September 2021

EU Tech Chamber White Paper
Advanced Manufacturing Council

10 KEY RECOMMENDATIONS FOR EUROPEAN MANUFACTURERS

European Technology Chamber
eutec.org

EXECUTIVE SUMMARY

Technology and innovation have advanced enormously in the last decades. The advancement of automation and digitalization capabilities further driven by the advancement of the internet, communication technologies, computing and data science have caused a fourth wave of disruption to the manufacturing industry.

This disruption gave birth to the fourth industrial revolution widely known as Industry 4.0, which is changing manufacturing to become an advanced industry. Advanced technologies that make the trend Industry 4.0 are considered as the transforming force that enables this transition.

However, successful adoption of Industry 4.0 and the integration of advanced technologies in manufacturing are important because it results in operation technologies, information technologies, people and data to be connected along the entire manufacturing process.

This transformation is offering opportunities to the manufacturing industry to improve its products, processes and procedures, asset performance, customer experience and workforce engagement. It brings more resilience and flexibility to meet the challenges of this decade associated with sustainability, remaining competitive and making employment experience more attractive comparable to other industries.

To foster a competitive Europe to compete with the rest of the world and stay competitive, they need to transform into an advanced manufacturing nation.

Creating a culture of collaboration and education, establishing networks of expertise and frameworks to support successful adoption especially amongst SME's and sharing knowledge on the applications of advanced technologies in manufacturing and the gains achieved are important for rapid transformation.

This paper presents ten recommendations for the European manufacturing industry to improve the advanced manufacturing sector and to create products that make Europe's position more competitive.

European Technology Chamber

With great technology comes great responsibility.

Technology Obliges!

The European Technology Chamber is a registered NGO, which enables European businesses to use their technologies for the benefit of Europe and mankind. The EUTEC Chamber has three major goals and believes that technology is the answer to reach those.

Competitiveness

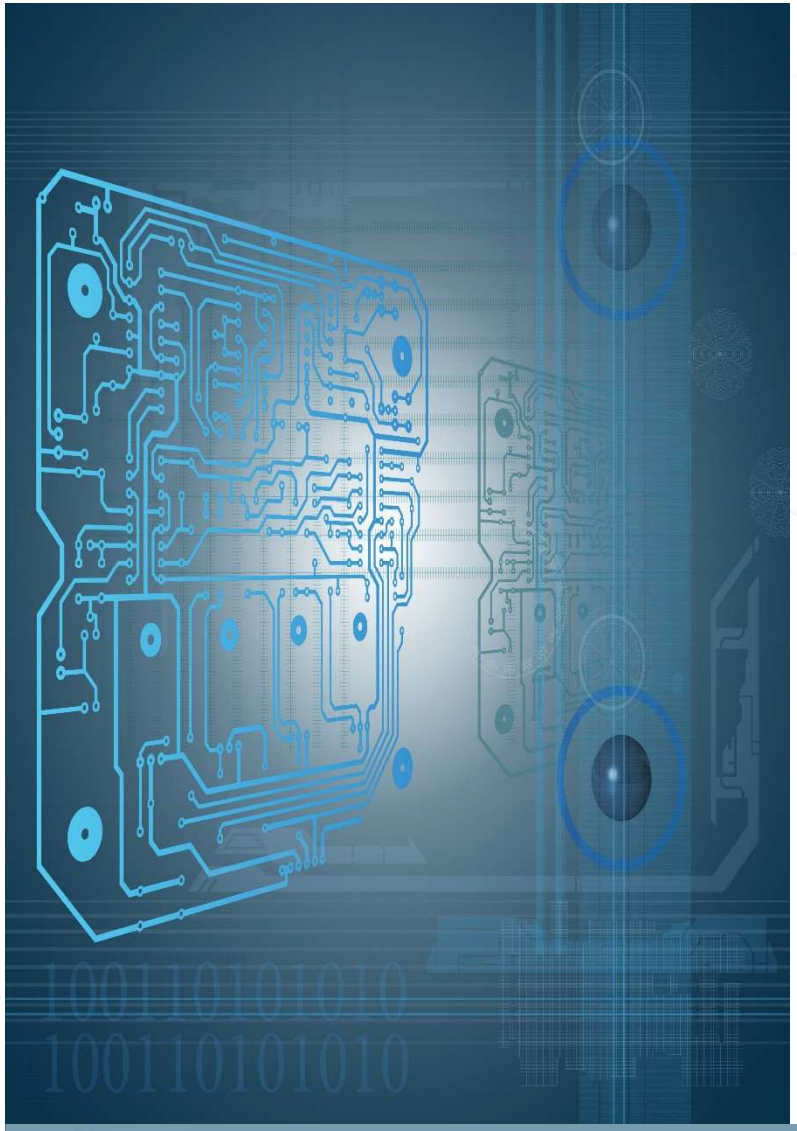
Strengthen Europe's competitiveness and transformation capabilities in its Global positioning

