be heavily dependent on these connectivity solutions, manufacturers will put high demands on their reliability, bandwidth, latency and security. Considering that an automotive manufacturing site finalizes a new USD 20,000–80,000 sales item roughly every 1–2 minutes,[4] even a few minutes of assembly line downtime could result in severe revenue losses.

Each device type will have its specific demands on connectivity. The tens of thousands of wireless sensors in an electronic component factory will benefit from energy-efficient communication. On the other hand, wireless robotic control from a PLC in the cloud will need millisecond-latency communication.

Almost 60 percent of the surveyed manufacturers use Wi-Fi in their production facilities, including for basic connectivity for machines, smartphones and tablets. Manufacturers are satisfied with Wi-Fi's uptime, the fact that it is easy to deploy and maintain, and the benefit of a vast amount of available spectrum that doesn't require any license. Wi-Fi 5, and earlier generations of Wi-Fi, might work well for access to the internet and other less demanding connectivity. However, when manufacturers start using them as a backbone for production, these networks will face situations for which they were not originally designed. In the most current release, Wi-Fi 6, functionality has been added to cope with more challenging network environments and needs.

5G networks can offer reliable, low-latency connectivity, both indoor and globally. It operates in a licensed spectrum, allowing a controlled radio environment with a lower risk for disturbances.[5] However, the ecosystem for cellular connected tools and machines is still under construction, with a need to grow devices, solutions and vendors. In addition, manufacturers and their IT departments often lack the knowledge to design, install, run and maintain cellular networks. Nevertheless, 8 out of 10 manufacturers have already deployed 5G networks or are planning to within the next 5 years. At the outset, ICT-enabled production tools and automation will need the deployment of advanced wireless networks. As can be seen in Figure 9, both big tech companies and system integrators are highly rated as potential providers of wireless networks, in addition to communication service providers and network infrastructure vendors.

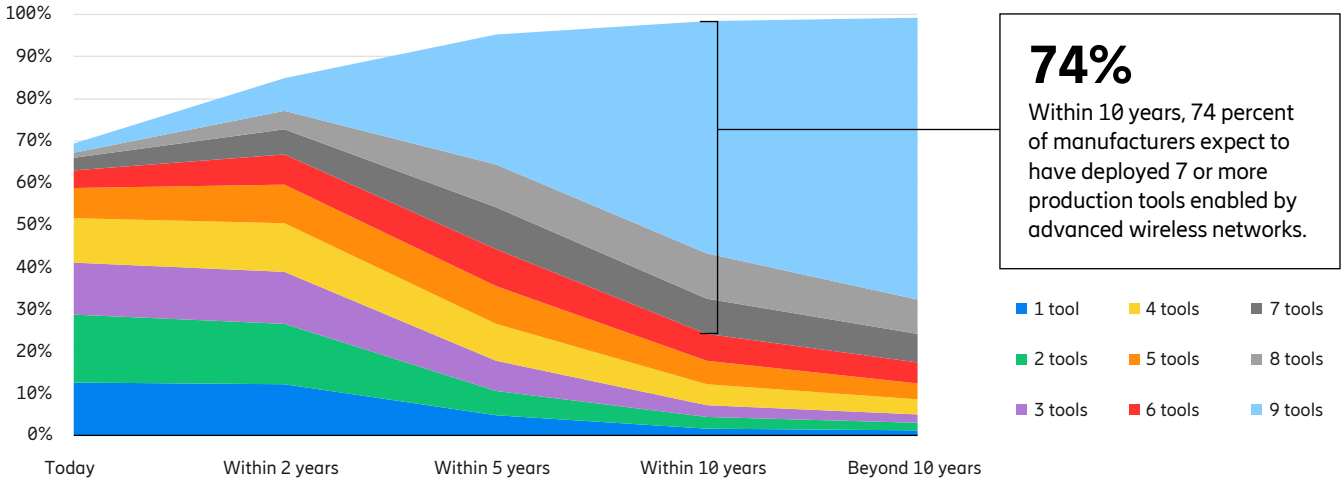
Figure 9: How manufacturers rank suppliers in terms of trust to deliver wireless networks for production facilities



[4] Two born every minute, inside Nissan Sunderland's factory, 3 Nov 2016, Carmagazine.co.uk
[5] J. Sachs, K. Wallstedt, F. Alriksson and G. Eneroth, Boosting smart manufacturing with 5G wireless connectivity, Ericsson Technology Review, February 2019

What lies ahead?

Figure 10: Percentage of decision makers that say how many different ICT-enabled production tools their respective companies use, and expect to use in the future (self-reported)



As previously outlined, the long-term goal amongst manufacturing decision makers is a fully automated production process, with almost two-thirds of decision makers expecting their manufacturing to be automated to 80 percent or beyond within the next 10 years.

