

INNOVATIE **NU**

March 2021



02

**OUTSMARTING
THE FUTURE**



A MESSAGE FROM THE EDITOR

We would like to acknowledge and thank the support from the following organisations:



Technological advancements available today are elevating manufacturing industries towards an intelligent, autonomous factory system integrated with the internet and fueled by data. This smart factory facilitates machinery to learn and provide accurate real-time data to enable pro-active decisions. Although the implementation is still in its infancy, manufacturers are already adopting a smart system initiative or are planning to have one. This will reshape the way manufacturing is seen today.

But the future of manufacturing is not realized by what is happening on the shopfloor today. The technological advancements of tomorrow are made through research, curiosity, and willingness to improve. To actually shape the future, we often have to think outside the box. To quote science-fiction writer and futurist Sir Arthur Charles Clarke: “the only way to discover the limits of the possible is to go beyond them into the impossible”. We can interpret this in a way that ideas no matter how ridiculous they may sound in the beginning might become reality at some point in time. By continuously discovering new possibilities and adapting we can achieve more than we ever thought we were able to. The leaps taken in technological advancements, visibility and performance provide potential to industry that we are only just beginning to tap into.

There is a clear opportunity for manufacturers to accelerate their digital-transformation journeys and achieve the higher levels of productivity they need in the short term to keep them ahead of the curve. The critical task is to future-proof their digital transformation so that the technology and processes they introduce now don't lock them out of the next round of advances.

Future-proofing starts with a clear vision for how digital manufacturing will deliver a competitive advantage. Without, it's easy to be led by the latest shiny object rather than focusing on the digital-manufacturing solutions that address specific operational pain points and drive tangible bottom-line impact. It is therefore of great significance that knowledge transfer and training are set as the number one priority to shape the (r)evolution of manufacturing. Not surprisingly, the only way to go into the impossible is to have education as your driving force.

GIJS BEUMKES
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InnovatieNU is a quarterly magazine published by the Fraunhofer Project Center at the University of Twente (FPC@UT) created for the manufacturing industry with content covering advanced manufacturing tools and techniques.

The online version can be found on amcenter.nl/knowledge/library/innovatie-nu/

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Printed by te Sligte-Olijdam BV, Marssteden 31, 7547 TE Enschede, The Netherlands, March 2021



Printed on FSC certified paper

We would like to thank our industry partners that have contributed towards Issue #2 of InnovatieNU:

University of Twente

Fraunhofer Institute for Production Technology

Fraunhofer IIS, Institutsteil EAS

KEX Knowledge Exchange AG

QING Groep

Suplacon B.V.

The Cyber Partners B.V.

Holland Innovative

CONTENTS

11

FEATURED

5G *For SMEs*

- 1** **FAST ADAPTATION
OF NEW COMPETENCIES**
The essence of industrial survival

TECHNOLOGY & INNOVATION

- 13** **YOU CAN'T BUY INNOVATION
OFF THE SHELF**
It's hard work!
- 17** **CYBERSECURITY**
*A way to improve business continuity
in digital transformation*
- 21** **TOWARDS A
FUTURE-PROOF FACTORY**
- 25** **MAINTENANCE**
The way forward
- 35** **THE LEARNING CURVE EFFECT**
On manufacturing

SPOTLIGHT

- 39** **SET SAIL TO AI**
With the AI Navigator ©
- 45** **FRAUNHOFER'S PERSPECTIVE
ON ADVANCED TRAINING**
To promote intelligent, sustainable growth

29

TECHNOLOGY & INNOVATION

QING

*Putting Digital Twins
to work*

AMC NU

- 49** **AMBITION**

SUSTAINABILITY

- 51** **THE POWER OF
GENERATIVE DESIGN**
*And its role in the green future
of manufacturing*

MOVING FORWARD

- 57** **FOSTERING TALENT**
For Twente

LESSONS LEARNED

- 59** **GROW YOUR BUSINESS**
By developing your workforce
- 65** **DOING THINGS DIFFERENTLY**
*Testing materials with
low uniform elongation*
- 69** **MAXIMISE YOUR MARKETING
POTENTIAL**

FAST ADAPTATION OF NEW

COMPETENCIES:

THE ESSENCE OF

INDUSTRIAL SURVIVAL

“New technologies and availability of information are making “I don't know” obsolete, creating new skills and knowledge possibilities never known before.”

- THE EUROPEAN COMMISSION ON EDUCATION AND TRAINING



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Technological advancement foster changes in work processes, as a result, organisations cannot deny the need to upgrade their skills to be relevant and be able to compete globally. The necessity for new ways of learning and development within companies in the current industrial revolution can be used as an organisation strategy for competitive advantage.

Technological advancement has challenged the industry and educational system to start thinking in another direction. The knowledge gaps created by the rapid progress in technology trends are felt at all levels of society. The workforce on a global scale is faced with a challenge to develop new competencies faster than ever before, to be able to multitask and focus on problem-solving. What we see today is that companies, especially SMEs, are seeking much more focused, frequent and affordable competence development programs. Conventional training and workshops often do not match fully expectations of the participants, requires significant time and money investments and cannot be seamlessly shared and adopted into the organisation. The multidisciplinary approach is the biggest challenge: interaction of IT, production, engineering and logistics into one inter-connected and inter-dependant system is a new reality that needs time and deep understanding.

Companies are aware that the competencies that were required in the past are not the same today. They also understand that the ability of the workforce to learn, develop, apply and adapt continuously to the changes within an organization is key to success. Developing non-traditional businesses and new competencies is a function of a company's ability to organize itself into a knowledge-creating system.



DEVELOPMENT

SKILLS



There are still organisations that focus on CV-initiative or import (buy) skills to fill the gap of competence rather than focus on building on the skillset of their existing workforce. The knowledge and skill set of an organization needs to follow and adapt to the technological advancement inside the company. Organizations should accurately improve and integrate new knowledge into their fundamental skills. Many companies feel that they are not prepared and equipped to support knowledge growth, not realizing that only they can create learning programs that will address the requirements of the organization.

If companies can combine their knowledge, experience and technology advancement with an ability to understand what competencies will be needed in the future, they can lead the organization forward at a time when fast development of new skills is so crucial to success. In today's global competition, it is not a question, If learning and development should be deeply integrated with an organization's strategy; it is a necessity. There are a lot of e-learning platforms and tools that support the development of new competences, however, these skills may not be that obvious for manufacturing companies. The company leaders need to be willing to create a more dynamic environment within the organization, to give space for learning and development. At the beginning the following questions should be asked on the top level of the organisation:

HOW CAN WE ALIGN THE STRATEGIC PATH OF THE COMPANY WITH THE LEARNING AND DEVELOPMENT PATH OF OUR EMPLOYEES?

WHAT NEW LEARNING AND DEVELOPMENT APPROACHES OR TECHNOLOGIES CAN SUPPORT THE FAST DEVELOPMENT OF NEW COMPETENCES?

HOW CAN WE CREATE A MORE DYNAMIC GOVERNANCE STRUCTURE WITHIN THE ORGANIZATION?

The above questions do not only focus on the learning and development within a company but also focus on an organisational strategy for creating a competitive and sustainable business. Continuous learning and development in companies are key for sustainability and process knowledge creation, especially in manufacturing. This article discusses some of the key point organisations can focus on to integrate learning and development within their organisations.



Companies should focus on adding a layer of new skills on top of the fundamental skills already existing in their workforce

In manufacturing, we are always learning and growth is driven by continuous technological changes and advancements. Therefore, the decision for adding new skill sets within an organisation requires constant revision of fundamental skills existing within the workforce so they can follow the industrial revolution and gain competitive advantage. The revision of fundamental skills and the addition of new layers of skills create dynamic companies and always ensures comparative advantage.

Automation and digitalisation will have a big impact on skills manufacturers need to remain competitive

Amid the epidemic, we have seen the need for automation and the possible impact of automation and digitalisation in companies. New ways of doing business emerged, although some companies are still struggling they are learning to adapt to the new ways of doing business characterised by Automation and digitalisation one way or another. No doubt about the necessity of learning and development in this regard. It is also important to note that automation and digitalisation are engulfed in advanced manufacturing

technologies driven by the current industrial revolution also known as Industry 4.0. Manufacturing companies need to upskill their workforce on advanced manufacturing technology skills that will enhance their competitive edge. This includes an in-depth understanding of the current trends and foundational skills required in the current manufacturing era. Most of the skillsets required in adopting industry 4.0 are available publicly. However, every company need to decide on their skills based on their business value, needs and customers. The learning and development within the organization is a continuous process and it always needs to go hand in hand with the business value.

On the job learning and through work experience is an important way of developing competence

Relevant work learning and experience are key points for ensuring competencies within a company. In this case, companies need to have experiential learning and skills development aligned with their general organisation priority and values to enhance competence. Companies need to be able to spot talent, keep talent and maintain it through continuous learning and development within a company. This can be achieved through organisation values and lifelong learning culture. Companies should enable and empower their employees to have professional growth and development as well as personal development.

Participate in new projects/ working groups in your workplace

Participation in working groups and new projects is one of the imperative ways of learning and skills development in companies. Participation in new projects increases motivation and creates a sense of responsibility on an individual and group level which also promotes organisational competitiveness. This is also one of the productive ways of identifying what skills to work on within the company.

Reflect on what you have done and learned. That will deepen the knowledge and help you look at things from new angles

Share and communicate the lessons you learned to a wider audience

This point emphasizes on knowledge creations concerning skills development which leads to process knowledge. Process knowledge is one of the key factors for competitive advantage and it is important for the manufacturing industry. Lesson learned in projects or during training and implementation are building stones for skills development within a company for the workforce. The documentation and sharing of knowledge learned to create opportunities for improvements on the learnings and the sharpening of the attained skills. Expert and leaders understand opportunities that come with knowledge sharing among which are; growth, competitiveness and improvements.

There are many other ways that companies can use to learn a new skill in the current global competition. Everything required to succeed is at our disposal however, it is not easy to apply it without actually being aware of the need for it. Companies that are successful today are realising and taking advantage of skills that improve their competitiveness. The technology that supports lifelong learning is already available it is a matter of how the companies will use it and adapt it to its current and future requirements.

Lifelong learning approach in companies

Employers and employees are acknowledging that formal education credentials are no longer the only way to recognize and develop talent. Different from formal education, lifelong learning is the "ongoing, voluntary, and self-motivated" pursuit of knowledge for either personal or professional reasons.

Just advocating the concept of lifelong learning and placing the responsibility of learning on employees is not good enough and cannot guarantee the best results. While employees should be proactive, the company must also offer the resources, support and training needed to foster this kind of workforce and guarantee the maximum corporate benefit from lifelong learning. And this is particularly true to technological and fast-changing industries (which include almost all companies nowadays!).

There is a continuum from purely self-interested lifelong learning and rigid formal education where employers are taken from the workspace to the classroom. While the former does not guarantee the learning alignment to the company's interest, the latter brings the workers to a space that seldom resembles the real work problems they daily face. In the continuum between these two extreme scenarios, proactive employees are fostered at different degrees by the companies to follow some learning paths.

We can summarize the companies' alternatives within this continuum in three categories: just-in-time learning, opening learning paths, and focused training. In each of these categories, technologies can play an important role and university-industry collaborations can leverage their results either in terms of teaching methods or in terms of up-to-date content.

Just-in-time learning (JIT): I need, therefore I learn

JIT learning is an approach to an individual or organizational learning that promotes need-related training to be readily available exactly when, where, and how it is needed by the learner. So, the information is delivered to learners at the moment they need it and to the location they need it in, without pulling the employees away from their jobs. JIT learning can either replace or enhance traditional education.



With today's advances in technology, on-demand services have been integrated into almost all aspects of everyday life, and JIT is about on-demand education. This education might relate to specific information about something or information on how to proceed while executing a task. JIT learning is most effective for personnel who work in the field and need courses and technologies "to-go" and often use mobile devices. Responsive technology brings the flexibility to successfully employing JIT learning methods. Augmented reality is another technology that can play an important role in JIT learning while executing activities.

Content for just in time learning methods should be short, yet highly relevant. The best way to address this is to look at actual competency gaps. The courses must also be categorized and organized in such a manner that searching for them is easy and requires the least possible amount of time and effort.

University-industry collaborations in terms of JIT-learning can lead to the definition of pedagogical methods for delivering the content, the structuring of the content, and the designing of the learning environment.

Opening learning paths: a beacon shedding light to the preferred direction


One way to align the employees' lifelong learning initiatives to the company's interest is by making its business and technology roadmap goals available to the workforce. In this way, the company creates a "beacon" for giving direction to self-driven learning. Additionally, openly available courses or remote laboratories can be recommended or can be tailor-made to align with the company's roadmap.

Platforms such as Coursera and CEPHEI are examples of sources of courses (some open

“Continuous learning and development in companies are key for sustainability and process knowledge creation, especially in manufacturing.”

Ivana Mishikj M.Sc

Project Manager
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“Although these technologies are indeed promising to education, they are the means and not the goal.”

Dr. M.V. Pereira Pessoa
Assistant Professor,
Engineering Management
University of Twente

and free) for lifelong learning. The CEPHEI platform, which the University of Twente takes part in, focuses on linking the education with the practice, thus integrating the reality of professional innovation activities to the context of education according to the demand of the industry. The CEPHEI is a good (and not unique) example of the opportunity for university-industry collaborations. The companies can reach the CEPHEI partner universities and seek or suggest courses for including in the platform. In this win-win scenario, the industry benefits from high-quality courses that fit its interest and the university benefit from bringing to its courses real industry experiences.

A remote laboratory is the use of telecommunications to remotely conduct real experiments, at the physical location of the operating technology, whilst the scientist or students is assessing the laboratory from a separate physical location. For instance, an asset the industry has in several geographically distributed locations can be turned into a remote lab, so that all locations benefit from a unique training infrastructure.

Focused training: Formally follow a formal training

Formal training where workers are taken to the classroom (physical or virtual) is still a choice, particularly when there are specific pieces of knowledge a group of employees need to learn. In this case, the key aspect is to minimize the time the employees are pulled away from their jobs and maximize the benefits from the time they stay in the classroom.

Blended learning and particularly the flipped classroom setting is adequate to this situation. The flipped classroom is a pedagogical approach in which direct instruction moves from the group learning space (classroom) to the individual learning space (home). Therefore, the content is checked at home through videos, readings, and quizzes and the class time is used to perform more dynamic, interactive, and creative activities, such as problem-solving and project work.

While the supporting technologies are similar to the “opening learning paths” category, the university-industry collaboration goes one step further since it requires developing



courses with content that are specific to the company's needs. Here courses are developed together, where the university staff brings their pedagogical and content/best practice knowledge, and the industry staff brings their practical knowledge.

There is also the benefit of becoming partners of initiatives such as CEPHEI, since the industry can host its courses in a platform without needing to create its course authoring and management infrastructure.

Education 4.0? “Employees and Employers 4.0?”