Sustainability

Leverage innovation, key technologies and business opportunities to achieve 17 UNSDGs

Growth

Build bridges to international markets and establish partnership for an inclusive growth



About Advanced Manufacturing Council

Expose European Manufacturers to innovative, sustainable, and efficient ways to produce goods, demonstrating how important digitalization is for the manufacturing sector and encouraging them to grow their business expanding existing and joining other markets.

EU Tech Chamber Advanced Manufacturing Council main goal is to increase competitiveness between European manufacturers to be able to build excellent products whose quality standards are the same or even better than the ones produced in other markets.
We also believe that the only possible way to scale productions with high quality standards is to implement clean and environmental tools and technologies.
Expansion of European Manufacturers is also one of EU Tech Chamber main goals, being able to compete, learn and bring innovation and quality products to other markets.

Expose

Demonstrate

Impact & Inspire

METHODOLOGY

EU Tech Chamber White Paper

An EUTECH White Paper serves as an informational document to share knowledge, foster exchange and collaboration, and create value for our advocates and the larger EUTECH community from society to businesses, from industry professionals to technological innovators.

Sharing technology-driven solutions and methods to help solve some of our most challenging questions on how we can improve our lives, providing insights from engineers, experts, and researchers.

A White Paper is carefully curated in collaboration with EUTECH advocates, supporters and contributors who share EUTECH's vision and values and is published by ETUECH Sections for educational and knowledge sharing purposes.

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10 RECOMMENDATIONS FOR EUROPEAN MANUFACTURERS

10 RECOMMENDATIONS FOR EUROPE

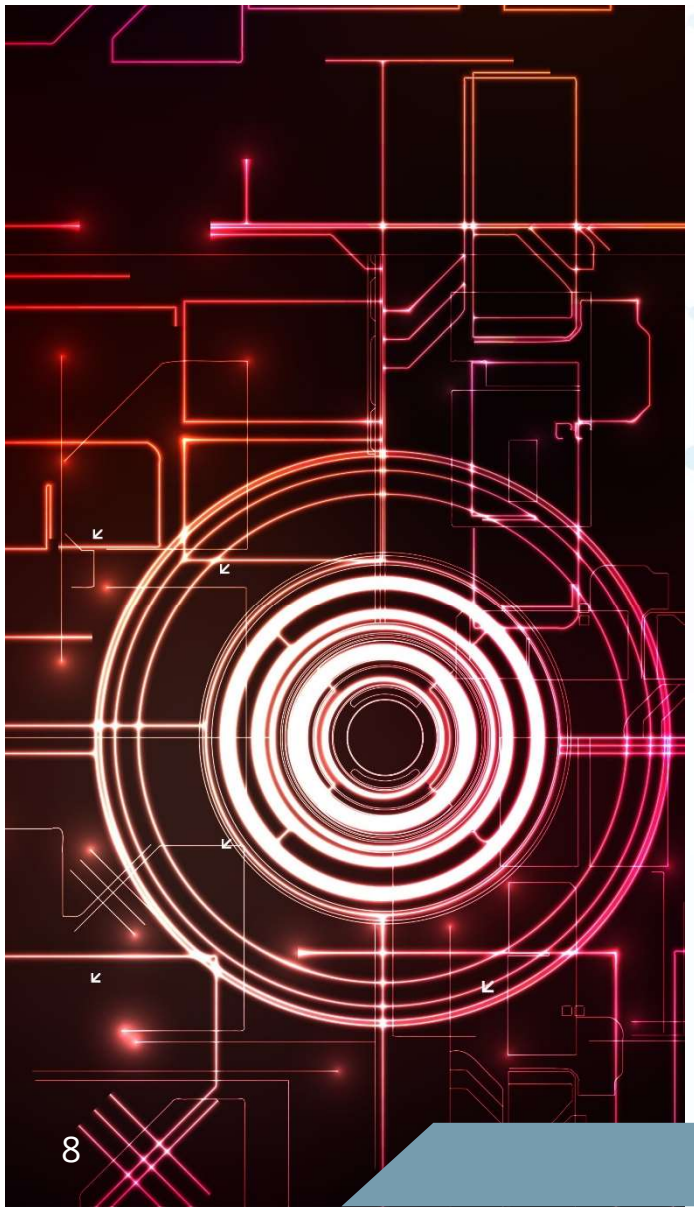
1. Create an open-minded and cooperative environment for all participating people across the industries: create and make accessible regular educational content via massive open online courses (MOOC) platforms. Drive an educational culture in all companies - even incentivize to learn and develop. Induce digital hubs into the countries, to become replicators, coaches and innovation labs especially for SME type customers. Use Public/Private Partnerships (PPP) for innovation especially between universities with focus on Industry4.0 related engineering/technology.