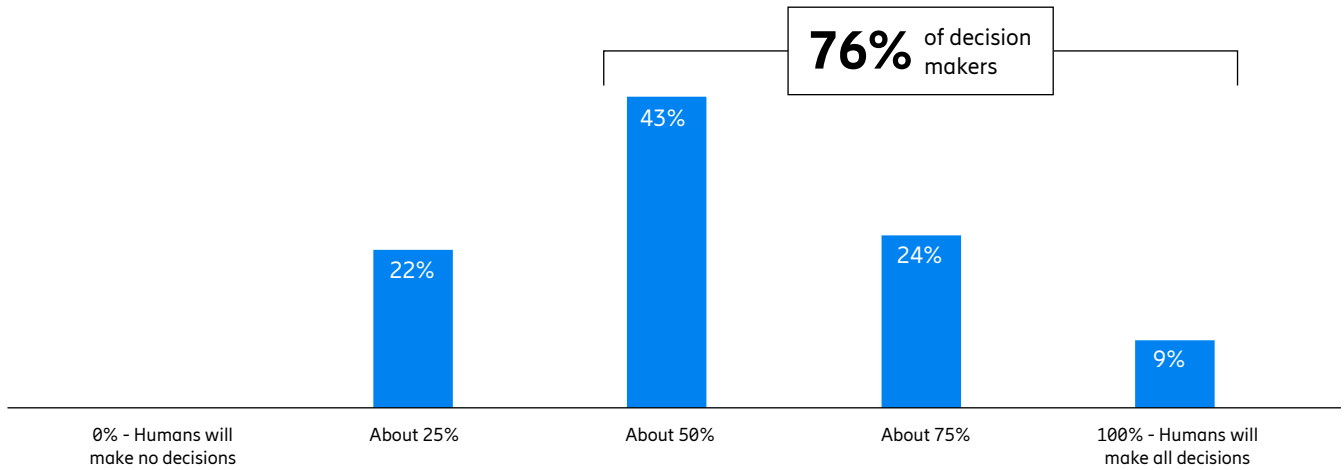
However, for the short to medium term, more than half of all surveyed decision makers expect ICT-enabled production tools such as AR, VR, digital twins and exoskeletons to bring significant value to their respective companies in the next 10 years. This will enable their employees to continue to have an active role in the production flow. Figure 10 shows that 74 percent of manufacturers expect to deploy 7 or more ICT-enabled production tools within 10 years. At the same time, these tools are speeding up the process of digitalization and streamlining, which could act as an additional driver for further automation.

What will future manufacturing jobs look like?

Roughly half of production employees say they are ready to upskill to take on more advanced jobs, and 7 out of 10 expect the importance of lifelong learning to increase by 2030.

However, more than half also believe that by 2030, more people will be needed in job roles just like the ones they have today, and only 1 in 5 believe fewer people will be needed. This incongruence between being aware of the ongoing shift towards automation and still believing nothing will change is perhaps naive, but also human.

Figure 11: Share of decision makers agreeing with each distribution of how production decisions will be made in the future (self-reported)



Decision makers also seem to suffer from the same affliction, however. While 87 percent expect AI to be used in their production processes within the next 10 years, 76 percent also think humans will still make at least half of all production decisions.

Decision makers and industry experts alike expect supervisory roles, as well as troubleshooting and other roles that involve more creative tasks, to make up a larger share of the remaining manufacturing work roles. In fact, 7 out of 10 decision makers expect that production employees in the future will need higher skills in creative problem solving, data analysis and computer programming, while half of all decision makers think low-skilled positions will disappear completely from their production facilities within the next 10 years.

The humans that continue to work on the future production floor will also have cognitive, sensory and motoric tools at their disposal, enabling them to interact with production processes in a smarter, swifter and safer way than today. Close to half of all decision makers expect a significant share of employees to have body implants by 2030. Production employees are also receptive to this evolution, with three out of four being very or somewhat interested in getting a body implant.

It is perhaps in the context of increased productivity that expectancy amongst production employees to work less in the future should be understood. In fact, close to half expect to work fewer hours in the future, with only 16 percent expecting to work more. Surveyed decision makers also see a future where less work will be done by humans. According to 54 percent of decision makers, jobs will not be around for everybody and universal basic income will be introduced as a result of automation by the year 2030.

Production evolving beyond the traditional factory set-up

As previously mentioned, manufacturing is facing a wide range of challenges, driving change throughout the production process. ICT and advanced wireless connectivity in particular are key enablers in the digitalization of manufacturing. More than half of the surveyed decision makers expect algorithms will be the battleground for successful manufacturing by 2030, which is perhaps why just as many expect their companies to have implemented AI-powered generative design, an iterative design process, in the same time frame.

Enabling their businesses to adjust their designs, production volumes and supply flow in real time is also high on their wish list, with 56 percent of decision makers expecting it to be in play by 2030.

> "Jobs that will disappear are… jobs where you only have a basic level of education. [Remaining] jobs… are going to require higher education, a lot more understanding of computer systems."
>
> **Decision maker, US**

Adjusting to real-time needs will lead to fundamentally different manufacturing in the future, giving rise to pop-up factories serving local, here-and-now needs, something 54 percent of decision makers expect to be commonplace by 2030.

Just as many agree that in the same time frame, additive production, such as 3D printing to enable flexible and cost-effective production, is expected to be an important part of their production process. The evolution of manufacturing is not likely to stop there. No less than 56 percent of decision makers expect manufacturing-as-a-service to be commonplace by 2030. The emergence of such manufacturing service companies, excelling in the production itself but without own products, would enable many of today's manufacturing companies to focus on other areas of their business than the production itself.

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Ericsson enables communications service providers to capture the full value of connectivity. The company's portfolio spans Networks, Digital Services, Managed Services, and Emerging Business and is designed to help our customers go digital, increase efficiency and find new revenue streams. Ericsson's investments in innovation have delivered the benefits of telephony and mobile broadband to billions of people around the world. The Ericsson stock is listed on Nasdaq Stockholm and on Nasdaq New York.

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