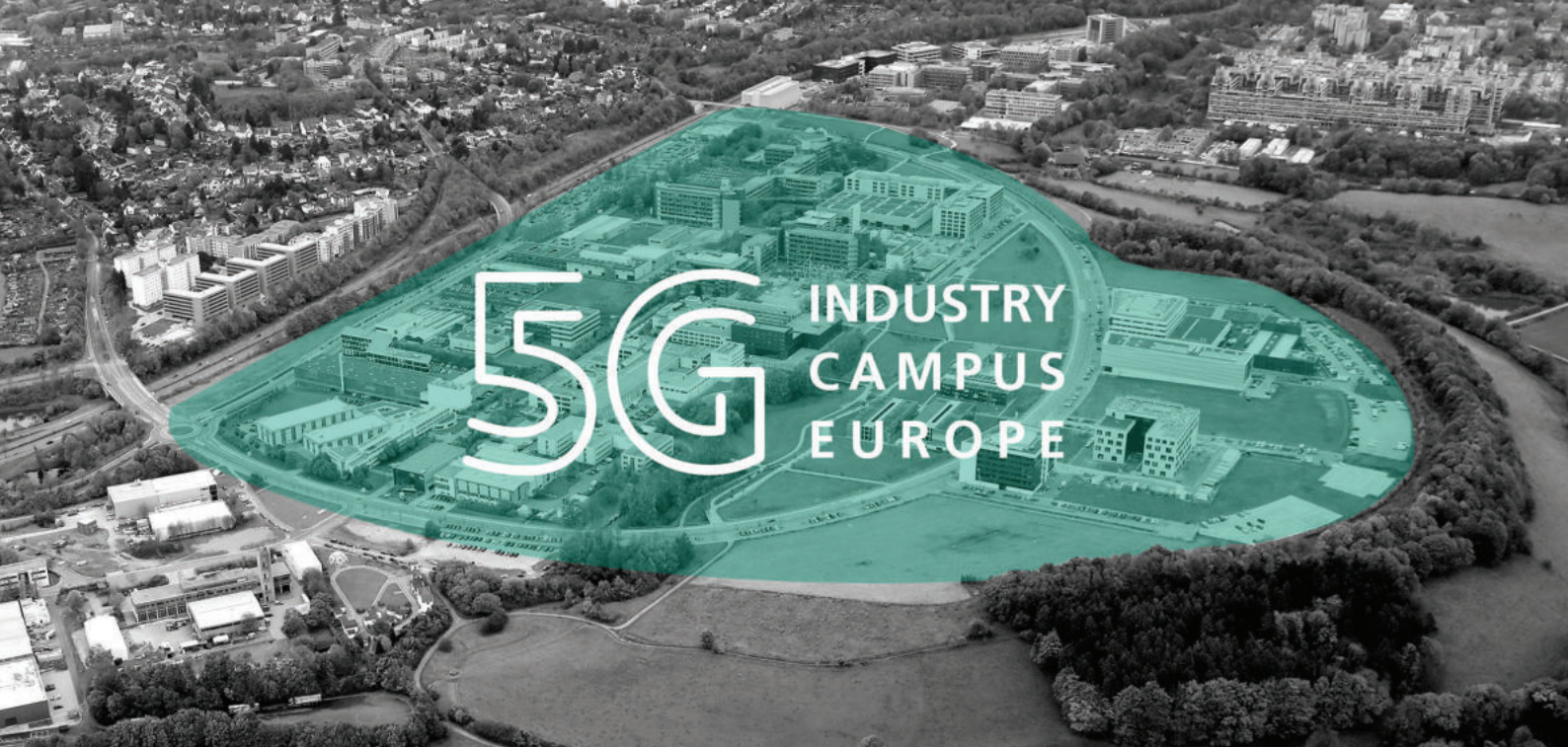
Industry 4.0 has become a buzz, and “Education 4.0” is yet another “4.0” term that has been used, which relates to aligning learning to the emerging fourth industrial revolution's technologies including robotics, IoT, digitalization, automatization, and teleconferencing to name few. Although these technologies are indeed promising to education, they are the means and not the goal. Education, from 1.0 to 4.0, is about defining learning goals, using the best fitting pedagogical approaches to promote the learning in each context, and

then selecting the best fitting technologies. The actual times, though, indeed require both “employees and employers 4.0”. Lifelong learning and the use of new ways of learning and development within companies is both a reality and an opportunity.

One final note

We discussed about the challenges companies are facing, when it comes to the point of building new competences. We also shed some light on the approaches that companies need to take in order to make the first step towards becoming a knowledge-creating system. Many times it is not the question of how to approach the challenge but who should approach it.

Companies need to understand that knowledge is part of all the levels in an organization and it is not a static process but a very dynamic one. Every employee is part of the puzzle to make the companies more competitive. Having a culture that encourages lifelong learning and invests time in revision of the fundamental skills and competences, plants additional layers to the strategic path of the company, creates a dynamic working environment and ensures a comparative advantage.



5G has enormous potential to disrupt industrial communication and data handling with extreme speed and near-instant response times. However, the implementation of the mobile communication technology is not merely setting up some 5G antennas in a factory environment. Manufacturers also face a wireless tech's added challenge that has seen nearly all technology development by telecom network operators and application-focused entirely on the consumer phone market.

Fraunhofer IPT's Niels König coordinates the 5G-Industry Campus Europe, the largest industrial 5G testbed dedicated to production in Europe. He provides us with a few insights and considerations for small manufacturers looking to take advantage of 5G's value offerings.

Industry 4.0 is seeing a rapid transition to new ways of integrating technology with various cyber-physical systems. With this comes new requirements and challenges for the fast transfer of big data. We are beginning to see a new fundamental need to handle and utilize data beyond what existing communication technologies can support.

Existing and future factories will likely see high value in transitioning to fast wireless communication technologies such as 5G.

To date, 5G has not moved far away from a consumer offering. Only recently have a few large companies, such as Mercedes, started to take advantage of 5G's potential.

5G offers some incredible advantages over existing network communication technologies. In summary, a 5G network offers a factory environment with far superior speeds, low latency, and the ability to support massive amounts of data over a considerable bandwidth. However, the caveat to this is that a factory environment will not achieve these benefits on a public or consumer network. The real value of 5G wireless data transfer is only achievable on dedicated private networks.

"The fact that on the 5G-Industry Campus Europe, we have a fully equipped testbed helps us to demonstrate 5G applications not on lab-scale but in a realistic production scenario. Since there is lots of marketing and no proper market offer, it's all about credibility for the topic. Our objective is to convince industrial users to get motivated to start with 5G and create a market pull. So, chicken and egg very well describe the current situation."

Here is where one of the significant challenges lies, especially for an SME or Start-up looking at getting setup with 5G to support advanced manufacturing operations. Very few manufacturing firms would have the knowledge or expertise to establish their own 5G private network. The detailed design and implementation of a communications network are also critical to enable and support edge devices and cloud-based systems.

There is currently very little help available in consulting services with knowledge and experience with 5G for industrial networks. The network technology requirements towards a non-public network are not well understood yet across manufacturing industries. One big standout here is that public 5G is optimized for download traffic. General customers need fast video and content downloads. A manufacturer, however, needs superior and optimum uploading capabilities.

For SMEs especially, any solution needs to be affordable, and the most powerful solution may be out of reach. SME's do not often have highly resourced IT departments that support network change and implementation, which can be a challenge.

“A stand-alone isolated 5G network, in which you have the highest performance and guaranteed quality of service, completely at your disposal, may be unachievable for small companies. A decision for a more affordable solution may lead to partially make use of public 5G resources. For example, the core network or even the user plane. Then a company relies completely on the public 5G network with no guaranteed quality of service.”

Niels König

Chief Engineer

Department of Production Metrology
Fraunhofer IPT

Niels and the Fraunhofer IPT team are currently working on a special 5G-Audit that will support small companies to fill these gaps in effectively implementing 5G solutions. Part of this involves a tool that an SME can use to get guidance and clarity on the potential of 5G value offerings.

“You have to analyze each business case independently. We are working on an assessment tool that can calculate a potential cost-saving effect of using 5G based on a set of multiple production KPI.”

The 5G-Audit acts as a steppingstone for project planning. From here, Fraunhofer IPT can support and advise on the application and implementation of 5G communications, whether across existing infrastructure or starting from scratch and setting up new equipment. It extends from the factory planning stage to how to retrofit existing equipment such as milling machines with 5G sensor technologies.

In the outlook, Niels states,

“I expect that in a year or two, we'll have reached the point where 5G will be normal in the industry.”







**YOU
CAN'T
BUY**

INNOVATION

**OFF
THE
SHELF**

IT'S HARD WORK!

For a sheet metal working supplier like Suplacon, the digital agenda is a top priority. Equipped with modern and reliable machinery and a well-functioning ERP system, attention is now focused on a reliable planning system and shorter lead times.

As far as lead times go, there is still a great deal to be achieved. Despite all our efforts, the wait times of combined orders can amount to 90% of the lead time. As part of the AMC programme of the Fraunhofer Project Center (Maaik Slot, programme manager), Suplacon has initiated a research programme together with three other companies in the area to develop a support system using an enhanced planning system and smart AI algorithms to reduce wait times by almost half.

There are seven working processes involved in the project and we have already held the first in-depth session at Suplacon. The value chain has been mapped out in precise detail and the management has received many questions about the whys and wherefores.

Positive results from this research could mean an extremely welcome improvement to our in-house developed platform **Plaatwerk 365, which has been continuously developed over the past few years**

This platform enables customers to upload their 3d drawings and allows them to check the feasibility of manufacturing their products by comparing the difference in price when selecting different materials and quantities. In the case of an order, the current online capacity and/or the planning status is, of course, particularly important. It is worth noting that when the customer uploads a large number of files to the platform at the same time, the platform switches on extra WICAM calculation capacity for the CNC machines using an API. An e-marketing research study is currently looking into the experiences of the various groups of users of the UI. These findings will form the basis of the subsequent look and feel of the UI of plaatwerk365.nl.

Plaatwerk365.nl **MAKING SHEET METAL WORK** **DIGITALLY.**

COMPLETE, FRIENDLY,
EASY TO USE
TRY US

SCAN ME



Powered by Suplacon



In addition, a study has now been initiated in cooperation with HS Windesheim to work out how Work In Progress carts can be moved around the factory using an AGV. The unusual part of this task is that the AGV would not have to move from point to point but is dependent on the sequence of order production stages on the cart. And that is then related to the workload of the first available production machine. You can't buy digitalisation – it's sometimes hard work.

However, we are not solely occupied with digital innovation

We now have a talent pool of five young professionals engaged in the continuity of the business and developing future entrepreneurship. We do this by discussing all kinds of subjects with the talent pool which are related to running a business. This includes finance for non-financials, inspiring management, and attendance at (pre corona) expertise lectures and presentations, for example. The members of the talent pool all fulfil their roles within their own professional field. These range from e-marketing to being

ICT product owner of plaatwerk365.nl. They also share a lot of knowledge, including aspects of innovation, with each other.

Every now and then, it is time to move forward

Suplacon was an early adopter of process integration of CNC management. Over the years, we have produced many custom-made items, but now that products such as Wintheon/ECI and Wicam API have come on the market, it is time to switch over to them. This means that we are now abandoning some of our own software modules and switching over to the above-mentioned products. The ICT capacity released will then be used to develop and speed up our own platform Plaatwerk365.nl, our connection to the platform economy of the sheet metal value chain.

Together with a young management team and a clearly defined digital path the future is not only hard work, but also challenging and bright.



Jellard Koers is the CEO of Suplacon B.V.

Suplacon is a B2B co-supplier for sheet metal products. Engineering solutions for our clients by delivering custom made parts and modules serving different industries. Due to a well formulated innovative digital agenda and our platform www.plaatwerk365.nl servicing clients over the digital highway.

Making sheet metal work DIGITALLY.



CYBER SECURITY

Cyber security is not a goal, nor will it ever be. Business continuity, however, is.

Accordingly, cyber security is a topic that should be addressed every once in a while. Cyber security - digital safety & security - is a precondition for safely using the opportunities digital transformation offers.

Nowadays entrepreneurs face cyber threats on a daily basis. Measures must be taken and investments should be made to defend your core business against these threats.

However, where to start?

The best way to deal with cyber security depends on the type of company. Some examples are:

- Large enterprises have a (non-executive) board which should monitor the cyber resilience of the organisation, as is stated in the Dutch 'corporate governance code'.

A WAY TO IMPROVE BUSINESS CONTINUITY IN DIGITAL TRANSFORMATION

- Fortunately, most large enterprises have invested in technology, processes and education of their staff. Yet, they typically remain vulnerable through their connections with business partners.
- In some cases these companies need to find an effective strategy to regularly update their ways to stay ahead of the newest threats.
- Medium-sized enterprises usually do have some measures in place, but in about 60% of the recent assessed cases, the compliance to these measures depends on only a few staff-members that recognise the importance.
- Cyber security threats to smaller organisations are similar to enterprise-sized risks. Without large IT and security teams, these organisations depend on external technology and cyber security providers. Asking the right questions not only helps to assess the company's cyber risk better, but also evaluate the right security partner for you.
- In specific industries e.g. the defence, or medical industry, specific cyber security standards have been developed.
- When running an international business, international and foreign laws could influence your cyber security.

Since the start of the COVID-19 crisis, the urgency to invest in cyber security has increased tremendously.

Building and growing awareness of cyber threats and security should be a continuous process in every organisation. Seeing the ongoing developments in this area it is necessary to keep on learning continuously as well.

Fortunately, no one needs to start from scratch. We have collectively gathered quite some experiences over the last couple of years.

Let us look into the example of so-called “phishing” mails. Experience has taught that phishing mails can be identified by a combination of the following three characteristics:

1

The sender is a person (CEO, “CEO-fraud”) or an organisation (tax office, bank) with authority

2

The recipient is a staff member with digital authorisation power, e.g. someone who is authorised to carry out a financial transaction or software update.

3

There is always a means of (psychological) pressure involved, such as time. “You need to act quickly”, “Pay before tomorrow, otherwise...”

How to train the workforce to recognise these types of threats?

And, when being recognised, what should people do?

Specifically for industry 4.0 there is more to know. Production should never be interrupted. And it is highly important that the data received from partners and clients are protected in your organisation as well. Yet, in most manufacturing environments, not all updates and upgrades are implemented automatically, even if they are available.

Industry 4.0 environments are more dependent on their technology supplier. What questions should be asked and what can be done in your network architecture?

Cyber security is not the goal, but a way to be able to stay in business.

Did you know?

- that since the start of the COVID-19 crisis, the amount of cyber attacks has increased five fold?
- that remote working has significantly increased the dependency on digital infrastructure?
- that most cyber incidents (80%) are (unknowingly) caused by own staff or from their account?



Evelien Bras

Director

The Cyber Partners

The Cyber Partners is founded by Evelien Bras.

Evelien has finished her degree in Computer Science more than 25 years ago. She started her career implementing solutions in securing international telecom infrastructures. She turned to the aerospace and defence domain leading innovation and public-private partnerships. Cooperation and cyber security became the key focus.

Nowadays, she is a non-executive board member in a multinational organisation in the automotive domain, guest lecturer at the University of Leiden for the part-time executive master Cyber Security, she chairs an assessment committee of NWO (Nederlandse Organisatie voor Wetenschappelijk Onderzoek) and is recently appointed as director of FERM, an initiative to evolve cyber security in the Rotterdam harbour.

The Cyber Partners is a cooperation between professionals, focusing on the governance of cyber security within commercial organisations.

The human factor is the most critical aspect in keeping your business safe.

WORKSHOP

How to organise resilient digitalisation?