2. Drive EU and national initiatives and make them better known to the industry: orchestrate and create a network of experienced people to help especially the SME'S. There is so much financial power available, but it needs to be distributed differentially. Use existing infrastructures of engagement for companies like national Chambers and organizations to scale out knowledge, financial support and first level navigational support to get started.

3. Collaborate with the industry organizations and standard bodies: Create better interlock between nations engineering and IT groups. (Germany: VDMA / BITKOM). Sponsor and support events with firms, PPP's, startups etc. to show the benefits of innovation, Industry4.0 and market trends.

4. Create Industry4.0/technology framework for successful Industry 4.0 engagements: Work together with successful system integrators like IBM, Cap Gemini, Accenture and also smaller integrators. All of them have created methodologies and groups of experts to drive innovation and Industry4.0 projects. Learn from positive examples and share lessons learned .

5. Share knowledge about the applicable technologies available today: IoT platforms, Artificial Intelligence and Bigdata as well as Robotics, Digital Engineering etc. Universities can help here, but also good cooperation with major cloud providers AWS, Microsoft, Google, IBM , Chinese platforms or local platforms dependent on the country need to be established.



10 RECOMMENDATIONS FOR EUROPE

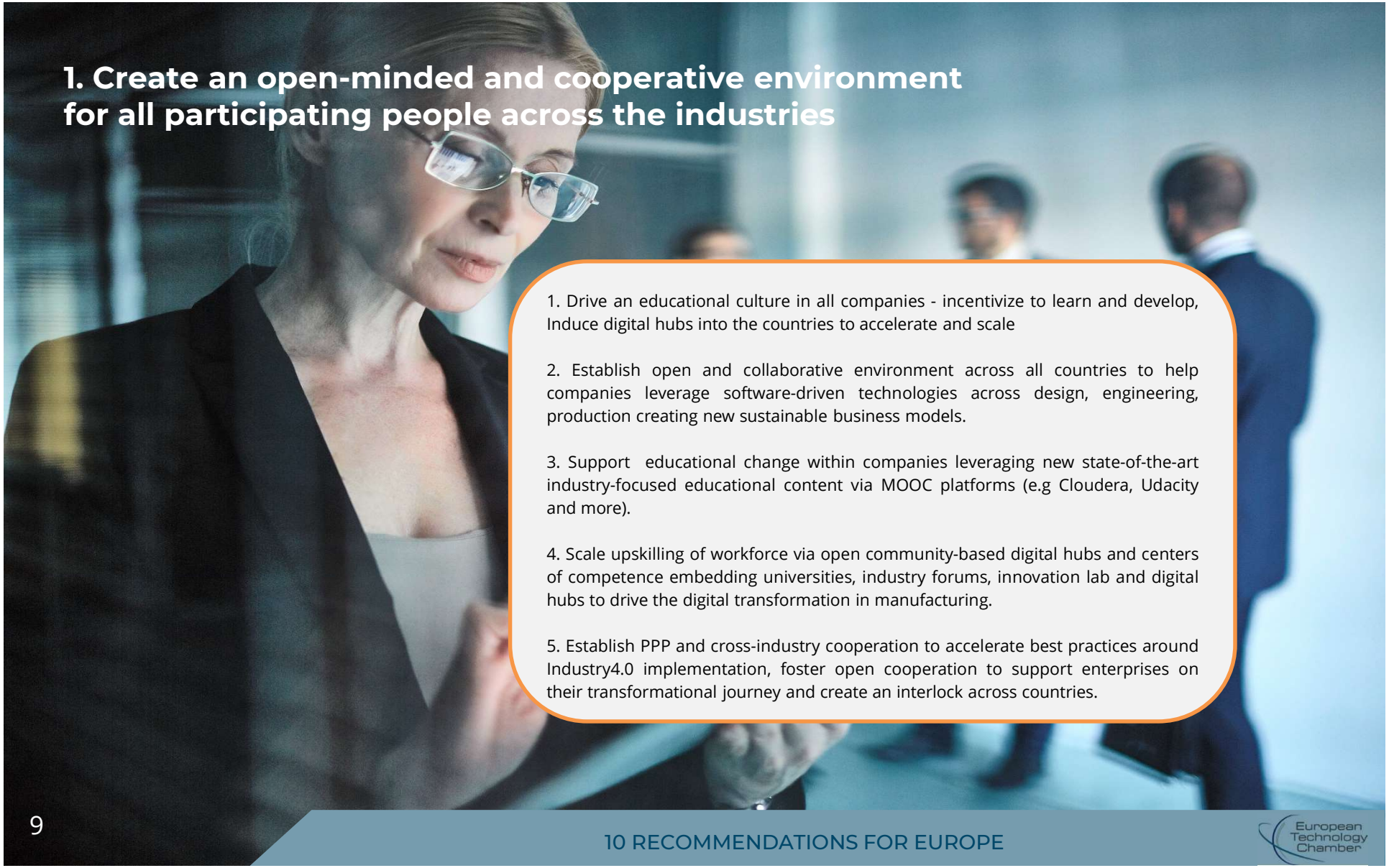
6. Mass personalization/customization realized without waste: Batch size one realized through machine-to-machine and machine-to-product connectivity. Output quality from one machine is input quality to next operation.

