

INNOVATIE NU

December 2023

10



THE FUTURE OF
MANUFACTURING

Steps of an audit:

1

Industry 4.0 Quick Scan

A brief investigation to develop an understanding of your specific needs, goals, and expected challenges to scope a tailored audit approach.

2

Current State Analysis

Receive an expert breakdown of your current processes and Industry 4.0 competencies.

3

Benchmark & Gap Analysis

Identify your competitive environment, your position within the industry, and potential gaps.

4

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5

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A MESSAGE FROM THE EDITORS

On Tuesday, 10th October, the University of Twente proudly opened its Advanced Manufacturing Centre. This AMC provides a long-awaited equipment base to support the offerings of the Fraunhofer Innovation Platform for Advanced Manufacturing at the University of Twente (FIP-AM@UT). Local manufacturers can collaborate with FIP-AM@UT to explore how advanced manufacturing technologies can be used to further their own offerings through a ‘test before invest’ concept. Companies are facing increased pressure from all directions and in countries like the Netherlands the demand must be focused on high added-value due to high labour costs and other socio-economic factors. Efficiencies must therefore also be high and the increased focus on environmental impact requires us all to think about how we can reduce energy costs and material wastage.

Every engineer understands the principles of inertia. It is much easier for manufacturers to remain moving in one direction than to instigate change. This form of organizational inertia has worked for many companies in the past. However, disruptions like COVID have proven that if a company is unwilling or unable to quickly change, it could easily go out of business. Modelling manufacturing processes at a digital level and having technology that can be easily adapted to new purposes can reduce the energy and cost required to implement change when required. With the world that we are seeing today, advanced manufacturing technology can be a good option towards future-proofing our local manufacturing industry.

IAN GIBSON

Director

*Fraunhofer Innovation Platform
for Advanced Manufacturing
at the University of Twente*

In the spirit of progress that my co-editor so aptly described with the opening of the University of Twente’s Advanced Manufacturing Centre, this edition of our magazine widens the lens to the vast business landscape. We’re not only toasting to the grand opening of a cutting-edge centre (and our magazine’s 10th issue, no less); we’re welcoming the start of an exciting new chapter in the way businesses work.

In the articles that follow, you will discover how cutting-edge technologies like ChatGPT, generative design, and additive manufacturing (AM) are injecting unprecedented value into various business operations—from human resources and supply chains to customer service and sales—and across a multitude of industries.

These innovations may not have the shock value of the steam engine or the internet, but their impact is no less significant. Instead of inventing the wheel, the innovations we’re focusing on today are enhancing the wheel’s performance, refining and redefining processes with a level of sophistication and efficiency that far surpasses the old models. This reflects a broader trend where the driving force behind today’s tech evolution is not the invention of brand new technologies but the ingenious integration of existing ones. These integrations are not just improvements; they are leaps in capability, enabling us to do familiar things in unfamiliarly effective ways.

Echoing my co-editor’s insights, we recognize that the manufacturing sector, particularly in high-cost socio-economic environments like the Netherlands, is under immense pressure to deliver high value. The AMC, with its ‘test before invest’ concept, is a beacon for companies navigating these pressures, offering a tangible way to embrace these (unfamiliar) advanced manufacturing technologies. It’s about minimizing the inertia that so often holds firms back, providing the tools and the testbeds to adapt swiftly and sustainably.

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ADDITIVE MANUFACTURING

FUTURE-PROOFING

THROUGH THE

Advanced Manufacturing Centre

In a world where technology is rapidly advancing and consumer demands are evolving, manufacturers face constant challenges. The pressure to provide better products with shorter time-to-market and lower costs is unrelenting. Moreover, consumers often demand solutions requiring low batch sizes or customised features, providing additional layers of complexity to the manufacturing process. A possible way to address these challenges lies in advanced manufacturing technology, supported by digital models and other innovative concepts. The Fraunhofer Innovation Platform for Advanced Manufacturing at the University of Twente (FIP-AM@UT) has taken a significant step towards assisting manufacturers by opening the Advanced Manufacturing Centre (AMC) on the Kennispark next to the university in Enschede, Overijssel.

The opening of the AMC is not only a milestone for the University of Twente but also a pivotal moment for the entire Netherlands. It provides a unique platform where companies can explore and test ideas, paving the way towards the best possible solutions before committing to substantial investments. This can be particularly beneficial for small businesses who may lack the resources to undertake their own research and development initiatives.

The AMC boasts a distinctive capability, centred around two major demonstrators: one focused integrating 3D printing into the process chain, and the other on a reconfigurable, modular assembly processes. These demonstrators are highly automated and supported by sophisticated digital twins that are continuously fed with real-time data, allowing companies to experiment with cutting-edge technologies and processes in a risk-free environment.

The AMC addresses the pressing needs of manufacturing industries in the region, focusing on improving their processes through technological advancements. Most manufacturers can no longer rely on traditional methods to stay competitive. To thrive in today's dynamic business landscape, they must embrace innovation and adapt to the ever-evolving market. The AMC provides a fertile ground for exploration, experimentation, and innovation.

The AMC's commitment to supporting local businesses is a testament to the importance of collaboration between academia, industry, and research institutes. It leverages the multi-disciplinary team of highly motivated research engineers at FIP-AM@UT who are dedicated to providing solutions for local manufacturers.

**Most
manufacturers
can no
longer rely
on traditional
methods to stay
competitive.**

The University of Twente, along with its international partner, the Fraunhofer Institute for Production Technology, based in Aachen, Germany, bring a wealth of knowledge and expertise to the table. This alliance forms the backbone of the AMC's knowledge-base, ensuring that state-of-the-art concepts can be explored for the benefit of industries in the region.

A unique selling point of the AMC is its focus on delivering value to businesses of all sizes. Small businesses, in particular, stand to gain significantly from this resource. They often lack the financial means and manpower to embark on their research and development projects. The AMC offers them a lifeline, providing access to cutting-edge technologies and expertise that would otherwise be beyond their reach. By offering a platform to experiment with new ideas and concepts, the AMC empowers small businesses to remain competitive in a rapidly changing industry landscape.

However, large manufacturing organisations can also tap into the AMC, since all companies struggle to test out new ideas unless they have the luxury of an experimental platform. The AMC's demonstrators showcase the potential of advanced manufacturing techniques that can revolutionize how products are designed, manufactured, and delivered to market. By facilitating hands-on experience with these technologies, manufacturers can make informed decisions, reducing the risks associated with costly investments.

Digital twins play a crucial role in the AMC's operations. These digital replicas of physical systems allow manufacturers to simulate and optimize their production processes in a virtual environment. By constantly collecting and analysing real-time data from physical processes, digital twins enable companies to fine-tune their operations for maximum efficiency and productivity. The AMC's integration of these tools ensures that manufacturers have access to cutting-edge technology that can drive their businesses forward.

FIP-AM@UT's commitment to the local manufacturing industry is further demonstrated by the support it receives from regional, national, and European funding. This backing solidifies the AMC as a one-stop shop for companies looking to explore smart industry solutions tailored to their specific needs. The combination of funding and expertise provides a unique opportunity for manufacturers to tap into global knowledge and resources while focusing on solving local challenges.

In conclusion, the opening of the Advanced Manufacturing Centre is a significant step toward future-proofing manufacturing industry in the Netherlands. By providing a platform for companies of all sizes to explore, experiment, and innovate, the AMC empowers manufacturers to stay competitive in an ever-changing landscape. With the support of regional, national, and European funding, and FIP-AM@UT's team of dedicated

A possible way to address these challenges lies in advanced manufacturing technology, supported by digital models and other innovative concepts.

research engineers, the AMC is poised to drive technological advancements and foster a culture of innovation in the manufacturing sector. As manufacturers embrace the opportunities offered by the AMC, they will not only enhance their competitiveness but also contribute to the growth and sustainability of the Dutch manufacturing industry. ■

THE AI REVOLUTION

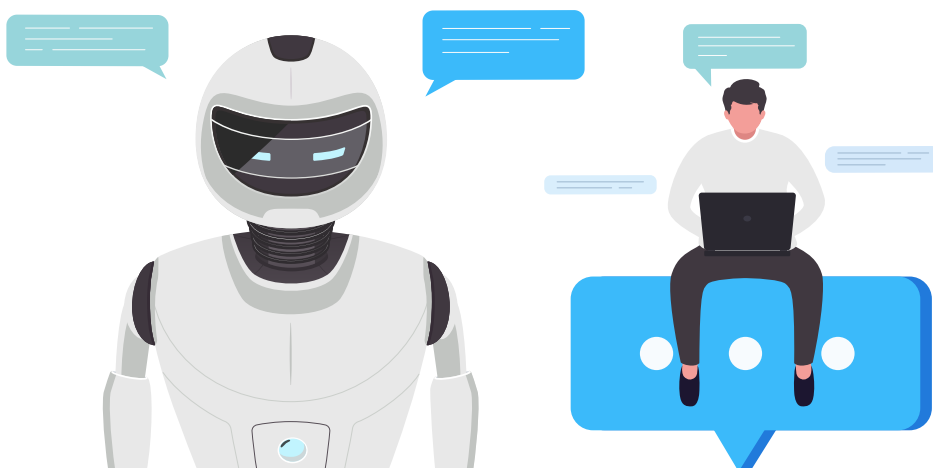
IN MANUFACTURING MARKETING

The manufacturing sector has come a long way since the advent of digital technologies and the emergence of the smart factory. As we enter the fifth industrial revolution, where humans and machines will work synergistically, it is time for marketing teams to incorporate digital transformation into their strategies too. AI plays a pivotal role by enabling manufacturers to create and scale targeted campaigns that can improve customer experiences and promote smarter working practices.

The AI advantage: The evolution of manufacturing marketing

The second industrial revolution of the late 1800s heralded a period of unprecedented change in the way manufacturers produced goods. With mass production being possible for the first time, businesses could reach much larger audiences, and thus the concept of marketing was born.

That basic concept – to promote a company's products or services – has remained largely the same ever since. But today, instead of print ads, billboards, and TV commercials, marketers are turning to strategies that emphasise the importance of the customer experience. In doing so, they are investing heavily in creating content that delivers real value to their audiences.



As an old-world industry, many manufacturers still rely heavily on traditional marketing methods such as industry events and networking to find distributors, retailers, and other buyers for their products. They also rely on these channels to generate leads and referrals. While there is nothing wrong with these methods, digital strategies present many additional opportunities, especially when augmented using the power of artificial intelligence.

AI has the advantage that it can augment and scale marketing strategies and goals, including customer segmentation, content personalisation, and predictive analytics. Given that around three quarters of manufacturers have fewer than nine employees in their marketing departments¹, AI has substantial potential to overcome the problem of limited resources.

Making the case for AI: Why manufacturers need AI in marketing

Many manufacturers have already made the transition to digital marketing to improve sales, increase brand

awareness, and reach broader audiences. Some of the most important tactics include leveraging online reviews and testimonials, publishing videos and blogs, and social media marketing. However, challenges remain, particularly regarding producing high-quality content, accurately measuring campaign performance, and aligning strategy with the buyer journey.

To remain relevant, manufacturers must step up their marketing by investing in solutions and expertise that help them scale their operations. The key advantage of AI is that it works at machine speed to analyse the increasingly vast amounts of data that organisations collect during their day-to-day operations. AI can turn data into insight by identifying patterns and trends. This provides a complete overview of customer behaviour for decision-makers to understand what works and what does not, ensuring that their budgets do not go to waste.

The scalability benefit of AI cannot be underestimated. Few manufacturers have a fully staffed marketing department, which is understandable

when topics like research and development (R&D), and production line optimisation and maintenance are prioritised. However, like any business, they also need to attract customers by standing out in a highly competitive landscape. By assisting in the creation of personalised customer outreach strategies and data-driven decision making, AI lets lean marketing teams achieve more.

Building better relationships: How AI improves customer experience

Customer experience is the new marketing, simply because the experience that a customer has when dealing with a business is what ultimately determines their loyalty to the brand and the likelihood of their recommending it to others. Customer experience is important for any business, but in few cases is it more vital than in the manufacturing space, which typically involves very large transactions and long-term relationships with distributors and retailers.

