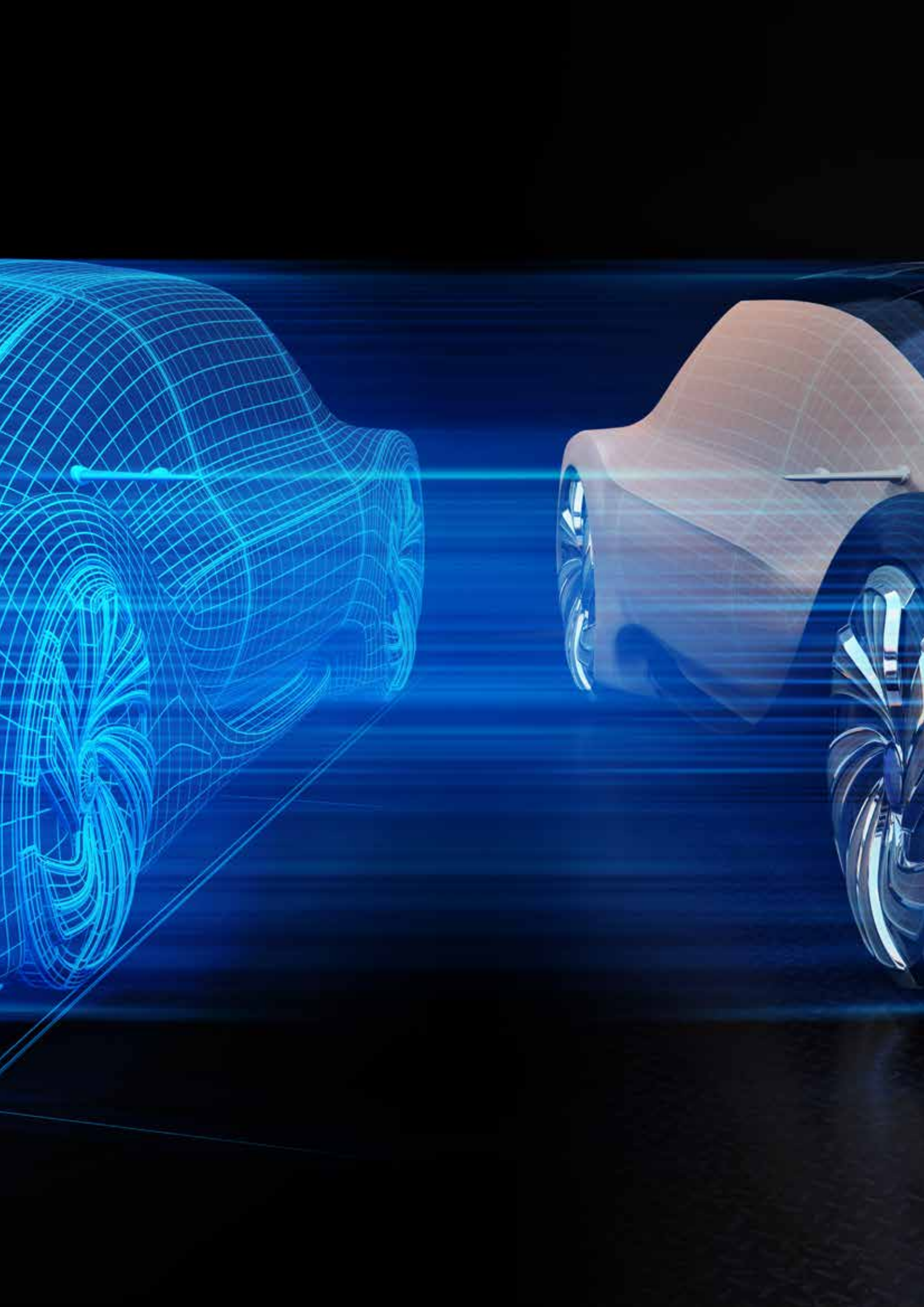
UNIVERSITY OF TWENTE. | FRAUNHOFER INNOVATION PLATFORM FOR ADVANCED MANUFACTURING

WHITE PAPER

FACTORY OF THE FUTURE

SEVEN CHANGE DRIVERS FOR SMART MANUFACTURING



CONTENTS

INTRODUCTION

What will the factory of the future look like? An intriguing question that no one can answer for sure, considering the racing speed of technological developments. But you will probably see highly automized and super flexible production systems, with automatic guided vehicles (AGVs) driving around for all intralogistics, supervised by people wearing AR glasses to check if everything runs smoothly. The human involvement in the manufacturing process will change drastically. The capabilities of both humans and machines will be combined optimally and synergetic. That could mean human hands are still assembling highly complex products, but in some cases humans will move to a control level, guaranteeing error-free, efficient and sustainable production, with increased quality and reduction of costs. Those benefits are why companies are pushing for smart manufacturing in the first place.