CYBER SECURITY

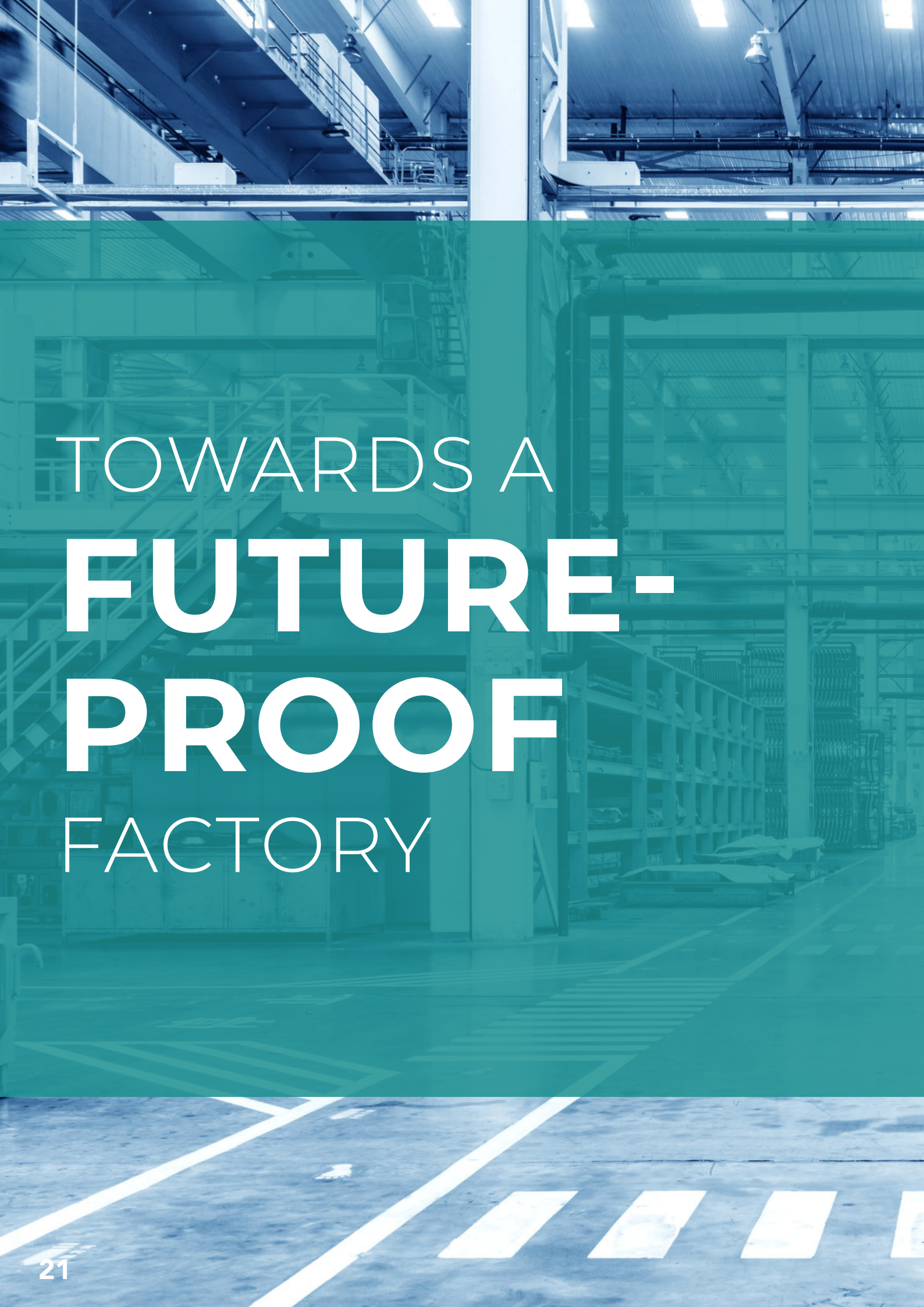
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- Governance
- Cybersecurity
- Privacy & Compliancy
- Standards & investments
- Ethics
- Awareness & the human factor



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TOWARDS A
**FUTURE-
PROOF**
FACTORY

The fourth industrial revolution is changing the way our factories run. Increasing productivity, reducing operating costs, increasing quality and improving on innovative capacity and capabilities are all key benefits of entering an interconnected cyber-physical factory world.

Understanding and benefiting from cyber-physical systems in a factory environment will be common-place and likely essential to staying competitive moving into the future. As manufacturers, we need to be careful about the plans and changes we make in our new and existing factories today, so that we can extract value and avoid obsolescence in the future.

Future Proofing People – Staff & Culture

Before any manufacturer can look towards implanting Industry 4.0 initiatives there must be strong and agreed support and drive from the top of the organisational hierarchy. It is commonly understood that without this top-down approach and commitment at the executive level, most initiatives would be almost guaranteed failure in realising their Industry 4.0 goals. Through a company culture that embraces innovation and making the best use of available technologies, the primary benefits of Industry 4.0 can be achieved.

Beyond top level support, it is important that hiring and training key innovation staff at the operations level is seen as a priority. It can be too easy to place bias on investing on equipment and systems, but not rather than having the right talent and knowledge in-house to steer the ship. Having staff trained in a new way of working is critical.

In a new interconnected role, where interaction with cyber-physical systems are a part of normal working life, the employee's role will likely transition away from basic labour tasks. While it has become increasingly common to negatively associate new technology with job loss, we will in no way see replacement of human labour. **Through data connected technology, negative labour tasks can be improved upon or eliminated.** A factory worker's role shifts from manual labour to working with and being aided by information that integrates into their workflows. An interconnected mix of man, machine, data and method. People are still, and always will be, at the heart and core of any data integrated system.

Modern Infrastructure – Getting the Digital Gears Spinning

Spending valuable investment and resource on data collection with no strategy will always be wasteful. Buying the latest equipment, data handling systems or investing in sensor technology is a recipe for tremendous waste if not spear-headed with a clear strategy.

Many make the mistake of misunderstanding the industrial internet of things as needing to capture all data. Having lots of data is great, but only if you can use it to work towards a well-understood goal. To avoid this, future factories need to have a very good understanding of the role that data plays in processes within an entire manufacturing lifecycle. Interconnectivity and real-time data should be implemented in process areas where it can improve and enhance. For example, a retrofit of an existing machine may help to make predictive maintenance smart, and based on live data. Further adding value to an existing, difficult to predict, planning operation. A poor execution of this same technology may just give operators a fancy new way of monitoring past machine events and real time status.


Looking beyond sensors and individual machines, the entire network infrastructure of a modern factory needs some careful attention. Older, traditional factory network systems often take an overly simplified and easily exposed approach to the various levels of equipment and process control. Segmentation and correct handling of network data traffic is one of the key areas to creating a modern factory that is both smart and safe. By having correctly setup redundancies and data routing network architectures, as would be typical in a modern Converged Plantwide Ethernet (CPwE) network for example, we can setup the backbone to better protect ourselves from both avoidable system downtime and dangerous external attacks.



Cybersecurity – More essential than ever

As we transition deeper into a digital future, aging and legacy systems that are often embedded into our factory equipment and processes are attractive targets to those that wish to cause us harm. Legacy systems especially can be easy targets, with poor, if any, digital security maintenance and support. When more equipment and workflows are interconnected via networked technology, those attackers can cause more damage in different ways. New areas of our factories may be opened and exposed to threats, increasing our risk of exposure to areas that may have been offline in the past.

To transition into a future digitalised factory environment means understanding and taking strategic measures to eliminate and design out cyber threats. Understanding a factory cyber security needs and strategising around this is something that should be addressed very early in any Industry 4.0 project. It can be too easy to simply focus on new technology and equipment, but we must also place focus on where we expose both old or new systems to the wider interconnected world. It will likely be critical to protect areas of the factory we have not had to safeguard from cyber threats in the past when we expose these to any type of digital network. Existing, emerging and future risks need to be planned and managed with effective security measures implemented that consider and protect the entire interconnected manufacturing lifecycle.



Has reading this made you ask yourself a few questions about the future of your factory?

If so, connect with our team and let us work together to realise your Industry 4.0 manufacturing goals.

MAINTENANCE THE WAY FORWARD

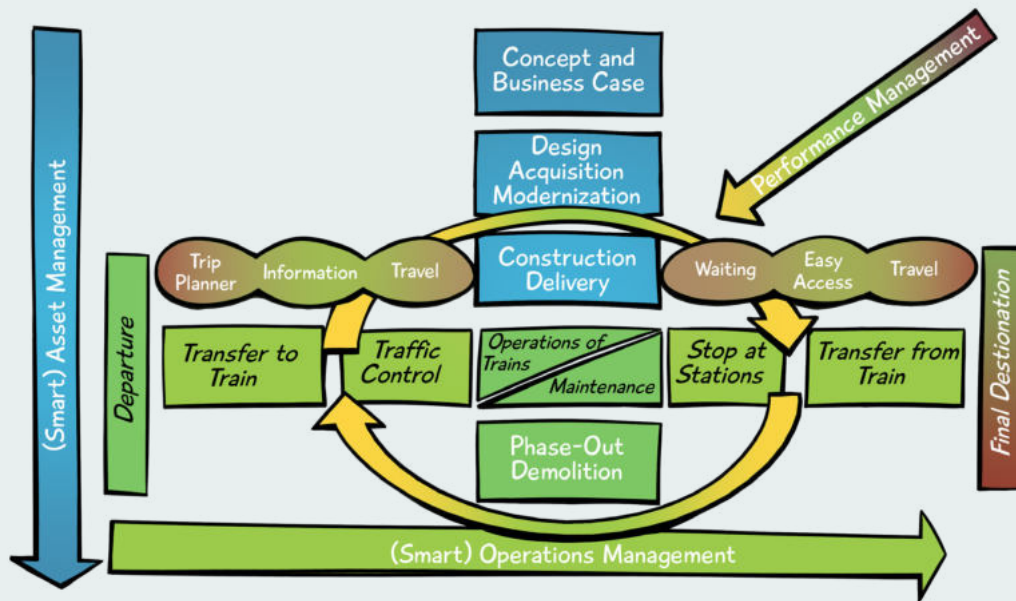
Maintenance engineering has always had one core objective: to reduce and ideally eliminate the downtime of equipment in the pursuit of operational efficiencies. However, the way we approach maintenance is changing due to the emergence and diffusion of digitalised technology and smart sensors.

The competitive nature of today's economy sees equipment downtime due to maintenance as a core aspect of manufacturing that must be managed effectively to remain efficient and competitive. In many highly competitive industries, preventative maintenance is critical to avoid expensive downtimes and equipment damage.

Traditional maintenance engineering saw reactive approaches accepted as the status quo; in simple words, we waited for a failure before we replaced or repaired the damaged part or system. In the last decades of the past century, there have been relevant developments in the way to approach this situation, introducing predictive maintenance solutions, with manufacturers looking at reducing down-time to drive efficiencies and performance.



The overlap between asset management and operations management for a passenger transport company is shown below.



On the vertical axis the life cycle of the conveyance is shown: from concept and business case, via acquisition, design, construction and delivery to actual operation including maintenance and subsequently decommissioning.

The customer experience is represented on the horizontal axis: departure from location, transport to station, traffic management, driving and stopping the train and subsequent transport to destination. The customer experience mostly concerns information, travel and visiting.¹

Routine manual inspections and strategy-based approaches can still assist in creating statistics-based predictive maintenance plans and models that were traditionally based on existing reactive maintenance operations. However, these activities are still susceptible to low-occurrence failures, and unplanned failure events that can cause major issues in a manufacturing production line.

With the emergence of affordable sensor technologies, factory floors are becoming more interconnected and allowing maintenance engineers to use digital technology with networked equipment and infrastructure to develop better strategies when it comes to keep a system or piece of equipment producing. Where prediction used to be based on past collected data, new technology allows real-time live data to be collected and used to keep systems functional and operational, bringing closer and closer “smart” asset management and “smart” operation management

With the emergence of affordable sensor technologies, factory floors are becoming much smarter and allowing maintenance engineers to use digital technology with networked equipment and infrastructure to develop better strategies when it comes to keeping a system or piece of equipment producing.

At the intersection between Asset Management and Operation Management, the available digital information and equipment facilitate the operational management at strategic, tactical and operational levels. Data on the product, the operational production processes and the condition of the assets are the main drivers. Efficiency and effectiveness can be enhanced by also linking smart asset management and smart operations management properly from a digital point of view. Performance management takes place at this intersection. The adding value is that this structure brings the longer-term strategy and the short cyclical operational processes closer together.

¹ van Dongen, L. A. M., Frunt, L., & Martinetti, A. (2019). Smart Asset Management or Smart Operation Management? The Netherlands Railways Case. In S. Singh, A. Martinetti, A. Majumdar, & L. van Dongen (Eds.), *Transportation Systems: Managing Performance through Advanced Maintenance Engineering* (pp. 113-132). (Asset analytics). Springer. https://doi.org/10.1007/978-981-32-9323-6_8

Three main advancements in technology and innovation are driving the transition towards a new form of maintenance:

1. *Internet of Things (IoT)*

Manufacturing process flows, along with their associated plant and equipment are becoming more integrated and network connected thanks to digitised technologies. To enable companywide digitisation, new (and old) equipment is often fitted with advanced digital sensors that can provide operational data to operators and management.

2. *Sensors & Integrated Networking Technology*

Through sensor embedded networks, we see huge potential for change in the way maintenance engineering is undertaken. Predictive maintenance is able now to be facilitated by live data from our factory floors and built environments.

3. *Digital Twin*

Some industries, such as energy, mining, aerospace and defence, are already seeing major benefits and leading the way in developing the future of these new maintenance systems.

Evolve **faster!** Get **smarter!**



A large part of the development drive coming from these industries is the huge overhead costs and safety implications involved if parts, systems or equipment fail unexpectedly or are unavailable for long periods.

What we are now beginning to see is a diffusion beyond these large industries flowing into general manufacturing. No longer the realm of huge enterprises, these sensor-based technologies are becoming very accessible to SMEs and teams who do not have extensive resources and technical knowledge.

A simple example of how this may be applied in a factory environment can be given with a drive motor. Let's say a motor that drives a machine has built in sensors which can monitor specific physical phenomena. An IoT connected sensor system can trigger a procurement event for a spare motor part in a firm's enterprise resource planning (ERP) software before downtime or a critical failure occurs. This often allows to completely automate the process of manual check equipment condition, and parts' purchase.

The adoption of real-time condition monitoring, in its more advanced form at least, allows creating a digital copy of the real asset, also called 'digital twin'. With a live feed of operational and machine data acquired from sensors, the virtual replica can become a very powerful tool to not only understand the actual state of the system but also predict its future state. Considerable savings in time and cost can be made when a factory environment is simulated using operational data from physical equipment to create a closed feedback loop of a system.

Virtual and Augmented Reality and Operator 4.0

When looking at shop floor or field-based applied technology, virtual reality (VR) and augmented reality (AR) technology is set to change the way technicians and field engineers maintain and work on equipment, creating empowered workforces often referred to as 'Operator 4.0'. With simple and affordable network-connected devices such as tablets or wearables, even a small firm can create tailor-made maintenance procedures with virtual guidance and prompts laid over the assembly or equipment that a technician is working on. In its simplest form, an operator can hold the camera of the device up to the equipment which will then provide the overlaid work or maintenance instructions, guiding him or her through the necessary steps or providing accessible live information. This can completely illuminate cumbersome paper-based manuals and rapidly decreases the time to re-commission a piece of equipment to operational capacity.

It is predicted that these technologies will become commonplace in future factories, making maintenance operations faster, less prone to human error and allowing for higher performance in maintenance engineering tasks. Many of the technologies discussed here are only in their infancy when it comes to practical application. The future will see endless possibilities for new applications that will improve the way maintenance operations are performed, creating safer factories and reducing the human labour required to perform important but often repetitive tasks.



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QING

PUTTING DIGITAL TWINS TO WORK

Digital Twins are at the frontier of industrial technology and are changing the way in which we approach factory design, operational management and development. Capturing real-world industrial operations data in a virtual simulated environment to accurately simulate process, a Digital Twin has enormous application potential far beyond what most businesses are realising today. In this article, we get together with engineering firm QING to discover their industry leading approach to driving the Industry 4.0 revolution.

The concept of a Digital Twin has been around for some time now but has not yet become commonplace in wider industrial applications. Traditionally, to effectively use large amounts of industrial data has been prohibitively resource intensive for many. Often requiring dedicated internal experts, highly specialised tools and knowledge and been constrained to limited areas of operations. Of those that do utilise a form of Digital Twin in their business toolbox, the application is too often underwhelming and constrained to basic operations monitoring or even as a single-use standalone tool. The true value potential in how businesses can use a Digital Twin is often strongly misunderstood.



“Digitisation of the industry includes many new technologies that must come together to lead to powerful innovations.”

Bart van Went
General Director
QING Groep

“We create awareness that Digital Twin technology could be a strategic tool with various lifecycles. This is a challenge because companies mostly look at it as a single use tool. Here lies the true potential of Digital Twin technology.”