It might sound counterintuitive at a time when people have grown tired of things like chatbots and auto attendants, but AI can also greatly improve the customer experience. As with almost any innovation, uptake and success depends on the deployment strategies.

After all, the last thing a manufacturer wants when looking to expand its business is to have high-intent leads being turned away because they are unable to speak to a human in the sales team.

AI comes in many different forms, and it has reached the point where it has valuable utility in every stage of the sales and marketing cycle. For example, sentiment analysis can analyse customer communications to identify high-intent leads, while hyper-personalisation can precisely target the right people instead of bombarding them with irrelevant advertising content.

Augment, not replace: How AI helps marketing teams work smarter

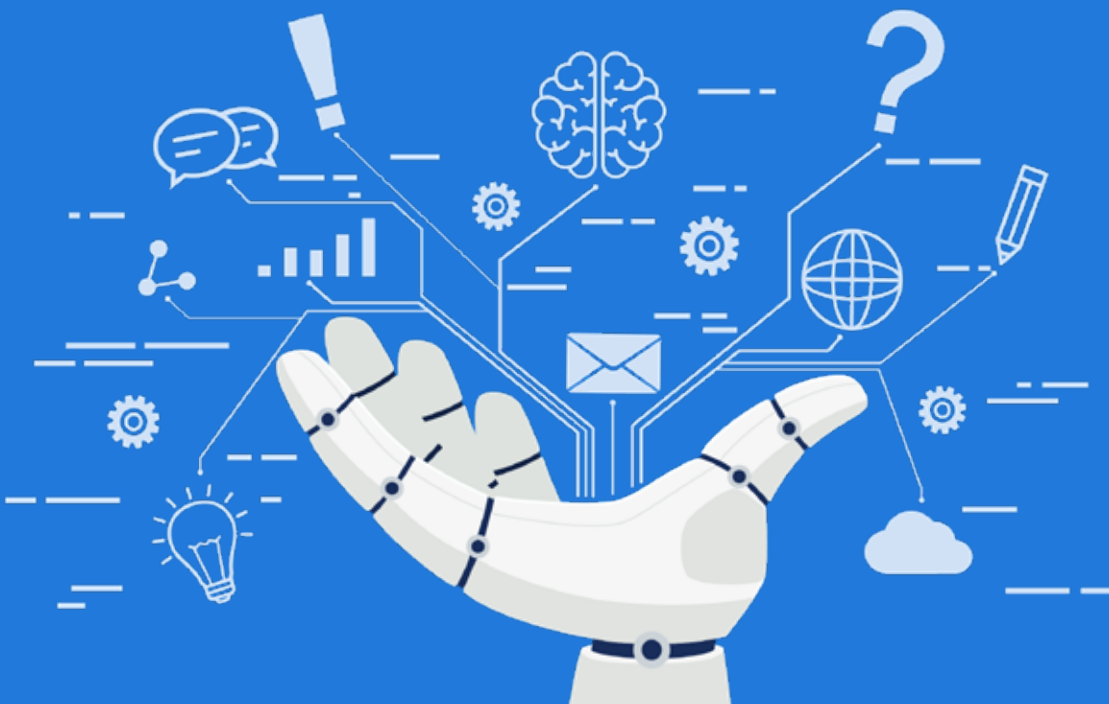
While AI is undoubtedly a powerful tool, it should not be viewed primarily as a way to reduce costs or replace human talent. Effective marketing requires a set of innately human skills, such as creativity and critical thinking. Over-reliance on AI, especially when creating content, strips away the human element and, in doing so, erodes trust and authenticity – two things that B2B (or business-to-business) customer relationships are built on. Instead, AI must work in tandem with marketing teams to augment their abilities and free up time for people to focus on building real and meaningful relationships with

their audiences. AI is not a silver bullet, but it is vital for automating repetitive tasks such as data entry and analysis, which are two things that marketing relies heavily upon.

To get the most out of AI, it is important to ask the right questions and set measurable goals. For example, instead of thinking about how you can use AI to reduce marketing overheads, you should be asking how it can automate steps such as outreach and lead generation. This approach has the overarching goal of reducing repetitive tasks for human teams so that they can better serve their customers. Furthermore, instead of asking what customers want, consider which specific features and functions they value in your products, so that AI can provide tailored insights to inform marketing strategies.

The future is now

Incorporating AI into marketing strategies is no longer just a trend for technology companies. It has now become a necessity for manufacturers to thrive in a competitive market, not to mention an uncertain economy. By leveraging AI to automate tasks, create personalised experiences, and empower people to work smarter, manufacturers can achieve more with less. The future is now, and AI is leading that transformation. ■



Sources

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AN INTERVIEW WITH FRANS GENEE

MANAGING PARTNER
AT PI CONSULTANCY, *THE GRANT EXPERTS.*

In this special interview, we dive into the world of regional funding and innovation with Frans Genee, a seasoned grant consultant. With a 25-year career, Frans has played a pivotal role in forming alliances between public and private sectors to transform cutting-edge concepts into real-world products. Frans works with a diverse range of clients, including SMEs, large enterprises, and renowned universities, who are focused on research and development in fields from healthcare to manufacturing technology.

Frans is a key player in East Netherlands' manufacturing community, with a passion for tackling challenges and promoting innovation. He's all about learning and teamwork, finding creative solutions to research and development problems leading to exciting projects like the Advanced Manufacturing Center (AMC), Industry 4.0 initiatives, and the FACTORY2030 project.

We explore Frans's journey to his current position, the importance of manufacturing in East Netherlands, and the role of regional funding in the larger economic landscape. We also examine what manufacturing firms must consider when searching for funding, as well as how sustainability and innovation impact funding decisions.



Nowadays Pi Consultancy has 6 partners, covering all relevant fields of expertise to provide full subsidy and innovation consultancy services.

How did you connect to FIP-AM@UT and what is your contribution to their development?

My first contacts with Fraunhofer Innovation Platform (FIP-AM@UT) were initiated within my network. Introduced by one of my dear clients, IMS in Almelo, I succeeded in developing an R&D-project on advanced vision technology and applying for EFRO-subsidy. With FIP being the main project leader, this PRISMA project was the stepping stone towards developing a strategy with a range of new programs and projects. We have managed to successfully apply for RegioDeal funding, for the Advanced Manufacturing Program (AMP) at FIP. This AMP offers industrial SMEs in East Netherlands dedicated R&D-support towards exploring and adapting smart industry solutions.

Based on this AMP, we also developed and executed the Industry 4.0 investment project to establish the Advanced Manufacturing Centre (AMC), funded by REACT-subsidy. At the AMC,

manufacturing companies can be introduced to state-of-the-art machinery, tooling, and equipment for Advanced and Additive Manufacturing, and get inspired, or even have the opportunity for pilot production.



To create a common understanding of the capabilities of the AMC, matching to the needs and demands from industry, we've joined forces within the EDIH-Boost initiative and managed to secure subsidy from the European Commission. EDIH-Boost offers SMEs cost-effective propositions to learn how they can implement Industry 4.0 to their own production processes, in various steps of "test-before-invest".

In parallel, we have built FACTORY2030, one of the collaborative Smart Industry projects within the NEXT-GENERATION HIGH-TECH

program for which 450 million euros subsidy has been awarded this year by the Nationaal Groeifonds. FACTORY2030 deals with technological challenges in manufacturing processes for a.o. innovative medical devices and energy transition solutions such as batteries and heatpumps.

And succeeding the outcomes of the PRISMA project, we have constructed the BRAINS project, also funded by EFRO-Oost subsidy. BRAINS builds on the data acquisition from vision and sensing systems in production processes, developing data learning principles to improve product quality. Next to FIP, the innovation hub Perron038 in Zwolle is also involved in BRAINS, for dissemination activities. Perron038 is currently executing a similar REACT-project for its Lighthouse Labs, as FIP for AMC. Both innovation hubs offer related, but distinctive state-of-the-art production facilities and equipment to manufacturing companies, spanning the Province of Overijssel from Twente to Zwolle. This could be one of the valuable structures for further collaboration between University of Twente and Windesheim University of Applied Sciences, focusing on innovative research and future technical staffing for manufacturing industry.

How did you get to this position? The journey you took.



After my graduation from the Faculty of Economics at the University of Amsterdam, I started working at a vocational training institute. At that time, beginning of the '90s, a new subsidy program from the European Social Fund was launched. I was challenged by my manager to apply for subsidy. So, I started with studying and understanding the rules and criteria for funding, developed a project to train process engineers in food manufacturing and managed to submit the very first application in the Netherlands for that program. I still remember its reference number: ADAPT-001. Also because of its success, winning that first subsidy left me wanting more.

Both my competitive nature, my creativity towards new approaches and my analytical and communication skills were triggered. I decided to start my career path towards subsidy consultancy. After working for larger consultancies, I started Pi Consultancy in 2013, building a strong position in the high-tech industry and manufacturing community in East Netherlands, with many innovative projects, new collaborations, and successful grant applications.

Nowadays Pi Consultancy has 6 partners, covering all relevant fields of expertise to provide full subsidy and innovation consultancy services.

Can you provide an overview of the current state of regional funding opportunities for manufacturing organisation?




FIP's funded project portfolio is quite impressive. The regional funding programs have enabled the keen positioning, investments, and outreach of FIP to manufacturing companies.

Although some programs have ended, there are still many opportunities for companies to benefit. First, the **AMP** is open, until the end of this year, for SMEs to onboard feasibility studies and explorations towards smart industry solutions. AMP offers no subsidy, but more some kind of "free R&D-support" from FIP.

Almost similar to AMP, the **EDIH-Boost** program offers SMEs a significant discount on test-before-invest services provided by various Smart Industry field labs. Regional innovation brokers can direct SMEs to

these services and field labs. Furthermore, the **EFRO-Oost** program is open for new applications. Collaborative R&D-projects, in which at least one SME participates, on topics as technological innovation and smart renewable energy systems, can get up to 1 million euro subsidy. Applications are evaluated against 5 strict criteria, so it is crucial to submit a high-quality proposal.

Other regional funding programs such as the **MIT Haalbaarheidsprojecten** (for feasibility studies at SMEs) and **MIT- R&D samenwerkingsprojecten** (for collaborative R&D at SMEs) are currently closed. As they have a yearly opening, it's always good to have a keen eye on these opportunities.



Twente is famous for its strong foothold in various industries, a.o. textiles production, metal processing and high-tech.

In your opinion how important is the manufacturing industry for East NL?



As we all know, manufacturing industry is one of the key drivers of regional economy. These companies rely on a dedicated value chain, comprising of many suppliers and subcontractors in their region. The same counts for East Netherlands, especially due to its history. Twente is famous for its strong foothold in various industries, a.o. textiles production, metal processing and high-tech. One example of such a long-lasting technology-driven company in Twente is Hazemeijer, later renamed Hollandse Signaalapparaten and currently known as Thales. This multinational has endeavored all kinds of global changes and challenges in the last decades and has proven to be agile and sustainable. Nowadays Thales is still the

core of an extensive regional network of all sorts of supplying companies, including some of their own spin-off companies, contributing to job creation and economic growth. And the establishment of the University of Twente, starting as Technische Hogeschool Twente in the '60s, was instigated by the regional potential of technological innovations and industrial needs for R&D and academic staffing. So, through the years the importance of the manufacturing industry for East Netherlands have only increased. Finally, recent developments from Industry 4.0 solutions enable profitable business cases on insourcing, leading to the establishment of new production facilities, thus strengthening the regional value chain once again.

How does regional funding align with broader economic development goals for the region?



Fostering the impact of manufacturing industry is depicted by the extensive ecosystem on technological innovations. Not only are there various supporting organisations, such as OostNL and Kennispark, but led by a.o. the Provincie Overijssel and Twenteboard there are always developments on new policies, programs and budgets for attracting, retaining and strengthening the manufacturing industry. Also engaging with similar initiatives abroad, such as just across the border in Germany within the Interreg program, strengthens the competitive position of our manufacturing industry. One actual example is the collaboration from UT

with the Battery Cell Production initiative in Münster. In close connection with parallel R&D-activities in the NEXT-GENERATION HIGHTECH program, a leading position in this very promising market can be obtained. And from these kind of promising economic perspectives, funding programs and budgets will be constantly evaluated and become available.



