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November 2022

07

POWER TO THE PEOPLE

THROUGH **TECHNOLOGY**

A MESSAGE
FROM THE EDITOR

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

provincie Overijssel

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Twente

Being a human is hard, being a bot should be easy.

As the world progresses, it is becoming increasingly difficult to be a human. With the rise of automation and artificial intelligence, many jobs that were once done by humans are now being done by machines. Even in our spare time, we are overwhelmed by computers. Where we used to be dominant in creative thinking during a game of chess, the now most unlikely moves are being accused of cheating, embroiling the chess world in the biggest cheating scandal it has seen in years.

But is it really that black and white? Are humans the disposable element in this world? To me, this negative message of the adaptation of automation is at the heart of the misperception of what want to achieve from automation: not to automate the human, but to strengthen the human.

In many ways machines are more efficient than humans, can work 24 hours a day, and analyse data within seconds. But none of these technologies can automate entire jobs, rather just job tasks. Technologies on the factory floor can "think" to a certain extent and emulate certain (simple) types of actions, but they move according to the programme written by the engineer. Through this programme, the human does not need to perform that boring, repetitive task, and therefore does the combined function quicker. Therefore, automation ought to help human beings so that they can get more done by saving time.

While the time savings realised by different companies may be a few minutes or a few hours a day, every second can add up to big savings over a week or a year. As a result, employees and customers save time, have less stress and have more meaningful interactions when they don't have to worry about tedious processes before, during, or after an interaction.

This may give us humans a chance to reclaim our game of chess…

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MANUFACTURING PROCESS AUTOMATION

A NEW APPROACH TO YIELD RECOGNIZABLE BENEFITS

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Manufacturing automation (MA) has been around in some form since early 1900 focusing on the support, or elimination, of manual operations, most recently by utilization of robots or dedicated mechatronic solutions. Traditionally, reduction of cost and increase in production throughput have been among the main drivers for production automation in the Industry 3.0 era. MA focuses on longer production runs where robots perform repetitive, sensor-controlled operations. Furthermore, it involves the labor-intensive development of dedicated control software with a relatively long ramp-up period (days/weeks).

Recently, companies have been driven toward automation due to new triggers such as labor shortage, competition, reshoring, resilience, local production, and production independence. Traditionally, MA was investigated by big manufacturing firms to assess the potential benefits of mass production. Nowadays, small and medium scaled companies are also interested in exploring the benefits of automation as technological advancements have induced flexibility in automation solutions. Within Industry 4.0, the development of automation solutions for small to medium-sized production runs is seen as a significant objective. This builds the client's expectation of automated systems that involve the least programming, ramp-up, and maintenance efforts.

Opportunities

Current technological developments deliver many of the building blocks required for the MA solutions of tomorrow. Modern system hardware is packed with a wide range of sensors. These sensors create much more data than can be seen on human interfaces. Additionally, it also helps to monitor the internal functions of the system. Older hardware is retrofitted with modern sensors to get insight into production quality and throughput. All this data can be made available to support automation processes. With the help of ERP/MES software systems, hardware from the production floor can be connected to form a larger cluster of cyber-physical systems. Data created in individual production steps can be shared to up and downstream locations to streamline the production process. Smart sensors do not just sample the environment and generate data but also create information to draw meaningful insights. For example, smart camera sensors cannot only see RGB values but also interpret clusters of RGB values to recognize objects. Cobot (and robot) hardware and software are being supplemented with different types of safety systems that allow efficient, safe, and fenceless implementation. Sensor data / 3D CAD models assist automated robotic systems in making decisions based on a logic framework. Artificial intelligence and machine learning strategies are being developed for automated systems to make decisions in a relatively unstructured environment where it is impossible to define a logical framework. The use of supercomputers to simulate a factory in a virtual environment (also known as digital twins) has shown promising results in predicting production flow and identifying potential bottlenecks or breakdowns over a long time frame.

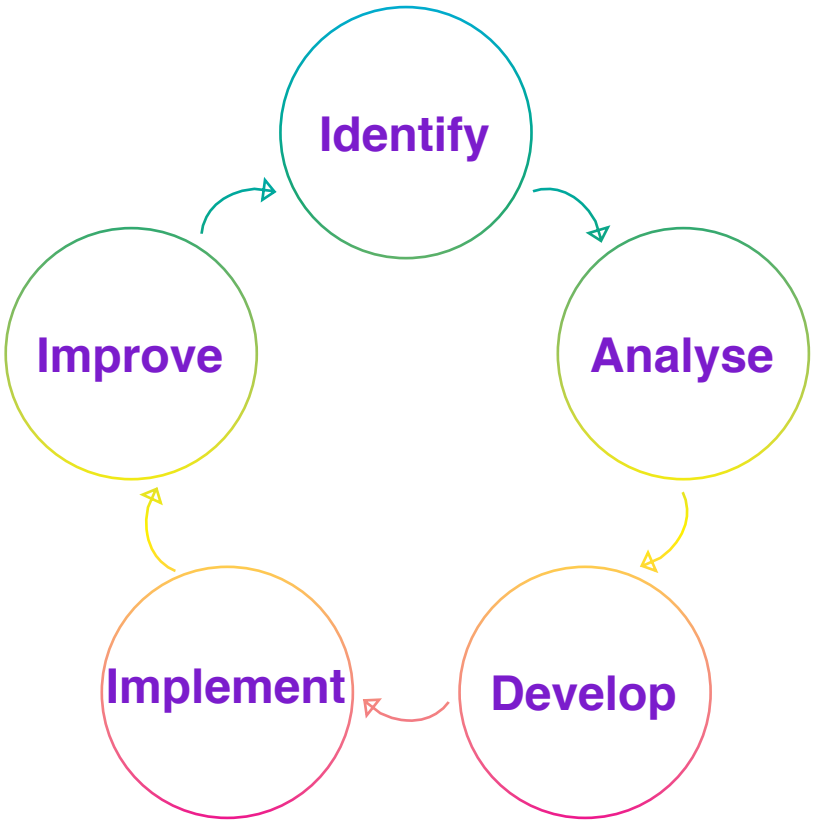
Challenges

Most of the production plants were not defined on a drawing board but gradually grew to their current composition. Additionally, human worker tasks are often easy to execute for humans but hard to program as automated solutions. This includes complexities such as dealing with flexible or randomly shaped products or making decisions based on unstructured data. Usually, manufacturing tasks can be categorized as primary and secondary tasks. The secondary tasks do not contribute directly to the process goal, but it is essential for the primary task to be carried out. These secondary tasks can be intuitive for operators, but usually, it is challenging to integrate the primary and secondary tasks seamlessly into automated systems.

Transformation to automated systems does not just involve reduction in labor dependency, but the management will also have to foresee recruiting the missing skills. For instance, the company will have an increased demand for maintenance engineers and robot programmers.

Finally, uncertainty often accompanies this transition. Globalization has led to a wide-scale increase in demand in most production sectors. This, in turn, would force the manufacturers to increase the reliability of the processes. Any failure might result in a production halt and considerable loss, while the chance of failure might be tough to predict before the actual implementation of the system. The economic aspect of automation also takes a massive toll on the investigation, implementation, and maintenance. Theoretically, any type of task can be automated, but the reliability, flexibility, and robustness determine the cost of these systems. A preliminary

> **Transformation to automated systems does not just involve reduction in labor dependency, but the management will also have to foresee recruiting the missing skills.**



Manufacturing Automation Cycle- High-level process cycle to achieve the objective of manufacturing automation.

and detailed study is necessary to ensure the system designer presents a fail-proof solution. The total cost of transition should include the expenses of research, simulation, fabrication, and implementation. Finally, process automation heavily relies on the product's nature. Working products with rigid nature and definitive geometry increase the likelihood of automated operation. While on the other hand, products with soft nature and non-definitive geometry limit the possibilities/increase the complexity of automation.

Manufacturing Automation

Identifying potentially interesting processes for automation can be compared to the recruitment process for a company. The HR department assesses the candidate on several levels, from finding the right fit within the company regarding intellectual capabilities to a personality test. Similarly, not every process is suitable for automation at the present moment. The decision to proceed with automation for a process depends on several aspects, such as assessing the harmful effects of a process failure and its countermeasures beforehand. It could also depend on technological capabilities; for example, the packaging and material handling process in meat production possesses a high potential for automation due to the current maturity of solutions in the industry. On the other hand, considering the current availability of technology, the deboning process is far from reach due to the cognitive complexity involved in the process.

When looking at the automation of cognitively demanding manufacturing operations, mimicking human operations to automated counterparts is often too complex. In such cases, a detailed task decomposition helps the designer identify all the relevant task requirements, redefining the operation suitable for automated systems and thereby considerably reducing the complexity of operations. It is essential to have a structured tool that can be used to assess the production unit (or even smaller sections) to find the right processes for automation. From a high-level view, using such tool results in automation projects with the following benefits:

1. Minimal or reversible effects in case of a system failure
2. Straight forward (or) binary decision-making points
3. Standardized operating methods
4. Independence in processing (i.e., Lower interference with preceding or succeeding processes)

Examples

Effect of variables in automated systems

Material handling of apples in a factory using machine learning (for object detection) on a moving conveyor can be compared to a rover dedicated to pick up apples from a forest can involve a world of variables thereby making the system more complex.

Effect of task complexity on automated systems

Welding of sheet metal assemblies with individually shaped parts involves a lot of variables. Each part deforms differently, which is quite straightforward for manual working. But, for an automated system, this corresponds to irregular welds. Therefore, a detailed analysis must be made in terms of gripping forces, weld gun dynamics, and material deformation, to ensure error-free operation.

Realizing the benefit of using 3D CAD models to support automated systems

Automating the process of applying the final torque to bolts can be relatively easy. This is primarily due to the rigid and defined geometry of the bolts, and its peripherals. Additionally, 3D CAD models of the bolt and the main assembly can be imported to ensure that the robot approaches the correct bolt, at the correct location and with the correct angle.

Effect of standardized product geometry in automation

Automation of material handling systems with definitive product geometry (boxes, cartons etc.). While, automating the material handling of vacuum packed meat products can involve a much higher level of complexity. ■

DIGITAL TRANSFORMATION REQUIRES A DIFFERENT VIEW ON LABOUR

HOW IS THE DIGITAL TRANSFORMATION WITHIN MANUFACTURING AFFECTING THE INDUSTRY'S WORKFORCE?

THE IMPLICATIONS COULD BE MORE FAR-REACHING THAN SUSPECTED, THOUGH.

HOW CAN MANUFACTURERS ANTICIPATE THIS?

Digitization is top priority for the industry. Why? The continuously changing customer demand and increasing expectations for product diversity, quality, safety and sustainability. This requires efficient, effective and adaptive manufacturing processes.

The transformation to a desirable level of digitization is a major challenge for many companies. The phased and structured implementation of new technologies in the production domain that both fit the needs of the current situation and also contribute to desirable professionalism, is challenging enough.

The human factor plays an important role within manufacturing processes today and will continue to do so for the foreseeable future. Of course, the playing field is changing and a digitized production environment places different demands on workers in terms of knowledge and skill levels, but people will continue to be indispensable for manufacturers and production companies.

I am happy to share my vision and insights from years of working with manufacturing clients. Core to this vision: Digitalization of the production domain calls for focus on all POTI aspects (Process, Organisation, Technology and Information). This article focusses on the organizational or people aspect.

Note: The Fraunhofer Innovation Platform for Advanced Manufacturing & CGI were present on the CGI Manufacturing Inspiration day in Utrecht to highlight our partnership. Please get an impression of this inspiring event through the QR-code below.

SCAN ME

MOM Maturity Levels	1	2	3	4	5
Process	Processes, collaboration, ways of working, quality of work, execution				
Organisation & People	Focus, motivation, roles, tasks and responsibilities, skills and knowledge, communication, vision				
Technology	Technology status, technology landscape, digital transformation awareness, knowledge and understanding				
Information & Data	Information availability, data sharing				

Figure 1: *POTI aspects*

> **Digital transformation is not just technology and data.**

What key workforce-related developments do we see?

Aging workforce.

Over the past decade, the labour force, measured by ages 15 to 75, has grown by more than half a million people. This growth will decrease to only 130 thousand people in the next 10 years. The effect of a higher retirement age is minimal. This means that the number of people between the ages 15 and 75 will also continue to decrease. At the same time, the proportion of older people within the labour force is increasing. In general, older workers work less often and also fewer hours per week. Whether this aging will lead to a shortage of workers depends on the number of people working, the number of hours that people work and labour productivity needs versus actual labour productivity (source CBS)

The digital transformation of the production domain will not result so much in higher labour productivity, but rather in higher labour efficiency and effectiveness. In other words: The ability to achieve the same production with less labour. But does that fully mitigate the adverse effects of aging? Digitalisation of the production domain requires a significant investment that will have to show returns, leading to pressure on the revenue model. Possible consequence is the need to produce more which again increases the need for labour....

Tight labour market.