7. Processes reinvented through advanced analytics: Advanced analytics enable shift from detect to predict, to go from sorting quality to produce quality. Continuously analyze machines and equipment to move from reactive to predicted maintenance and to have machine learning as an integrated part.

8. New and Advanced production Technologies and methods: Additive manufacturing with integrated and accelerated manufacturing technologies.

9. Human machine interaction: Sensors and Virtual/analytical tools to support Industrial automation via Digital performance management. The key is to provide the right information to the right people at the right time and the right place. This will enable and empower the operation to take on key responsibilities.

10. Integrated digital Logistic systems: Seamless information flow from cradle to grave with customer service in focus.



1. Create an open-minded and cooperative environment for all participating people across the industries

1. Drive an educational culture in all companies - incentivize to learn and develop, Induce digital hubs into the countries to accelerate and scale

2. Establish open and collaborative environment across all countries to help companies leverage software-driven technologies across design, engineering, production creating new sustainable business models.

3. Support educational change within companies leveraging new state-of-the-art industry-focused educational content via MOOC platforms (e.g Cloudera, Udacity and more).

4. Scale upskilling of workforce via open community-based digital hubs and centers of competence embedding universities, industry forums, innovation lab and digital hubs to drive the digital transformation in manufacturing.

5. Establish PPP and cross-industry cooperation to accelerate best practices around Industry4.0 implementation, foster open cooperation to support enterprises on their transformational journey and create an interlock across countries.

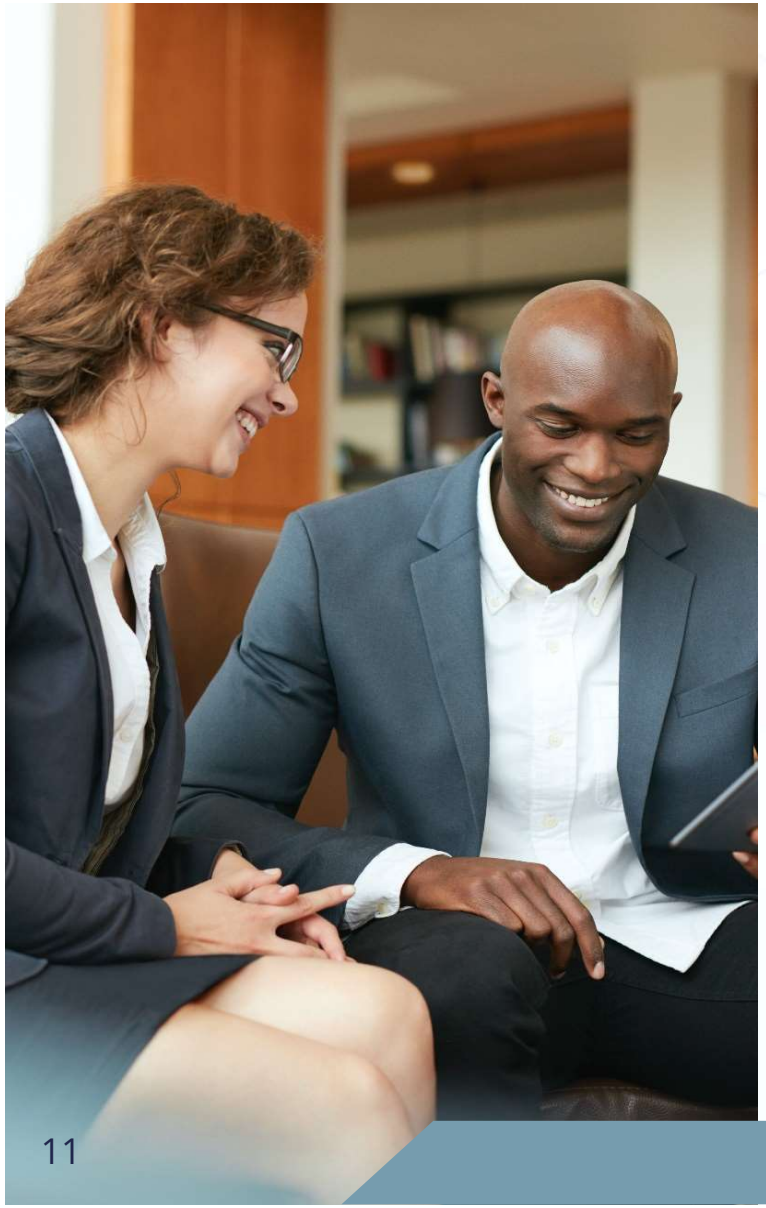
2. Drive EU and national initiatives and make them better known to the industry