Bram de Vrugt
Business Manager
QING Groep




A key technology

QING are an engineering firm with a strong focus on innovation, taking a different and self-confessed unconventional approach to applying the latest in industrial technology. Over the last three years, QING have been introducing European food and agriculture businesses to the true value and potential of Digital Twins. General Director Bart van Went and Business Manager Bram de Vrugt provided an interesting insight into how QING are doing things a bit differently. They see Digital Twins as a key technology to unlocking maximum value in future technology implementation. Below we give an overview of how they are emerging as leaders in how industry should be taking technology into the future.

Where QING differentiate themselves is by moving away from simply being a technology provider that pushes a single solution or technology to solve a problem. Bram de Vrugt, described that they put as much of the emphasis on developing and improving the application of Digital Twin technology internally as they do on developing unique solutions in collaboration with clients.

Technological Potential

The QING approach to a Digital Twin is multi-faceted and quite original in specification and application towards each client's unique problems and goals. Bram describes that recently working with machine builders and manufactures has shown that the true value of a digital twin is realised through knowing how and



Digital Twins allow us to simulate and test scenarios that could be a potential investment and allow us to decide if those investments and risks are worth taking.

Bram de Vrugt
Business Manager
QING

to strategically utilise data driven simulations across different functions of a business.

Bart van Went describes how the QING approach to Digital Twins sees the application potential of a modern virtual simulation as the most important aspect when engaging with the complex data environments and needs of clients. Something that is often completely misunderstood by many is that a Digital Twin has potential far beyond copying or simulating an established industrial process. A common status-quo in understanding a simulation often comes from traditional CAE (Computer Aided Engineering) methods. A virtual environment is used at a single point in time, often only in development, using disconnected historic data to prove a point. The simulation is usually an almost disposable single use tool, archived after

use to never be opened again. In the same way, sometimes simulations are simply understood as a tool that can observe and monitor an industrial process.

QING does not look at a Digital Twin as a standalone tool or something that is used for only one single purpose. They create awareness that Digital Twin technology can be a strategic tool with various lifecycles that can be adapted to suit a specific business's needs. Bram de Vrugt stated that this has been one of the main challenges that QING has faced. Many people enter conversations or projects with a misinformed idea that a Digital Twin is a single use tool. This is not the case at all. The ability to completely tailor the lifecycle to a business or projects unique requirements lies the true potential of Digital Twin technology.

Adding Value to Business

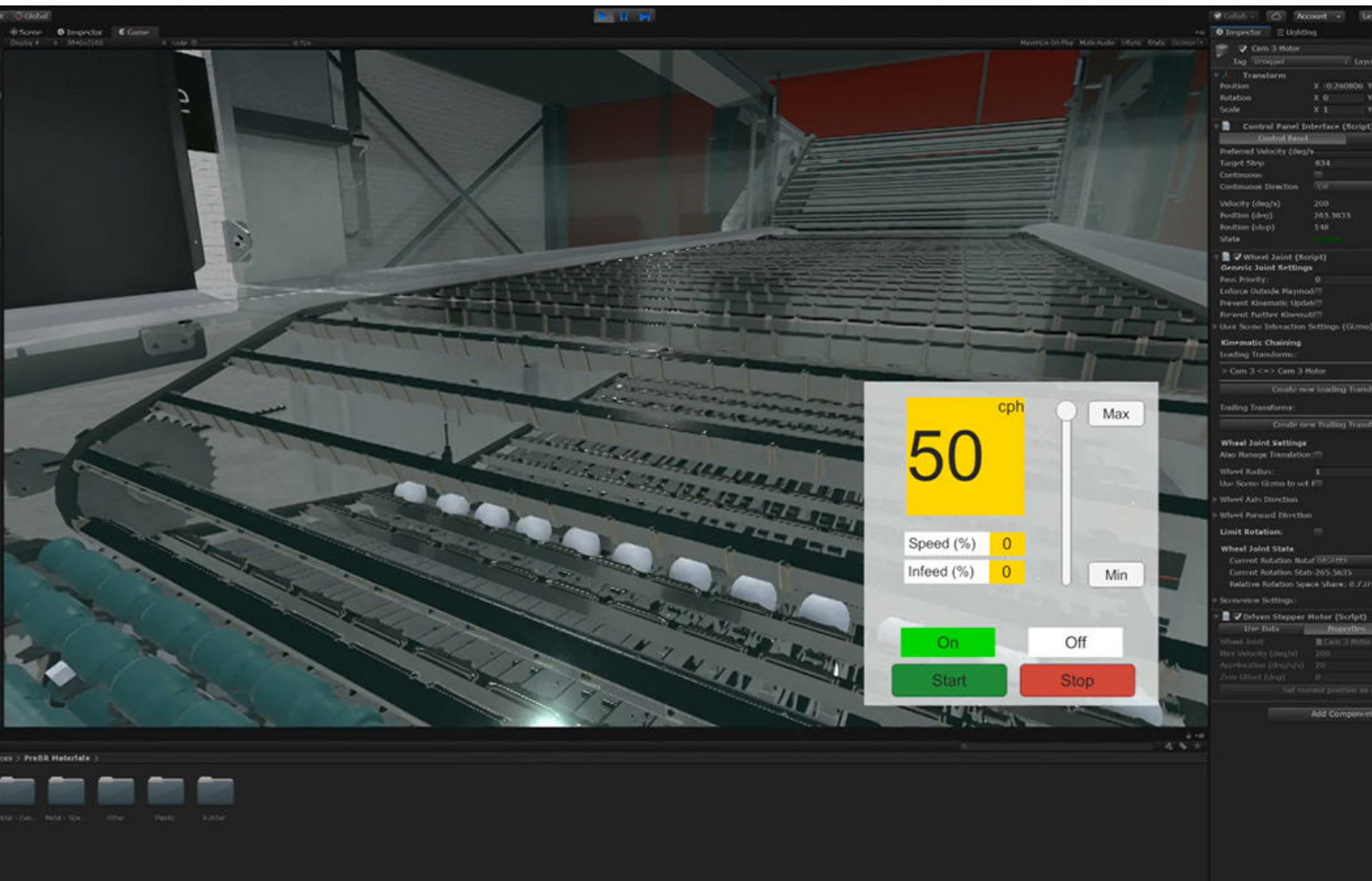
Digital Twin applications that serve and provide longitudinal value over time create a foundation that can complement and enhance a diverse range of business functions. Using data and technology in new ways allows for a simulation that is easily accessible by all staff, across various areas of a business. Below we cover a few select areas from both a technology and management perspective that may see a Digital Twin become an essential tool.

Operations Level

At the operations level, QING sees value in providing advanced capabilities in observing and measuring processes. Using live data in real time, a process management team can ensure strict regulation of environmental controls or conditions with extremely fast if not instant response times. Having rapid reaction capability to changing conditions can result in drastic improvements in operating efficiencies.

Extending beyond process control, the Digital Twin can also offer capabilities in taking the role of extremely effective staff training. Moving away from standalone detached training, modern ways of using interconnected data can see information feedback loops providing live staff guidance and direction as to whether a task is being performed correctly. Another benefit of having an interconnected Digital Twin based training environment is that training programs can be updated automatically in real time when processes change or evolve.

QING see operations efficiency as only the beginning of the value offering of a Digital Twin. An effective Digital Twin can become a very powerful tool for providing information for managing change and developing new projects in any industrial setting. For QING, this is seen as one of the most important applications of Digital Twin technology. By using simulations based on Digital Twin data, new project development can be streamlined with simulations that become extremely powerful tools for risk management. The existing digital twin outputs can feed virtual



prototypes of entire complex systems which would traditionally be performed by using real world physical prototyping. The value here is that the virtual prototype removes many of the usually prohibitive costs, risks and lead times associated with traditional prototyping. Many diverse settings and scenarios can be run with minimal resource requirement, that would normally not be possible.

Executive Level

Strategically and from the executive decision-making level, this gives fantastic insight into future investment and business case scenarios. To invest in technology is an expensive endeavour and this type of simulation can provide an excellent way to manage the risks involved with investing in future projects. The way that this information is presented is also far more developed than the old days of graphs and images on a presentation. For future development scenarios, the Digital Twin can be used as an immersive tool to give a broad range

of stakeholder's involvement and interaction with prospective future changes. The various aspects and decision-making points of a project can be explored, and then in-context data driven decisions can be made at the executive level.

Core Foundation

In the end, it is up to businesses to try and understand what they really want to achieve from a digital twin and to fully understand the true value potential. For companies asking where the ROI is on investing in Digital Twin technology, Bram describes that industry needs to not look at a Digital Twin as a single expendable tool. At its core, Bram and the team at QING see Digital Twins as being indispensable future tools with a lifecycle that is potentially almost infinite: a tool that can be used in vastly different ways in development, operations management, training, and risk management. The Digital Twin has potential to become a core foundation for everyday decision making across the entire business.

**SMART IDEAS
DRIVEN BY
CURIOSITY**

We are QING. A lively team of eighty inventive engineers, consultants, project managers and advisers.

Based on our unstoppable curiosity, we deliver innovative and sustainable solutions for a huge number of clients in agri, food and packaging. We find answers by asking questions and we will help you with solutions that take you even further.



more info www.qing.nl

QING
forward engineering

THE LEARNING CURVE EFFECT

ON MANUFACTURING



Remarkable increases in productivity are typically realised as organisations gain experience in production. A variation is observed between those who learn and those who show little or no learning. Reasons can be found in organisational learning curves including organisations “forgetting” employee turnover, transfer of knowledge from other products and other organisations, and economies of scale.

In manufacturing, productivity is defined as a degree of getting imperative work done efficiently and consistently which improves over time. The term “Productivity” is mostly applied in production environments and it is associated with cost reduction and getting the most out of finite resources. It is acquired by understanding

the production process through which work is done and it is a measure of the number of important tasks performed in a specific period. Understanding of production processes in manufacturing is obtained through actually doing the work. Efficiency in a job improves if it is done diligently over time with repetition. The manner of acquiring knowledge by doing work is known as the “Learning curve” and leads to productivity improvements within an organisation.

A learning curve is an interaction between an employee’s performance on doing work and the time it takes an employee to complete the work. The learning curve in manufacturing is realised by looking at the Takt time and the lead time within the organisation. Under this effect, the Takt time is reduced which consequently reduces the lead time and increases productivity and competitive advantage by ensuring that customer demands are satisfied in time.

It is also important to note that productivity increases when the costs of production – including labour costs – decrease with increasing performance. Most manufacturing firms leverage on the advantages of experience and learning curves effect while others do not understand the advantages and the competitive edge that come with this effect. Manufacturing leaders, however, are aware of the learning curve effect and somewhat aware of the benefits that come with it. This awareness is seen in the skills development projects that are taking place within organisations as workforce skills improve with practice over time.

In today’s competition, skills development has been realised as one of the tools to gain a competitive advantage and increased productivity. Manufacturing organisations invest resources in this area which enhances the workforce’s ability to do work efficiently and consistently and through repetition the learning curve effect improves. The learning curve effect on manufacturing is prominent and measurable and should be treated as one of the improvement tools. This is because manufacturing variables are repeatable measurable and can be tracked over time.

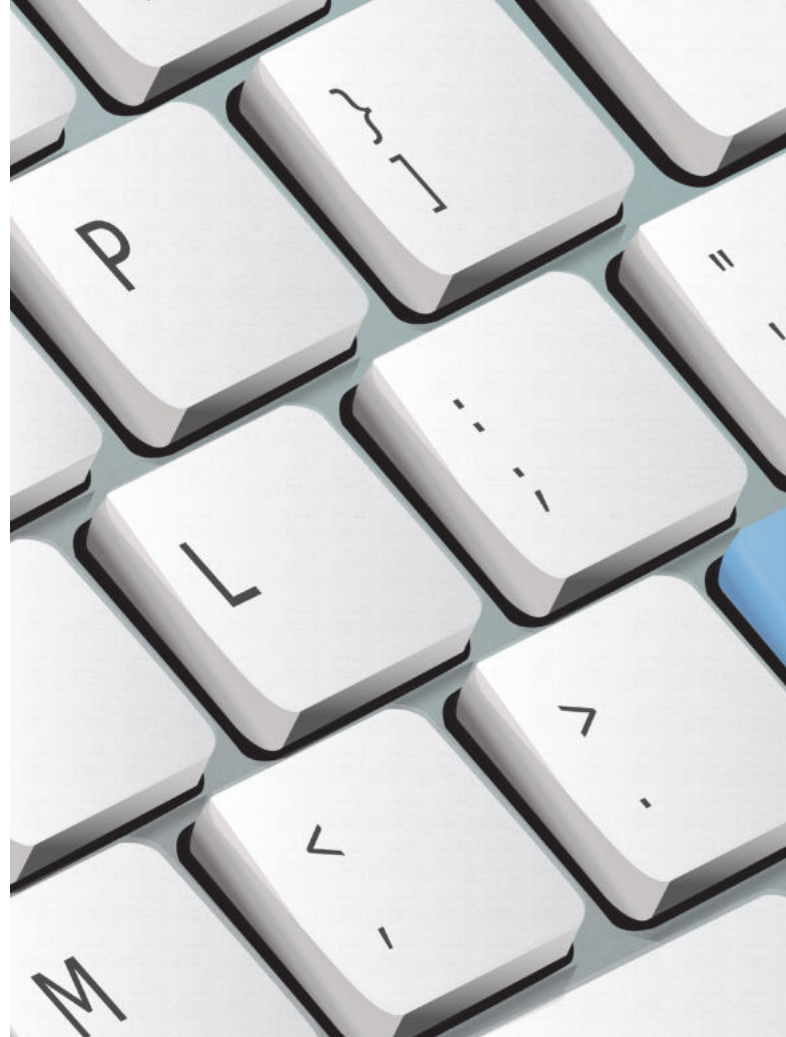


Although the learning curve effect may be a convenient way of improving productivity, it is not always the case in other manufacturing organisations. This is observed in some manufacturing organisations showing outstanding productivity improvements while other organisations show little or no learning at all. In some of these organisations, lack of productivity is influenced by employee turnover, the transfer of product and process knowledge from one employee to the other, and it is highly influenced by organisational culture and values.

Employee turnover affects productivity in manufacturing organisations because new resources will be invested on training new employees and during training productivity is reduced. The learning curve effect is established from the principle that manufacturing organisations gain knowledge by performing work and repeating it. Under this effect, the workforce gains process, product, and production knowledge that develops into perpetual changes within the organisation. Hence, the way learning is executed in an organisation is very important in ensuring workforce development through the experience and the learning curve.

The significance of the experience and learning curve effect on manufacturing cannot be disregarded due to the nature of working and learning. However, some manufacturing organisations struggle to leverage on this effect. The struggle to leverage on the learning curve is influenced by a decrease in employee turnover, the organisational culture and values, and the learning strategy in the organisation. Manufacturing organisations should review their learning and development strategies, their organisational culture and values on their workforce learning and development to at least decrease their employee turnover and also ensure knowledge transfer between employees.

When looking at Takt time in a practical sense, it can be considered a measure of what a manufacturer needs to do to meet our changing demand at any one point in time. A simple ratio of the available time over unit demand can highlight to a manufacturer where there



are opportunities for process improvements to better meet that demand. If a manufacturer can balance their Takt time and processing times, then their throughput to meet the demand will be efficient.

In a similar manner, measuring Takt time can also highlight when processing areas are underutilised which can show opportunities for further value adding or even chances for rolling out new product manufacturing operations.

A real-world example of Takt in action can be seen by many manufacturers' response to the global COVID-19 pandemic. With the product demand across many industries facing erratic surges and drops, many manufacturers were forced to rely on good lean principles and reduce Takt to meet this demand. For example, in the automotive industry an unusually high demand for previous conventional car models remained, even while manufactures are ramping up early production of newer hybrid models. Couple this abnormal surge in demand and required production throughput with pandemic related labour restrictions and



Takt time refers to the amount of time a manufacturer has per unit to produce sufficient goods to fulfil customers' demand. It is an essential tool in ensuring that goods flow through each build station in the most efficient manner.

$$T = \frac{Ta}{D}$$

Ta= Available production time

D= Customer demand

T= Takt time

forced shutdowns and there is suddenly a real need to be able to reduce Takt time to improve the process and meet the demand with lower human and resource investment.