Currently, the labour market is already tight. One of the implications of this for employers is the challenge of remaining relevant and interesting enough for the current population of employees. With the departure of employees, a lot of knowledge and experience often walks out the door, leading to capacity challenges, but also jeopardizing competitiveness. So it is important to retain existing employees. We see that turnover is relatively low in companies that continuously pay attention to employee well-being. However, employee well-being is not only influenced by primary and secondary benefits. Paying attention to the person behind the employee and their needs is also important: a sufficiently challenging role in line with the employee's needs and capacity, including associated tasks and responsibilities keeps motivation and commitment high. This is exactly why the human factor is an important part of my vision. Fortunately, digital transformation offers plenty of opportunities for employees to advance to appropriate and challenging roles.

Need for knowledge retention and development.

A higher degree of digitisation within production requires personnel with a higher level of knowledge and competence. This does not necessarily mean different personnel, but it does mean that continued development of the skill and knowledge level of the current workforce should be high on the agenda of manufacturing companies in the industry. There will have to be a shift to a different type of workforce as the production environment continues to digitise. It is important to ensure the right balance between the "maturity" of the production environment and the duties and responsibilities of employees. A clear and concrete transition plan of digital production maturity helps tremendously in this regard.

Focus on recruitment of new employees remains as important as ever. More and more manufacturing companies are therefore looking to connect with colleges and universities to get students excited about jobs within manufacturing. When students can be involved early on in the process of digital transformation at manufacturing companies and make a significant contribution, it increases the likelihood for employers to hire them as employees thereafter.

Manufacturing companies suffer from the loss of valuable knowledge when employees leave and try to secure this knowledge in various ways. Digital transformation offers opportunities and solutions for this as well. Examples range from basic solutions such as securing knowledge in processes, flow charts and instructional videos. Similar solutions are often found in manufacturing companies that are still relatively low on the maturity ladder. But we also see the securing of valuable process knowledge using Digital Twins, Machine Learning and Artificial Intelligence being applied more and more. A positive consequence of the growth in digital maturity. Thus, by recording important process actions and events by employees, valuable information is retained for manufacturing companies.

Wrap up / Key Take-aways

Digital transformation is a must for manufacturing companies. On the one hand, to respond to rapidly changing market dynamics in order to maintain a competitive position and on the other, to increase labour productivity to compensate for the tightness in the labour market, partly due to an aging population.

Digital transformation is not just technology and data. A clear and concrete transition plan of digital manufacturing maturity includes all the four POTI aspects and guarantees necessary focus on the organization and employees of manufacturing companies. A phased approach consistent with vision and strategy provides solutions in the area of knowledge retention and development. ■

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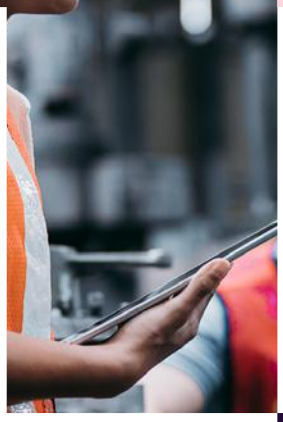

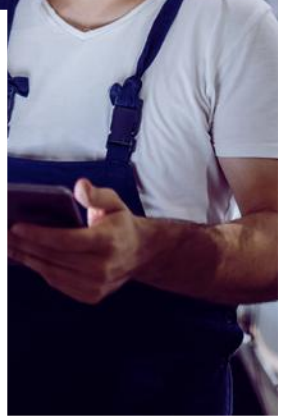

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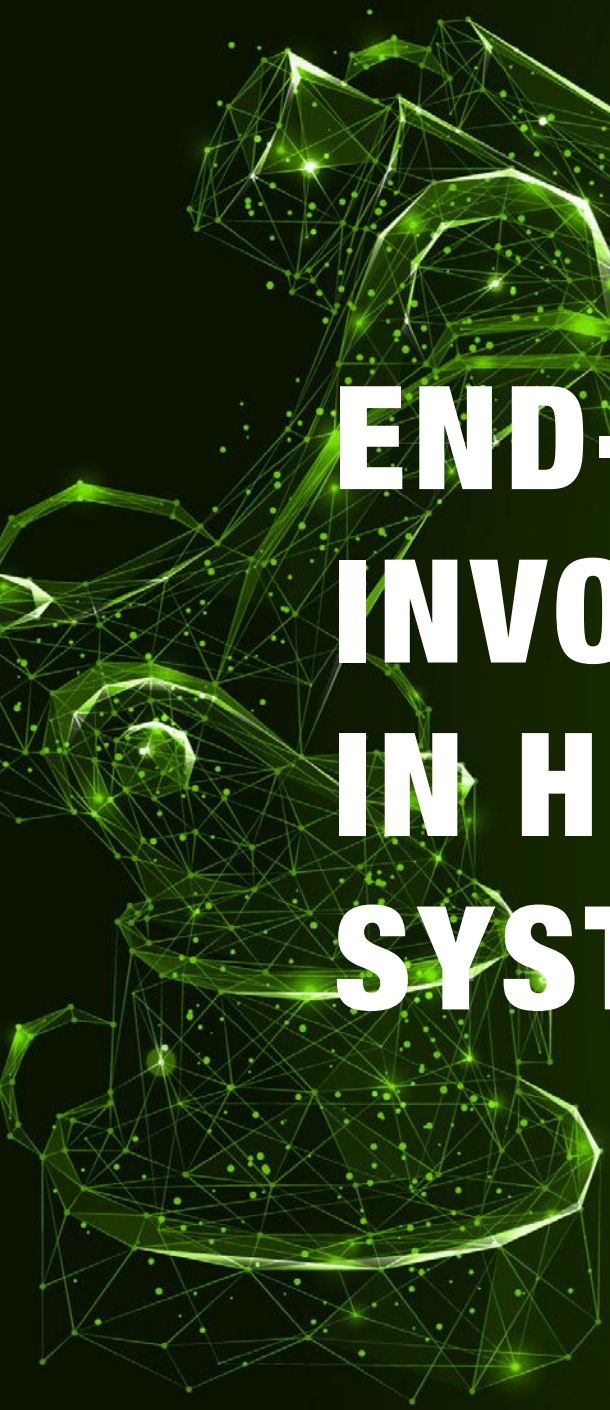

END-USER INVOLVEMENT 2.0 IN HUMAN-ROBOT SYSTEMS:

UNLOCKING OVERLOOKED POTENTIAL

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In the 1950s, the first industrial robot arm was introduced at General Motors. Now, over seven decades and tons of research and development activities later, the industrial robot became an irreplaceable part of the manufacturing landscape. These robots are operationally excellent, multifunctional, come with increasingly user-friendly software, and can sometimes directly interact with its end-users, such as machine operators or production workers. For long, manufacturers used industrial robots to maximally automate their mass production systems in a pursuit of reducing costs and becoming a fully automated 'lights out factory'. However, diversifying customer demands, reducing batch sizes, and skyrocketing product variations require manufacturers to drastically increase the flexibility of their production system to remain competitive. To build flexible production systems, high alignment between end-user and machine capabilities is essential. In this article, we explain why end-users are highly important for sustaining human-robot systems and why this urges for more end-user involvement. We introduce the idea of 'end-user involvement 2.0', showcase what it could look like, and advice manufacturers how they can closely involve end-users in the design of futureproof human-robot systems.

Given that most industrial robots are as robust as the product variation and issues they are programmed for, end-users are essential to make industrial robots usable for flexible production purposes. Ideally, end-users work closely together with industrial robots, oversee its functioning and product flow, solve unforeseen issues, and reparametrise or reprogram the robot application. To assure that end-users can sustain such a role over time, it is important that working together with industrial robots is perceived as challenging but manageable due to the presence of sufficient decision-making opportunities. It is also important that the robot application triggers end-users to stay alert for the robot's movements and potential error. If end-users' work perceptions or alertness are at risk, chances are they get demotivated, stressed, or injured to an extent they cannot sustain the robot application. To safeguard end-users' work perceptions and alertness, it is important they are closely involved in the design and redesign of their human-robot systems.

> **To build flexible production systems, high alignment between end-user and machine capabilities is essential.**

At the moment, end-users' involvement is often limited. In the robot implementations we came across, production managers and engineers dominated the decision-making process. In some instances, end-users had one or a few opportunities to share their ideas, suggestions, and advices with the decision-makers who, in their turn, would implement or ignore the received input. Once the robot applications were decided upon and developed, end-users had limited to no opportunities to change it. This form of end-user involvement, which we refer to as 'end-user involvement 1.0', could result in suboptimal work perceptions and alertness if decision-makers misjudge their end-users' perceptions. It might lead to the design of technically-sound robot applications that, in hindsight, cannot be sustained over time. Here, we present an alternative approach, namely: end-user involvement 2.0.

In end-user involvement 2.0, the decision-making power is redistributed to an extent that end-users become co-designers that have a say in the design and redesign of the robot application. They will play an integral part in the robot implementation process and be equipped with the opportunity to adjust and align the robot application with their perceptions. The differences between end-user involvement 1.0 and end-user involvement 2.0 are summarized in table 1. To test if end-users and manufacturers could benefit from more end-user involvement, we ran an experiment.

	End-User Involvement 1.0	End-User Involvement 2.0
Position in Implementation	Design Phase	Integrally
Decision-Making Power	Advisory	Co-Designer
Flexibility Robot Application	Fixed	Adjustable

Table 1: Comparison End-User Involvement 1.0 and End-User Involvement 2.0

> **To safeguard end-users' work perceptions and alertness, it is important they are closely involved in the design and redesign of their human-robot systems.**

Description of the Experiment

A manual workstation and three collaborative workstations were built in a lab environment at Saxion. The collaborative workstations were equipped with a collaborative robot (Universal Robots 5) and had different levels of decision-making opportunities: low, medium, and high. Based on the level of decision-making opportunities, end-users were allowed to design their human-robot task allocation, manipulate the robot's speed, and adjust the robot's programs. Demonstrations, work and safety instructions, and workplace assistance were provided in all instances.

Students from regional universities and community colleges joined the experiment. All students had no recent working experiences with robotics. To discover if these end-users would produce better and more sustainable with the robot, we let them execute a number of flexible assembly tasks. They would conduct these tasks at the manual work station first. After that, they conducted the same tasks at one of the collaborative workstations.

We looked into how decision-making opportunities were leveraged, what the design of the human-robot looked like, end-users perceptions (work perceptions and alertness) and performance outcomes (productivity and reliability).

Based on 80 work sessions, we learnt that high end-user involvement could be beneficial for both end-users and manufacturers. Higher levels of end-user involvement enabled end-users to design more efficient task allocations and meet similar productivity outcomes compared to the manual production method – working together with the robot resulted in less product defects across all levels. We also found that higher end-user involvement was beneficial for the end-users' work perceptions. It prevented end-users from feeling constrained in their decision-making. And although we did not find any work perception improvements, the absolute majority of the end-users agreed that working with the robot would allow them to sustain their work activities better. We did not encounter notable alertness differences across end-user levels, but we did find that higher levels of end-user involvement required more alertness. The robot sometimes functioned too fast or robot applications became unstable when parts of the programs were adjusted incorrectly.

Finally, we noticed that design opportunities were not always used or used constructively. For instance, a third of the end-users who had the opportunity decided not to redistribute the task allocation between the robot and themselves, suppressing personal strengths. Furthermore, only halve of

the end-users that we allowed to modify the robot application's program actually changed it themselves, asked for assistance, or came up with suggestions. Sense of time pressure played an important part in preventing end-users to change the robot application's program. End-users' limited working experience with robots could be an alternative explanation and stressed the importance of proper training and workplace support. These lab insights lay a base for how manufacturers can implement end-user involvement 2.0 into their production systems. More information about this experiment can be found in the green box on the previous page.

Manufacturers interested in end-user involvement 2.0 should focus on organizing three important conditions. Firstly, it is important that the end-users structurally receive the (shared) decision-making opportunities and time necessary for affecting the robot application. One way to do this would be to include a few end-users in the project team overseeing the use of the robot. Secondly, the end-users must acquire the necessary knowledge and skills to make informed decisions regarding the robot application. These competencies go beyond maintaining and adjusting the robot application and should also include defending work perceptions and mental alertness. Thirdly, a solid support system must be available to proactively assist end-users in their decision-making. Technical support and safety ques could be provided by engineers while the safeguarding of mental alertness and proper work perceptions could be done by human resource professionals.

To summarize, modern industrial robot technology offers an important opportunity for manufacturers to solve productivity and flexibility issues and remain competitive. In this article, we stressed the importance of end-users to leverage robot technology potential. Lab findings were presented and indicated the added value of end-user involvement 2.0. We hope to have inspired manufacturers with our take on end-user involvement and invite them to follow suit.