What role does innovation and sustainability play in the evaluation criteria for regional funding programs?



Funding programs, both regional, national or even on a European level, are intended to stimulate innovations. The subsidy is a financial trigger to start working on “risky business”, based on a new idea for a product, process or technology, in general or in a specific domain. The level of innovation, “new to your company” up to “new for the world”, guides you to the actual funding programs and budgets. In general: the higher the level of innovation, the newer the idea, the better are the chances for a match with a subsidy program, and actual a high score on the relevant criteria.

Another issue that is increasingly important in the evaluation of

applications is the impact to sustainability. If not the direct goal of such a program, projects need to show at least a neutral ecological impact, but obviously much better is a positive contribution to ecological sustainability. We see an increase in projects that innovate on material usage, both in matter (renewable, biobased instead of fossil) as in waste reduction, by improving production processes towards “first time right” and zero-defects. The BRAINS project uses AI to predict the product quality automatically, so that the process can be aligned, improved or even stopped in order to prevent valuable loss of resources.

What are the key factors that manufacturing companies should consider when seeking regional funding?



As you might imagine, the number of projects, programs, initiatives, networks in East Netherlands are huge. How can a company, an SME, find its way and benefit from this? Well, one thing is sure: be open to collaboration and get connected. Find your way through field labs such as FIP, as one of the key-drivers of Industry 4.0 implications. Otherwise, if you have some kind of innovative idea, just reach out to me or one of my colleagues, and we will be happy to check your opportunities to connect and collaborate. Moreover, we will look into funding opportunities. To

get maximum benefit, an early start is required. In that way you can finetune your project to the requirements of any funding program. ■



THE FUTURE OF ADVANCED MANUFACTURING

ACCORDING TO CHATGPT

_Human_Input: The future of manufacturing is undoubtedly highly reliant on upcoming digital developments. In the current industrial transformation, we see the biggest shift in operations is due to digital developments, such as automation, robotization, and digitization of processes. Big data and Artificial Intelligence are playing an increasingly important role and will influence the shaping of future manufacturing. The introduction of ChatGPT, an artificially trained intelligent chatbot, marks one of the greatest leaps forward in AI technology, now embraced by individuals and businesses alike. To explore its capabilities, we asked ChatGPT to write an article on the upcoming trends in Advanced Manufacturing. Whether this chatbot can meet the standards and expectations for high-end informative articles is now up to you, but it for sure has been fun to experiment with!

_Query: I need a semi-scientific article on Upcoming Trends in Advanced Manufacturing, what the future holds. The length should be around 800 words.



Title: Exploring Upcoming Trends in Advanced Manufacturing: Illuminating the Path to the Future

Introduction (*approximately 100 words*): The realm of advanced manufacturing has been witnessing remarkable advancements, propelling industries into new dimensions of productivity, efficiency, and innovation. As we look to the future, several emerging trends are poised to revolutionize the landscape even further. This article aims to delve into these exciting developments, shedding light on the potential they hold for the manufacturing sector. From additive

manufacturing and automation to artificial intelligence and sustainable practices, we will explore how these trends are shaping the future of advanced manufacturing.

Additive Manufacturing and 3D Printing (*approximately 200 words*): Additive manufacturing, commonly known as 3D printing, has emerged as a transformative force in the manufacturing industry. Its ability to produce complex and customized components with precision and speed has already revolutionized several sectors. Looking ahead, we can expect further advancements

in materials, processes, and scale. New materials, such as graphene and carbon nanotubes, will enable the production of stronger, lighter, and more resilient products. Additionally, the scale of 3D printing is likely to expand, enabling the manufacturing of larger structures, including entire buildings and infrastructure. The convergence of 3D printing with other technologies, such as robotics and machine learning, will unlock novel applications and accelerate the adoption of this disruptive manufacturing technique.

Automation and Robotics

(approximately 200 words): Automation and robotics have been steadily transforming manufacturing operations, driving efficiency, reducing costs, and enhancing safety. The future of advanced manufacturing will see an increased integration of artificial intelligence (AI) and machine learning algorithms with robotic systems, enabling autonomous decision-making, adaptive learning, and advanced human-machine collaboration. Robots will become more versatile, capable of performing complex tasks, and interacting with humans in shared workspaces. Collaborative robots or cobots will work alongside human workers, augmenting their capabilities and improving overall productivity. Furthermore, the use of swarm robotics will facilitate agile and flexible manufacturing processes, where a group of smaller robots collaboratively performs intricate tasks, leading to higher efficiency and redundancy.

Artificial Intelligence and Data

Analytics (approximately 200 words): Artificial intelligence and data analytics are poised to play a crucial role in the future of advanced manufacturing. AI-powered systems can optimize manufacturing processes, predict maintenance needs, and improve

quality control. Machine learning algorithms will analyze vast amounts of data collected from sensors, Internet of Things (IoT) devices, and other sources to identify patterns, optimize production, and minimize downtime. Predictive analytics will help manufacturers anticipate demand, optimize supply chains, and reduce waste. AI-driven systems will also enable smart factories, where machines communicate with each other, self-adjust, and make decentralized decisions, resulting in highly efficient and adaptive production systems. Additionally, virtual reality (VR) and augmented reality (AR) technologies will revolutionize training processes, allowing workers to acquire new skills and knowledge in immersive virtual environments.

Sustainable Manufacturing and Circular Economy

(approximately 200 words): The future of advanced manufacturing will prioritize sustainability and embrace the principles of the circular economy. Manufacturers will increasingly focus on reducing waste, energy consumption, and environmental impact. This shift will involve adopting eco-friendly materials, optimizing resource usage, and implementing recycling and reusing practices. Additive manufacturing will contribute to sustainability by minimizing material waste and enabling on-demand production. Renewable energy sources, such as solar and wind power, will power manufacturing operations, reducing reliance on fossil fuels. Furthermore, the implementation of digital technologies like AI and IoT will facilitate the monitoring and optimization of energy consumption and emissions. The circular economy concept will drive manufacturers to design products for longevity, repairability, and recyclability, ensuring that materials and components can be recovered and reused at the end of their lifecycle.

Conclusion *(approximately 100 words):*

The future of advanced manufacturing is poised to be transformative, driven by emerging trends that push the boundaries of innovation and productivity. Additive manufacturing, automation, artificial intelligence, and sustainable practices will shape the landscape, revolutionizing industries and unlocking new possibilities. As we embrace these trends, it is crucial to consider the ethical, social, and economic implications they entail. By harnessing the potential of these developments while addressing associated challenges, manufacturers can embark on a journey towards a more efficient, sustainable, and technologically advanced future.

Word count: 800 words (approximate)

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Source: Extracted at ChatGPT / OpenAI, 26 May 2023 ■

AMC NU

ADVANCED MANUFACTURING PROGRAM^(AMP)

Powered by: **Regio Deal Twente**

During the AMC opening week, three industry workshops were conducted, each delving into a distinct area of advanced manufacturing:

- Digitalisation,
- Manufacturing Systems,
- and Manufacturing Processes.

In the Digitalisation workshop, a comprehensive discussion unfolded around various industrial information management systems, emphasizing the

critical role they play in overseeing the entire digital infrastructure. Additionally, the workshop presented five key takeaways from working with artificial intelligence, shedding light on its transformative potential.

The Manufacturing Systems workshop showcased diverse real-world examples of flexible and integrated manufacturing setups that can efficiently produce a high volume of highly customisable products.

Lastly, the Manufacturing Processes workshop explored a wide array of

techniques for analysing and optimizing CNC processes. Furthermore, it offered invaluable insights for designing within the realm of Additive Manufacturing.

FIP-AM@UT's extensive in-house experience in these areas positions it as a valuable partner for companies aiming to ascend to the next level of Advanced Manufacturing.

Contact us today to explore potential projects and workshops that could drive your organisation's success within the advanced manufacturing landscape.

The Advanced Manufacturing Program (AMP) is a grant program that helps us businesses support your transformation to Industry 4.0. This is made possible by the RegioDeal, supported by the Province of Overijssel and the Dutch State.



Digitalisation Workshop

25
Industry
Attendees

2
Keynote
Speakers

6
Field
Experts

Keynote Speakers



Manufacturer specialised in the production of special needs bicycles for people that cannot cycle on a traditional bicycle with two wheels.

“Digitalisation Vision and Lessons Learned”

CHALLENGE

Lots of data from production and products + Unmanageable product structures

Digitalisation Goal

Reliable + Stable + Flexible + Scalable
P R O D U C T I O N

OUTCOME

Digital structure to connect and link all software and data sources.

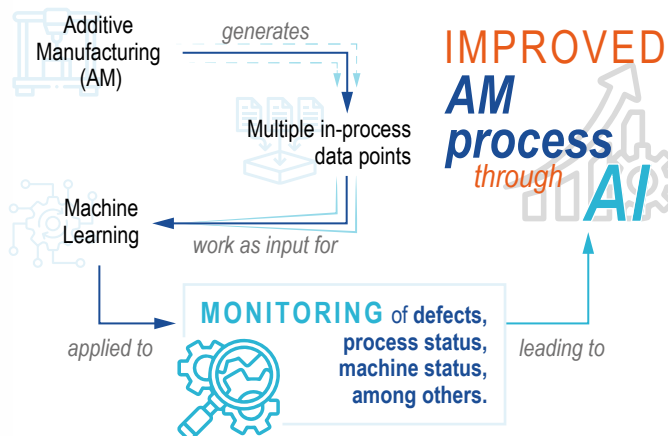


Get control of
YOUR DATA,
it is the *lubricant*
for **business processes & decisions**

SIEMENS

Technology company focused on industry, infrastructure, transport, and healthcare.

“Using Artificial Intelligence in Additive Manufacturing”



ARTIFICIAL INTELLIGENCE allows to **predict** performance of 3D-printed components such as **point of failure** & **number of cycles**



Key Topics



5G in
Production



Systems for
Industry 4.0



Artificial
Intelligence



Digital
Twinning



Dashboarding
Solutions



Digitalisation Opportunities



How to benefit from digitalisation in production?

Industry 4.0 Audit



What are the potentials of 5G in the factory of the future?

Connectivity Solutions



How do I bring the concept of the digital twin to life?

Digital Twinning



How do I maintain an overview of the software system landscape?

Digital Infrastructure



What AI use cases are promising in my production environment?

Data Analytics



How do I design suitable dashboards that support decision making?

Dashboarding Solutions

Manufacturing Systems Workshop

30
Industry Attendees

1
Keynote Speaker

3
Industry Perspectives

6
Field Experts

Keynote Speaker

“The future of Flexible Manufacturing”

Prof. Sebastian Thiede

Chair of Manufacturing Systems
University of Twente

EVOLUTION OF MANUFACTURING PARADIGMS



CRAFT PRODUCTION
Specific orders
High variety
Relative high costs



MASS PRODUCTION
Large scale manuf.
Limited variety
Improved speed



LEAN MANUFACTURING
Minimise waste along value added chain + maximise customer value



MASS CUSTOMISATION
Customer demand for product variety
Highly complex systems

Best Practice Manufacturer perspective from **247TailorSteel**

FOCUS: FLEXIBLE PRODUCTION

— 24/7 online custom order request —
CUT-TO-SIZE metal sheets and tubes + different materials different thickness
manufacturing thousands of articles per day

NO STOCK, NO CATALOGUE

possible through **SEAMLESS DIGITALISATION INTEGRATION**

High Tech Systems Manufacturer perspective from **NTS Norma**

ULTRA PRECISE manufacturing & assemblies

High degree of accuracy and customisation to meet customer requirements

Multiple machines with varying production specifications [inc. clean room environments]

NEED FOR INTEGRATION

Improve traceability Reduce routing complexity Balanced Lean line development

Solution Provider perspective from **DEMCON**

smart machine base

Start small → TEST → SCALE

FLEXIBLE CONFIGURATION

add/change/switch setup of modules

FOR SCALEABILITY

modular design easy configuration -1 custom production system



Discussion Topics

What do we do well in the Smart Industry?