The car manufacturer was able to look at its existing hard wired digitally connected tools used for assembling and measuring fastener values across a range of assembly steps. It was identified that the current systems were cumbersome to use and taking up valuable operator time due to the tools being slow to use and data entry difficulty. The skilled tasks that involved feeding the tool readout data back into the quality systems were only able to be performed by a small handful of very skilled and well-practiced operators throughout the assembly team. The company learned about a process inefficiency through having historical repeated problems with these tools. Learning by doing.

An opportunity was then identified to reduce Takt time by improving tool use and measuring the process by migrating wireless tool readouts and data collection instead of the existing

cumbersome system. These tools were far easier to use and allowed for a greater number of operators to upskill and learn how to feed faster data back effectively and efficiently to the quality and traceability systems. This allowed a better meeting of the current market demand as well as providing continuous improvement in the process. The improved tool that allowed operators to become highly skilled in a much shorter time is critical when operating under conditions imposed by the global pandemic. Where turnover might be higher or temporary contract workers might be bought in temporarily, proficiencies in operations and reduced learning curves such as the tool use example become critical.

Using Takt time ratios and measurements of the expense and investment was justified to provide value and an improvement over the old methods of work. Takt time was reduced and the overall learning curve to become proficient at a particular tool type was reduced. This resulted in a factory that was able to far better meet the demand while maintaining or improving the quality and traceability.

SET SAIL TO AI



Artificial intelligence (AI) is on everyone's lips. Countless companies are already trying their hand at it.

How can these companies benefit from the AI Navigator?

Anne Loos: Artificial intelligence has become a rather hype word in the last couple of years. It has become almost a common understanding that you can and should solve every problem – in particular highly complex ones – with artificial intelligence, which has often been the reason why many AI applications failed.

Antonela Sisejkovic: That is where the AI navigator comes into play: identifying and then implementing the right AI use cases is a continuous learning process, but also a crucial part towards successful use of artificial intelligence. A lot of use cases turn out to be not as easy as they seemed in the beginning. That is why we have come up with our 4-step approach to make sure only the truly promising and value-adding use cases are pursued.

Can you briefly explain the principle of your approach?

Antonela Sisejkovic: The AI navigator consists of 4 stages: Ideation, Assessment, Data Testing, Implementation. First, the ideation step is based on the principle: "Start with more, stay with less". It is an important creative process in which new use case ideas are found based on the patterns from previously successfully implemented AI use cases by KEX AG. The identified ideas are then methodically tested to define the problem-solution fit.

Second, the assessment step in the process to help identify if the selected application (use case), as well as the company are ready to implement the potential use cases, from the perspective of readiness and competencies. The use case is assessed in terms of processes, data base, and the company in terms of mindset as well as IT infrastructure. Company's categorization into the AI maturity levels provides guidelines on how to proceed to enable a successful implementation of AI use cases. The understanding of the range of the maturity levels is comparable to the autonomous driving levels, from simplification to full autonomous systems.

WITH THE AI NAVIGATOR

KEX AG & Fraunhofer IIS/EAS have jointly developed the so-called **AI Navigator** ©

*With it, they want to give companies a tool with which they can find their individually optimal way to use AI technologies successfully and profitably. **Antonela Sisejkovic**, Senior Technology Scout at **KEX AG**, and **Anne Loos**, Head of Business Development at **Fraunhofer IIS/EAS**, give us an insight into the idea behind the tool.*

More information will also be available on the website from spring 2021:
www.ai-navigator.de

“ Not every problem can be solved through AI (yet), nor it should be. Careful identification, assessment and testing of the available data is crucial for a successful implementation of AI-based applications. ”

Antonela Sisejkovic
Senior Innovation and
Technology Consultant
KEX Knowledge Exchange AG

FOUR PHASES *FOR USE CASE* *IDENTIFICATION*

PHASE 1 : **IDEATION**

- Purpose and goal of the desired AI system
- Apply confrontation and analogy principle to ideate new potential AI use cases
- Definition of jobs to be done (pains and gains analysis)

PHASE 2 : **ASSESSMENT**

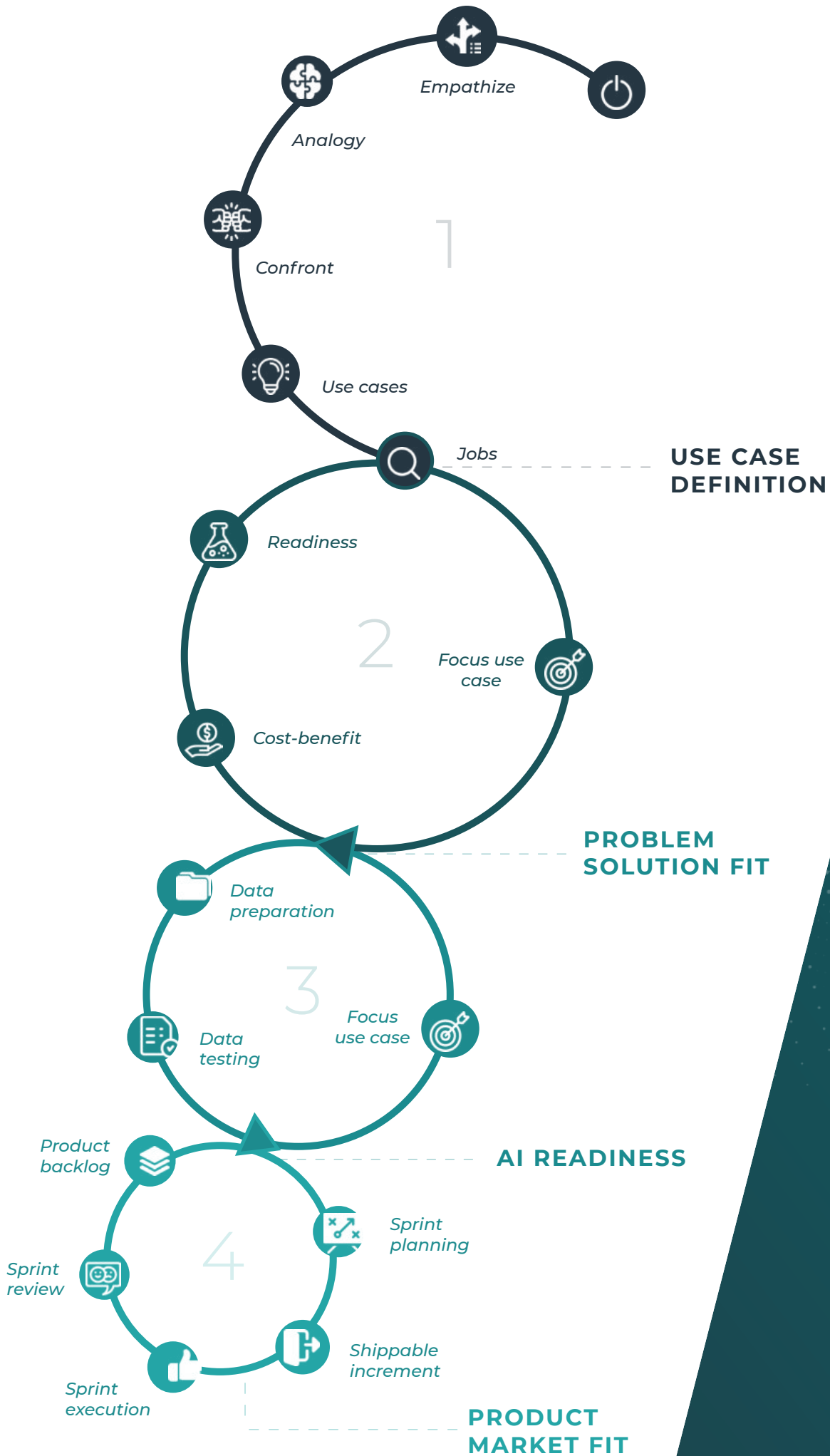
- Information on how the AI system works
- AI readiness assessment for each AI use case to understand potential costs
- Qualitative cost and benefit analysis of the AI use case

PHASE 3 : **DATA TESTING**

- Understand and focus use case context and goal
- Prepare data set of different historic data
- Test comprehensiveness, labeling and failure of data-set for the desired use case output

PHASE 4 : **IMPLEMENTATION**

- Agile project implementation (also for software-hardware combination) for flexible needs adaptation
- Highly iterative process to prototype, review and adapt
- Integrate internal or external stakeholders



It has become almost a common understanding that you can and should solve every problem – in particular highly complex ones – with artificial intelligence, which has often been the reason why many AI applications failed.

Anne Loos

Head of Business Development
Fraunhofer IIS/EAS

Anne Loos: The third step, data testing, ensures there is an adequate amount of required structured and labeled data sets in the right quality to yield the necessary results. Data testing provides initial insights concerning the feasibility of the use case prior to a full implementation. Finally, in the last step, the implementation, the focus is on agile development methods to ensure the built solution is user driven and that it matches the customer requirements.

Are there any limitations to your approach in terms of company size or industry that need to be considered?

Antonela Sisejkovic: There are no limitations in the use of the AI navigator regarding the size and the industry of a company. Choosing the right use case before investing significant amount of money and resources is a key requirement for both, small and big companies.

Can the companies use the principle independently or does it require professional support?

Anne Loos: We have been accompanying our clients for many years during the exploration and implementation of AI solutions. In order to be able to use the tool independently, it is advisable to undergo at least basic training in the field of AI to understand the technological fundamentals and stay up to date e.g., of current best practices. With regular trainings (basic, as well as advanced), we provide the necessary key knowledge headed by KEX AG. Besides this, we offer train-the-trainer programs to enable interested companies to use our AI Navigator.

What do you recommend to companies that want to use AI in their business?

Antonela Sisejkovic: It is important to have a clear understanding of the problem that should be solved, when looking for AI applications. Only then can an approach like technology scouting be utilized to find potential solutions. It can then either be AI or another existing data analytics solution that successfully solves the defined problem.



Authors:

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Head of Business Development
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FRAUNHOFER'S PERSPECTIVE ON ADVANCED TRAINING



It is easy to agree, in theory, that regular staff training is necessary to encourage growth and enhance productivity. There is also no doubt that a highly trained team provides superior performance in comparison to a team with haphazard training, or worse yet, no training at all. So why do so many companies balk at the idea of developing a comprehensive, ongoing and sustainable training strategy?

Training can be a polarizing topic. It takes your people off the shopfloor, creating staff management headaches. Like rowing against the current, if you stop paddling, you fall back. Once this happens, it is extremely difficult to catch up. Ceasing training, therefore, is not a viable option, which is why many companies view training as a necessary evil, knowing they need it but begrudging the expense and time it can take to get their people up to speed.

When properly planned, co-ordinated and implemented, training is an ideal way to energize your people and maximise their talent, providing avenues for their personal growth, which they can then use to improve your company.

Approaches to industrial training have grown in leaps and bounds in recent years and Fraunhofer has been at the vanguard of this mentality shift. Gone are the days when students would report to a classroom, sitting all day at desks while a teacher talks at them. This approach worked only with people who were highly motivated to learn. Most training participants are not highly motivated. They often view training either as a waste of time, or as an opportunity to fail, publicly and spectacularly. How then do you change the mindsets of your workers and encourage them to accept a new training regimen?

A photograph of a modern, multi-story building with a textured facade. The building features the Fraunhofer IPT logo on its upper left side. The image is partially obscured by a large, semi-transparent teal circle that serves as a background for the main title text. The sky is blue with some light clouds, and there are green trees visible on the right side of the frame.

TO PROMOTE INTELLIGENT, SUSTAINABLE GROWTH

Innovation as a Training Strategy

Innovation in your factory processes and in your training are the keys to staying ahead of your competition. Fraunhofer, who specialize in bringing innovative solutions to industry, also offer technologically innovative training to help you and your people adopt new technologies, improve on your existing methodologies and most importantly, increase motivation and receptiveness to change.

We know from our experience in pioneering new technologies, that when we implement bold new ideas, we invite interest from other successful innovative companies who are looking for new ways to grow and improve. This presents unique opportunities for collaboration with like-minded companies.

How to Devise a Workable Training Regimen

Start at the top. To achieve cohesive uptake of all training programmes, responsibility for oversight should always start with Executive Management. They are in the best position to know where remedial training is required to address existing issues and to anticipate training needs for innovations that may still be in various stages of planning and therefore, not widely discussed.

Invest time and consideration into planning. This will help you devise a workable training strategy that accomplishes your overall goals and takes your ambitions for the future into account. Your strategy needs to work for your company's unique requirements and circumstances.

Take a collaborative approach to training. Choose a training provider who has expertise across all aspects of your business. From shop floor to dispatch, from customer services to marketing, using one provider to cover all training needs ensures you have company-wide uniformity and cohesiveness, minimizing the chances for operational conflict between departments. When you are all on the same page, you are helping and supporting each other to get future fit.

Successful training outcomes start with quality professional training. Find an innovative training company who shares your company's values and understands your unique needs. Ensure they have the resources to do the whole task and not outsource parts of your training program to subsidiaries or strategic allies, because this will undermine your need for cohesion.

Fraunhofer's Vision

Devising new and exciting technologies and industrial methodologies is meaningless - unless you have the expertise to implement them. It is for this reason that Fraunhofer continue to focus their expert attention on innovative ways and

means of training. They have finely developed strategies for translating raw knowledge into shop floor practices. After all, what would be the point of devising masterful innovations if your workforce is unable to follow-through?

Finding that meeting point between creativity and practicality can often be an art in itself. It is one that Fraunhofer has mastered. An example of this is our seminar, 'Machine Learning and artificial intelligence in production', where individual learning steps are accompanied by practical, hands-on exercises where participants learn to pre-process data sets, train ML algorithms and evaluate the results, using the knowledge and tools gained during the seminar.

To achieve a seamless switch from traditional techniques to innovative ones is challenging enough, without needing to worry about the impact such changes will make on your workforce. Fraunhofer can help smooth your transitions by helping prepare your workforce for these new challenges, giving you a head-start in implementing your move to innovation. Our 'Chief Technology Officer' (CTM) training course is a case in point. The five-day certificate course presents participants with the skills they will need to fully utilize the technological potential

“How then do you change the mindsets of your workers and encourage them to accept a new training regimen?”

Susanne Krause
Head of Communications
Fraunhofer Institute of
Production Technology IPT



within their company, providing them with the tools they will use to reduce 'time-to-market' and streamline development costs.

Helping companies establish innovative cultures has been the cornerstone of Fraunhofer's work since their inception. Developing continuing education programs to re-educate workforces is a vital part of that vision. Using high-quality knowledge transfer is an innovation that Fraunhofer continues to refine and their work in this area is on the cutting edge of industrial education.

In addition to purpose-built training solutions for innovative companies, Fraunhofer also offers a wide range of seminars, workshops and conferences designed to move companies and personnel towards a fully integrated and intelligent workplace.



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AMCNU

BOOSTING INDUSTRIAL GROWTH WITH EMERGING TECHNOLOGIES

Together with regional government and partners, the Fraunhofer Project Center (FPC) has developed the Advanced Manufacturing Program (AMP) to establish a transitional framework towards Manufacturing 4.0 and empowering manufacturing industries in the Eastern part of the Netherlands

The Advanced Manufacturing Program (AMP) provides subsidies through the RegioDeal supported by the Province of Overijssel and the Dutch state. It aims to encourage rapid development of Twente and other regions in the East Netherlands by forming an Advanced Manufacturing hub with an outward looking European image. With this the AMP greatly enhances the region's reputation and business climate.

Within the AMP, the Fraunhofer Project Center at the University of Twente develops innovation projects around manufacturing technology themes. Every AMP project is built around solid industrial collaboration, empowering companies with relevant knowledge and new technological and industrial methodologies. Through the hub, these can be shared with other high-tech manufacturing industries in the region.