> **The absolute majority of the end-users agreed that working with the robot would allow them to sustain their work activities better.**

About Research Group (Lectoraat) Employability Transition

Research Group Employability Transition is part of Saxion University of Applied Sciences' School of Applied Psychology and Human Resource Management. Driven by the mission to prepare workers and organizations (profit, non-profit, and government) for a hightech future, the research group functions as a solid bridge between academia and professional practice. By uniting different fields of expertise in multidisciplinary projects, the research group strives towards practical and evidence-based solutions to sustainably optimize business, technology, work, and human capital. More information about the research group can be found in the article "Technology: not good, or bad, or neutral, but always... human!" on **page 31** of this magazine issue. ■

WHAT CORPORATE SOCIAL RESPONSIBILITY MEANS TO SME MANUFACTURING FIRMS

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Socially responsible manufacturing firms can cultivate a positive brand image, boost customer loyalty, and attract top-tier employees to ensure lasting success.

Is no secret that the manufacturing sector at large is one of the world's major contributors to environmental degradation. The social cost of many manufacturing operations, vital to modern society though they might be, is simply too high to ignore. This is why manufacturing firms, no matter the size, must invest in sustainable innovation, philanthropic responsibility, and human equity.

Corporate social responsibility (CSR) goes hand-in-hand with socially responsible practices to help cultivate a positive business reputation. As a form of self-regulation, CSR goes beyond legal mandates to incorporate industry best practices and initiatives such as charity programmes and investment in greener production systems. To that end, CSR is inseparably tied with various other mission-critical functions, such as brand management, supply chain management, and risk management.

Most conversations about CSR concern large global enterprises. After all, their activities have by far the greatest impact on society and the environment. Furthermore, they attract far more media attention than their smaller counterparts, thus making CSR a practical necessity. Small manufacturing firms, on the other hand, often fear they lack the resources necessary to adopt more sustainable and equitable processes.

In spite of these concerns, the business considerations for CSR for SME manufacturing firms are every bit as important as they are for large enterprises. Indeed, there are countless new start-ups appearing in the space that make a point of exploiting more sustainable production opportunities. Any hesitance to do so can be countered by the fact that CSR is not a destination, but rather a journey of continuous improvement.

Sustainable brands are more profitable

There is no denying that investing in areas such as reducing a company's carbon footprint or reducing its negative social impact can be costly. That said, strategic investment in CSR is an investment in long-term success. The main reason for this is that customers are far more likely to do business with brands that help them live sustainably. One study of 1,004 respondents in the US and the UK even found that 88% of consumers[1] were more likely to buy from companies with an environmentally friendly and ethical track record.

Of course, no business wants to risk disappointing such a huge majority of their customers. In the era of social media and online reviews, such disappointments are dramatically amplified as well. Even while it might only be a minority of customers who spend time trawling through a company's environmental record before making a purchase decision, it is vital to remember that the internet has given everyone a voice. Thus, brands that fail to demonstrate their efforts to become more environmentally sustainable and improve their societal impact will soon find themselves in the limelight for all the wrong reasons.

Extending CSR across supply chains

CSR is not just about what an organisation does internally. A company might have the most robust internal policies in its respective market, with regards to sustainability and equitability, yet weak links might persist somewhere down the supply chain. Manufacturing firms have it harder than most in this respect, since their supply chains are often highly complex and rely heavily on raw materials that are not always easy or even possible to source sustainably. For example, many ubiquitous consumer goods, such as smartphones, use lithium-ion batteries. However, not only does the extraction and processing of lithium consume huge quantities of water and energy – lithium-ion batteries also require graphite, the mining of which can have catastrophic impacts on local environments[2] and public health.

The importance of human equity across supply chains can also not be underestimated. Many manufacturers outsource some of their operations to factories and suppliers that do not meet satisfactory employment or safety standards. For example, if a serious accident that results in loss of life occurs in a factory with inadequate safety

> **88% of consumers[1] were more likely to buy from companies with an environmentally friendly and ethical track record.**

standards, the reputational fallout may also extend to any brands that outsource their manufacturing there.

Given such examples of just how vulnerable supply chains can be, it is essential that manufacturers, regardless of their size, take the utmost care with regards to who they do business with. This is why know your customer (KYC) and due diligence checks are some of the most important processes in supply chain management, not to mention how deeply tied they are to CSR. After all, few things damage a brand's image more than having their labels associated with a major human tragedy.

Becoming more attractive to resellers

While an increasing number of manufacturers sell directly to consumers, most SMEs depend more on wholesalers and retailers. Yet these industries are also investing in CSR, hence the benefits of extending CSR across supply chains cuts both ways. As such, a manufacturer with a proven track record in adopting sustainable and ethical business practices presents a far more attractive business opportunity to resellers. In fact, given the increasing importance of CSR in today's supply chains, manufacturers can safely assume that any resellers they hope to work with will be even more aware of sustainability and business ethics than consumer audiences.

> **83% of workers reporting that their companies are not doing enough to fight climate change[4].**

Both retailers and wholesalers are becoming increasingly wary of where and how the products they sell are sourced. Major scandals, such as the 2013 horse meat debacle[3], have served to further raise awareness to the need for transparency across supply chains. Such supply chain abuses now mean that retailers are especially careful when conducting due diligence checks. For manufacturers, this means they must have comprehensive CSR programmes in place, as well as the documentation and evidence to demonstrate their efforts, if they hope to pass such tests.

Attracting top-tier talent

CSR is not just important to customers and stakeholders, but also to employees. After all, it is common sense that, when an employee believes their company is trying to have a good impact on their community, they will likely be happier and more productive. This means manufacturers should also take a strategic approach to communicating their efforts to employees, which is why CSR starts with strong leadership.

That said, it remains a common misconception that employees are really only concerned about their salaries. The truth is, that when employees feel their businesses are socially responsible, they are likely to have a greater sense of belonging. This translates into a stronger connection to the company which, in turn means an increased likelihood of companies retaining the best talent – i.e. people whose own ideals align with those of the brand.

With environmental and social sustainability being top of mind among today's jobseekers, the need for CSR from an HR perspective is clearer than ever. However, according to one survey of 2,000 office workers in the UK, there remains a serious gap between what employees want and the actions their employers are taking, with 83% of workers reporting that their companies are not doing enough to fight climate change[4]. Another study, by the IBM Institute of Business Value in 2021, found that 71% of people considered environmentally sustainable companies to be more attractive employers[5].

Recent studies have consistently shown that employees from line managers all the way up to senior managers are more engaged and more productive when they are fully aware of their employer's CSR initiatives. This translates into enhanced productivity and helps to foster an environment of sustainable innovation and continuous improvement.

To communicate these efforts, senior executives should regularly share tangible evidence of the positive outcomes of their

CSR initiatives and invite employees to share their own thoughts and ideas on the matter. After all, improved sustainability ultimately comes down to motivation and smarter decision-making, hence the central role of strong leadership.

> **71% of people considered environmentally sustainable companies to be more attractive employers[5].**

How CSR adds real business value

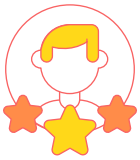
Adopting environmentally sustainable business practices, bolstering diversity and inclusion, and engaging in philanthropic initiatives does not come cheap. But then neither should these things be considered merely as cost centres or minimum legal requirements.

Corporate social responsibility is not about choosing between profitability and doing business sustainably. It is about harmonising the two with a view to long-term success. Manufacturing firms must look beyond their economic and financial aspects, as these are not the only things that add value. History has proven time and again that organisations with strong track records in environmental, social, and governance (ESG) aspects consistently perform better over the longer term than their non-sustainable competitors.

To summarise, such companies boost long-term profitability and reduce risk by leveraging the following key benefits of adopting effective CSR programmes:

Enhanced customer reach and loyalty

Reduced risk across supply chains



Increased employee satisfaction and retention

For manufacturers, those benefits are simply too important to ignore. Adhering to legal regulations and universal trade and industry standards is just the beginning.

Sources

1. https://www.forbes.com/sites/solitairetownsend/2018/11/21/consumers-want-you-to-help-them-make-a-difference/?sh=571345116954
2. https://www.washingtonpost.com/graphics/business/batteries/graphite-mining-pollution-in-china/
3. https://en.wikipedia.org/wiki/2013_horse_meat_scandal#:~:text=The%202013%20horse%20meat%20scandal,meat%20content%20in%20some%20cases.
4. https://www.reutersevents.com/sustainability/employees-want-climate-positive-action-companies-heres-how-they-can-deliver
5. https://newsroom.ibm.com/2021-04-22-IBM-Study-COVID-19-Pandemic-Impacted-9-in-10-Surveyed-Consumers-Views-on-Sustainability

SHELTERSUIT FOUNDATION:

BECAUSE EVERYONE DESERVES SHELTER, WARMTH, AND DIGNITY

Although we live in the Netherlands, a relatively rich first world country, there are still homeless people freezing to death on the streets. In Enschede in 2014, Bas Timmer's best friend's father died of hypothermia. This shocked Bas into taking action. Already running his own clothing line, Bas was uniquely qualified to design a product that could help prevent homeless people from freezing to death. The Sheltersuit was born, immediately offering warmth, shelter, and dignity to the homeless.

Sheltersuit was founded and established in Enschede eight years ago, producing products that offer an immediate, short-term solution to a long-term global problem. They have now expanded their operations to Cape Town and New York, and plans are underway for the establishment of Sheltersuit in the United Kingdom.

The organisation: Sheltersuit Foundation

Sheltersuit was founded by Bas Timmer in 2014, with the aim of giving back to society. Youp Meek, Partnership Manager at Sheltersuit, explains, "Bas struggled with the dilemma of selling upmarket clothing on the one hand, while on the other, he recognised that many people throughout the world have no money at all to buy warm clothes and are therefore at risk of hypothermia. When the homeless father of his best friend was frozen to death, Bas came up with the Sheltersuit: a jacket with a zippable sleeping bag."

Sheltersuit is an organisation with clear goals. Firstly, to produce responsible and sustainable clothing with little impact on our planet and huge impact on end-users. Secondly, as much as possible, they collaborate with local suppliers. Sheltersuits are produced locally, often by former refugees and also disenfranchised people who have struggled with access to the labour market. The suits are distributed through humanitarian organisations, who are well-placed to know the needs of their communities and possess the infrastructure to ensure seamless distribution.

> **I actually have to thank you; you guys saved my life. I used to walk down the streets with a sleeping bag from Action.**

The act of issuing a Sheltersuit forms a dual purpose. It allows social workers to more readily come in contact with homeless people, making it less likely that these people will slip through the cracks unnoticed. Then, as this moment of contact increases, so too does the homeless person's willingness to accept help. Youp gives an example: "In January, we went to Rotterdam to hand out suits through a humanitarian organisation. One of the volunteers there came to us and said: "I actually have to thank you; you guys saved my life. I used to walk down the streets with a sleeping bag from Action. I didn't want to hear anything about the homeless shelter. Then I met someone from this shelter who said, "If you come with me, you'll get a cup of coffee and something warm."" He went to the homeless shelter and spoke to the people there and was given a Sheltersuit. For the next three days, he slept on the streets in his Sheltersuit. He felt warm and safe, feelings he was not accustomed to having. He decided to work as an experienced volunteer at that homeless shelter himself. He also started sleeping there, and last summer, we had a housewarming, because he became eligible for Housing First – a Rotterdam housing organisation for homeless people, and he was allocated his own place to live. It is stories like this that energise us, encouraging us to continue the work we have started. "

The products

A Sheltersuit offers shelter and warmth to the homeless in colder climates. It is a windproof and waterproof jacket with a zipper at the bottom, to which a sleeping bag can be attached. The hood protects the face from rain and streetlights and allows people to lie relatively covered.

There is also a variant for warmer climates: the Shelterbag. This is basically a single-person tent with a sleeping mat in it. Also the Shelterbag features a large hood, which is designed to cover the head. The Shelterbag is lighter in weight than the suit, and therefore easier to carry for those who move a lot.

The production process

The Sheltersuit Foundation has three pillars:

Repurpose for purpose:
upcycling residual material

Opportunities and development:
Creating new jobs for people with a distance to the labour market, like former refugees

Sharing shelter:
Providing warmth, because everyone deserves that

The products are made of residual materials from donations by high-end, often local, suppliers. “The willingness to donate is great; it’s a big problem it’s a big problem that they’re eager to help solve.”

The Sheltersuit production process consists of approximately 120 steps. The first step involves cutting the pattern for the outer layer, cutting about 250 layers at once with a hand-cutting machine. After that, the lining is cut. Then the suit goes into production. The production process consists of seven to nine stations, with everyone simultaneously making a different part of the suit. Finally, the entire suit is assembled, and the snap fasteners are hammered in.

Sheltersuits are available in a range of sizes, from Small to XXL, so they can be sure to have the optimal size for each of their clients. It takes about five hours to make one suit and the cost price is about €300. Having the objective of making their production process more efficient, this cost price will decrease in the future. This year, Sheltersuit will produce a total of 5,000 suits and their goal is to annually make 20,000 suits within five years.

In Enschede, there are currently 18 people employed in the Atelier, with a further 20 volunteers, and nine people in the office. “As our second pillar indicates, the Atelier employs many former refugees, especially from Syria and Eritrea, some of whom are very experienced in the clothing industry.

Having run an Atelier in Damascus for renowned clothing brands, with a production line of 300 employees, our key people know exactly how things are supposed to run. They have considerable experience in the clothing industry, and they are willing to share their skills and knowledge with us. We also help for example young people with a depression, who work with us as a daytime activity. We often find helpers in unusual places. For example, we had a retired woman working with us. She felt lonely and unhappy at home and because sewing was her hobby, she wanted to support us with that.”