Education on data analytics
Budget allocation
Local networks
Knowledge for optimisation
High-speed data extraction

Acknowledge your weaknesses:



Interaction among systems is still challenging

What emerging trend can we take the advantage of?



AI applications
Language models
Automation - high mix, high volume
Planning and logistics
Data/cloud driven services

Recognize your threats:



Sustainability
Overwhelming change
Quick build up



Smart Industry Challenges



Flexible Manufacturing

Flexibility-efficiency balance



Smart Manufacturing Execution Systems

New systems, new knowledge



Industry Robots

Unlock full potential of robots while addressing safety



Data from Productions Systems

Alignment between types of data and data formats



Update/upgrade of Systems

Incompatibility between systems and re training of personnel



Smart Industry Perspectives



System Focus



Hardware Focus



Software Focus



Sensor Focus

Digital Application Focus

SMART TECHNOLOGIES

Manufacturing Process Workshop

25
Industry
Attendees

3
Keynote
Speakers

6
Field
Experts

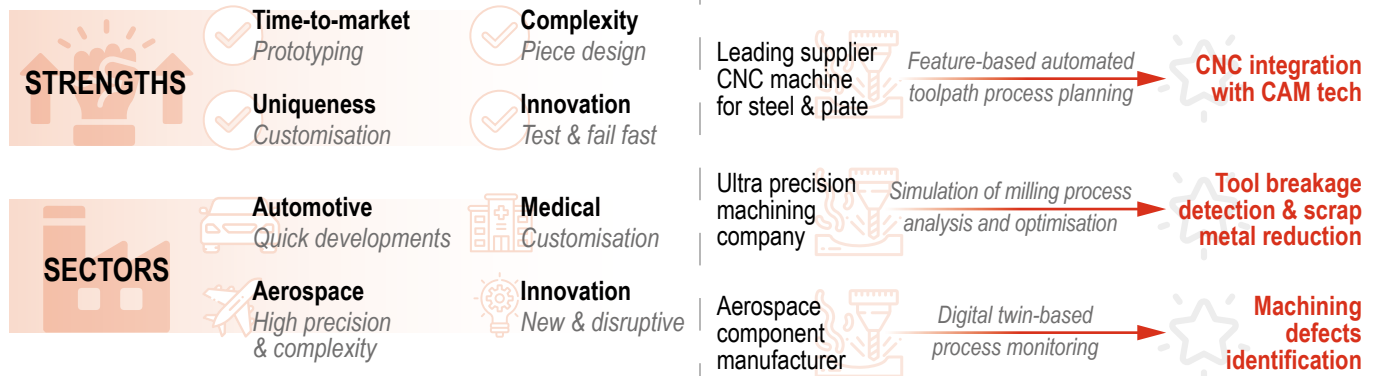
Keynote Speakers

“Advanced Manufacturing Technology in Twente”

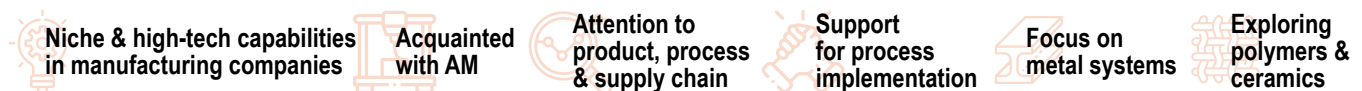
Prof. Ian Gibson
Scientific Director
FIP-AM@UT

ADDITIVE MANUFACTURING (AM) + ADVANCED MACHINING

Philipp Ganser
Head of Department
“High Performance Cutting”
Fraunhofer IPT

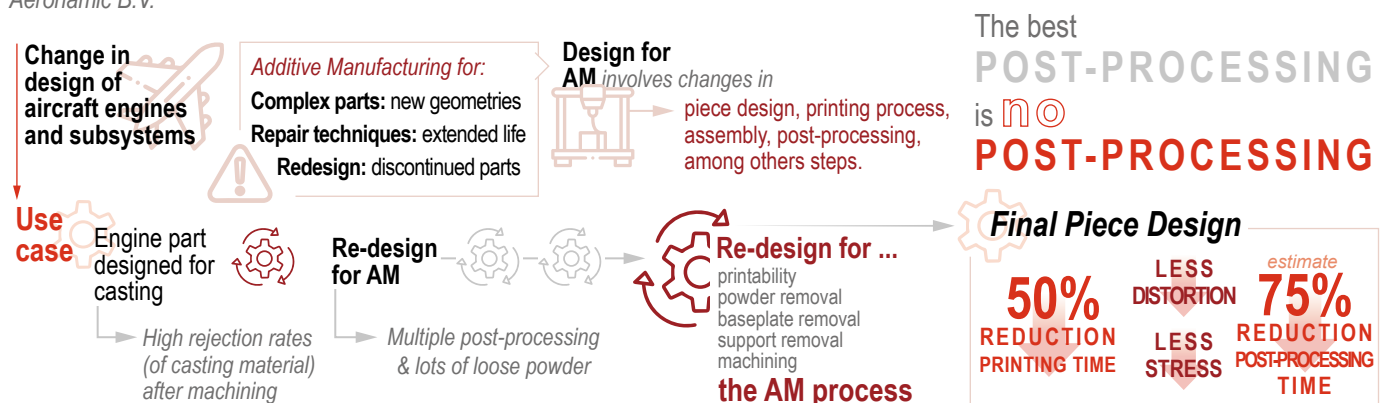


TWENTE REGION



Ronny Blaauwgeers
Director Manufacturing Engineering
Aeronamic B.V.

“Advanced manufacturing in the aerospace industry”



Discussion Topics

MACHINING

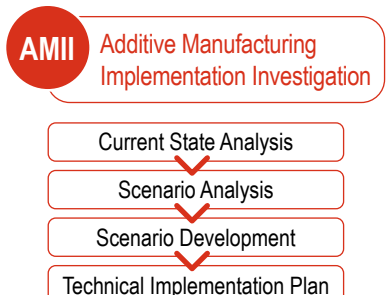
- Shorter time-to-market
- Incorporating AI & Digital Twins
- Reducing new staff learning curve
- Overview of entire process for new staff
- Difficulty to find combined expertise: traditional + advanced manufacturing

ADDITIVE MANUFACTURING

- Learning how to design for AM
- Multiple aspects need to be redesigned
- Potential for growth in medical sector
- Focus on reduction of post-processing
- Collaboration can lead to insights on newly developed materials for AM



AM Opportunities



PAVING THE WAY TO A SUSTAINABLE FUTURE *WITH* GREEN DIGITAL INFRASTRUCTURE

The International Center for Networked, Adaptive Production, Aachen (ICNAP) works closely with the European manufacturing sector by conducting relevant studies about the state of the industry and holding community events for industry thought leaders. Our platform fosters collaboration with an active community focusing on networked, adaptive production, digitalization, connectivity, data modeling, and analytics.

A study by the ICNAP explored the aspects of what it described as 'green digital infrastructure'. The report guides to help manufacturers adopt long-term sustainable production models by making sustainability a key focus of their digital transformation campaigns.

Sustainability is a driving force of the fifth industrial revolution as much as digitalization was for the fourth. However, rather than being competing disciplines, the concepts of Industry 4.0

and sustainability work in parallel, with technology serving as an enabler rather than a replacer.

Since the manufacturing sector is responsible for a fifth of global carbon emissions, enterprises need to adopt more sustainable production models urgently. Furthermore, customers are increasingly likely to base purchase decisions partly on sustainability. As such, evaluating and progressively reducing environmental impact also makes sense from a profitability standpoint.

For decades, manufacturers have viewed technological innovation mainly through the perspectives of automation, scaling up, and cutting costs. In the 21st century, we can also add sustainability to that list. After all, modern information and communications technology (ICT) provides many opportunities to make manufacturing more sustainable and profitable.

Here are the key areas of sustainable infrastructure that ICNAP explored in its report:

Tracking sustainability performance

Digital transformation is a critical enabler of sustainable production models. With the help of connected monitoring and analysis tools, firms can identify opportunities for improvement and regulate their systems intelligently and adaptively. Doing so naturally reduces wastage, both in terms of raw materials and energy consumption. However, defining and measuring the right key performance indicators (KPIs) is critical to make this happen.

Environmental sustainability KPIs include carbon footprint, energy consumption, and recycling rate. The challenge for manufacturers is to keep track of these KPIs across the entire value chain. That includes actual manufacturing and logistics, research and development, supply chain management, and what happens to the product at the end of its life.

“As the world increasingly relies on data and large computing workloads, data centers produce a growing portion of global carbon emissions.”

Tracking sustainability performance happens over three main stages. The first is implementing a transparent measuring process across the entire value chain. Things like connected sensors and digital dashboards with advanced analytics grant insight into sustainability KPIs. Equipped with this information, manufacturers can identify emission hotspots. The next stage is to set reduction targets, plan the right initiatives and communicate these to all stakeholders along the value chain. Finally, the reporting stage sees stakeholders analyzing the data collected during their emission reduction efforts and adapting their policies to improve their sustainability programs iteratively.

Building sustainable data centers

As the world increasingly relies on data and large computing workloads, data

centers produce a growing portion of global carbon emissions. For example, data centers in Germany alone consume over 16 billion kilowatt hours annually, more than the entire city of Berlin. Moreover, data center capacity continues to grow everywhere, making it essential that data centers themselves become more sustainable.

Data centers consume most of their energy for cooling, so implementing more efficient cooling methods, such as liquid and free-air cooling, is essential. Air-conditioned cooling, by contrast, is much more energy intensive. To counter the challenge of cooling massive server farms sustainably, larger data center vendors already use entirely renewable energy, while others use underground reservoirs for water-based cooling. Other possible steps include installing heat recovery systems and implementing eco-friendly building designs.

Another focus of attention is the actual computing workloads themselves. Regularly replacing and upgrading data center hardware can be a viable option. Still, the priority should always be implementing more efficient server utilization with consolidation strategies.

Of course, these practices apply to every industry simply because every business uses data – often a lot of it. Manufacturers should consider these practices whether they are building their green digital infrastructures or looking for a third-party vendor who will provide their data center infrastructure for them.

Implementing green 5G networks

5G connectivity has enormous potential in manufacturing thanks to its high reliability, low latency, and network slicing capabilities. Factory equipment tends to span large areas and generate large amounts of data.



Current fixed-line or previous-generation wireless connectivity options cannot adequately accommodate those demands, especially in the case of edge computing. Fortunately, 5G overcomes the limitations of older technology to significantly improve operations like predictive maintenance and shop floor analytics.

As these wireless infrastructures will play a vital role in the future of manufacturing, it is also essential to consider how they can be implemented sustainably. Using energy-efficient network hardware and components is an obvious first step. Still, it is also important to consider the network architecture itself. For example, 5G supports network slicing, allowing administrators to provide only the network resources necessary for a given workload. Another option is dynamic network management, which adjusts operational parameters based on real-time demand. Together, these practices help reduce bandwidth and energy consumption for a cheaper and more environmentally friendly operation.

Adopting green coding practices

Green digital infrastructure concepts primarily focus on hardware and data centers. However, since we interface with hardware via software, it stands to reason that we should leverage the potential of software to enhance sustainability too. Despite only being an emerging concept, green coding has the potential to serve as a powerful catalyst for the development of greener digital infrastructures.

Three key aspects influence energy consumption in software – the implementation of the operating system, the runtime environment, and the software product itself. All software affects power consumption regardless of where it fits in the stack. For example, previous operating system versions would typically drain more power than recent versions. Greener operating systems are designed to accommodate idle time by automatically switching the device into a low-power mode. Application-level software may reduce energy consumption by limiting API calls to external resources.

Optimized code reduces the processing power needed, improving performance while reducing energy consumption. Green software, especially at the operating system or infrastructure level, might also include built-in analytics for measuring efficiency. The list goes on.