Member companies' of the AMP can solve their specific technology problems and answer their market-oriented questions. This is achieved by developing and creating demonstrators that offer participating companies direct technological insight. FPC then utilises workshops and master classes to further disseminate this newly acquired knowledge.

The Advanced Manufacturing Program (AMP) is a funding program that helps us support you in your transformation to manufacturing 4.0. IT is made possible through the RegioDeal supported by the Province of Overijssel and the Dutch state.



Rijksoverheid



regio
Twente



Together, Fraunhofer Project Center and industries can significantly combine to create industrial technology solutions that meet the challenges of a constantly changing global environment.

Here are some project opportunities that we are currently seeking collaboration on, benefitting from our extensive network to achieve applicable solutions for your business:



As traditional manufacturing plants are transforming into smart factories, new skills will be required as the industry focuses on innovation to drive productivity and competitiveness. We are looking to create project collaborations that focus on knowledge transfer towards future-proofing the workforce.

We are interested to discuss with companies whose work includes the field of synthetic environments (human-computer/ human-machine interaction), or in R&D (digital twinning, software development), or companies that have experience in transferring knowledge to manufacturing industry.



Energy and resource management are among the top priorities of manufacturing companies with many seeking ways to monitor and improve their efficiencies. We are working towards a scalable decision-making support tool for energy and resource management efficiency compatible with an organisation's current digital infrastructure.

Participating companies can expect recommended scenarios with indication on how to improve their energy and resource efficiency, transparency in the way their energy and resources are utilized, and scalable decision-making support tools for energy and resource management efficiency compatible with their current digital infrastructure.

Fraunhofer Project Center can support this process through research and assessment of the current state of the company, and planning, organizing and executing the necessary workshops and trainings regarding the topic, as well as providing a technology (software, system) advisor, creation of proof of concept, and support in the implementation phase.

Contact Fraunhofer Project Center to find out how we can work together in achieving the objectives of this type of project.



THE POWER OF GENERATIVE DESIGN

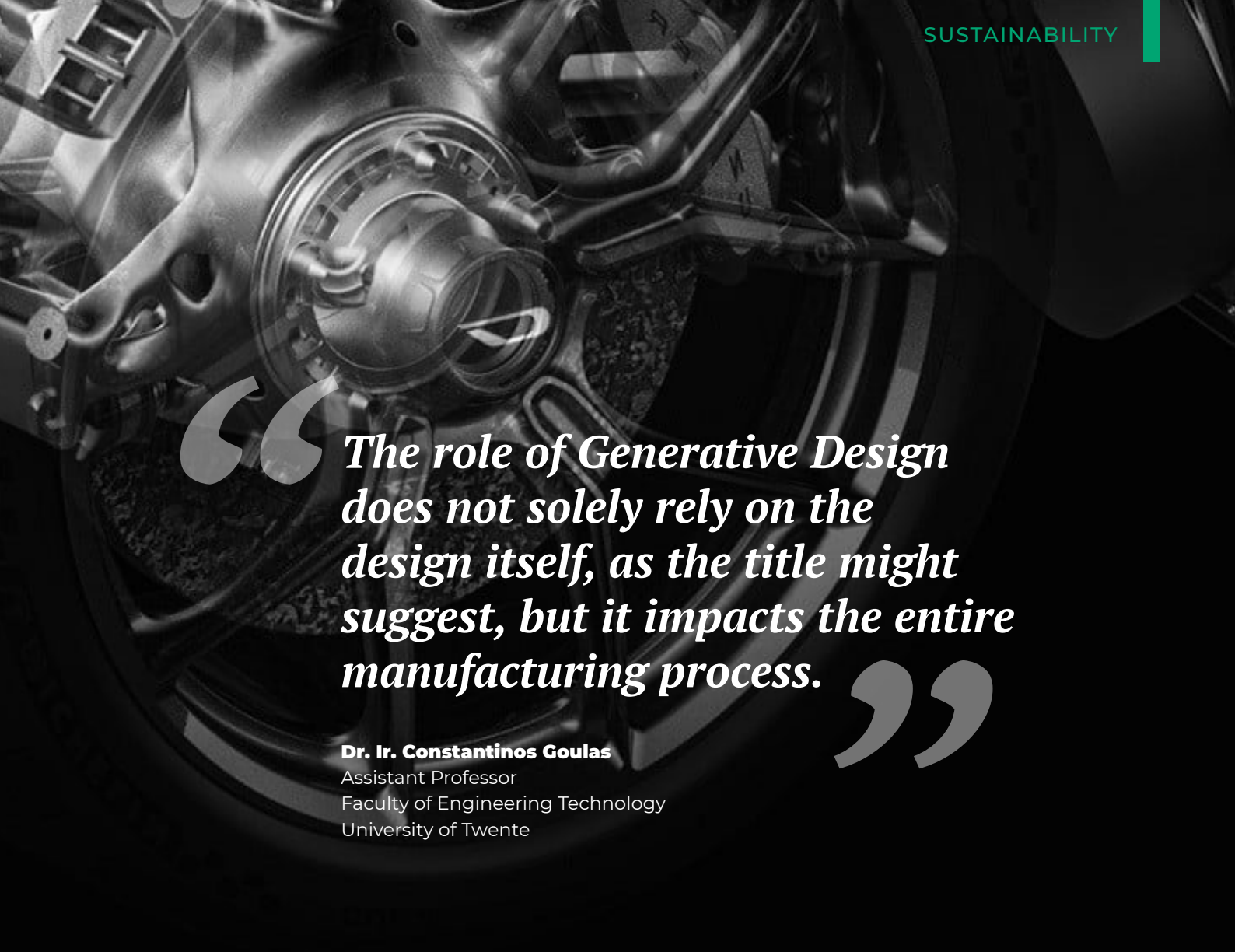
AND ITS ROLE IN THE GREEN FUTURE OF MANUFACTURING

Designing a part with a tool like Generative Design resembles booking a flight.

Setting a place, preferred dates, layovers, prices, and travel times, looking at all the possible options until finally settling on the one that best matches your criteria.

But how does it work?

What are benefits and costs?



The role of Generative Design does not solely rely on the design itself, as the title might suggest, but it impacts the entire manufacturing process.

Dr. Ir. Constantinos Goulas
Assistant Professor
Faculty of Engineering Technology
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Generative Design is a design tool that enables the exploration of multiple suggested design solutions to an engineering problem. By using unprecedented cloud computing power, Generative Design is able to produce design variations that have not been thought of or were simply not possible to materialise with conventional manufacturing technologies a few decades back. The tool requires input of certain parameters or constraints such as weight limits, geometric constraints, material, and manufacturing methods. Considering these constraints, it creates a set of design solutions, which fulfill these criteria to different levels. It is in that sense different than Topology Optimization. Generative Design aims to display a wide arrange of solutions for a problem, while Topology Optimization focuses on creating a single optimised solution.

The ability to get a multitude of designs from a single tool introduces a new approach to part engineering, which is shifting the design process entirely. Design engineers are being converted from part optimisers to expert parameter curators and skilled design evaluators. The process shift is essential, because GD input parameters are carefully specified to obtain high quality output solutions which need to be then evaluated during the output selection process. For example, two different solutions might meet all specifications. However, one could be slightly stronger, while the other is lighter. Which one would ultimately be the better performer? These key decisions cannot be left to an AI algorithm. In their new role, engineers have to oversee that the design(s) fulfill the specified engineering requirements in the best possible way, while they still have to consider factors such as aesthetics, marketability, and human perception.

With GD it is possible to obtain multiple feasible solutions for diverse manufacturing processes in a single study. Of all the generated solutions, the ones that have the highest weight to performance ratio are often solely producible with Additive Manufacturing. Therefore, even though AM and GD are independent upcoming technologies, pairing GD with Additive Manufacturing might be key for harvesting the full potential of GD and their sustainability benefits. Some of which are:

- **Weight reduction**

The design for weight optimisation brings cost and energy savings during transportation and service.

- **Parts consolidation**

Making multi-part assemblies into single-part products, simplifying the assembly process while reducing the amount and variety of materials used. This means fewer components in the warehouse and a shorter supply chain.

- **Waste reduction**

When GD parts are made by AM, minimal material is often being used, which reduces waste while allowing for more freedom in design geometry.

- **Design exploration**

Being able to explore not only different shapes, but also materials and production constraints empowered by AI. With the right parameters, solutions are easy to evaluate.

- **Faster solutions**

by investing time in setting the right parameters, one can obtain an initial solution to a complex design problem that would have otherwise taken days to create conventionally.



Industrial sectors including aerospace, architecture, and construction, are rapidly adopting GD. In these sectors GD has already enabled engineers to produce innovative part designs and to support design decisions based on data, while reducing costs. Since all the output solutions are CAD-ready, the design more quickly goes through stages of evaluation or directly to production, bringing products to market in record time. Generative Design can play a very important role in helping manufacturing companies achieve their sustainability goals and reach higher market value. From a business perspective, some key benefits of using GD are:



Product differentiation

Creates high performance parts with an exotic look and innovative design that the market has not seen before.



Expert results

An engineer with limited experience can create a part and gain expertise by testing, evaluating and making relevant decisions while letting AI do the design exploration work.



Optimised production costs

Saves money and resources by eliminating parts that require several materials or complex manufacturing and assembly steps.



*“Generative Design
is paving the way
for making the
unimaginable,
possible.”*

Ir. Florian Vandepoel
Research Engineer
Fraunhofer Project Center
at the University of Twente

The role of Generative Design does not solely rely on the design itself, as the title might suggest, but it impacts the entire manufacturing process. In some ways, it could even be argued that “generative manufacturing” would be a more appropriate term. Generative Design, in combination with the implementation of new manufacturing developments, will shape the way manufacturing and production evolve in the coming years.

The 21C hypercar by Czinger is a great example of what can be achieved when pairing Generative Design with Additive Manufacturing technologies. Each component of the 21C has been custom designed, engineered and manufactured for high-performance, stability

and ideal weight distribution. For transportation industries, having a good power-to-weight ratio is very important for fuel savings and higher speeds. The incorporation of added functionalities in structural systems, as for example temperature regulation and sound management features within the design, has set a new standard for future design and performance requirements in the automotive industry.

What GD teaches us is that the functional designs, which we currently use, are not necessarily optimal. The optimal designs are yet to be explored. Generative Design is paving the way for making the unimaginable, possible.



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FOSTERING TALENT FOR TWENTE



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Three years ago, an idea of having a team of students connected to the Fraunhofer Project Center at the University of Twente (FPC@UT) came to life. The intention was to interact with these students early in their studies, preparing them for their professional future. The team was named FEST (FPC Expertise Student Team) and it was envisaged that it would provide students from diverse cultural and ethnic backgrounds and varying fields of study, with a nurturing environment, encouraging skills growth and workplace experience. Support and guidance from FPC@UT would always be on hand to foster the growth and professionalism of these young cohorts.

FEST was not only created for the benefit of students; the concept was much more far-reaching. FPC@UT believed that industry and educators would also be big winners. The revolutionary project hoped to create an integrated community between students, industry and academia, bridging the gaps between interested parties whilst creating opportunities for dialogue and growth for all. It is envisaged that relationships formed through FEST would create life-long learning opportunities and knowledge-sharing for all participants.

A Collaborative Approach

FEST students work with participating companies, applying the theories they have learned at University to real-world challenges. They are able to study current methodologies, technologies and practices in the workplace, supplementing their theoretical learning with practical applications. This provides a unique vantage point, whereby students can observe the way companies currently function and pinpoint possible areas for improvement and/or innovation. An added benefit to this collaborative approach is the retention of potential young talented workforce in the region. Having already built a solid working relationship with a locally-based potential employer, gaining employment locally is made much easier. The companies also benefit from the unique approach FEST students bring to the workplace. Students have few pre-conceived ideas about how things should be or have always been. Fresh from studying state-of-the-art industrial practices at University, students are well-placed to spot opportunities for innovation and improvement that may be of immense benefit to participating companies.

Smarter Outcomes

Through this collaboration, we aim to create an upward spiral of knowledge and positive action. FEST students inject new knowledge, acquired at University, into participating companies, helping them develop. The companies, in turn, share their years-long experience with the student, preparing knowledgeable, industry-prepared students/workers for seamless entry into the workplace. Educational institutions feature on the continuum, as they gain an increase in practical knowledge, shared by the FEST student, which is then passed on to the next batch of students, thus continuing to provide state-of-the-art education which these future students will share with their employers.

Future-Proofing Against Inevitable Change

Automation, Artificial Intelligence (AI) and smart, connected machines are dramatically altering our workforces and ushering in the 'Fourth Industrial Revolution'. Workers are now required to quickly adapt to rapidly changing technologies and methods. To keep pace, companies and organizations need to identify and cultivate behavioural competencies that allow personnel to master new technologies, acclimate to new ways of working and thrive in their new environment.

The downside is that one does not need to look far to find headlines announcing the demise of entire occupations due to technological takeover. Losses of this type are not new, but have usually occurred over extended periods of time, where adjustments to workforces can be slowly and methodically implemented. In the 21st century however, the speed with which massive change occurs is breath-taking. In order that our communities continue to move forward, it is imperative that immediate action is taken to future-proof workforces. This is far more complex than it seems. Certainly, skill-mapping, continuous training, social learning and agile tech learning have their place in alleviating this worrying scenario, but their results may prove insufficient to the massive task ahead of us all.

Building Collaborative Alliances

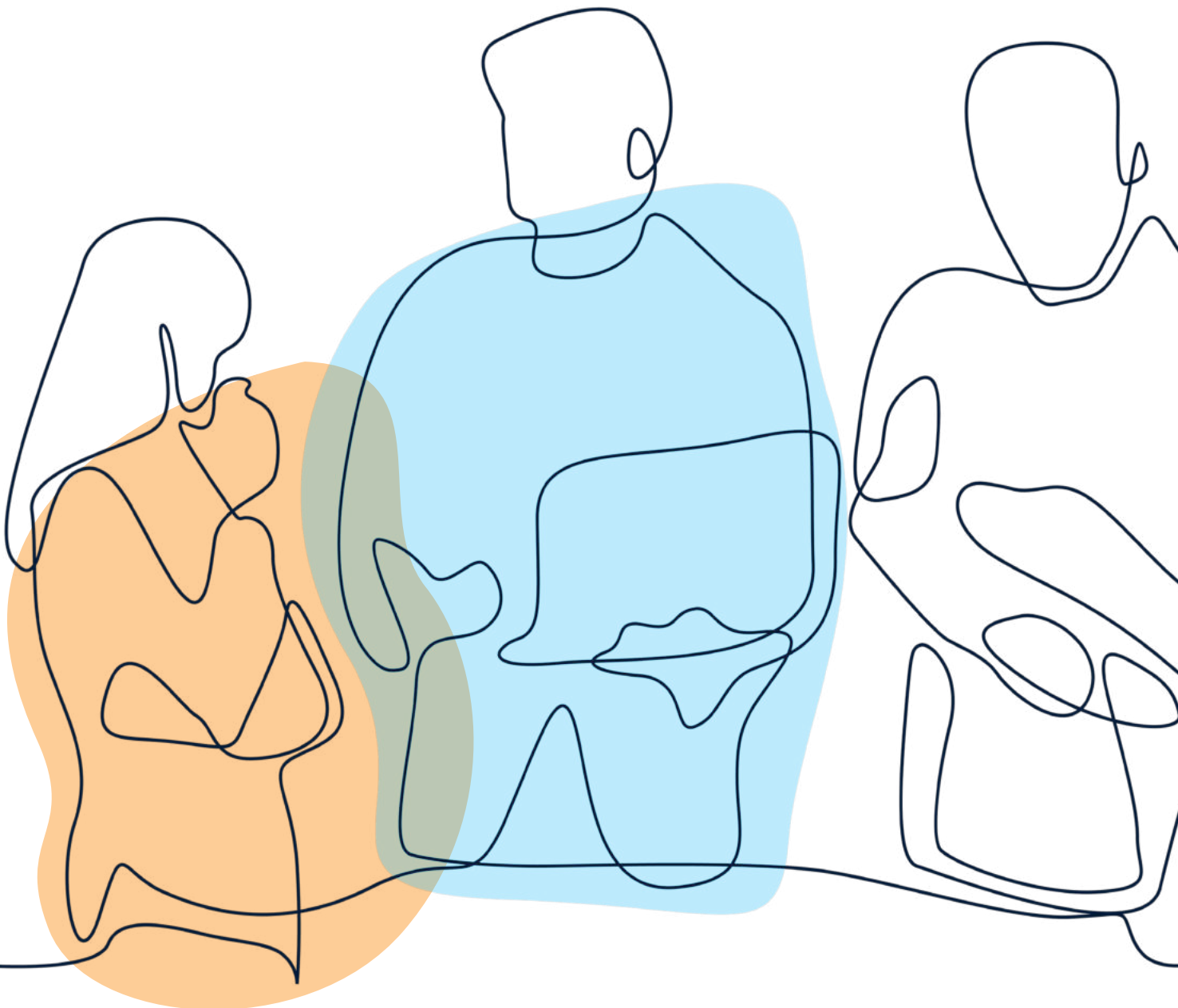
It is anticipated that student organisations like FEST herald a new age of mutually beneficial alliances between educational institutions and industry. The hope is that learning institutions like the University of Twente and institutions such as the Fraunhofer Project Center can continue to forge strong relationships with industry leaders, enabling more innovative programmes across a wide range of industries throughout the region. This offers a tantalizing glimpse of a future of co-operation and inventiveness where academia learns from industry and vice versa. Academia's strengths in abstract problem-solving and intellectual development should marry well with industry's need for increasingly competitive work practises and highly specialised and targeted solutions.