The future

Currently, Sheltersuit is almost entirely dependent on donations and gifts. Sometimes these are financial contributions by companies or individuals, sometimes a donation is done in the form of joint distribution of the suits, supported with a financial contribution, or by (temporarily) taking over part of the production free of charge. Another form of income for the foundation is generated by 'remanufacturing' a product. Youp explains: "We have, for example, made orange high visibility jackets into sports bags for a construction company. They then bought them back from us and gave them to their staff. A short while later, I received photos of 1,500 employees as they walked into the gym with their reflective orange bags; super cool!".

In order to generate an extra income stream, Sheltersuit launches a clothing label for end-consumers too. The clothing and accessories will entirely be made from dead stock material.

With regard to technology, Sheltersuit hopes to make the production process even more efficient in the future. First steps in this direction have already been taken, with a recent move to a larger location in the current establishment, Spinnerij Oosterveld in Enschede, and therefore more production capacity. A next step could be an automated cutting machine. On a social level, the people of Sheltersuit hope to contribute to activating the business community to make their production process more sustainable: "In the end, textile industry is one of the most polluting sectors. We hope to motivate companies to take responsibility in combatting pollution." Furthermore, they hope to become active on every continent, bringing people together to provide everyone of us with a bit of dignity. ■

Would you like to read more or contribute yourself? https://sheltersuit.com/

Are you ready for the next step?

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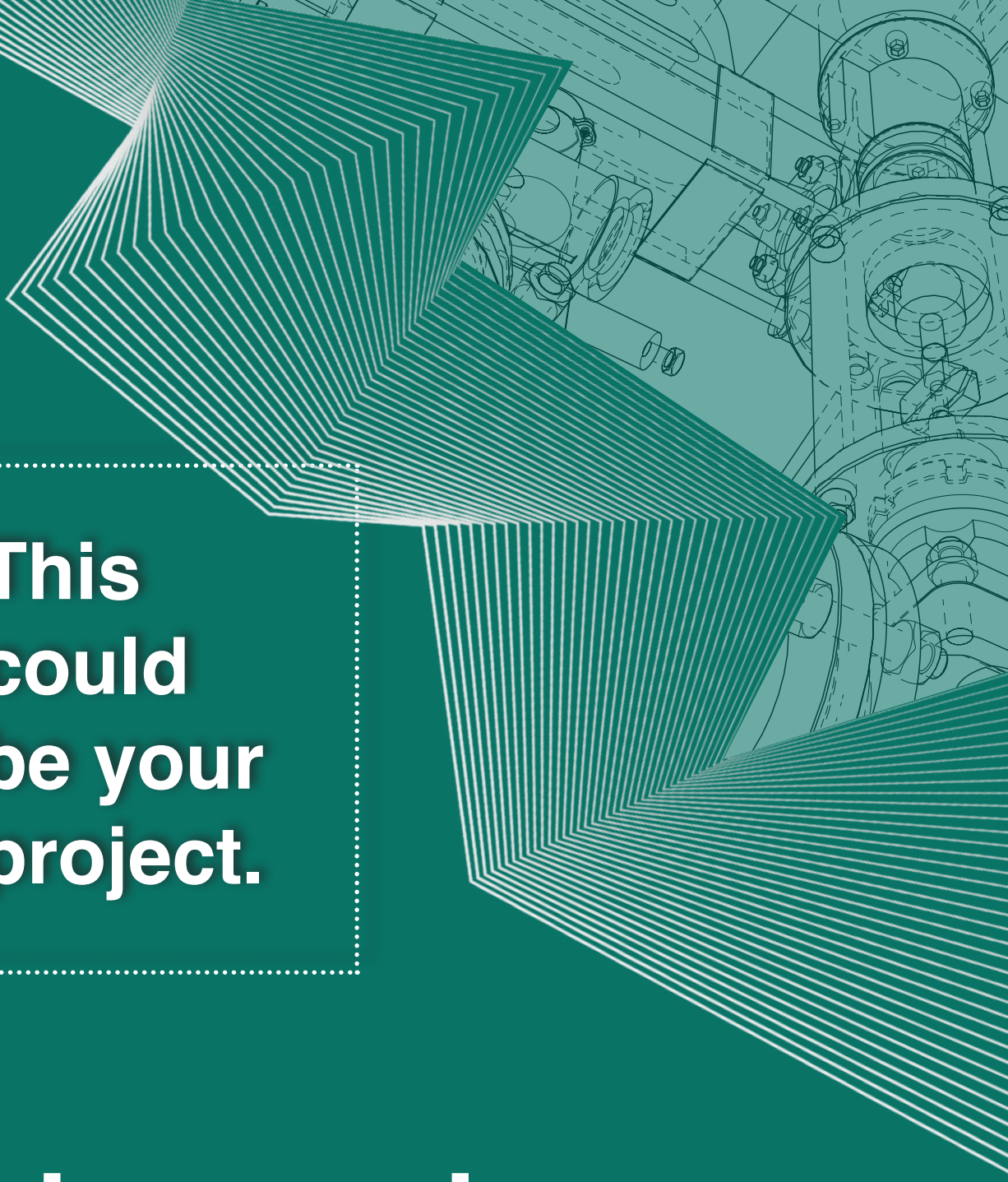

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AMC NU

ADVANCED MANUFACTURING PROGRAM (AMP)

Powered by: **Regio Deal Twente**

Together with regional government and partners, the Fraunhofer Innovation Platform for Advanced Manufacturing (FIP-AM) 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 Innovation Platform for Advanced Manufacturing 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. FIP-AM 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. This is made possible through the Regio Deal supported by the Province of Overijssel and the Dutch State.

Rijksoverheid

provincie Overijssel

regio Twente

Twente

TOPIC 01_

DON'T WAIT, INNOVATE!

AND WE ARE HAPPY TO HELP YOU WITH THAT!

It can be difficult to conduct an innovation. Often a new idea arises to, for example, produce more cost-efficiently, reduce material waste, or simplify the production process, but people do not always know how to take the next step in this process. Which and how many people are needed for this innovation project? What budgets are available and is that enough? What timeframe is feasible? In practice, regular daily business often takes over in terms of prioritisation, and new, valuable ideas unfortunately remain on the shelf.

In a free of charge exploratory meeting, we shine our light on your idea and support you in the next steps. **We are happy to assist you as an external innovation manager, extra R&D capacity, project manager or as a gateway to other specialist parties (field labs, professors, engineers, or other experts).** Our hours can be paid for with the support of the AMP.

TOPIC 02_

ADVANCED MANUFACTURING CENTER

WHICH DEMONSTRATOR WOULD YOU LIKE TO SEE?

You've probably heard of it: soon we will open the doors of our own Advanced Manufacturing Center! This state-of-the-art industrial test-before-invest facility opposite the University of Twente offers manufacturing companies extensive opportunities for industrial research projects. Our projects always have a demonstrator as an end result: either a tangible demonstrator, or a digital proof-of-concept solution.

Which demonstrator would you like to see in our AMC? Let us know, we appreciate your input!

TOPIC 03_

SUSTAINABILITY AS AN INTEGRAL PART OF YOUR PROJECT

BECAUSE SUSTAINABILITY IS MORE URGENT THAN EVER

Sustainability can relate to various aspects, with the common denominator being the contribution to a healthy earth with thriving inhabitants and well-functioning ecosystems. Literally it means 'durable' or 'long-lasting' . This can be all about the technological, economic, ecological, political or social field developments.

Sustainability in your project can therefore relate to a sustainable deployment of people, reducing the consumption of raw materials and materials such as gas and electricity, or being able to use a certain component more sustainably (= for a longer term). It can also be about a truly more environmentally friendly production process.

Do you need help with your sustainability issue? We can also support you here! ■

Would you like to know more or do you have any specific innovation ideas around these topics? Contact Elias!

e.rouchou@utwente.nl +31 (0)6 4876 7414 **Elias Rouchou**

FROM TRUCKDRIVER TO 3D PRINTER OPERATOR

Author:

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Marketing & PR,
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When truck driver Ronald van Huffelen became the victim of an accident, he thought he would never find a job again. Read below how he found his new job as a 3D printer operator.

Cooperation between Lucrato and SDD

Due to a work-related accident, Ronald was unable to do this work as a truck driver anymore and he unwillingly ended up at home. This he experienced as extremely frustrating and undermining. He did not have the slightest idea what kind of work he was able to do, no more than what he wanted to do.

Ronald came into contact with Lucrato. Lucrato is a government-subsidized entity that works for the municipalities of Epe, Apeldoorn, and Heerde. It helps and guides people who are jobless because of physical or other disabilities, in their search for a fulfilling job. The power of Lucrato is the ability to see the talent of the people they help and not their disabilities. Within their network, they look for a company or institution that matches best the person they are trying to help.

And so Ronald joined up with SDD in Emst (belonging to the municipality of Epe). SDD is a distributor of print finishing solutions: they assemble and distribute binding, cutting, and folding machines. SDD is a progressive company, willing to create new jobs when necessary and desirable.

During the time that Ronald was looking for a suitable job, SDD-subsidiary AMR Europe was just trying to fathom the 3D printer: find out what you can do with a 3D printer and how to deploy it in favour of your production process. Subsidiary AMR Europe has sold and distributed 3D printers since 2015.

Press Trim Module

Now we need to bridge the gap to the Press Trim Module (PTM). The PTM is a module sold worldwide by SDD to major printer companies such as Canon, for inline use behind their production printers. The PTM contains 72 components, which SDD previously had made by suppliers.

An example of a component is a part with conical holes, made out of POM (polyoxymethylene, a very strong plastic). The cost of making this part used to be very high.

The supplier made use of subtractive production techniques: sawing, cutting, milling, and drilling.

Causes for the cost-ineffective production were:

- Small production series
- Laborious product
- Expensive material
- High amount of material used by the supplier

3D printing as an alternative production method

Because of the small annual amount needed, SDD started to look for an alternative way to produce the above component.

The alternative was: 3D printing, also called additive manufacturing. Production series below 3000 items make 3D printing profitable.

Ronald proved to be the ideal person for SDD to operate 3D printers. Ronald found it exciting to learn something new but also stressful at times. However, he persisted and has worked as a 3D print operator for almost two years now. He communicates with his superior about the work for the day every morning and prints 2000 components every month. Ronald thrives at SDD and is happy that he has a job close by.

Advantages of 3D printed components

SDD produces most 3D-printed parts with ABS-A100 (acrylonitrile butadiene styrene). This is a material SDD was awarded HB certification for. (HB stands for Horizontal Burning Test and gives information about the flame resistance of a material).

ABS-A100 is strong, abrasion-proof and very useful for 3D printing.

Ronald's day-to-day work gives SDD:

- Lightweight components
- Effectively manufactured components
- Stronger components than before because of the honeycomb structure

Further advantages of 3D printing for SDD are flexibility in material, flexibility in design, and the ease of prototyping new components.

Last but not least, the 3D printed components give less wear and tear in the machines than the subtractively manufactured POM components. ■

For questions, email:
info@amreurope.com

TECHNOLOGY:

NOT GOOD, OR BAD, OR NEUTRAL, BUT ALWAYS... HUMAN!

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Within the Research Group Employability Transition at Saxion University of Applied Sciences, we conduct practical research into themes at the intersection of people, work, and technology. Together with organisations and knowledge institutions, we work on approaches and tools to shape lifelong development, an inclusive society, and people-centred technological innovation.

We study the adoption and implementation of technology for employees. After all, it is not the technology itself, but the way in which it is used, that determines the extent to which the effects are experienced as positive, negative, or neutral for employees. Therefore, we consciously look at dealing with the use of technology in general, particularly in the production process. Specific research questions are for example:

- What are the effects of this technology on the quality of the work of our employees and how do we secure this?
- How can we use this technique to increase the quality, accessibility, and sustainability of our jobs, and thus our production capacity?
- How can we create meaningful and decent work?

Formulating and answering these questions is increasingly important due to the digital transformation. Within the digital transformation, developments in robotics, artificial intelligence, and virtual and augmented reality play an important role. This requires from us, the Research Group, both good knowledge of the employee (work psychology), as well as of the possibilities, opportunities, and risks of technologies. Emerging technologies also often have a direct impact on the production process and the work of the experts, and sometimes lead to suboptimal cooperation between human and machine. But they also offer opportunities!

> **“Technology is neither good nor bad; nor is it neutral” (Kranzberg)**

When HR is not involved, this can lead to non-optimal deployment of employees in the production process, which reduces the quality of work and reduces the autonomy. The effects on the quality of work depend on how the cobot is used.