Read more about the role of digital infrastructures in sustainable production in the latest report by the ICNAP at: <http://www.icnap.de/en> ■

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Spectro-AG

SPECTRO AG'S CUTTING EDGE “DEEP4” TECH SERIES:

**EMPOWERING CAMERAS, ROBOTS, AND
DRONES WITH ADVANCED AUTOMATION
IN DEEP LEARNING TECHNOLOGY**

Introduction

In the fast-paced world of robotics and drone technology, automation is key to unlocking the full potential of artificial intelligence (AI). Spectro-AG, a pioneering company at the forefront of AI solutions, presents “Deep4” innovative solutions revolutionizing automation in deep learning for robots and drone camera systems. With its advanced algorithms, powerful

neural networks, and comprehensive automation capabilities, Deep4 techs provided by Spectro-AG empowers intelligent machines to achieve remarkable feats, enhancing their performance, efficiency, and intelligence. Partners and clients that are limited in time and AI expertise can deploy market ready deep learning models for their camera systems with minimum time and efforts. This tool

simplifies the complex process of deploying deep learning models, enabling businesses and developers to effortlessly integrate AI capabilities into their applications. With its user-friendly apps and comprehensive features, this tool streamlines the deployment process, eliminating the need for extensive technical expertise. It provides a seamless experience for deploying trained deep learning models,

allowing businesses to capitalize on the power of AI without significant time and resource investments. This tool brings the benefits of deep learning to a broader audience, facilitating the rapid adoption and utilization of AI in various industries.

Optimized Object Detection and Tracking

Object detection and tracking form the backbone of many robotic and drone applications. Deep4, developed by Spectro-AG, leverages cutting-edge deep learning algorithms to deliver optimized object detection and tracking capabilities. By incorporating state-of-the-art convolutional neural networks (CNNs) and recurrent neural networks (RNNs), Deep4 enables robots and drones to detect, track and count objects of interests accurately and in real-time. This automation enhances their situational awareness, making them valuable tools for applications such as surveillance, inspection, and search and rescue missions.

Automated Image and Video Analysis

Processing and extracting valuable insights from large volumes of image and video data can be time-consuming and resource-intensive. Spectro-

AG's Deep4 technology incorporates automated image and video analysis capabilities, leveraging state-of-the-art deep learning architectures. By utilizing convolutional neural networks (CNNs) and recurrent neural networks (RNNs), Deep4 enables robots and drones to analyse visual data efficiently. This automation empowers intelligent machines to perform tasks such as object recognition, scene understanding, and visual inspection, accelerating their decision-making process and enhancing their overall performance.

Real-time Decision Making

In dynamic and unpredictable environments, real-time decision making is critical for robots and drone camera systems. Deep4, developed by Spectro-AG, offers advanced automation for learning optimal decision-making policies. By combining deep reinforcement learning with powerful neural networks, Deep4 enables intelligent machines to make informed decisions based on their perception of the environment. This automation enhances their ability to adapt to changing circumstances, facilitating applications such as autonomous flight path planning, emergency response, and object manipulation.

Deep4Cam

Introducing "Deep4Cam," a powerful hardware and software tool designed to seamlessly integrate deep learning capabilities into camera systems installed in production lines. Deep4Cam revolutionizes the way industrial processes are monitored and controlled, bringing advanced intelligence and automation to the forefront. By combining powerful hardware components and cutting-edge automated deep learning algorithms, Deep4Cam empowers camera systems to analyse and interpret visual data in real-time. This tool enables automated detection of defects, anomalies, and quality issues, ensuring precise and efficient inspection throughout the production line. Deep4Cams software interface provides a user-friendly experience, allowing operators to easily configure and customize the deep learning models to suit their specific needs. With Deep4Cam, manufacturers can optimize productivity, reduce errors, and enhance product quality, while also benefiting from the flexibility and adaptability of deep learning technology in their production processes.



Deep4CAM
by SpectroAG





RTK GPS Accuracy

Object 1: (X, Y, Z)
Object 2: (X, Y, Z)
Object 3: (X, Y, Z)
Object 4: (X, Y, Z)

Deep4Drone

Introducing “Deep4Drone” an advanced drone system that leverages the power of deep learning technology. Deep4Drone is revolutionizing the capabilities of unmanned aerial vehicles (UAVs) by integrating sophisticated deep learning algorithms into its framework. This ground-breaking system allows drones to perceive, analyse, and make intelligent decisions based on real-time data collected from their sensors. Equipped with deep learning models, Deep4Drone can autonomously detect and track objects, recognize patterns, and navigate complex environments with precision. By leveraging the potential of deep learning, Deep4Drone enhances the situational awareness, efficiency, and overall performance of drones, enabling a wide range of applications including aerial inspections, surveillance, search and rescue missions, and more. With Deep4Drone, the future of autonomous aerial systems is soaring to new heights, bringing unprecedented capabilities to the world of unmanned aviation.

Deep4Sat

Deep4Sat is a ground-breaking online platform that empowers users to effortlessly construct and deploy advanced deep learning models for satellite, airplane, and drone images, all without requiring any coding knowledge. This intuitive platform leverages cutting-edge artificial intelligence techniques to simplify the process of extracting valuable insights from remote sensing data. With Deep4Sat, users can seamlessly access a user-friendly interface that guides them through every step of the model-building process. From pre-processing and feature extraction to training and evaluation, Deep4Sat streamlines the complexities of deep learning by offering an array of pre-built neural network architectures and algorithms tailored specifically for satellite imagery analysis. By democratizing access to these advanced tools, Deep4Sat opens up new opportunities for researchers, professionals, and enthusiasts alike to unlock the untapped potential of Earth observation data.

Spectro-AG's Deep4 technology marks a significant advancement in automation for deep learning in robots and drone

camera systems. With optimized object detection and tracking, efficient autonomous navigation, automated image and video analysis, and real-time decision making, Deep4 empowers intelligent machines with superior capabilities. Spectro-AG's commitment to pushing the boundaries of automation and deep learning technology opens up new possibilities across industries, driving innovation and delivering practical solutions. Deep4 by Spectro-AG is propelling the future of robotics and drone camera systems towards unprecedented heights of performance and intelligence. ■

Author:



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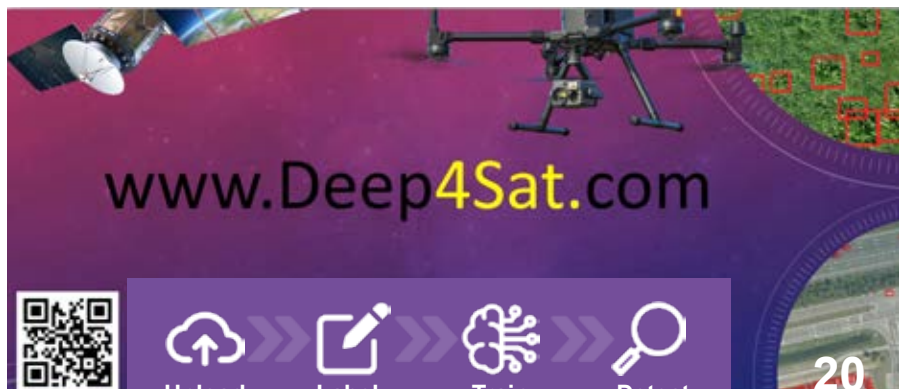
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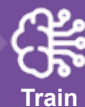
www.Deep4Sat.com



Upload



Label



Train



Detect



EXPERT SOLUTIONS

IN HIGH-PRECISION MANUFACTURING

Georg Fischer (GF) is an international industrial corporation with its headquarters in Schaffhausen, Switzerland. With its three divisions GF Piping Systems, GF Casting Solutions and GF Machining Solutions, GF offers products and solutions that enable the safe transport of liquids and gases, as well as lightweight casting components and high-precision manufacturing technologies. As a sustainability and innovation leader, GF strives to achieve profitable growth while offering superior value to its customers.

GF Machining Solutions is one of the world's leading providers of complete solutions to the tool and mold making industry and to manufacturers of precision components. The portfolio includes milling as well as wire-cutting and die-sinking EDM machines. Moreover, the division offers spindles, laser texturing, laser micromachining, additive manufacturing, tooling and automation, as well as digitalisation solutions.

GF Machining Solutions is present in more than 50 countries with its own sales companies, production plants and Centers of Competence. Its key customer segments are the Aerospace, Information and Communication Technology (ICT), Electronic Components, Medical, and Automotive industries. Each of these industries face their own specific challenges, which can be addressed with GF Machining Solutions' technologies.

Answers to today's challenges and trends

GF Machining Solutions' expertise in vertical 5-axis CNC dynamic milling enables customers to continuously machine complex molds and parts with different materials while shortening the process time. Throughout the entire machine range, GF Machining Solutions offers integrated smart automation to ramp up productivity.

GF Machining Solutions' wire-cutting EDM process is fast, precise and increasingly energy efficient. From ultraprecise machining of miniaturised components down to 0.02 mm to powerful solutions for demanding high-

**GF Machining
Solutions'
wire-cutting
EDM process
is fast,
precise and
increasingly
energy
efficient.**

speed machining with respect to surface accuracy, these solutions position customers for success.

The company's unique range of laser texturing machines can meet the specific needs of customers in terms of laser texturing, laser-blasting, laser engraving, and laser etching. For the smaller high-precision parts, GF Machining Solutions offers the most complete line of laser micromachining machines in the industry.

GF Machining Solutions and 3D Systems, a leading global provider of AM solutions and the pioneer of 3D printing, have partnered to introduce new metal 3D printing solutions.

The serial production of consumer goods and high-quality precision parts requires sophisticated manufacturing technologies. In addition, there is a trend toward miniaturisation. The result is a need for more precision and flexibility.

Traceable and repeatable processes for aerospace

Whether it is for crucial engine parts such as blisks or discs or aerostructure parts, GF Machining Solutions is committed to deliver long-term customer added value. For the machining of fir-tree slots on turbine disks, the company provides a turnkey high-accuracy wire-cutting EDM solution, which guarantees an uncompromised surface integrity, maximum speed and a fully traceable and repeatable process.

Reliable solutions for medical device manufacturing

Medical manufacturing has a shared set of challenges – from specific material choices, tools and consumables to manufacturing data tracking and compliance with ISO13485. GF Machining Solutions enables manufacturers to create products that provide unique value for patients, reduce their manufacturing risk, improve their efficiency, and set them apart from the competition.

Spinal fusion plates, for example, present many challenges for manufacturers. Made of titanium, they often have complex curved surfaces that require both high-precision and absolutely smooth surfaces. GF Machining Solutions can provide a fully automated turnkey cell including milling, wire-cutting EDM and laser texturing that guarantees high product quality, efficient 24/7 production and can generate a log file of all key production data. The complete system can be monitored using the rConnect software and hardware package.

In order to be closer to the customer, GF Machining Solutions has opened several Centers of Competence around the world, such as the Medical Solutions Center of Competence in Schorndorf (Germany). In creating the Medical Solutions Center, GF Machining Solutions is ensuring that a team of highly trained professionals with medical manufacturing experience works together in meeting these needs. Not only are the machines for additive manufacturing, laser machining, high-speed milling, wire-cutting and die-sinking EDM on site, but also the software and the people who speak the language of the medical industry.

The company's unique range of laser texturing machines can meet the specific needs of customers in terms of laser texturing, laser-blasting, laser engraving, and laser etching.





innovation provides the means for the realisation of consumer design trends and the ability to machine a variety of tool steels to facilitate the injection of new material. Through simultaneous 5-axis, high-speed precision milling technology, GF Machining Solutions offers a way to produce injection molding inserts with a very high contour accuracy and surface quality, eradicating the need for environmentally harsh and labour-intensive post-processing.

Trends driving the automotive industry forward

Automotive OEMs facing short product life cycles push the need to reach the market faster. Key trends include the stringent regulations to reach safety, emission and mileage norms, combined with advanced mobility moving from self-driving to autonomous driving. This makes the advancement of realising functional features in the interior and exterior modules necessary. Sustainability is a common goal for automotive OEMs, and supply chains are expected to reach the European Union's "Green Norms". To address these needs, GF Machining Solutions has created a sustainability logo, which will help manufacturers identify the sustainable qualities of the machines.