Innovative and imaginative solutions like FEST are certainly taking steps in the right direction, helping to anticipate the changing needs of industry and assisting in future-proofing workforces before they become redundant. Education will play a vital role in ensuring workforces are properly prepared for foreseeable changes and agile enough to respond to unforeseeable ones. Student organisations like FEST, that narrow the existing divide between academia and industry, ensure that industries and workforces are better prepared for a rapidly changing world. They are laying the groundwork for a more efficient, more affluent society in the future.



GROW YOUR BUSINESS

BY DEVELOPING
YOUR WORKFORCE



[...] managers often expect that these day-to-day activities alone will be enough for employees to maintain and develop their knowledge, skills, and abilities.

Ivo Aarninkhof

Managing Director
Holland Innovative

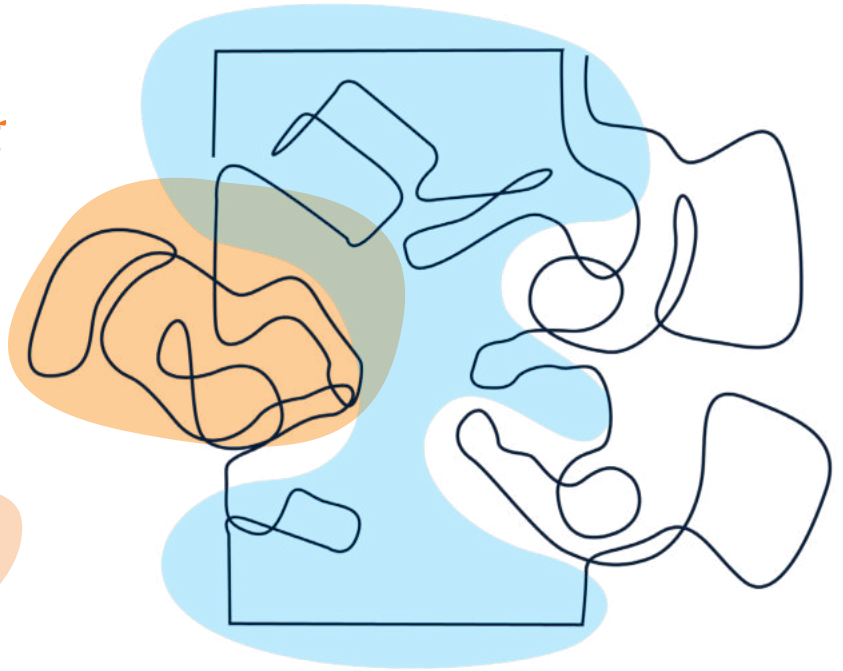
Few sectors of the global economy embody the fourth industrial revolution's ideals and challenges more than manufacturing. In such a rapidly evolving industry, powered by advanced technology and digitisation, HR teams face rising pressure to develop their workforces while facing often enormous financial and employment challenges.

Constant change in the manufacturing sector places a significant burden on managers, who need to ensure their workforces are always ready to adapt. For example, workers on the shop floor must be prepared to deploy new technologies, such as Internet of Things (IoT) and industrial robotics powered by AI and machine learning.

These challenges demand the constant nurturing of existing workforces from initial onboarding through skills development, ongoing training, and career pathfinding. HR teams must, therefore work closely with every department and employee to drive a culture of continuous learning whilst maximising employee engagement, productivity, and satisfaction.

Yet, while on-the-job training is undoubtedly necessary, the most effective way to learn is through experience.

Chantal Boomkamp-Eppink
Operations Manager
Fraunhofer Project Center
at the University of Twente



The real cost of employee turnover

The workforce is an organisation's most valuable asset, no matter how junior it is. Yet, staff may walk out the door any day in search of new opportunities. Financial compensation is not the only motivation for employees to leave a company. Other key drivers of employee turnover include career development, satisfaction in the workplace, and whether one's values align with those of the company.

Employee turnover costs are hard to quantify universally since they vary widely by sector and position. That said, research suggests it typically costs between six and nine months of an employee's salary to replace them. For higher earners, such as executive-level employees and highly specialised positions, the cost of turnover can be much higher. In the manufacturing sector, which often relies heavily on proprietary systems and machinery, requiring highly specialised workforces, the cost of employee turnover can be enormous.

While a degree of employee turnover is expected, managers should have a clear idea of how much it costs to replace employees, if only to recognise the importance of developing their existing workforces. Aside from the obvious costs associated with employee turnover, such as hiring and onboarding, there are also those that are hard to quantify, but can have an even greater impact on business growth and sustainability. Among the most significant is the cost of lost productivity. For example, it takes an average of eight months for a new employee to reach peak productivity, and then there is the lost engagement and cultural and reputational impact to consider.

The importance of manager engagement

Just as capital investments in assets like machinery demand regular upkeep, so too does the workforce. To continue operating at peak productivity, as well as adapt to constant changes in the manufacturing environment, employees need ongoing skills development

and training. However, these factors often get overlooked after the initial onboarding phase as day-to-day activities take precedence.

At the same time, managers often expect that these day-to-day activities alone will be enough for employees to maintain and develop their knowledge, skills, and abilities.

Manager engagement is by far the top enabler of a successful talent marketplace. Without a strong employee engagement strategy, employees are more likely to view their workplaces negatively or just do the bare minimum to get through the day. According to Gallup's State of the Global Workplace survey, 85% of employees fall into this category. In other words, employees have no emotional attachment to the companies they work for, which has a knock-on effect on everything from productivity to loyalty to customer satisfaction. After all, you cannot expect to grow your customer base if you are not developing your workforce.

Realising the need for employee engagement in growing their customer base, managers often focus their efforts on customer-facing staff. However, this singular focus also misses the point that a good customer experience depends on employee engagement levels across the

board. For example, if there is a lack of employee engagement with workforces on the shop floor, it may result in reduced product quality and longer cycle times. Employee engagement strategies must therefore be applied throughout the organisation.

Engaged managers who lead by example create more engaged employees, and there is far more to leading than just paying attention to what looks good on paper. The development of any workforce must start with a top-down approach. Those at the executive level should perpetuate a culture of engagement and learning through an optimal blend of skills development, training, ongoing communication and feedback.

Seminars and workshops are not enough

To future-proof their workforces, managers must provide the time and space necessary for people to learn through experience. Traditionally, they would rely on methods like seminars and workshops and simple directives like having experienced employees watch what others are doing. Yet, while on-the-job training is undoubtedly necessary, the most effective way to learn is through experience. The reality of the situation is that managers often rely on on-the-job training because they do not have a proper employee training and skills development program.



On-the-job training is valuable during onboarding, but managers should not rely on it entirely. Moreover, single events like training seminars and workshops do little to drive a continuous improvement culture alone. Whether on the shopfloor or in the back office, employees must continuously adapt to new demands and situations. This requires regular engagement and teamwork, whereby employees have multiple options to learn and develop their knowledge, skills, and abilities. In other words, employees must be in a position where they can easily align their own professional goals with the company's long-term vision.

How can HR teams maintain their workforces?

Managers often fear that providing comprehensive training will encourage employees to seek better opportunities elsewhere. The reality is that driving a corporate culture of learning makes organisations stronger, more adaptable, and less prone to risk.

Loyal employees are those who believe in the company's mission, and whose personal values align with the corporate vision. These are the employees who see a future in the companies they work for, both in terms of the organisation's impact on the community it serves and their long-term professional goals. If employees can see opportunities for professional growth, they will reach a much higher level of morale and productivity than would otherwise be possible.

An organisation's ability to address the widening skills gap, especially in as dynamic a sector as manufacturing, is critical for ensuring future growth. Relying entirely on the recruitment of new employees is simply not going to be viable. Furthermore, the rapid transformation of the shopfloor is creating new roles and changing existing ones. Thus, employers must focus on creating a culture of innovation and continuous learning through a program that incorporates ongoing training, skills development, and career pathing.



Ongoing training

Training typically starts during the onboarding phase, but then it often ends up getting forgotten about after some months as new hires settle into their primary roles. But, given the constantly changing environments in manufacturing, as well as virtually every other sector, the need for ongoing training is clearer than ever. Training programs must be ongoing, yet must also allow enough flexibility to accommodate a wide range of learning styles and adapt to new conditions.

Seminars and workshops still have a place in any comprehensive training program, but they should never be the only options on offer. Companies should assess innovative learning tools, such as online training and virtual labs. This will allow them to learn both on and off the clock to develop their knowledge not only for their job roles, but also for their own professional goals. Training should also align with skills development and career pathing.

Skills development

While training programs help develop an employee's knowledge and skills in line with their job requirements, skills development takes things further by learning through doing. There is also some crossover between the two. For example, many online learning platforms provide hands-on virtual labs that allow employees to put their knowledge and skills to the test in a more practical way.

Managers should encourage skills development throughout an employee's tenure, with a view to giving them the opportunity to validate their skills through experience. Skills development

is also a vital part of the certification process, in cases where an employee must earn a specific certification to fulfil certain regulated roles.

Career pathing

A proven way to motivate employees to stay with the company is to give them opportunities to develop and progress professionally within the organisation. After all, not many people want to be stuck in the same job for their entire working lives. If they see an opportunity to advance their careers (and their financial goals) within a particular company, then chances are they will be far more willing to do that than go through the rigmarole of looking for a new job with a new employer.

Career pathing encompasses various forms of career progression, such as career ladders. That said, it is a good idea to allow for some flexibility to enable employees to progress into the areas they end up being most accomplished in. In other words, there should be an opportunity for them to change course later on. This is especially important given the need for organisation-wide culture change, multigenerational workforces with different goals and needs, and the growing talent crunch in many key areas.

Final words

Employees are a company's most valuable asset, so it makes sense to invest heavily in human resources. By demonstrating a strong commitment to learning and professional progression, organisations can reduce their own costs and drive growth while maximising the satisfaction and wellbeing of their employees. In these highly uncertain times, such goals have never been more important.



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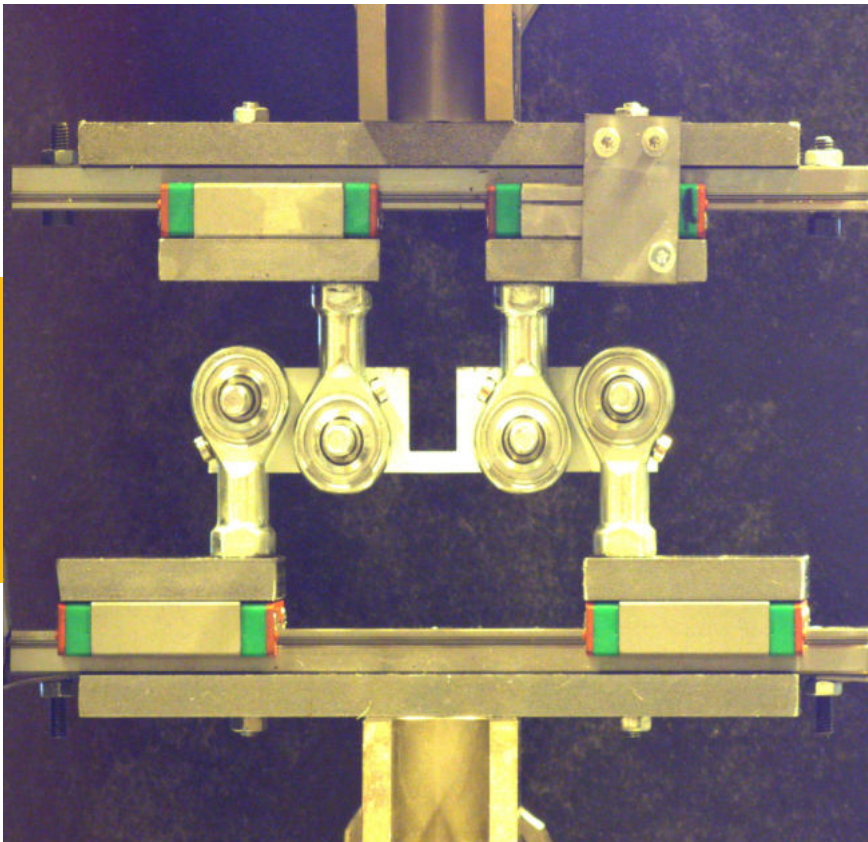
DOING THINGS

TESTING MATERIALS WITH LOW UNIFORM ELONGATION

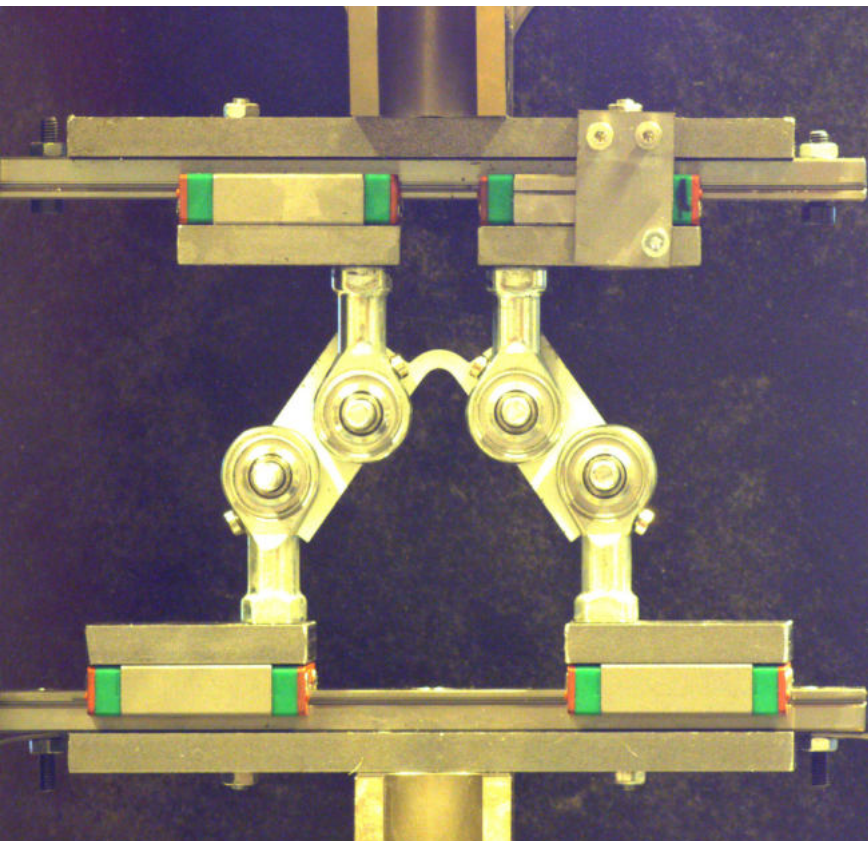
It is a necessity for metal forming industry to know the material behavior at high plastic deformation in order to perform accurate simulations. A standard practice in industry is to perform a tensile test to get the required material deformation data. Often the material deformations are higher in metal forming processes than what can be achieved by tensile tests. The data from a tensile test is commonly extrapolated using curve fitting techniques. Where the choice of fitting function brings high uncertainty to the accuracy of the results.