In principle, jobs can be enriched with the use of technology, which increases opportunities on the labour market and the quality of work, especially for people who are currently experiencing a distance to the labour market. It is important to pay attention to maintaining the vitality of employees and the chance to have employees develop in the workplace and to keep them sustainably employable. For a large group of people who now find it difficult to connect to the labour market, new forms of work can arise. This group receives dignified and meaningful employment and is challenged to develop further. However, raising awareness about and acting upon the possibilities (and possible risks) of this technology is a major challenge. This is not always done optimally, which means that companies miss opportunities to strengthen their company and their employees. With people-oriented technology development, we try to contribute to ensuring that current employees remain connected and/or that new employees with a distance to the labour market, for example due to a physical, sensory, intellectual, or psychological work impediment, are connected, and that this is continuously well monitored and supported at work.

Who are we?

At the Saxion Research Group Employability transition, we, Sjoerd de Vries and Luuk Collou, together with a large group of colleagues, are conducting research into the ways in which technology can be used in a people-oriented way. Under the leadership of professors Stephan Corporaal (Human Capital) and Jan Willem de Graaf (Brain & Technology), our mission is to contribute to the quality of work with practice-oriented research, in which lifelong development is a given, and technology strengthens the human.

One of the places where we do this research, is the Technohub INclusieve Technologie (TINT) in Apeldoorn. TINT is a collaboration between public-private parties, such as Aventus, Lucrato, VDL, and IJssel. TINT focuses on sharing knowledge and practical applications of inclusive technology. Inclusive technology offers a solution to people with a distance to the labour market, who, for example, can do assembly work thanks to instructions by a beamer that projects on the worktop. More on visually projected instructions will come later. Inclusive technology can also be used for people are at risk of getting a distance to the labour market. With this, technology can make working more pleasant and valuable for everyone. With the use of augmented reality, for example, via an Operator Support system (OSS), tablet or smart glasses, cognitively intensive work processes can be made easier. With an exoskeleton, physical work processes can be supported in a similar way. By involving people in the (re)design of production solutions from day 1, work processes can be better tailored to the person.

The TINT was founded with financial support from A+O Metalektro and aims to make and keep people sustainably employable. We do this by making knowledge with regard to the use of inclusive technology easily accessible, and with support and guidance for companies and employees in the TINT Lab. In the TINT Lab, companies, employees with and without occupational disabilities and other interested parties can experience the possibilities of Inclusive Technology and together with stakeholders we look for solutions for practical issues.

The Human Centred Design approach (HCD) is always used as methodology. This turns out to work very powerfully. For each issue, all relevant stakeholders are involved during various solution steps, from, for example, an operator to a job-seeking candidate with an impediment, or from an older employee with RSI symptoms to an engineer. HCD is based on the principles that

a) the underlying problem must be solved, not the symptoms;

b) when designing solutions, the people who (can) start using the solution must be central;

c) solutions always require system thinking;

d) rapid iterations and prototyping are deployed.

HCD often consists of 3 phases: inspiration, ideation, and implementation. With this, an issue related to human-technology interaction in the workplace can be investigated.

Each step can be taken and competed multiple times if a solution has not yet been fully achieved yet. The end user (the operator, the job seeker with an impediment) participates in the design of a (technological) solution in several iterative steps.

The HCD method and the above approach sounds logical and is essential to achieve human production processes. Unfortunately, in reality this is still far from being applied in every case. If this method is used though, we see wonderful results. At Lucrato, for example, the assembly of door locks was investigated. A complex work process for employees with, for example, concentration problems, or employees who are afraid of making mistakes. To solve this, the entire work process has been shaped in such a way, that it is easy for everyone to follow the process through small steps (see figure 2). They are namely supported by visually projected instructions and motion detection, based on the needs of the employee. The result is that employees are less likely to get distracted, are able to go back and forth through the steps, and thus have control over the work process and by camera detection and direct feedback the number of flaws will reduce. HCD of cognitive support ensures in this way that people with a lacking or lower level of education can

Via an OSS, cognitive support in the form of augmented reality allows more complex tasks to be done by more people and reduces errors.

still do more complex work, the work is regarded nicer (more autonomy is experienced), and people can develop in the workplace.

Other examples of human-centred inclusive technology are cognitive support through AR, training and education with VR, digital work instructions, the use of an exoskeleton, and 3D printing of tools. It could also consist of a translation device or noise cancelling headphones.

It often pays off to first take a step back and look carefully at which solution can be most effective for a certain situation. Sometimes it is a simple adjustment in the workplace (colour coding, more poka yoke - or error-proof organising), sometimes it means looking differently at the different processes and jobs, redesigning work, and, for example, cutting a complex process into less complex stages, so that the production line is improved, and more people can be employed in a dignified way. Participants of TINT can experience what can be achieved with each technology in the lab, they can study several modules, and participate in a learning community where they work with students and employees of TINT on projects and practical cases of companies.

Conclusion

All the time, working on human-centred technology development requires careful analysis and organisation of the entire "system", including the employee, the work process, and the specific technology. Ready-made solutions are usually not available. In this way working with the HCD method also requires the employer and the entire organisation to look at (some) business processes differently, for example by dividing them up ("carving" them) and thus involving a larger group of people (with support) in the labour process. This makes this method intrinsically interdisciplinary: psychology, (technical) business administration, and engineering, amongst others, are involved. All these disciplines are important to bring this knowledge into practice. Developing an inclusive work culture and guiding the organisation in this, plays an important role when implementing the solutions. All these therefore are central to our research. As a result, the human capital solutions that are created in this way not only have an impact on the employment issue, but actually also have a very direct social impact. ■

HOW DIGITAL TWINS ARE AUGMENTING THE HUMAN WORKFORCE

THE REVOLUTION OF **INDUSTRY 4.0** AIMS NOT ONLY AT DIGITALISATION AND AUTOMATION OF MECHANICAL PROCESSES; IT CAN ALSO AUGMENT HUMAN WORKFORCES BY EMPOWERING THEM WITH DATA-DRIVEN INSIGHTS. THE CONCEPT OF DIGITAL TWINNING IS A GOOD EXAMPLE OF THIS. THE AIM OF DIGITAL TWINNING IS TO PROVIDE **PURPOSE-DRIVEN INFORMATION,** TO MAKE THE JOBS OF THE WORKFORCE EASIER AND THEIR WORK MORE SUSTAINABLE.

> **Digital twinning is arguably the holy grail of manufacturing innovation for a number of reasons.**

The need for digitisation in the manufacturing sector is currently clearer than ever, but not as a means to replace people. It is to give them a greater sense of purpose, perspective, and priority. After all, manufacturers face growing pressures to adopt more sustainable business models, while also accommodating a soaring demand in a constantly evolving global economy. As a result, production environments and supply chains alike have become incredibly complex, and it has never been more important to have the right information on hand at the right time to support informed decision-making.

Data has become the world's most valuable resource. With the right tooling in place, data becomes the fuel driving not just automation, but also informed decision-making, and continuous improvement. In the age of IIoT-connected machines and information systems, manufacturers now have the opportunity to gather data more effectively and transfer that into useful information for the workforce. What matters even more, though, is that they have the means to transform this information into actionable insights.

How digital twinning facilitates decision-making in modern manufacturing

As a virtual representation of a real-world object or environment, a digital twin can address possible consequences of adjustments in the current system based on measured data. In manufacturing, this might be in a virtual representation of a particular product, machine, production line, or even an entire shop floor.

There is, however, much more to digital twinning than simply creating a digital equivalent of a real-world object. A true digital twin continuously synchronises operational data from its counterpart, to provide an accurate, relevant, and current representation of this information, that is valuable and tailored to the workforce.

Digital twinning is arguably the holy grail of manufacturing innovation for a number of reasons. It allows for more than only the primary function of a digital twin: providing a digital representation of a physical object. Digital twinning namely also aims to combine measured data with data generated during the design phase of the object, which subsequently allows for a simulation of real-world scenarios and to show simulated data. This enables to facilitate a continuous feedback loop that can be used for validation, optimisation, and simulation - without affecting the daily operations.

In manufacturing, one of the most important use cases for digital twinning is decision support. After all, there are many factors that influence the outcomes of decisions in production environments, that are often not explicit. Digital twinning supports decision-making by showing possible outcomes of decisions and, in this way, it largely eliminates the possibility to misinformed changes in live production environments.

Many production lines depend on highly specialised, proprietary equipment that is not only extremely expensive, but also hard to operate and maintain. As such, any changes need to be tested thoroughly before they can be safely applied in a real-world scenario. Ineffective changes could lead to standstill or unwanted situations on the shop floor. Digital twinning enables engineers and technicians to test proposed changes to machine settings and production lines in a risk-free virtual environment.

In addition to reducing risk by thoroughly testing proposed changes, digital twinning also gives technicians the opportunity to evaluate different scenarios in order to continuously optimise production lines.

Empowering purpose-driven implementation

When augmented by real-time data gathered from industrial IoT technology on the shop floor, workforces can equip themselves with foresight with a degree of accuracy that simply wasn't possible before. This allows them not only to get a clearer understanding of the purpose of any proposed implementations, but also the requirements of those implementations, along with their anticipated results.

This is best achieved by following a model based on purpose, perspective, and priority. The purpose of a project can be defined and evaluated in a traditional workshop- or interview-type setting, preferably involving all stakeholders - from company owners to workers on the shop floor. Perspective comes from having the required information available and represented in the required and appropriate way to make an informed decision, hence the role of digital twinning. Finally, priority helps determine the amount of detail that is required for the user.

The traditional approach of process formalisation focuses on enhancing productivity by defining processes and analysing activities. This approach is inherently limited, when it comes to the effective implementation of new technologies. Processes must also be defined by metrics like quality, sustainability, time factors, and production flexibility. After all, modern production environments are dynamic and often unpredictable, hence the need to have access to the right information at the right time. Combined with purpose-driven information management, digital twinning can help overcome those hurdles and drive continuous improvement in the era of Industry 4.0. ■

> **Digital twinning enables engineers and technicians to test proposed changes to machine settings and production lines in a risk-free virtual environment.**

Author:

Maaike Slot
Research Engineer,
Fraunhofer Innovation Platform for Advanced Manufacturing at the University of Twente

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Author:

Dr. Ir. Artur Pozarlik
Programme Director,
Engineering Doctorate (EngD) in Energy & Process Technology
University of Twente

The University of Twente is a leading research university focusing on technical developments and their impact on people and society. This is reflected in UT's extensive offerings of technology focused bachelor's, master's, and postdoctoral educational tracks. Our understanding of our world — including where we work or will work — has led to a unique vision for education: one that combines technology and engineering along with behavioural and social sciences. In this way, we are able to address complex issues never seen before by mankind; it takes creative, cross-disciplinary thinking to find such solutions. In one of these offerings, you can enhance your knowledge and skills in a two-year Research Programme known as an EngD (Engineering Doctorate) Degree.

Most relevant to advanced manufacturing, the Engineering Doctorate (EngD) programme in Energy and Process Technology focuses on science-based design of new processes, products, materials and/or prototypes. The developed products and processes are to be used in various branches of industry and technology, including nutrition, energy, transportation, packaging, membranes, water recovery, polymers, chemical processes, etc. The research-based design is driven by the industrial and societal needs. The developed technological innovations are swiftly, after the project finalisation, available on the market and can be used by the companies, engineers, and society.

The 2-years post-master EngD programme consists of the final design project, which is conducted in close contact and collaboration with industrial partners, and a tailor-made educational component to enhance the knowledge, design, and professional skills of the student. The in-depth technological research on the project is performed using state-of-the-art techniques and the infrastructure of the university and the involved commercial partner. The high-tech facilities, laboratories, monitoring and measurement systems and sensors, numerical and analytical tools are widely used to provide top technological design.

In the parallel line to the investigated project, the EngD student follows courses on the master and post-master level (e.g., courses given by ISPT or J.M. Burgerscentrum) and participates in national and international symposia and conferences. Each student receives a package of specialised tailor-made courses specific to the design project subject and to the background, knowledge, and interest of the student. Professional and career development courses are included.

The technological design is done under the guidance of the experts in the field, i.e., the university professor and company supervisor. After successful completion of a EngD programme, the student is entitled to use the academic degree of Engineering Doctorate (EngD). ■

More information about the programme can be found on:
https://www.utwente.nl/en/education/tgs/prospective-candidates/engd/programmes/energy-and-process-technology/

HUMANISING AUTOMATION:

AN INCLUSIVE APPROACH TO TECHNOLOGY

Automation in manufacturing is not about replacing human workforces, but about augmenting people's capabilities, improving cycle times, and more.

The fourth industrial revolution is now well underway. We live in an era defined by automation, computational intelligence, and big data. Sensors and apps have come to play a central role not just in manufacturing, but in every industry, and even in our personal lives.

The rapid evolution of technology, particularly in the context of manufacturing, has led a lot of people to question their own futures in the sector. Many workers fear their professional lives are under threat in the age of lights-out manufacturing and automated production lines.

The reality is much more nuanced. Automation does not create nor replace jobs – it transforms them. Automation in manufacturing is not necessarily a binary process, but a way to augment human capabilities to better meet the challenges of scale and agility in today's market.