Will factories in the future completely run autonomously? No, probably not. The human factor will not be erased, which is always feared when new technologies emerge. Their role will definitely change, but people will stay in the driver seat. And that is not because there will always remain things that cannot be digitized or automated, it's because companies need their people; they are the core and culture of the organization, not the machines. In the end, companies themselves have the wheel and will decide which way to go and what the right balance is.

Topics like digital twinning, VR/AR in manufacturing, 5G in production, artificial intelligence and 3D printing, to name a few, will all affect the future of the manufacturing industry. With every technology and every new option, companies need to figure out what is in it for them. How can they make it work in their advantage? Since there are so many factors that come into play and so many routes they can take, it can be a challenge not to lose sight on the bigger picture. Change is necessary – most of the times at least – but it is not sufficient to just buy a cobot or implement an advanced MES system. You need to start small, take it step by step, but you will also get lost without well thought-out mid-term and a long-term roadmaps.

SEVEN DRIVERS FOR CHANGE

The manufacturing industry has come a long way. From the introduction of steam and water powered machines during the First Industrial Revolution, through the rapid rise of mass production, industrialization and electrification in the late 19th century and early 20th century, to the digital revolution with the fast progress in computer technology. Currently, the industry is in the middle of the fourth industrial revolution, which evolves around the blending of technologies like artificial intelligence, cyber-physical systems (CPS), (industrial) internet of things and cloud computing. Connectivity is at the center of it all; extensive machine-to-machine communication to the point of an internet of systems and components all talking to each other over a worldwide network.

You might get overwhelmed by all opportunities that are out there, and all new technologies you have to get acquainted with to follow (or even lead) in this revolution. And for this might indeed be a challenge, it's no rocket science. There is logic behind all of it. We have identified seven drivers for the change and listed them to shed some light on the pillars under the transformation to a smarter factory.

1. DIGITALIZATION AND INDUSTRY 4.0

For many, Industry 4.0 is what the factory of the future is all about. Digital technologies such as advanced human-machine interfaces, data science, IoT platforms, AI, and the extensive exchange of data are pushing the manufacturing industry forward. Digitalization is the game changer on your road to Smart Manufacturing. Huge opportunities present themselves because of Industry 4.0.

On the other hand, digitalization is just one piece of the puzzle. The future of manufacturing is much broader. You can advance and improve in other areas as well. For some, all technical advances are 'only' the enabler for their much larger plans.

2. SUSTAINABLE MANUFACTURING

The manufacturing industry is the sector with the highest contribution to global greenhouse gas emissions. You can talk about reducing flight movements and choosing the bike over the car – which are of course still valid and important points – but sustainable manufacturing is way more relevant. Truth be told, most emissions come from heavy processing industries, like oil & gas, or steel production, but as a whole the sector has to tackle this issue.

In the future, companies will optimize their operations and production based on the use of energy and resources. They will know where their materials are coming from, and reduce the required energy to a minimum. With the current sky-high energy prizes, the latter isn't only good for the environment.

3. NEW PRODUCTS AND BUSINESS MODELS

Digitalization with its availability of data and connectivity of systems also stimulates a trend towards new products, services and related business models. You might not sell the product, but only sell the use of it. As-a-service models are all the rage. Think car sharing, where you only pay for the time and kilometers you have used the vehicle. Printer vendors are already well underway on this terrain; users don't own the printer at their desk but are billed for the number of prints they make. The same can be done for every machine in your factories. The wide availability of data opens the doors to advanced support services and innovative apps like we are familiar with on our smartphones.

4. HIGHLY CUSTOMIZED PRODUCTS

From ordering their own special cereal mix online, to designing their own sneakers, customers nowadays crave for personalized products. That puts a strain on the traditional efficiency-driven method of mass production. Factories can no longer deliver a million identical parts, they need to diversify, with flexible production systems, moving to efficient and cost effective manufacturing of lot size 1. Of course, this trend isn't valid for all manufacturing areas, since some products will be mass produced for a long time to come. But when you get to higher value products, the likelier it becomes that customization is required.

5. EMERGING PRODUCTION ALTERNATIVES

It's not just advancing information and communication technology that is pushing the manufacturing industry. Also on the hardware side, more options become available. Additive manufacturing is already a classical example here. 3D printing is challenging traditional manufacturing techniques such as injection molding and casting, offering companies a more flexible alternative. AI-powered robots, AGVs and cobots are other promising options to improve the flexibility and efficiency of production lines and factories.