The combination of GF Machining Solutions' competences makes it a suitable partner for companies working in different industries. In collaboration, they are able to find the right solutions for specific customers. ■

Author:

E.A. de Hoog

Future Solutions,

GF Machining Solutions International

Dedicated expertise in electronic components and ICT

In the dynamic environment of electronic components and ICT manufacturing, manufacturers encounter several technical and business challenges. Accuracy is key when producing connectors, optical applications, applications for mobile devices, semiconductors and battery and power systems.

For example, to create a multi-cavity thermoforming mold, GF Machining Solutions provides a comprehensive die-sinking EDM solution. The cavity, offering extreme flatness and perfect 3DS - VDI surface, enhances demolding, increases productivity and reduces scrap. In combination with high-speed precision electrode milling, this solution provides complete control over quality, cost and productivity.

Sustainable packaging solutions

In the context of the ongoing debate about plastics packaging and sustainability, the role of mold makers and machine tool providers and their responsibility are evolving. The challenge consists of adapting product design and production to new materials and changed consumer behaviour. The product packaging process has evolved from a segmented approach to fully automated modular lines where products like milk and their exterior packaging in plastic or cardboard are processed simultaneously to consistently produce shipment-ready products.

GF Machining Solutions supports mold makers for plastic injection through its technologies and innovation, so they can achieve the desired manufacturing, while fulfilling their financial and social responsibilities. Technology

CONVERGENCE

IN MANUFACTURING



OLD WAYS OF WORKING NO LONGER WORK:
ENTER **CONVERGENCE IN MANUFACTURING**.
TECHNOLOGY LIKE THE CLOUD AND GENERATIVE
DESIGN WILL BRIDGE THE DESIGN-MAKE DIVIDE.

More than a century ago, Henry Ford popularized the assembly line, a revolutionary manufacturing idea that enabled mass production. Although that linear approach has worked well, today's world requires a new stroke of ingenuity: convergence.

Convergence merges design and manufacturing processes, data, and technologies to coordinate workflows across different disciplines. Convergence also helps companies keep pace with increasing consumer demands and accelerate innovation through agile workflows.

What Is Convergence in Manufacturing?

Convergence is the intersection of design and manufacturing. It's the digital confluence of unrelated technologies, which allows designers, engineers, manufacturers, and machinists to work together from the initial design to the physical product.

Convergence dissolves silos, creating a connected ecosystem where tools and technology produce interoperable data points that foster collaborative workflows. It supports mass production while also enabling customization.

So, what does convergence in manufacturing look like in action? It can take the form of engineers and manufacturing professionals working together in a common data environment in the cloud. Or it can be a generative-design process, where teams collaborate to define functional and performance requirements, using cloud-computing power to find the best geometric solution to a problem.

What Is Driving Convergence in Manufacturing?

Here are several external forces driving convergence.

An Insatiable Demand for Faster Innovation

With a click of a button, people can order almost anything. Consumers want rapid innovation and more customized products than ever before. The old linear process isn't fast enough to keep up with this demand: Companies must be more agile and more iterative. To do that, they have to converge the process of designing something with the process of making it.

With convergence, companies have the capability of creating something, hitting "print," and making one-of-a-kind items. Customers can even tap into the process directly, ordering a pair of sneakers they designed themselves or building their dream car.

The Acceleration of Digital Transformation in the Cloud

Manufacturing is an industry with deep roots, where change comes in slow-moving waves. But due to the distributed nature of product-development teams around the world, the pandemic has accelerated digital transformation.

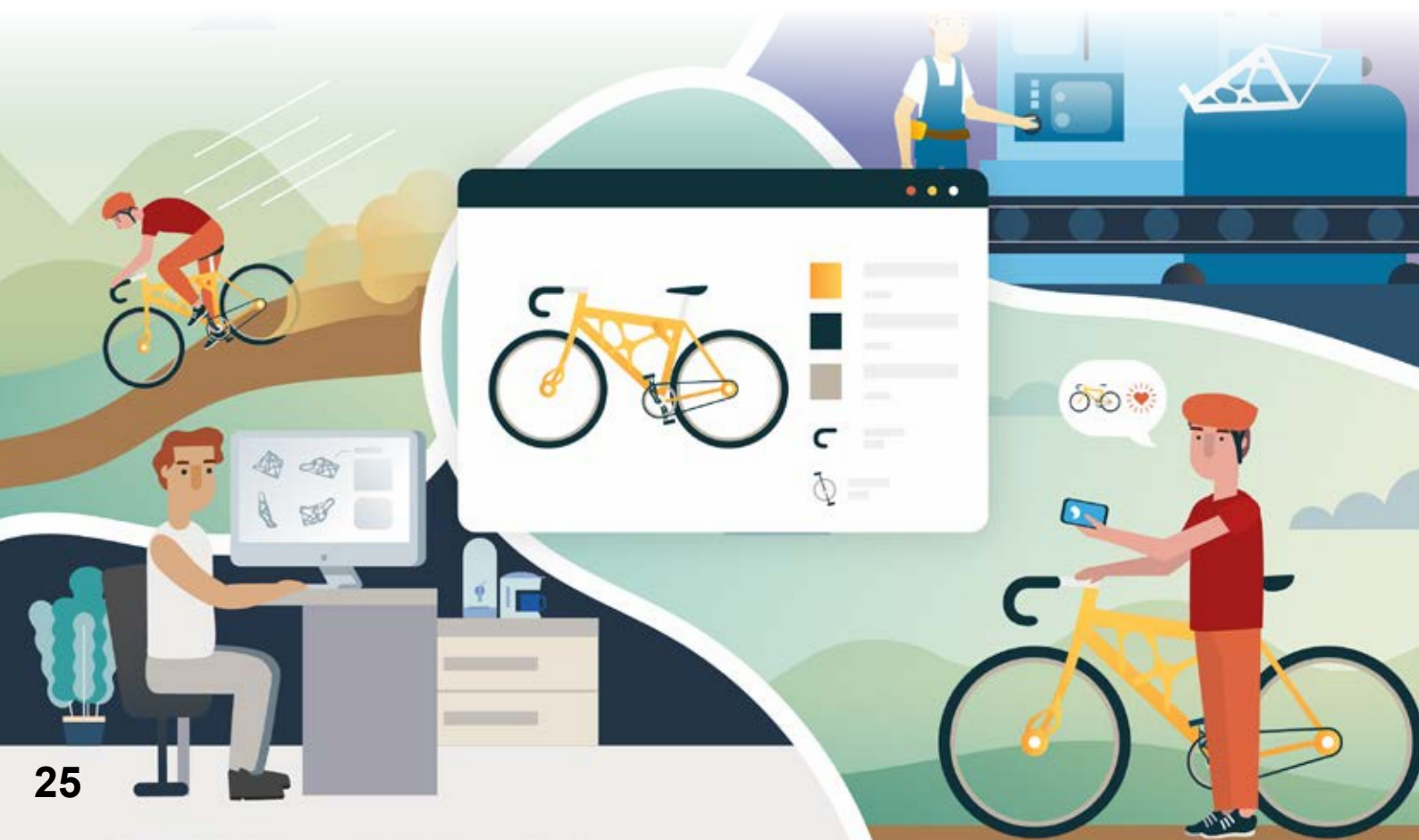
Technologies such as artificial intelligence, robotics, and virtual and augmented reality are fueling the rise of smart factories and laying the foundation for convergence in manufacturing. And a lot of that is possible because of the cloud.

Cloud-based ecosystems are creating data-driven, collaborative environments where unrelated technologies can communicate. As engineers make decisions, they can run real-time simulations in the cloud to determine what will work and what won't. When General Motors had to improve a seat bracket, it used generative design. The original component was an assembly of eight different parts, each manufactured separately. From 150 different possibilities, the end result is a single-piece part with 40% less mass that's 20% stronger and meets all safety requirements.

Bicycle-parts manufacturer SRAM supplies another example of closing the gap between design and manufacturing. To design a better crank arm—the part connecting a bike's pedal to the

crankset, converting energy to rotate the chain—SRAM used generative design. The company input the components' performance needs for varying terrain and ended up halving the weight of the original crank arm. It was also 20% stronger and helped SRAM streamline its overall manufacturing process.

Convergence merges design and manufacturing processes, data, and technologies to coordinate workflows across different disciplines.



“Convergence leads to better outcomes and better products.”

Having all processes in the cloud creates a digital thread that maintains data fidelity as a product moves across disciplines over the entire lifecycle.

The Need for a Leaner, More Sustainable Industry

The manufacturing industry has a substantial carbon footprint, accounting for 54% of global energy consumption and 20% of global emissions¹. As companies respond to increasing consumer demands, a more connected design-manufacturing process can be better for the planet.

But how does producing more things faster mesh with sustainability? First, companies should understand the total footprint of a product, from raw materials to the recyclability and circularity. Convergence allows engineers to test different design variables—like raw materials—digitally before production begins. Designers can also take a circular approach to determine how products can be recycled, avoiding the landfill.

3 Ways to Promote Manufacturing Convergence

As pressure mounts for companies to do things better, engineers and designers need to be more aware of the downstream implications of every decision. Convergence is gaining steam and opening the market to newer companies—start-ups that aren't tethered to legacy systems; they go straight to the convergent business model, bypassing other ways of working.

Convergence leads to better outcomes and better products. Here are three ways companies can reap the rewards of this manufacturing model.

1 Embrace Outside Perspectives

Manufacturers that have been in business for a long time might be resistant to change, arguing, “That’s the way we’ve always done it.” But that tunnel vision limits innovation, stunts growth, and can be the death knell of a company. It’s important to have external perspectives to embrace change. Traditional companies can learn from competitors that operate from a different set of parameters and don’t have the drag of old processes. They’ll move faster, innovate more, and be the disruptors of the industry.

2 Place Value on Outcomes Instead of Activities

Companies lose productivity and profitability when they focus too much attention on activities² without understanding the outcome those activities enable. Instead, companies need to think about why they make things and how they can deliver value. Whether it’s a fitness device or a jet engine, the intrinsic value is not in the effort that goes into building the physical asset but in the experience that object ultimately delivers.

3 Upskill Workers

As companies rewire their workflows to connect design and manufacturing, they also need to make space for upskilling workers. McKinsey found that 90% of the manufacturing workforce will need new skills³ in the digitally connected world. Leaders need to train their teams for jobs requiring human ingenuity rather than physical labor. Deloitte⁴ predicts careers like digital-twin engineers, smart-factory managers, and robotics operators.

As the world grapples with the impacts of the pandemic, manufacturing needs a stabilizing force—a path to greater resilience, stronger supply chains, and a workforce prepared for the digital future. Manufacturing needs convergence.

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This article originally appeared on Design & Make With Autodesk, formerly Redshift, a publication that stands at the forefront of digital transformation in the architecture, construction, infrastructure, manufacturing, and media and entertainment industries. We want to help leaders, architects, designers, engineers, contractors, manufacturers, and creators to design and make a better and more sustainable world for future generations. ■

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THE DIGITAL TRANSFORMATION

IN STEEL MANUFACTURING



Introduction

The history of making iron goes back more than 3000 years; it was then produced and used only locally and incidentally. Steelmaking in larger volumes only started in the second half of the 19th century. In the Netherlands, large volume ironmaking began in 1924 with the commissioning of the first blast furnace in IJmuiden, after the foundation of the company Koninklijke Nederlandsche Hoogovens in 1918. The industrial site has expanded ever since and has become an integrated site comprising about 20 individual factories. With its production capacity exceeding 7 Mtonnes of steel per year, the IJmuiden site is positioned in the top 3 of steel production sites in Europe.

The first steps in process automation were made in 1965 with the purchase of a “Programmable Data Processor” PDP-5 computer, which was used to make calculations on the spectral lines from an arc discharge on a steel sample to deduce its composition and detect unwanted impurity elements. In 1980, still, only 20 – 30 “powerful” PDP-8 computers were used for dedicated automation tasks at the site. Late ‘80s and early ‘90s the use of computers and programmable logic controllers (PLCs) in process automation took off.