There are many ways to implement automation on the shop floor, and most of them centre around *improving* the worker experience rather than removing it. Here are a few examples:

Reducing manufacturing cycle times

Any efficient production line depends heavily on repeatable processes, such as moving parts from one part of the line to the next. Carrying out these tasks manually might be sufficient for smaller production lines, but it soon becomes impractical at scale. Without the help of industrial robots and real-time, data-driven insights, it is never long before manual workers end up being overburdened. When that happens, production cycles get longer, manufacturers fail to meet growing demands, and people end up being overworked.

Improving production quality and accuracy

Machines do not make mistakes, but they are only as effective as the people who use them. It still falls to people to ultimately decide what works best and what does not. However, armed with data-driven insights directly from the shop floor gives workers the visibility into production lines they need to make informed decisions. Automation makes it possible to create products to the exact same specifications, with much lower fault tolerances. At the same time, real-time data gives workers the insights they need to iteratively improve their production processes.

Enhancing production line reliability

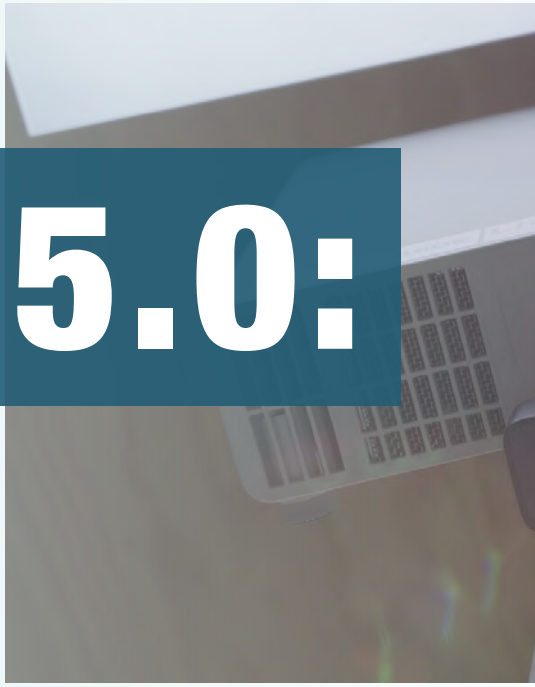
Perhaps the greatest human benefit of automation is the greater reliability of production lines. After all, machines breaking down, leading to disruptions across the shop floor, is a situation that no one wants. Automated systems, such as environmental sensors and actuators, eases the burden on maintenance teams by enabling predictive maintenance. This allows teams to quickly identify processes or equipment that is at risk of failure before it actually fails and leads to serious problems on the shop floor.

Eliminating repetitive and boring tasks

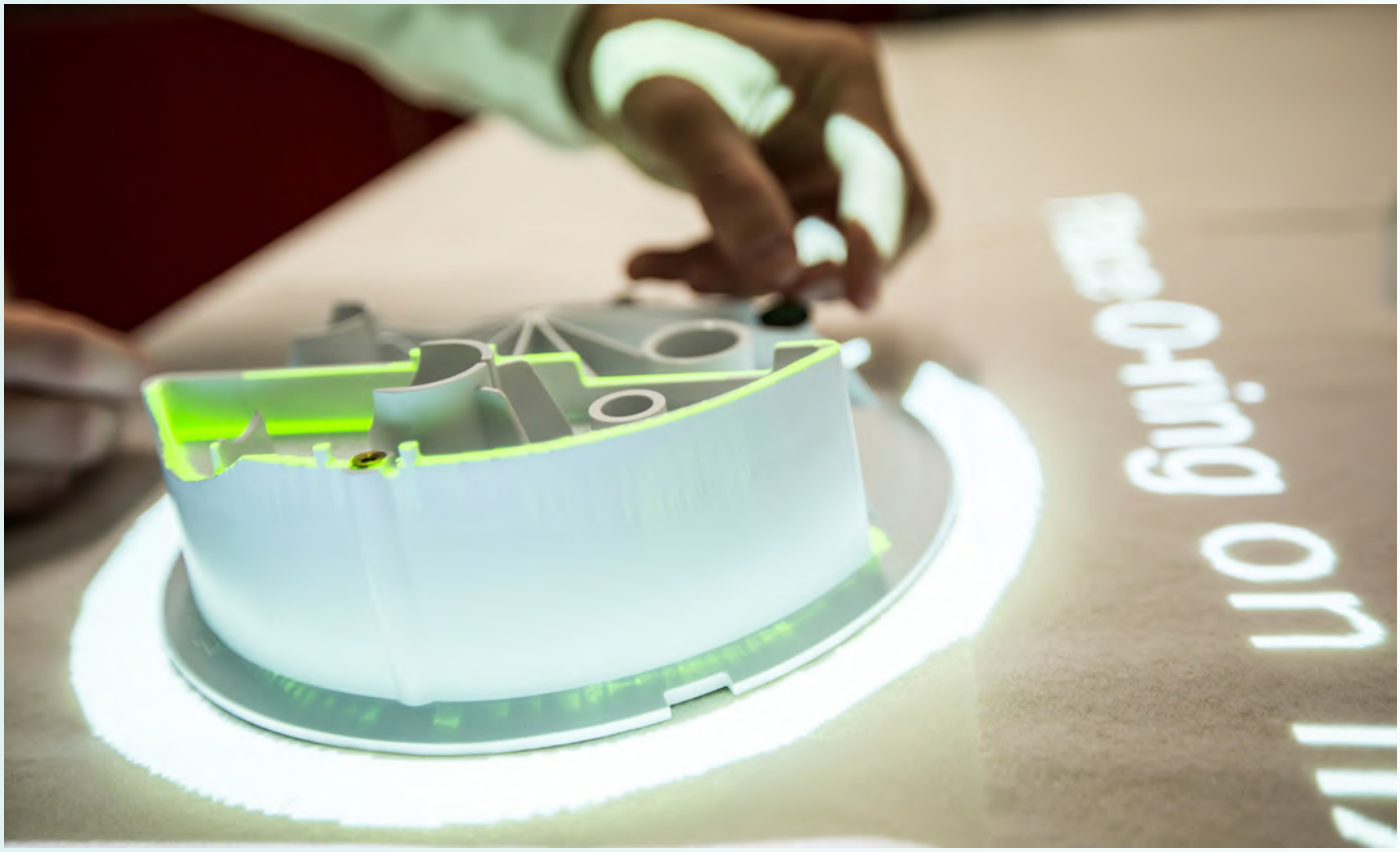
It is, of course, true that automation can and does replace certain tasks on the shop floor. For workers, that is not necessarily a bad thing either. A lot of manufacturing tasks are inherently repetitive and boring, and few would claim to enjoy carrying them out manually. Moreover, if a task is too burdensome, it increases the risk of burnout and accidents. By eliminating such tasks, workers can take on more creative, decision-based roles, such as optimising production lines or ensuring quality control.

Automation is undeniably the future of manufacturing, but its role is still widely misunderstood. Rather than replacing workers, automation offers numerous opportunities to enhance human aspects of manufacturing, thus increasing job satisfaction and making it possible to meet the challenges of scale in a constantly evolving market. ■

INDUSTRY 5.0:



HOW **LICHTWERK** AND **LIGHTGUIDEAR** PUT PEOPLE FIRST WITH TECHNOLOGY



The fourth industrial revolution (Industry 4.0), characterised by the increasing importance of digitalisation and technology at the core of production and production systems, is fundamentally changing the way manufacturing works. Digital technologies are helping manufacturing companies adapt to the increasing customer demand for smaller runs of increasingly complex products, more varied and personalised ranges, and higher quality requirements.

The emergence and integration of technologies such as artificial intelligence, Internet of Things, digital twinning, augmented and virtual reality, 3D printing, digital work instructions, personalised interfaces, and big data make companies feel the pressure to work radically differently, which is exacerbated by problems in the supply chain, labour market shortages, and the energy crisis. And all this at an unprecedentedly fast pace!

Due to the fast pace and unpredictability, there is a chance of losing sight of the human factor. That is why more and more companies are resolutely playing the card of Industry 5.0, in which smart collaboration between people and technology is the engine for sustainable growth and a resilient industry.

Lichtwerk makes complex work accessible

Based on a ‘Go Digital, Stay Human’ strategy and approach, Lichtwerk (www.lichtwerk.io) supports companies in the implementation of smart inclusive technologies, such as LightGuide Augmented Reality. Lichtwerk provides advice, infrastructure, and training. The innovative approach and solutions are applicable in all sectors, as permanent support or as training.

LightGuide Augmented Reality

Together with the American partner LightGuide (www.lightguidesys.com), Lichtwerk develops versatile projection-based Augmented Reality solutions for the manufacturing industry. Work instructions are projected step by step on the workstation by means of icons, photos, videos, pick-to-light methods ...

With pick-to-light, employees receive visual instructions for picking various components in different quantities. Numbers and locations are dynamically projected onto the work space.

Through vision systems and measuring devices, interactivity and feedback are built in. This increases the competencies of employees and leads to higher product quality, more flexibility and scalability. Untrained operators can learn new tasks faster and companies can guarantee quality up to 100%, even for the most complex assignments.

By using AR workstations and digital work instructions, companies are therefore achieving a double goal: they are taking steps in the field of digitisation and technological transformation (Industry 4.0), while at the same time strengthening their human capital (Industry 5.0).

The LightGuide platform integrates with numerous hardware and software solutions, including MES systems, PLCs, and peripherals such as coupling tools. The 'low-code' visual user interface also enables companies to draw up, adapt, and improve digital work instructions based on data and real-time analytics.

Impact study

Lichtwerk considers it important to be a partner in various research projects in order to promote the exchange of knowledge between industry, research centres, and academia.

A study conducted by the Catholic University of Leuven (Huang, 2018) in collaboration with Mariasteen, a Belgian Work Integration Social Enterprise (WISE) and important supplier to various Belgian, Dutch, and international production companies, shows that the well-being of employees increases through the use of LightGuideAR: operators experience less stress and complexity, and more autonomy and empowerment. The quality of the work they deliver is also higher: fewer mistakes are made and there is more 'quality by guidance'. Finally, the research finds that the technology also has a positive impact on productivity: the use of LightGuideAR increases the agility and efficiency of an entire department in a company. A similar study in the Netherlands (Bosch and van Rhijn, 2017) confirms the results of Huang (2018).

Versatile applications

In recent years, LightGuide has been used by numerous leading manufacturers in a large number of sectors, including automotive, aviation, electronics, food, the medical sector,

and the manufacturing industry. Wherever complex manual work can be found, the LightGuide system ensures immediate results on the factory floor.

Lichtwerk has also already implemented the technology at customers in various sectors and for very diverse and versatile applications. For example, the assembly of tram panels, an assignment from Hydro Extruded Solutions, is done with the help of interactive work instructions. The profiles are pressed in the factory in Harderwijk and are assembled by means of friction welding. They are milled and painted at an external party, after which the final assembly takes place with the support of the LightGuideAR platform.

The production of so-called bed beams for MedTech company Heyer also takes place with the help of the augmented reality solution. The bedside wall panels for hospitals provide electricity, alarms, data transfer, and diagnostics, and are often room- or department-specific. Thanks to the visual and interactive support of the LightGuideAR platform, the installation of the technical components is done by employees with a distance to the labour market and the quality is 100% guaranteed. For example, more than one thousand 'series of 1' bed beams have already been produced, including for hospital AZ Delta in Roeselare (Belgium).

The technology is not only used for permanent support, but also for training, up-skilling, and re-skilling employees. For example, the LightGuide technology ensures that shortly educated operators or employees with a distance to the labour market can (continue to) hold relevant positions in an increasingly digitising and automating production environment.