6. RESILIENCE OF PRODUCTION

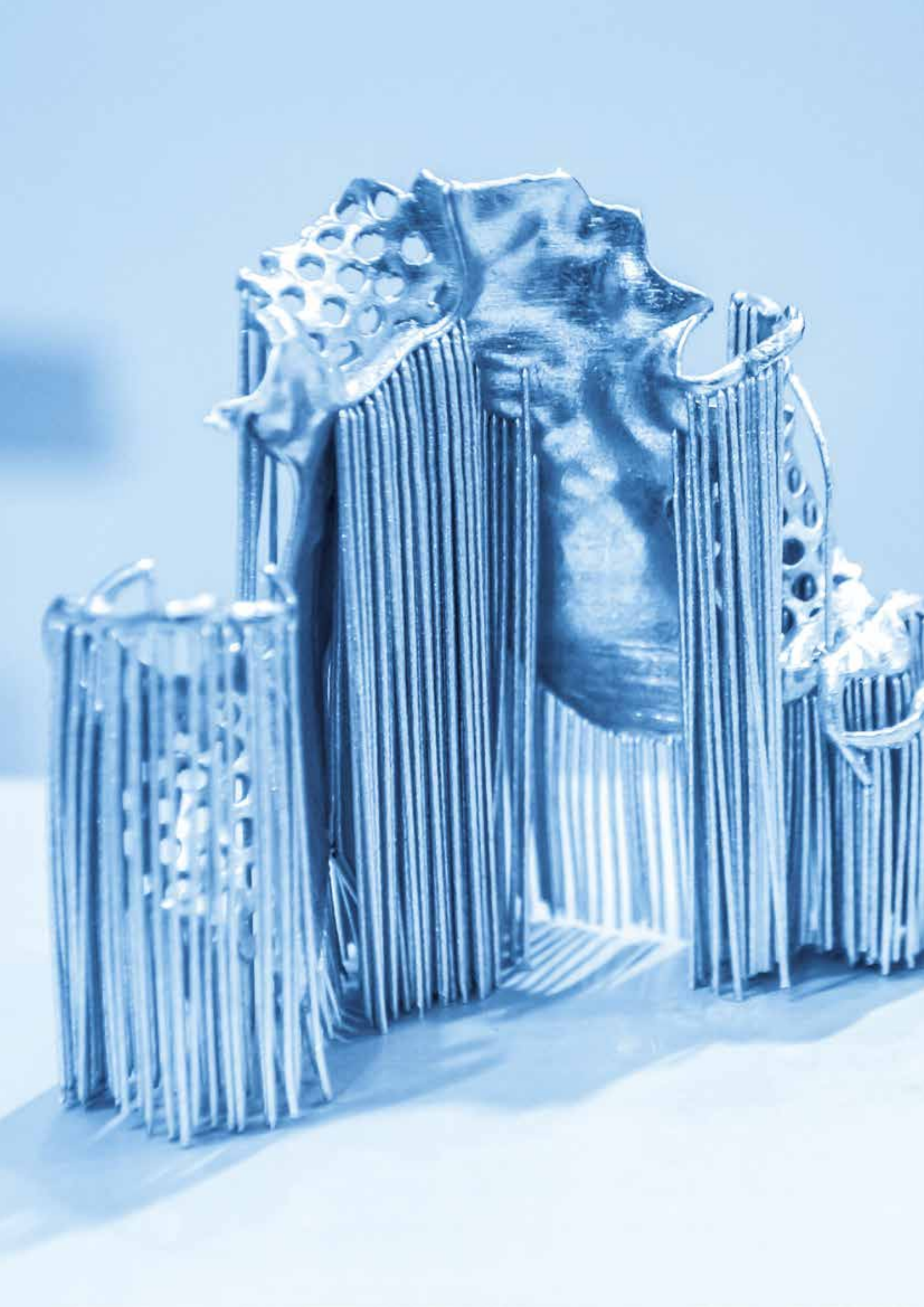
This wasn't a real big issue before, but the Covid-19 crisis has opened many eyes. Due to all necessary lockdowns, factories stopped producing and supply chains stuttered. So, resilience in production and delivery has become a hot topic in many board rooms. The war in Ukraine, and even the blockage of the Suez channel, show the strong dependency on global supply chains, how fragile they actually are and how susceptible they can be for unexpected disturbances. Be careful not to take things for granted.

Companies are beginning to reconsider the outsourcing of production to low-income countries, asking themselves the question: do we want to produce more locally again, or closer to our headquarter to have more control? And, where are our raw materials coming from and how can we make that flow as resilient as possible? Some organizations are building an ecosystem around themselves so they are not dependent on one supplier, but have multiple options in their network. Some are even moving towards urban manufacturing, bringing the production site as close to the end customer as possible, thereby cutting down on transportation.

7. SOCIAL ASPECTS

Often underrated or even ignored, but social aspects are an important driving force in the journey to Smart Manufacturing. For starters, we are in the middle of a demographic change, so more and more elder people have to be integrated in the digital transformation. But also younger generations can lack the proper skills. Being able to operate a smartphone doesn't make you a digital native after all.