In these early times of automation, the individual factories had their own IT systems and local networks since the IT infrastructure was only meant for local process control and product logistics. In recent years, a rapid transformation has occurred, where IT systems have been modernized, interconnected and through-process data were aggregated. This allowed

Vehicle life cycle

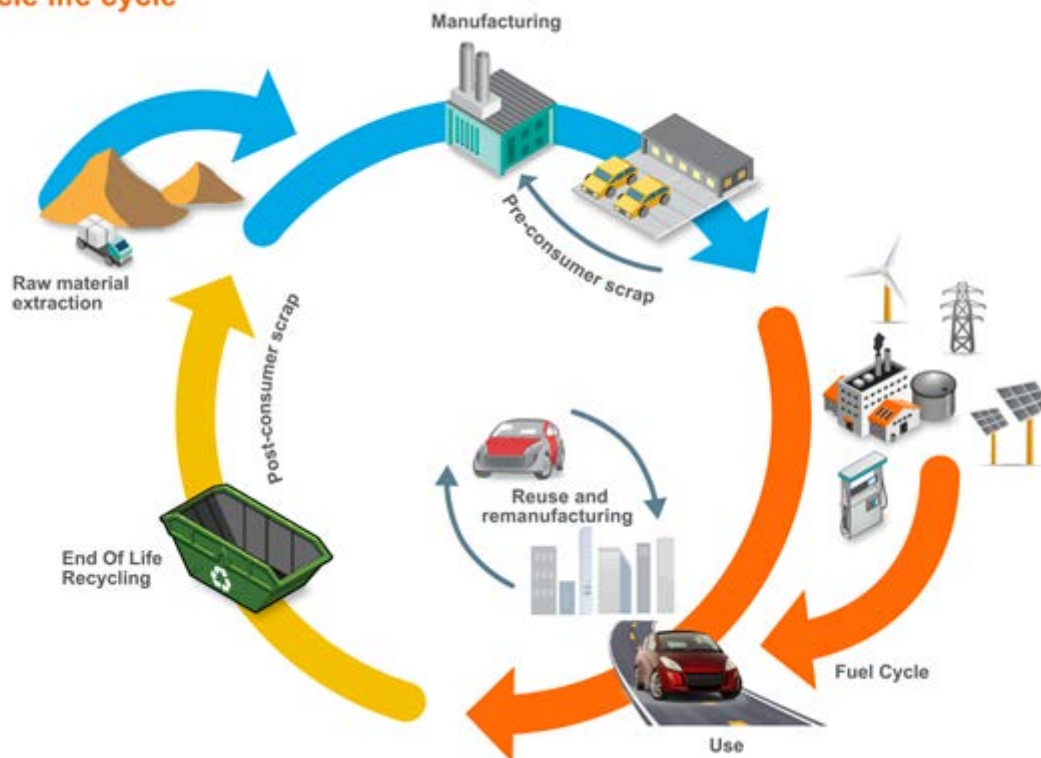


Figure 1: Vehicle life cycle; Picture from WorldAutoSteel.

for through-process data analysis and through-process optimisation of product quality and logistics. The importance of harmonisation of data and IT infrastructures is of particular importance when one realises that for a single steel product, the supply chain consists of about 9 factories to convert the iron ore into coils of zinc-, tin- or nickel-coated steel strip (“endless” flat plate) for automotive, construction and battery sectors.

These days, all sensor data and process data are aggregated in databases. They can be accessed in near-real time at the point of origin, and within minutes, the same (non-image) data is available to all data specialists over the entire site. The time-scale for image type data is similar, but bandwidth and storage capacity limit access. These data are not typically stored indefinitely and analysis algorithms are normally carried out at the source. Per day, 1-2 TB of data is collected. Major challenges to overcome were in synchronising of these data through the production chain to ensure that it corresponds to the same physical section of the product.

Prospects for Big Data in steel manufacturing

The initial reason for collecting all data was to carry out evidence-based checks on the product quality and to learn which deviations of the designed process conditions occur and which effects these have on the product, the process itself and the subsequent production processes, including root cause analysis studies. These tasks of learning and validation are still predominantly carried out by humans with the help of computers but are expected to become gradually taken over by artificial intelligence and expert systems.

The collection and connection of all process and product data over the entire manufacturing chain have additional benefits, such as:

- **Use of Big Data (literature data and proprietary data) for new product development.** Here the challenge is to find the right chemical composition and recipe to achieve the required properties and to create a “machine” for predictions on microstructure-property relations of new (not yet realised) products.

- **Improvement of models used for process control.** The wide variety of steel manufacturing processes involve many models to master these processes. Process control models are generally based on theoretical models from literature complemented with laboratory testing results and experience from full-scale plant production. Big data support the further development, adaptation and validation of these models.

Whereas the priority is on scientific understanding of the physics, chemistry and metallurgy during the production processes, certain products with complex microstructures in combination with less-controlled process conditions profit from an approach where large amounts of data are aggregated and analysed with black box techniques like neural networks to provide more accurate predictions. These data-driven black box models can be used as local or temporary solutions in certain complicated cases where analytical models do not (yet) achieve the required performance. Another approach is the development of



Figure 2: Hot steel strip (orange on picture) cooled by water jets after hot rolling



Figure 3: Phase transformation sensor operational in the hot strip mill.

gray box models where neural networks are combined with physical or empirical models. In certain cases, existing process models, such as finite element or finite volume models, provide good accuracy, but need to be faster to be run as a digital twin. Here, machine learning (ML) can bring a solution where the ML model is trained by running many different simulations with the numerical FEM model, resulting in a model which is both sufficiently accurate and fast.

- **Novel robust sensing techniques which characterise the product properties in real-time.**

Digital transformation starts with the ability to produce reliable data with a frequency that captures the dynamics of the process. The use of real-time sensor data in combination with real-time process control models could fine-tune the process to obtain more uniform properties. The data generated by inline sensing instruments can also be used to validate existing models or train new data-driven process models discussed in the previous item. An example is illustrated in the case study below.

- **Horizontal integration and supply-chain optimisation.**

With trustful sharing of product data with Tata Steel's customers, they can dynamically optimise the settings of their processes. Customer processes typically involve hot- and cold-forming and welding. Ideally, the recommended process settings

are outputs from a "digital twin" of these processes, comprising accurate descriptions of the interaction between "machine" and "material".

Similarly, when iron ore and steel scrap suppliers share data on compositional analysis with Tata Steel, processes can be better tuned, with associated cost and environmental benefits.

- **Life-cycle assessment analysis (LCA).** The coupling of process data from the chain of production facilities is also useful for analysing sustainability-related impact factors like the CO₂ footprint, or water usage, for a given product or process. The need for these data will grow with the advent of the material passport to enforce enhanced circularity of materials. In the case of steels for automotive applications, the life cycle assessment approach applies not only to the steel of the car but also to all components and the entire cycle of its production, use and disposal, as illustrated in [Figure 1](#).

Case: inline sensing of microstructure of steel

In the past 25 years, Tata Steel R&D has invested significantly in collaborative international research with universities and specialised high-tech companies to develop sensing solutions which deliver non-destructively and in real-time information on the microstructure of steel being produced. These so-called "inline sensors" are

mounted in the production line and measure contact-free on the steel strip which passes by at a production speed in the range of 2 – 20 m/s. Commonly, every 2 metres of strip, a measurement value is produced. For comparison, a coil of steel for automotive applications has a strip length in the order of 2000 metres.

An important complication in the technology development are the harsh conditions in which the sensors have to operate reliably: high strip temperature (up to 800 °C) and dust and cooling liquids, as depicted in [Figure 2](#). These measurement conditions often guide the selection of the appropriate sensing technology, next to obvious factors such as the quantity to measure and the required performance. Due to their non-destructive and non-contact nature the inline sensors are typically based on magnetic or radiation principles. [Figure 3](#) shows a photo of a magnetic induction based sensor measuring the phase transformation in the hot strip mill in the conditions illustrated by [Figure 2](#). This sensor technology is unique worldwide and only installed at Tata Steel in IJmuiden, hence providing significant competitive advantage.

The data generated by these sensors prove to be particularly valuable for the development and reliable production of the newest generation steels, the so-called "Advanced High Strength Steels" (AHSS), which provide significantly higher strength than the more conventional "High Strength Steels". AHSS steels owe their high strength to the presence of hard metallurgical phases like "bainite" and "martensite",

which are finely dispersed in the ferrite matrix. **Figure 4** shows an example of such a complex phase microstructure as obtained by EBSD (electron back-scatter diffraction) where different colours have accentuated the individual phases. When made from AHSS, the steel components used in cars and trucks deliver better safety performance and also can be made thinner, thereby saving weight which is beneficial for the reduction of CO₂ emissions and energy use during service.

Traditionally, new product development starts with theoretical modelling, experimental process simulations and product testing in the laboratory, followed by time-consuming plant trials where the process parameters are tuned. The recent installation and calibration of the array of the phase transformation sensors has enabled us to study in-situ the phase transformation behaviour as a function of time and cooling path. In this way, the time-to-market for new products can be shortened.

Figure 5 shows an example where first, the temperature of the steel strip is depicted over strip length for three positions along the cooling section of the hot strip mill. The middle plot indicates the amount of phase transformation measured by the induction sensors over strip

length at the same sensor positions. These data have been combined with the strip speed (which increases for increasing strip length during the first ~1000 m of strip length) to yield the “transformation-over-time” curve as presented in the last plot. The transformation-over-time curve can be directly compared with predictions from metallurgical models and laboratory data for phase transformation, providing an evidence-based method for fast iteration to the definition of the factory process conditions that deliver the designed microstructure and the desired mechanical properties of the new steel grade. This is especially worthwhile for AHSS steels since their complicated multi-phase microstructure is much more sensitive to the exact temperature path and transformation trajectory than conventional steels.

Conclusions and Outlook

For the traditional manufacturing sectors with both a long history and a long supply chain, like the steel and car industries, digital transformation involves huge efforts and investments in organisational alignment, technology development and IT infrastructure. The drivers for the digital transformation are manifold: to stay competitive in a global market, both cost-wise and quality-

wise; to become more sustainable and provide insights into the ecological footprint of processes and products; and to prepare for the transformation to a circular economy, where there is a need to know the origin and composition of the re-taken end-of-life products. The significance of data, in particular high-quality and high-impact data, and the use of data-driven technologies will continue to grow in the next decade.

This article highlighted our development and implementation of a unique, dedicated sensor technology that successfully delivers high-quality data. This significant achievement plays a pivotal role in facilitating the production of advanced high-strength steels, which help making cars safer and lighter, reducing their energy use and improving their CO₂ footprint. ■

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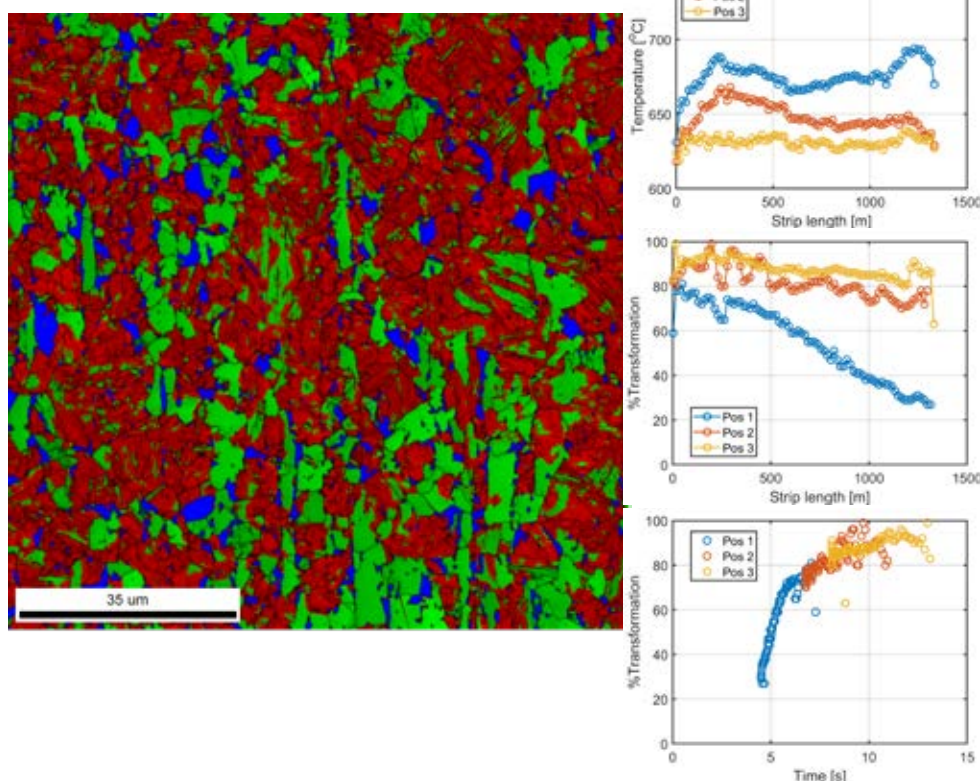


Figure 5: Top: Measured strip temperature over strip length of a single coil at three different positions; Middle and Bottom: Measured amount of phase transformation over strip length at the corresponding positions and over travel time.