People-centric technology for a sustainable and resilient industry

People-centredness, like sustainability, is no longer an option, it is a necessity. Companies understand that creating sustainable products, services, and production systems is the new norm for survival in the manufacturing industry and come to the realisation that a people-centred approach to digitisation and technologization is crucial.■

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Lisa Messely,
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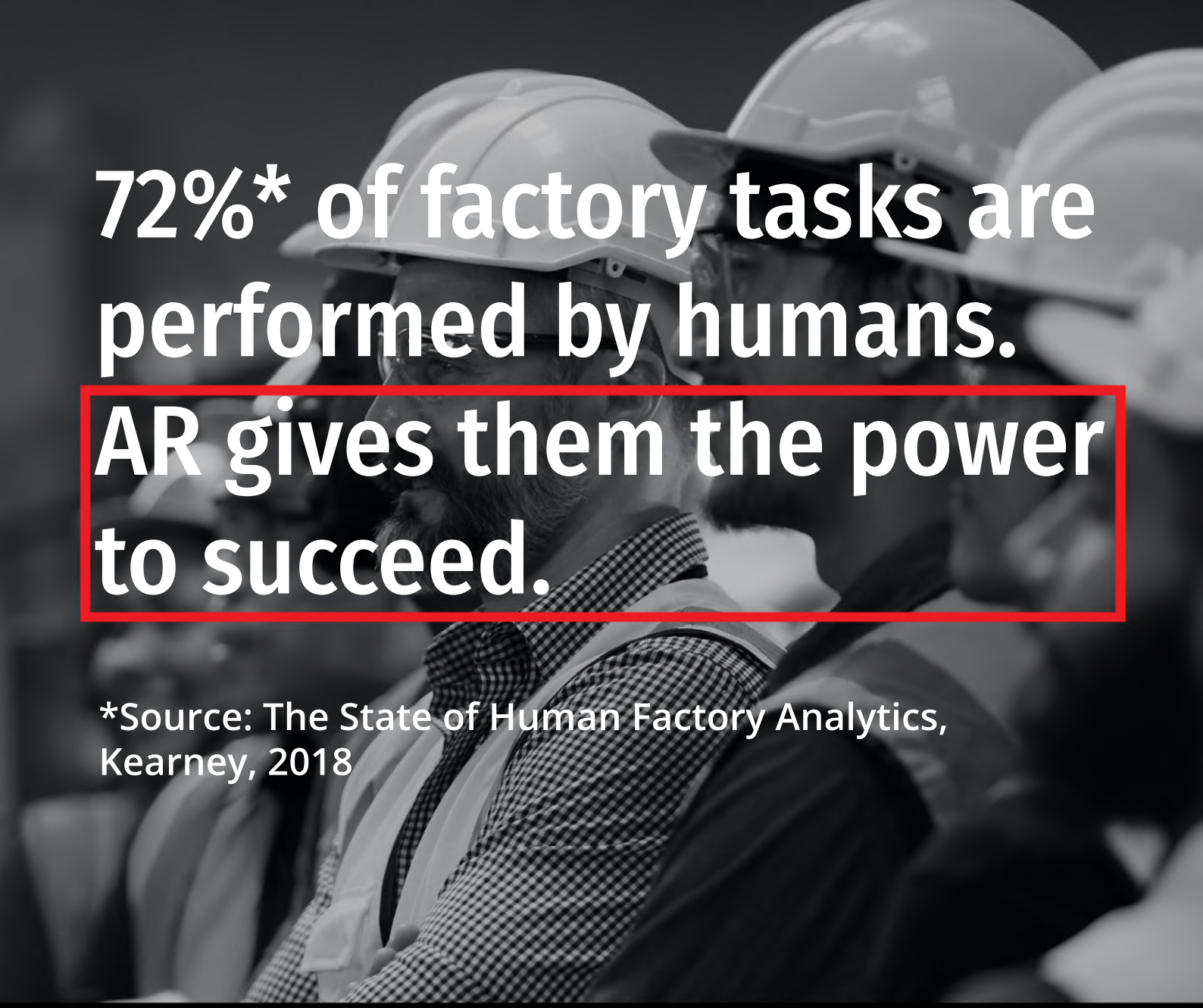


72%* of factory tasks are performed by humans. AR gives them the power to succeed.

*Source: The State of Human Factory Analytics, Kearney, 2018

LightGuide + LichtWerk

www.lightguidesys.com www.lichtwerk.io

LightGuide is the global leader in projected AR. The LightGuide AR software platform and solutions are deployed across more than 200 customers in more than 36 countries. Lichtwerk is the official LightGuide channel partner for Belgium, the Netherlands and neighboring countries.

DIVE IN TWENTE

The student team of Fraunhofer Innovation Platform for Advanced Manufacturing have undertaken a research project, proposed and financed by Gemeente Enschede, Twente Board, University of Twente, Fraunhofer Innovation Platform (FIP) and Keeping Talent in Twente (KTIT). It aims to explore the topic of diversity and inclusion in the workforce in the Twente area, focusing on manufacturing, engineering and software companies from the region. Members of the junior research team are Amalia Balan (Master Student of Communication Science) from Romania, Carithea Richard (Master Student of Industrial Design Engineering) originally from Jamaica, and Daria Lungu (Master Student of Business Administration) from Romania.

> **The demographics of participants told a clear story.**

The team of Dive in Twente.

Dive in Twente, as the project name suggests, required the research team to identify current diversity levels, measure the target group's attitudes and beliefs about social phenomena and most importantly, interactively devise best practices in how to inform, coach and persuade companies to increase their diversity and inclusion levels.

The objectives of the project were investigated by the main research question: "What are the differences in attitudes towards employment diversity of manufacturing companies in the Twente area in 2021- 2022?" This question was the driver of the study for over 9 months.

According to University of Twente statistics, during the 2021-22 period, over 12,000 talented young students commenced their studies within the educational institution, with 32% of them coming from abroad. It is relevant to mention that prior to this research, no scientific papers or studies had been conducted on the topics of diversity

and inclusion of the workforces of manufacturing, engineering, and software companies in the Twente area.

According to statistics, there is an increasing number of current local employees who are on the point of retiring. This has created a high demand for new, young employees to fill the vacancies left by retirees. What do regional companies do to facilitate the hiring of young talent? How do they expand industries and encourage the development of communities?

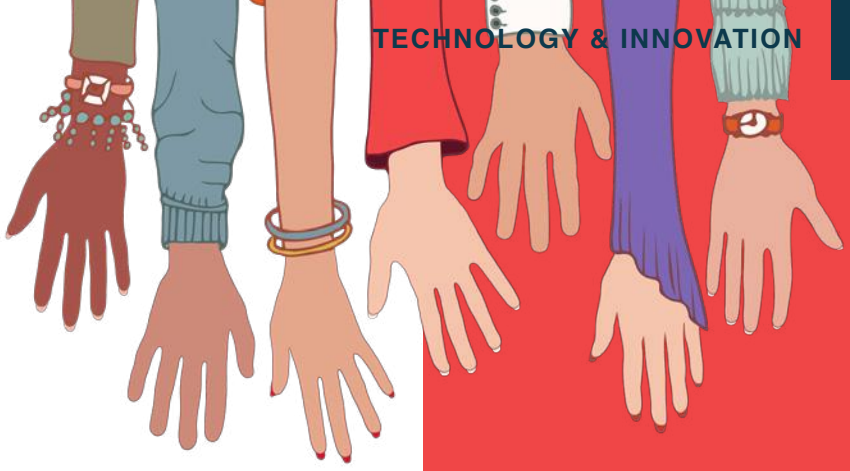
The ongoing transition to a more technological base within the industry comes with challenges that could, perhaps, be best addressed by a more youthful workforce, who are more tech savvy, more attuned to change, and because they are less set in the 'old way of doing things', are more adaptable.

Only 3.6% of the people who work in the Twente area have a different culture. Our research was able to shed light on current diversity readiness in local companies and devise a set of 'best practices' for each stage, with an emphasis on the challenges presented by the 'attraction' and 'retention' stages.

"The data indicates that 38% of the employees in manufacturing, engineering and software in Twente come from an international background."

The collecting of data for research purposes was conducted by the Research Team in two phases. Firstly, we compiled a list of all manufacturing, engineering and software companies in the Twente region, comprising 90 companies. In the first data collection phase, six companies were chosen at random, and were each invited to a forty-five minute interview. Our goal was to explore, in depth, each company's experience with diversity and inclusion, gathering as much information as we could elicit. Based on the data we collected and the resulting analysis, the research team created a template for the second data collection phase. This was in the form of a survey which aimed to collect opinions from the remaining companies, asking them about common aspects framed by participants in the interview session and also examine unique viewpoints. In total, over a third of the companies from the region took part in this research.

Key findings of the research indicate that manufacturing, engineering and software companies from the Twente region are reasonably diverse in many aspects and not at all diverse in others. Surprisingly, over 63% of the participants in the study claim that the main spoken language in their company is English, which is a solid indication that businesses are embracing international norms. It also exhibits a willingness to make foreign workers feel included in the work environment and facilitates an atmosphere of inclusiveness within teams. In this portion of the research, it appears the companies are diverse.



However, language was not the only focus of this study. Diversity is a broad topic and this research also focused on gender, ethnicity and age elements. The data indicates that 38% of the employees in manufacturing, engineering and software in Twente come from an international background. Additionally, the female representation in the manufacturing, engineering, and software companies from the region was 24%, and the male representation was registered to be 76%.

No company involved in this project had a Diversity Officer in their organization. To be more precise, when participants were asked, “Who is responsible for integrating international new hires?” in 30% of cases, the HR department was mentioned as taking the lead. Unfortunately, the second most common answer was ‘no-one’.

The demographics of participants told a clear story. Their job titles were CEO, Director, HR Managers. 19% of them are EU citizens, 81% are Dutch citizens and there was not even one participant from a non-EU country. Internationalization is represented only by EU citizens.

To sum up the findings; a considerable number of participants disagreed with the statement “My work-place is very diverse in terms of gender.” When asked their feelings on the statement, “My management team is diverse in terms of gender”, the most common answer was “I disagree.” When similar questions were asked about the international aspect of the management team, the answers again registered “disagree” as the most common response.

These findings were the basis for the final deliverables of this projects, specifically an academic paper, a board game, and a tool kit, designed to facilitate and trigger open discussion within regional companies, teaching them how to level up their current diversity levels. We have compiled the most interesting insights into our list of best practices which were unearthed by our study. These are included in a booklet especially designed to offer guidance for companies by informing them and coaching them to the most appropriate and practical solutions for their individual needs.

Dive in Twente is an invitation to get inspired, to enhance and improve your working culture by becoming a ‘local ambassador’ for our region. ■

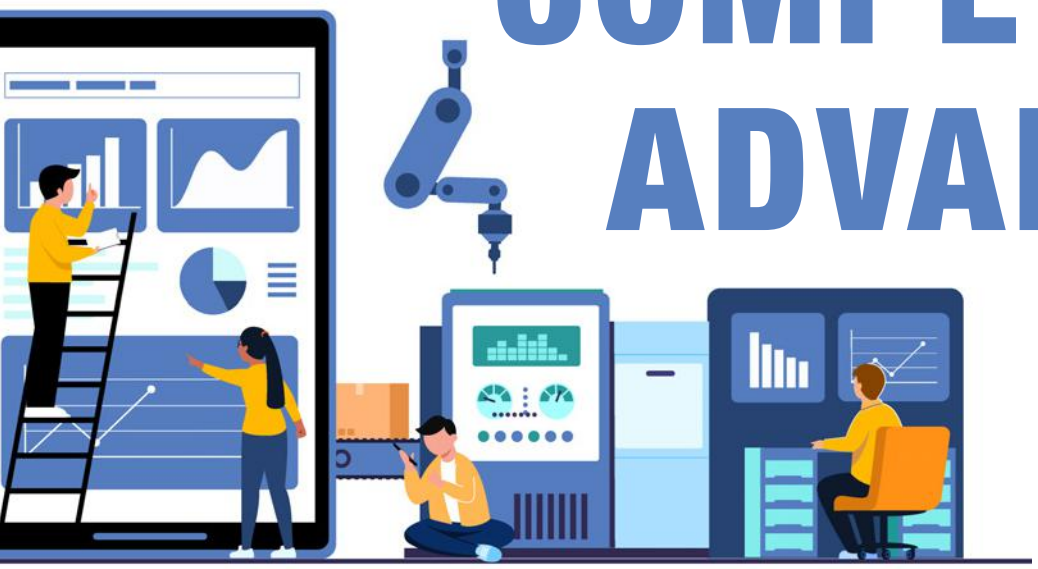
Author:

Amalia Balan
Junior Researcher for
Dive in Twente

“We are very pleased that we contributed to the DIVE study. The results are truly valuable, because it gives us insights in the workforce (arbeidsmarkt) of Twente. Now we know where can we put our joint effort to change it for the better. Also we are very happy that we can integrate the game in the pilot project about internationalisation.”

Linda van Asselt
Programme Manager talent

HUMANISED PRODUCTION WILL BE YOUR NEXT COMPETITIVE ADVANTAGE



Author:

Janet Xue
Research Scientist,
Fraunhofer Innovation Platform for Advanced Manufacturing at the University of Twente

When you think about optimising production processes, utilising digital technologies will be vital for connecting IIoT systems and drawing data insights by advanced data analytics or even machine learning. All companies are heading in this direction. However, what not all companies are aware of is - how to guarantee the ultimate success of their entire businesses by considering how humans use these machines or digital applications. Doing so empowers individual workers and therefore empowers companies. It is challenging to make human–machine teams work not only more efficiently but also more happily together. Here, I would like to share some thoughts on how humanised production will be your next competitive advantage. This short piece is based on our close watch of the industry as well as of five EU-funded Horizon 2020 research projects (A4BLUE, Factory2Fit, INCLUSIVE, HUMAN and MANUWORK, 2016–2020).

Yes, you are right. It will still take some time before the entire manufacturing industry fully embraces the 4th Industrial Revolution. Yet we are already headed into the 5th Industrial Revolution – using digital technologies to benefit people and society. To me, it is important to recognise that we cannot wait for Industry 4.0 to be fully implemented before we start to think about Industry 5.0. In fact, if you have recently embarked on digital transformation, then now you must think about converging Industry 5.0 with Industry 4.0. This means designing and operationalising three core elements: human-centricity, sustainability, and resilience in production processes and even in the business value model (I will explain in detail elsewhere). This will allow you to be flexible and adaptable in your future human-machine production processes toward a more sustainable society.