Also, because of ever stricter regulations and stronger emphasis on employee experience, health and safety issues are more significant than ever. Ergonomic and human-centered workspaces could be a solution to keep your employees happy and motivated, which is crucial in the war on talent and to overcome the image problem that the manufacturing industry seems to have.



TIPS ON HOW TO START

As said, it can be daunting to transform your factory to a manufacturing system of the future. Where best to start, depends on your company and its culture. Most often it begins at C-level management. CEO, CTO, CFO, COO, CPO, they all need to be aligned first and agree upon the vision of a smart factory. They need to understand what the transformation means for them, and how they can benefit from it. Also, they have to come up with a mission, a target, and a short-term, mid-term and long-term roadmap how to get there.

Start where you are

You don't need to kick off by immediately implementing a complete MES platform or introducing a full CAQ system. That has been a trap for many companies already. Start at your current situation, with the machines and systems that are already in place. You would be surprised, maybe even shocked, how much progress you can make by just analyzing where you are at the moment. In practice it happens frequently that systems and machines aren't used properly or not reaching their full potential. That may be due to, for instance, a loss of knowledge as the person responsible for the implementation has left the company. So understanding your starting point is a necessity. Only than you can identify bottlenecks, determine improvements and make real progress.

Don't aim for the fences by trying to implement the big solution at once. That will set you up to fail because it involves high efforts with little chance on immediate payback. Instead, identify meaningful and complementary use cases on a smaller scale; that is your low hanging fruit and creates the success story you need.

Seeing is believing. To trigger everyone in the organization you have to show the benefits of the change. No major shifts are needed to achieve that. You might be considering the implementation of a full MES system.

That might be indeed the best solution for you, but keep in mind that if you don't make sure it will land well in the organization, you run the risk that your big investment will not bring the improvements you were hoping for. In fact, it's much better to start small, dissect the process in digestible pieces, demonstrate the gains and make it tangible. Take your people through the process, step by step.

People management

Although technology is a big booster and a huge enabler for Smart Manufacturing, it is definitely not the whole story. In fact, many organizations struggle with something else entirely. Yes, at management level all may face the same direction, but in the end everyone will be affected by the transformation. From the top to the operators on the shopfloor since they are the ones with the day-to-day, hands-on experience. Often, the biggest hurdle is convincing everybody to get on board. So find yourself a change manager, maybe even a whole team, to drive the process and to motivate everyone. That person needs to keep pushing because you can't expect to be finished in one or two years; the transformation is a continuous process of changes and improvements.

And it's not only good people management and making sure everyone is facing the same direction. It is just as much about overcoming the boundaries between the departments within your organization. When everyone keeps operating within their own silo, true multidisciplinary and highly optimized solutions are simply out of the question.

New responsibilities and new ways of working also require a new set of skills. New qualification profiles are in order, so your employees need to be trained, not once or twice, but throughout their full career.

ABOUT THE FRAUNHOFER INNOVATION PLATFORM FOR ADVANCED MANUFACTURING

Originally known as the Fraunhofer Project Center at the University of Twente, the Fraunhofer Innovation Platform for Advanced Manufacturing emerged in 2022, continuing the strong collaboration between the Fraunhofer Institute for Production Technology IPT in Aachen and the University of Twente in the Netherlands.

The Fraunhofer Innovation Platform for Advanced Manufacturing at the University of Twente (FIP-AM@UT) is a research centre that collaborates with manufacturers to develop innovative and integrated solutions to serve and strengthen the industrial manufacturing community and benefit society as a whole.

FIP-AM@UT's primary goal is to strengthen and diversify the manufacturing sector in the Netherlands to ensure ongoing adaptability, competitiveness and efficiency. This can be accomplished by bringing highly skilled researchers and supporting staff to the region.

Their secondary goal is to source and develop innovative thinkers by engaging them in cutting-edge applied research for both industrial and public clients, and by promoting technology transfer through the joint exploitation of results. FIP-AM@UT is part of the University of Twente (UT), the only campus university in the Netherlands. Divided over five faculties, it provides more than fifty educational programmes. In addition, UT has a strong focus on personal development, aiding and encouraging talented researchers to conduct groundbreaking research.

HOW WE CAN HELP YOU

Fraunhofer Innovation Platform for Advanced Manufacturing at the University of Twente is in the ideal position to translate the theoretical knowledge at the academic level to the real-world operation at the factory floor. Bridging the gap between research and practice is our core competence. We can help you get underway, finding the right track, guide you from a push to a pull in your digital metamorphosis.

To start, we will evaluate your current situation together, and assist you in defining your end goal and the road to take. Then, we help you to create the best use cases, build proofs of concept and get to the first results. Those success stories will show the added value of the transformation and will motivate your people to join.

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