Alternative tests such as out of plane bending test, shear test and bulge forming tests offers higher stable deformations than a tensile test. These tests are challenging and complex in order to achieve a reliable and homogeneous deformation state during the test. On the other hand, conventional three point and four point bending test are simple and can be used in a tensile test machine but have issues with local deformations and friction at contact points. Also, the maximum strain is limited by sheet thickness in out of plane bending.

DIFFERENTLY



A new and simple bending setup is developed that can be used in a tensile test machine to perform pure bending. The bending happens in-plane of the sheet. The bending deformation can be seen in the figures to the left.



Using image analysis, the bending angle and curvature in the beam can be evaluated. Using the bending angle, specimen geometry and forces measured by the tensile machine, the bending moment can be calculated. The obtained moment–curvature relation can be used to evaluate material behavior in terms of stress–strain relation. For this purpose an analytical conversion method is used. However, this conversion method is only valid for strains up to 12%. This is because pure bending becomes non-linear and complex at high curvatures. This can be shown by comparing the stress–strain results from the developed bending test with that of a tensile test for a highly ductile Mild steel. It can be seen that the stress–strain curve that results from the bending test deviates from the tensile test at high strain. It is important to note that this limitation in finding the material data at high strains stems

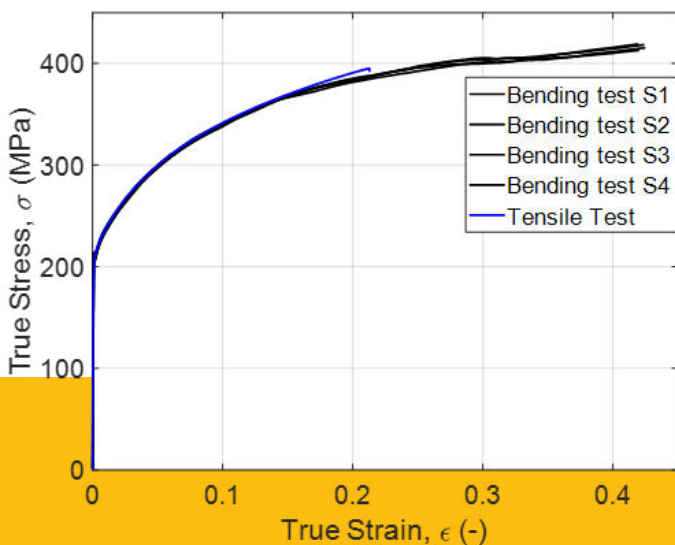
from the analytical conversion method, not from the bending test. This method can still be potentially used for materials with very low uniform elongation.

One such material, used in automotive industries is Docol 1400m from SSAB. By comparing a normal tensile test with the results from the bending test, it can be seen that the bending test provides stress–strain data up to 12% strain, while the uniaxial tensile test fails already at 3%. For higher strains a numerical approach can be taken.

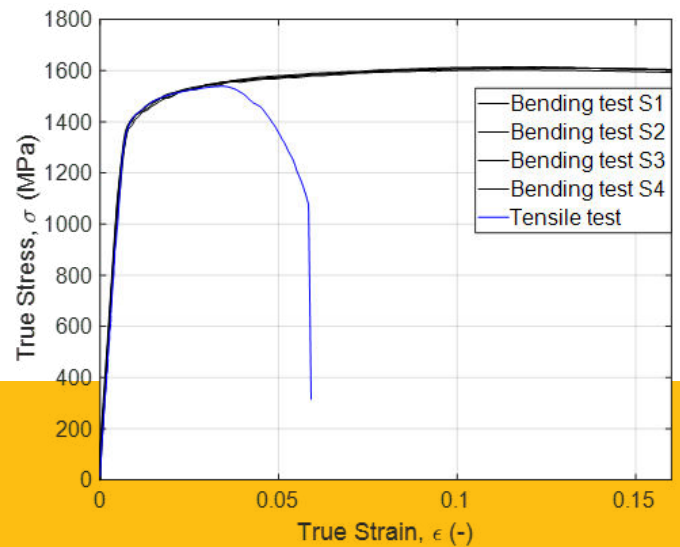
In conclusion: with the proposed in-plane bending test, material behavior can be characterized up to high strains, improving the accuracy of the material description and hence improving the accuracy of metal forming simulations.

Full article and references available at: <https://doi.org/10.1007/s11340-020-00621-5>

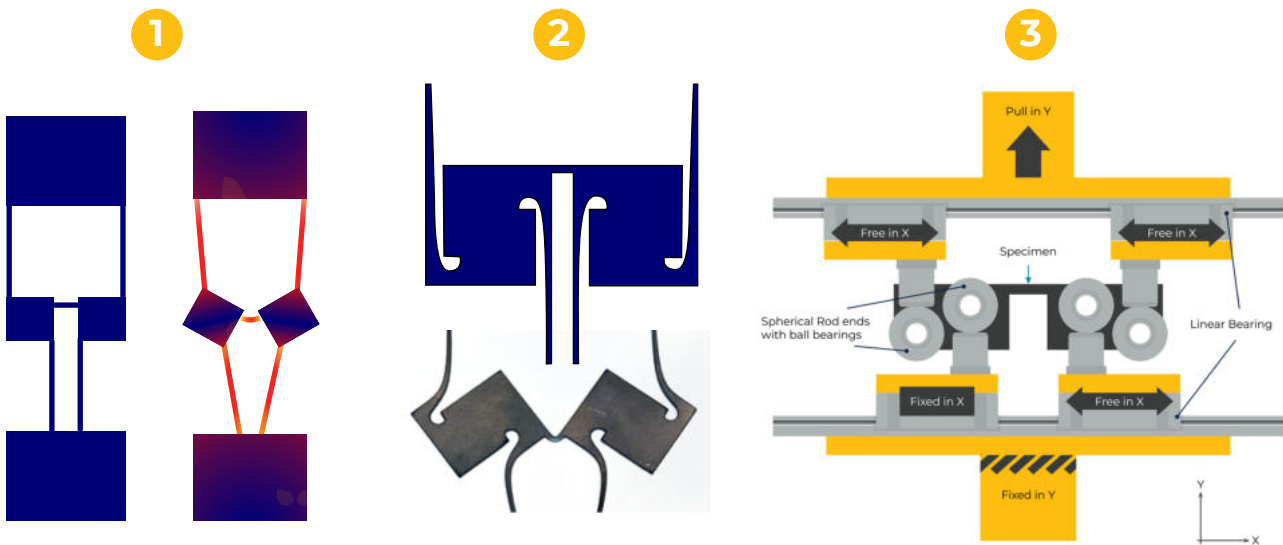
Comparison of bending test results with a tensile test for Mild Street



Bending test and tensile results for Docol 1400m



The test was developed in three steps:



The development started with the idea to perform bending deformation by simply cutting a shape in sheet metal. Such a sample can be clamped in a tensile test machine. Pulling the sample will rotate the two square support parts and the beam in the center will bend.

The first setup, however, did not result in the elongated strains as hoped for. Therefore, it was further optimized to increase the angle of rotation and the bending in the beam. This resulted in more bending on the desired location.

Still, it was found that the optimized sample would not produce enough strain in the beam. Therefore, using linear and roller bearings, a new device was designed. This device can be clamped in a tensile test machine and pulled. The pin-hole interface allows rotation of the two rectangular supports. As a result the beam in the middle deforms with pure bending. This eventually resulted in the appropriate elongation.

It is a necessity for metal forming industry to know the material behavior at high plastic deformation in order to perform accurate simulations



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MAXIMISE

YOUR MARKETING POTENTIAL

For traditional industries like manufacturing, digital marketing has long taken a backseat. The sector invests less than most on marketing strategy, instead relying heavily on dealer contracts and direct distribution to drive growth. Marketing often doesn't extend far beyond appearances at trade shows, website maintenance, and occasional publication of white papers or brochures.

Established manufacturing firms often rely on the same processes that have served them well for years. While people never stop learning, formalised training processes tend to finish at the end of the onboarding process, with little investment into upskilling and reskilling later on. In the fast-paced world of marketing, where the only constant is change, that isn't a viable option.

Digital marketing is constantly evolving, making continuous learning *extremely important*.

Why it's time for a culture shift in manufacturing

Today's manufacturing companies find themselves in the midst of constant digital disruption and increasing buyer control. Given that the sector lags behind most others when it comes to digital innovation, there's a clear competitive advantage to be had for manufacturers to invest in modern marketing strategies. That said, it isn't always easy. Digital marketing is changing all the time along with evolving consumer habits and business models and ongoing disruption to supply chains. Trends, tactics, and technology change quickly and often unpredictably. For marketers, it's necessary to change with them.

In the end, it's all about becoming adaptable in an increasingly uncertain future in which there will be both new opportunities and new risks. That's why continuous learning is extraordinarily important for marketing teams, especially in the case of manufacturing firms that have been lagging behind in their digital transformation efforts. **Manufacturers must invest in constant upskilling and reskilling their teams to drive business growth and adapt to regular and often unpredictable shifts in demand.** In other words, they must be driven by a culture of continuous learning, where ongoing training and skills development are inextricably part of the job.

Keeping abreast of new technologies to drive growth

By now, most manufacturing leaders understand the importance and impact of new techs like robotic process automation (RPA), machine learning, and predictive maintenance. Indeed, the sector has been investing heavily in these areas in recent years. Yet while the benefits of such solutions are without doubt, communicating them to stakeholders, partners, and potential customers poses a significant challenge.



Manufacturing marketing teams might not need a deep understanding of how such techs work, but they do need to be able to communicate their benefits. For example, RPA is instrumental in the rise of lights-out manufacturing, which itself is a key driver of sustainable manufacturing. Sustainability is now top of mind for many potential customers, as businesses seek to improve the efficiency of their supply chains and uphold their corporate social responsibility goals.

Understanding and communicating the increasingly important roles of these solutions requires continuous learning across every customer-facing department, such as sales, marketing, and customer support. After all, the solutions themselves are constantly advancing, rendering a lot of what team members might have learned years back largely obsolete. With adaptation and innovation being key ingredients for survival in today's market, learning demands a formalised, top-down strategy that doesn't stop.

With digital marketing revolving around the fast-paced world of technological advancement, it is also the product of evolving customer demands and habits. Even in traditional sectors like manufacturing, potential clients will be conducting research online in a multitude of ways, such as reading blog posts, downloading whitepapers, and signing up to email newsletters.

In many ways, Business-to-Business (B2B) clients are behaving more like B2C consumers, hence the increasingly important role of social media and content marketing.

While still important, direct selling and trade shows are no longer the only tools in the manufacturing marketer's arsenal. Teams must keep ahead of these changes with continuous learning, so they're always ready to serve the needs of the modern B2B customer.



Learning from one another to develop essential skills

Far from being all about advertising, digital marketing spans multiple disciplines and business departments. Success demands close collaboration between sales, marketing, procurement, and customer support. Thus, continuous learning must apply across the board, with employees being driven and knowledgeable enough to correct and learn from their mistakes and distribute those insights throughout the organization.

Continuous learning is less about formal training, and more about building a culture of learning and innovation driven by collaboration and communication. To make that happen, there must be an effective infrastructure in place that promotes close ties

between departments and stops information silos from forming. As such, continuous learning isn't something employees should be doing alone all the time. It needs to be punctuated by team-orientated events and hands-on learning. Above all, it must be engaging and promote knowledge-sharing.

People, process, and technology in continuous learning

With all the talk of automation, it's sometimes easy to neglect the most important things of all – people and strategy. Though technology naturally plays a central role in digital marketing, the importance of personal and interpersonal skills is greater than ever. Marketing teams, like any other department, need the optimal blend of people, process, and technology:

PEOPLE

Continuous learning requires excellent social and leadership skills. **Leaders must avoid taking a traditional academic approach and instead lead by example.** They must themselves be champions of innovation and advocates of transformation. That way, they can integrate organization-wide learning into their working environments and align the objectives of different employees and departments with common, business-wide goals.



PROCESS

Continuous learning requires an adaptable and scalable strategy that allows teams to put their skills and ambitions to practical use. **Processes include established standards for onboarding, training, and knowledge-sharing.** Team members should be motivated to document and record information for sharing across the organisation as a whole, and update it whenever they detect opportunities for improvement. This new knowledge should then be applied to learning activities.



TECHNOLOGY


Technology includes the tools needed to bring people together under a shared learning environment and enable the key processes that make it all happen. **A continuous learning program should incorporate flexible online learning platforms that allow employees to learn both on and off the clock, no matter where they are.** Other essential tools include data analytics for measuring key performance indicators (KPIs), communication and collaboration platforms, and readily accessible knowledge bases.

How to launch a continuous marketing strategy that works


Marketing is a vibrant and thriving sector, and manufacturers have many exciting opportunities to build and retain knowledge and, in doing so, become more sustainable both economically and environmentally. As teams continue to learn about digital marketing, they will be able to reach more customers and establish a clear competitive advantage over the many that still lag behind. Below is an overview of the key steps it takes to launch a continuous learning program:

Final words


Implementing a culture of continuous learning is increasingly important for manufacturers of all sizes and across all fields. It offers a dependable way to keep ahead of new trends and the latest technological innovations, and the changing customer habits that come with them. For marketing teams, this means building a stronger reputation and promoting a more sustainable and transparent business model in a time when customers are warier than ever about who they do business with.




Be clear about what you want to achieve. Modern marketing should not happen in a bubble – your objectives must align with the overarching vision of the organisation. For example, a solar panel manufacturer might hope to boost sales by 30% over six months by focussing on environmental benefits in its marketing communications.



Create your continuous learning process. Once you've defined your goals, you can start building a program that aligns with your vision. Although the actual content of the program will be tailored to your needs, the process should start with onboarding and continue in alignment with employee career paths and organisational goals.



Empower your employees with the right tech. Traditional methods like live classes, workshops, and seminars, still have a place, but online learning tools are excellent for supporting continuous learning. Being able to access knowledge and learning tools in any location at any time is precisely what today's employees need.



Establish a way to measure success. Progress must be constantly recorded and measured to ensure success and detect opportunities for improvement. Using specific success measurements engages and motivates employees. This is also a clear benefit of online learning tools, which often have built-in analytics tools.



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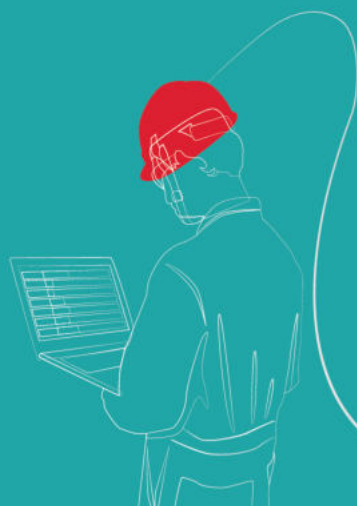
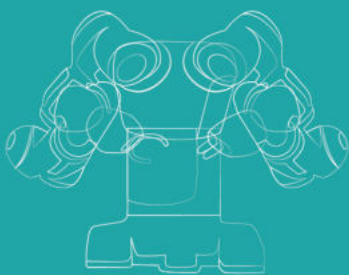
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ISSN 2772-4263