While offering humanised production that may make you a more attractive

working environment, what does this actually mean for you at your company? Digital transformation doesn't mean losing jobs; instead, it means creating more opportunities. Many employees may disagree, however. Myths abound that managers might neglect diverse employees before embracing digital technologies. Below, we identify these myths, and these are followed by some takeaway messages.

Myth No.1

Your team members are comfortable working with AI and cobots or making sense of data from dashboards.

No, they are not. Not all of them, not at the same level, and they might not all react comfortably to such developments. Often, the instinct is to suspect or reject these digital technologies – holding pen and paper still feels most reliable. However, to win back the time that is lost in copying information from the paper document to paper document or in printing orders, you must convince people to try out these new tools.

Emotional commitment

Convincing everyone on board is everything but a key start for digital transformation. Getting employees to recognise the true value of digital technologies by onboarding them at different speeds could massively improve production performance. Viewing technologies as competitors or replacements is common. Such instinctive resistance is not inherently related to age, but to mindset. It relates to how mentally ready to embrace such technologies an employee might be and how they view themselves using these technologies at more advanced stages. Map out the emotional commitment to understand these values that exist in your team and across your organisation. Identify the incentives that will help your employees to become willing to try these technologies and adapt their practices.

Myth No.2

Human workers can figure out for themselves naturally how to work with digital technologies.

The reality is that human employees are often not sure about their new roles and new expectations in such human–machine teams. New questions are often raised such as: where are you to locate human beings when humans and machines team up as colleagues? Helping employees to feel more relevant and that their contributions are valued on top of using machines. It is more than bringing human intelligence back into the loop. It is about augmenting human intelligence with digital technologies so that humans and machines can work together well within a new production norm.

Defining the roles of machines and humans

While managers often worry about how to make the most of human intelligence in human-machine teams, production managers must start paying attention to how the team members in their groups, those in marketing and sales, and even customers will react to such technologies. These processes release humans from repetitive work and empower them to be responsible for more valuable work such as reducing production incidents. Shopfloors never lack emergent moments that need human's thinking outside of the box. Human workers' years' experiences, intuition, and insights cannot be replaced by the analytical capabilities of AI applications. Imagine a situation in which shopfloor operators no longer need to worry about making mistakes when reading notes from the previous midnight shift. Using smartphones to receive notifications when needed can save time and energy. Imagine a production manager who can understand the matrix of machine downtime and so predictable on-demand supply will become manageable. Imagine a sales department that has access to live production data and can give promises to clients upon which they can deliver.

Myth No.3

Once human workers are upskilled, production performance will improve.

Human workers may need a long-term incentive to gain a strong sense of belonging. The new value they contribute needs to be recognised in the production process.

Empower humans by digital competence

It is essential to recognise the value that humans add to these new production processes. The growing value is variable and will be improved by the digital competence scheme. As mentioned earlier, mapping differing reactions to these technologies, the digital competence will take effect when they are customised accordingly. Systematic assessment of physical, cognitive, and psychosocial human factors will guide steps of personal progression along acquisition of digital skills. Approaches such as Operator 4.0 will help managers to understand the working situation and their employees' capacities within a new complex digital environment. For example, understanding profiles ranging from collocative operators to analytical operators helps managers to customise each employee's profile to their future training programme. Invite shopfloor operators to be part of decision-making teams and acknowledge their contributions. Other pilot experiments, such as the Factory2Fit project, aim to provide a dashboard for shopfloor operators to help them understand their well-being and work performance both between and during work shifts.

Investing in your employees will enable them to work happily and attract future talent. Through this, employees will become motivated, driven and on a mission to learn new skills they need in the future. Digital transformation can benefit individual employees in this way where the company eventually flourishes. ■

THE *SYNERGY* BETWEEN

HUMAN & MACHINE

THE USE OF NEW TECHNOLOGIES CAN MAKE THEIR HUMAN OPERATORS MORE EFFICIENT, DECISIVE, AND PERHAPS EVEN SMARTER. **BUT IT IS ALSO HUMANS WHO CAN TAKE TECHNOLOGY TO THE NEXT LEVEL THROUGH SMART APPLICATIONS.** THIS IS A LEVERAGING EFFECT THAT OFFERS ENORMOUS POTENTIAL IN THE MANUFACTURING INDUSTRY, PROVIDING REASON FOR THE INNOVATION CENTRE PERRON038 IN ZWOLLE TO INVEST HEAVILY IN MAN AND MACHINES.

Students working with a robot at Perron038. Photo: Perron038

> **Getting inspired, learning, and actually testing, in a factory of the future.**

If companies work together on developments with new technology, this leveraging effect is even stronger. Perron038, the innovation centre in Zwolle, works from this starting point. With 21 partners from the region, in the former NS building they work with and learn from the latest technology for the manufacturing industry. This initiative is growing and is preparing for the next step: the construction of a state-of-the-art facility that SMEs and students from the region can make use of. Getting inspired, learning, and actually testing, in a factory of the future.

From theory to best practices

At Perron038, companies, students, and teachers work with a large range of technologies. The starting point for a project is always a problem statement coming from a business. Partners such as Windesheim (research groups Industrial Automation and Robotics and Plastics Technology) and the Fraunhofer Innovation Platform for Advanced Manufacturing at the University of Twente (FIP-AM@UT) approach issues from a (scientific) research perspective. The Perron038 associated companies contribute knowledge and best practices. In the three years since the start of the initiative, successful use cases, demonstrators, and teaching materials have been developed. “The knowledge gained is shared among the partners and companies from the region during events. A formula that works and is valuable, but it’s time for the next step,” says Piet Mosterd, board member of the Perron038 Foundation and Director External Affairs at AWL-Techniek.

Physical factory as the next step

That step is the construction of a physical production facility, consisting of five different labs focusing on a specific technology. Project manager Marco van Wijngaarden explains: “Think, for example, of additive manufacturing, robotics & logistics, and vision technology. The labs are part of an integrated, data-driven factory concept. That is exactly what makes this innovation facility unique.” Van Wijngaarden is involved in the project through his role as Consultant Smart Industry at Hollander Techniek. In the

lab, every company can work on their own problem or research question. This can be for different objectives: for research, to test, or to gain knowledge and inspiration. The interaction between man and machine is one of the important focus points within the project. That is why, in addition to the wide range of physical possibilities in the factory, training courses at different levels around the five focal themes are being developed within the Perron038 Academy.

With this concept, Perron038 is able to help the manufacturing industry in the (Eastern) Netherlands to answer their digitisation or other specific questions, by means of demonstrations, workshops, and specific training courses. To this end, cooperation and connection is sought with other initiatives, such as the FIP-AM@UT. An important aspect is that the facility is also available to students, and research and educational institutions.

European subsidy

This facility requires a substantial investment. For part of this investment, in 2021 Perron038 applied for a subsidy (REACT-EU). In response to the Covid-19 pandemic, the European Social Fund made money available to accelerate the digital transition at companies. Perron038's application is one of the 47 projects awarded funding in the east of the Netherlands. The remaining part of the investment comes from Perron038 itself and its affiliated partners.

Actually getting to work

With several machine builders as partners, the first step – forming a project team – was quickly taken. They are currently developing a plan for the layout of the factory and the specific machine choices. Project manager Marco: "We are, however, involving more companies. This facility is built for a broad range of SMEs in the region. Therefore, we asked 50 companies in the manufacturing industry which technology is important to them and how they would like to use the facility. We take their responses into account for our plans."

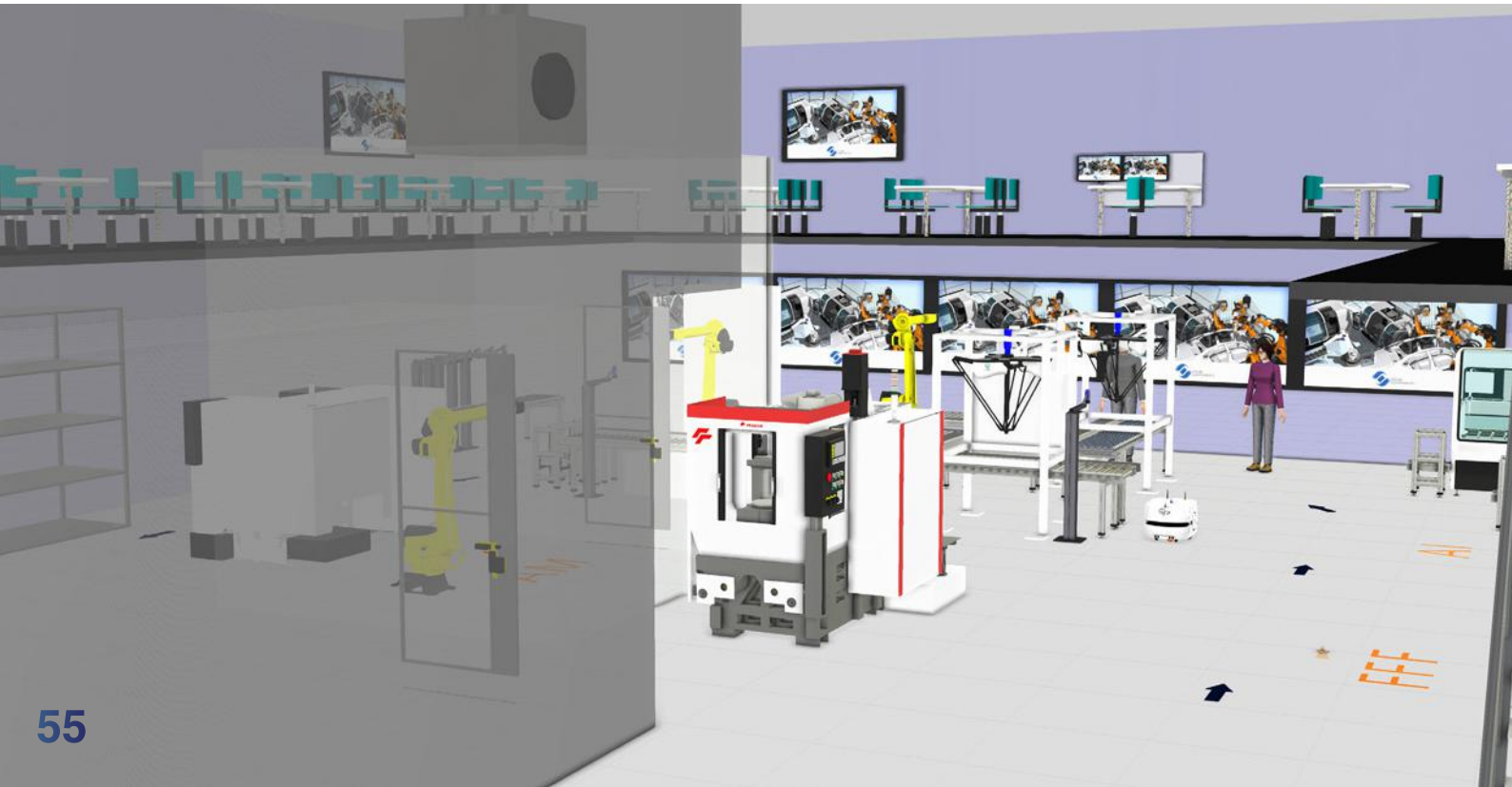
Wilbert van de Ridder, R&D Engineer at AWL-Techniek, is one of the people involved and responsible for the robotics & logistics lab. "In this lab, we want to develop a set-up in which companies can actually work on an assembly issue. For example, we start with a case of Zehnder from Zwolle. We are investigating possible solutions to automate their highly lean optimised, but manual assembly process. We develop and test possible solutions, but also gain insight into further implications for the process, the product, and the company. And, very important is also the impact on the people within the organisation. This offers an excellent opportunity to make man and machine work better together and learn from each other."

Preparations for the factory of the future in Zwolle are in full swing. Construction will start in 2023 and the project group has the ambition to have the factory up and running in the second half of the year. ■

Author:

Anne Raaijmakers-de Vos
Project leader Marketing & Communication, Perron038

A first rough draft of the facility that Perron038 hopes to realise in 2023. Image: Perron038



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Steps of an audit:

1. **Industry 4.0 Quick Scan**
   A brief investigation to develop an understanding of your specific needs, goals, and expected challenges to scope a tailored audit approach.
2. **Current State Analysis**
   Receive an expert breakdown of your current processes and Industry 4.0 competencies.
3. **Benchmark & Gap Analysis**
   Identify your competitive environment, your position within the industry, and potential gaps.
4. **Road Map Development**
   Create a custom implementation and action plan based on your vision and goals.
5. **Follow Up Support**
   If desired, implementation support and workshops are available.

The 4th **Industrial Revolution** isn't 'on its way' - **it's already here.**

Want to **stay ahead of the curve** & **solve tomorrow's problems** before they occur?

An Industry 4.0 Audit can help.

- Road Map Development
- Understand (and unlock) your full potential
- Explore new digital transformation opportunities
- Identify operational gaps and weaknesses
- Adopt new technology before your competitors
- Create a custom blueprint for continued success

Ready to get started? Call +31 (0)53 489 1818 to
schedule your FREE, no-obligation Industry 4.0 Quick Scan today.

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