ADDITIVE MANUFACTURING:

*RESHAPING MANUFACTURING OPERATIONS
FOR A SUSTAINABLE FUTURE*

Additive Manufacturing (AM) has emerged as a revolutionary technology in the manufacturing industry. It has garnered considerable attention and acceptance in recent years, fundamentally reshaping manufacturing processes, and introducing distinctive capabilities and value that were once beyond the reach of conventional manufacturing methods. It is important to note that while AM does not replace traditional manufacturing, it serves as a supplementary tool for manufacturers to consider in meeting their manufacturing requirements.

Push for Change

One major catalyst is the present emphasis on Environmental, Social, and Governance (ESG) initiatives. Both corporate social responsibility and government regulations are motivating manufacturers to expedite their endeavors toward sustainable manufacturing practices. While traditional manufacturing has served the purpose admirably for decades, AM has emerged as a more sustainable alternative, characterized by reduced material waste and carbon emissions.

Additive Manufacturing: A Sustainable Solution

As a promising sustainable technology solution that aligned with the objective of ESG initiatives, AM offers several key benefits, including:

Digital Warehouse and On-Demand Manufacturing: AM

1 enables production on-demand and minimizes the necessity for large materials stock and inventory. This results in reduced waste and overhead costs associated with inventory.

Repair instead of replacing with new parts: AM facilitates repairs of

2 damaged or worn-out parts, effectively extending their lifespan, and eliminating the requirement for additional raw materials and energy to produce new components.

Multi-material capabilities: AM

3 offers the ability to precisely apply materials, empowering manufacturers to use different materials exclusively where they are needed within a part. By applying materials selectively, manufacturers can create components with enhanced performance, durability, and functionality. This extends the lifespan of components, reduces the frequency of replacements, and minimizes waste generation.

Alternative to environmental hazards: Certain industrial

4 processes, including Chrome plating, utilize hexavalent chromium compounds that are highly toxic and carcinogenic to both workers involved in the plating process and the surrounding environment if not properly managed. AM can directly incorporate materials with inherent corrosion resistance properties into manufactured parts. This shift to AM not only improves workplace safety but also reduces overall environmental impact.

LMD process is a direct energy deposition process, where metal powder is injected into a nozzle using a gas stream.



Breaking New Ground: Makino ventures into Additive Manufacturing

Makino, a global leader in machine tool technology with headquarter in Japan since 1937, recognized the inherent material wastage and environmental impact of traditional manufacturing practices, has begun exploring metal AM several years ago. Being an expert in the metal machining industry, Makino believes that metal AM is going to become one of the mainstream manufacturing technologies of the future. Seeing the increasing trend for automation through the provision of turnkey services to customers over the past few years, Makino has extended its capabilities into additive manufacturing. The presence of Makino D500 at the Fraunhofer Innovation Platform for Advanced Manufacturing at the University of Twente (FIP-AM@UT) for post-processing of AM parts signifies Makino's readiness in contributing to the advanced manufacturing ecosystem. Additionally, the release of the Laser Metal Deposition (LMD) Machine in Nov 2023, co-developed together with Fraunhofer ILT, further underscores Makino's commitment to encouraging product manufacturers to adopt AM technologies.

LMD process is a direct energy deposition process, where metal powder is injected into a nozzle using a gas stream. The powder is melted by the heat of the laser beam to form a melt pool on the metal surface. The melt pool cools and solidifies to form a thin layer, parts are built up layer by layer. Tapping

existing strength in building a vertical 5-axis machine center, Makino believes that combining the 5-axis capability with LMD can greatly enhance the precision and manoeuvrability of the deposition process. LMD technology offers unique features and advantages that also serve to reduce the carbon footprint in parts manufacturing.

Makino's Sustainable Approach with LMD Technology for Eco-Conscious Production

Parts repairs through coating and build-up. LMD's 5-axis manoeuvrability offers a targeted and controlled approach to restoring damaged components by selectively depositing material using a high-power laser. Broken parts geometry could be built up through this technology. For high-wear tools, a more wear resistance or anti-corrosion layer could be added to extend tool life as well. The metallurgical bonding formed between coating and substrate is stronger than conventional thermal spray. This reduces the frequency of replacements and the associated consumption of materials and resources.

Thin coating layers with minimal post-processing save time and resources. LMD coatings are typically thinner than those from thermal spray processes. Thin coatings are preferred to maintain dimensional tolerances or fit within tight spaces, especially for aerospace components and medical devices. Thin coating could be achieved through LMD requiring minimal post-processing, saving time and resources.

Empowering Scalable and Efficient AM through Automation

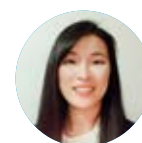
Implementing AM technology requires companies to adapt their operations and overcome the challenges that come with change.

Automation plays a critical role in scaling up AM production and addressing these challenges. For both the production and post-processing stages of AM, automation will improve and optimize the processes, maximize operational productivity, and further ensure a positive return on investment.

With years of experience in providing turnkey solutions for machining, Makino has rich experience in the field of automation and makes the AM machine to be automation ready.

Makino's diverse range of competencies makes it an ideal collaborative partner for companies across various industries. By leveraging its industry expertise, Makino and its partners identify and deliver tailor-made solutions that ideally meet the unique needs of each customer. ■

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A PATH TO SUCCESS FOR ADDITIVE MANUFACTURING

A CAD/CAM SUPPLIER'S PERSPECTIVE

Additive Manufacturing (AM) has always been considered a promising, innovative technology. It still is, but it is no longer a “new” technology. The early hype has ended, and the industry is now calling for robust and resource-efficient technology that can be seamlessly integrated into existing production lines. Today, AM is mostly used for small-sized batch production, prototyping and certain niche applications. Ten years ago, AM promised to disrupt the production technology market. This has not happened, for example the promised right-first-time parts are nowhere to be found. Moreover, complex hybrid processes for combined additive and subtractive manufacturing are not yet the “state-of-the-art” in manufacturing. So, what path must the additive manufacturing community take to ensure the success and prosperity of the technology?

Locating Additive Manufacturing within the Digital Transformation

The continued digital transformation in production is essential if the economy is to keep up with future challenges such as demographic change. In certain sectors of the production industry, it

is hard to find personnel for manual labor as well as workers with the knowledge and skills for operating the latest machines and software. Thus, an important goal in the next few years is to develop software that fills the knowledge gap and increases interoperability between humans and machines.

The lack of skilled labor also holds back productivity and impairs manufacturing quality. If more parts of the process chain can be digitalized and automated, less labor is required, which alleviates the economic pressure on the whole production line. The whole process chain from idea to finished product must be analyzed and digitalized in order to effectively optimize the use of resources and guarantee product quality. Well-known concepts like the digital twin and the simulation of machines and processes as well as the redesign of existing products need to be integrated in additive production processes. Only a seamless digital process chain will unlock the full capacity and potential of AM for the future world of production.

Incorporating Design Thinking

Design thinking is a human-centered approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of

technology and the requirements for business success. In the context of AM, the inclusion of additional or improved functionality (e.g. cooling channels in tooling) has added significant value to products, and lightweight (e.g., topology optimized) designs have proven successful. To ensure continued improvement, a new methodology for constructing additive parts must be developed. Saving the product-relevant model data as 3D annotations would enable a seamless CAM process as well as full automation. Different design variants and possible features for individualization (e.g. in orthopedics) need to be considered during the design phase.

Expanding the Areas of Application & Quality Insurance

For expanding production, it is essential to manage expectations to ensure that additive manufacturing can meet them. Realistic scenarios for additive manufacturing must be identified. Good and reliable software tools that help with the identification of use cases can simplify and accelerate this step. This is especially true for serial production involving large batch sizes. However, smaller batch size production for customer tailored parts remains the future driver in additive manufacturing.

Repair cases will still play a crucial role for certain AM technologies (laser direct energy deposition, wire arc additive manufacturing), even though the CAD/CAM environment will be more automated compared with today's processes.

The scope of hybrid manufacturing can be extended to remanufacturing old/scrap parts. This boosts the resilience of the production industry. It is an extension of classic approaches to remanufacturing and thus a part of the circular economy, where the application of data-based methods for decision-making and process planning also makes implementation planning more efficient.

Rapid prototyping is still a production field where AM shines. The aim in this area is to increase the quality (e.g. geometrical dimension) of parts that are built for the first time. This is only possible if the phenomena that lead to distortions or build errors are either physically modeled and the process planning is adapted accordingly, or with an improved in-line sensor feedback loop where the relevant process parameters are measured and the toolpath or process parameters are adapted if certain critical thresholds are exceeded. The parameters measured obviously vary according to the production technology used.

The in-line measurement can also be used to generate data for the digital twin of the product and for digital quality

assurance. If implemented correctly, this feedback loop positively affects the process chain and leads to more dynamic processes and consistently high-quality parts.

In addition, automated data logging enables the use of reinforced data-based learning methods.

Sample Use-cases

The example use-cases below, show the future vision of industrial 3D-printing and hybrid manufacturing. The area of application is expensive parts of small batch sizes that offer a high amount of added value due to additive manufacturing.

Ponticon 3DMD process with a feed rate of 50m/min deposition speed and integrated sensor:

- ◆ Machining of parts, measured by laser-scanner systems, for adaptation to the real part geometry.
- ◆ High speed and precise powder-based process:
 - ◆ Filigree 3D structures with wall thicknesses down to 500 μm and roughness depths of approx. 10 μm
 - ◆ Coating rates up to 1,000 cm^2/min , Build-up rates up to 600 cm^3/min

Lothar Glasmacher,

Head of Additive & Process Technologies
Project Director - Process Technologies
at ModuleWorks on:



The future of CAM applications for Additive Manufacturing

So far, the main effort has been spent on complex path planning as the basis for meeting the different needs of additive processes.

The synergies between different production technologies, from ultra-precision machining to complex robot kinematics, have been considered.

There has already been a long journey since the late 1970s to today to introduce CAM toolpath planning and simulation systems for industrial production. Digitalization and automation without manual intervention is now the next step for the industry. Already promised by marketing campaigns, we have not yet seen it in real world applications. In particular, complex hybrid processes that combine additive and subtractive manufacturing are not yet state of the art. This limits the industrial application of new additive processes in standard process chains. Since the complexity of the processes has increased, the risks involved in integrating new manufacturing methods, materials etc. into production chains are still too high. Additive technologies remain concentrated on small batch sizes and very specific niche applications. The full potential of the new additive technologies cannot be unlocked with the current hardware and software technology. ■



Figure 1: Ponticon 3DMD: A machine for coating and volumetric build up with high productivity.



The team at the

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**FRAUNHOFER
INNOVATION PLATFORM**
FOR ADVANCED MANUFACTURING

*would like to express our gratitude
to all contributors and readers. It
is in this spirit that we send best
wishes for the holidays and the
new year to come.*