1. Orchestrate the usage and adoption of EU and national financial and technical resources with a network of experienced people to help especially the SME's.

2. Provide excellency in funding , experience exchange and focused upskilling programmes and services to establish access for manufacturing countries of across the EU and on a country level.

3. Leveraging EU initiatives like Made in Europe / Factories of the Future, the possibilities of the European Green Deal and the European Partnership programmes to accelerate the further development of advanced manufacturing industries and enterprises and the creation of startup ecosystems.

4. Adopt a country-based example like the "Fraunhofer Competence Field Additive Manufacturing" to scale out knowledge, financial support and first level navigational support to get started.



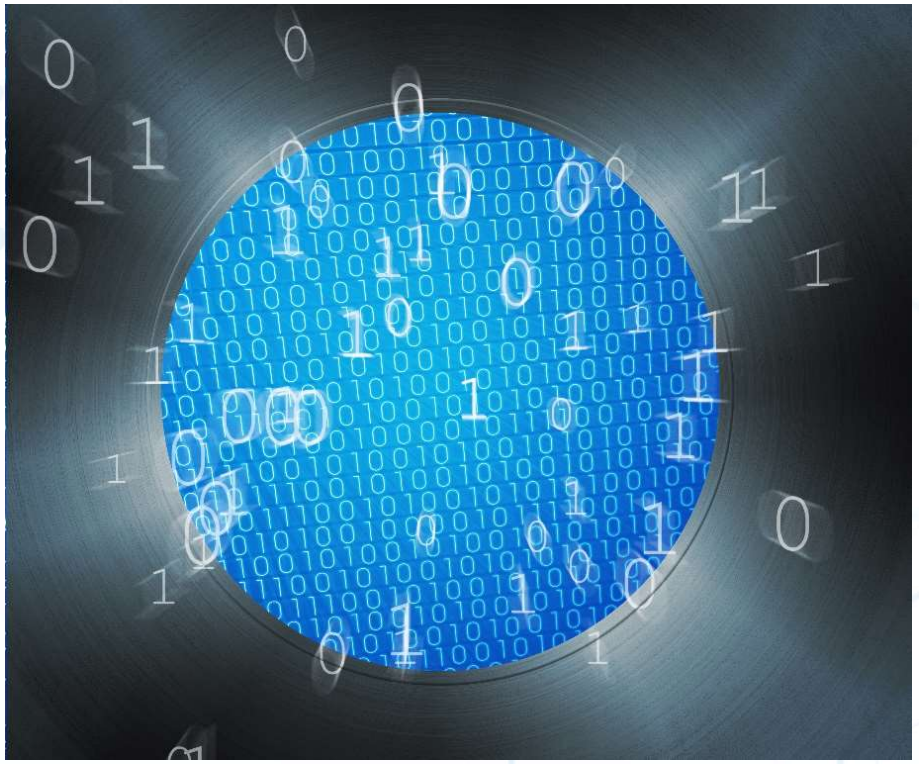
3. Collaborate with the industry organizations and standard bodies

Create better interlock between nations engineering and IT groups. (Germany: VDMA / BITKOM). Sponsor and support events with firms, PPP's, startups etc. to show the beneficial things of innovation, industry4.0 and also market trends.

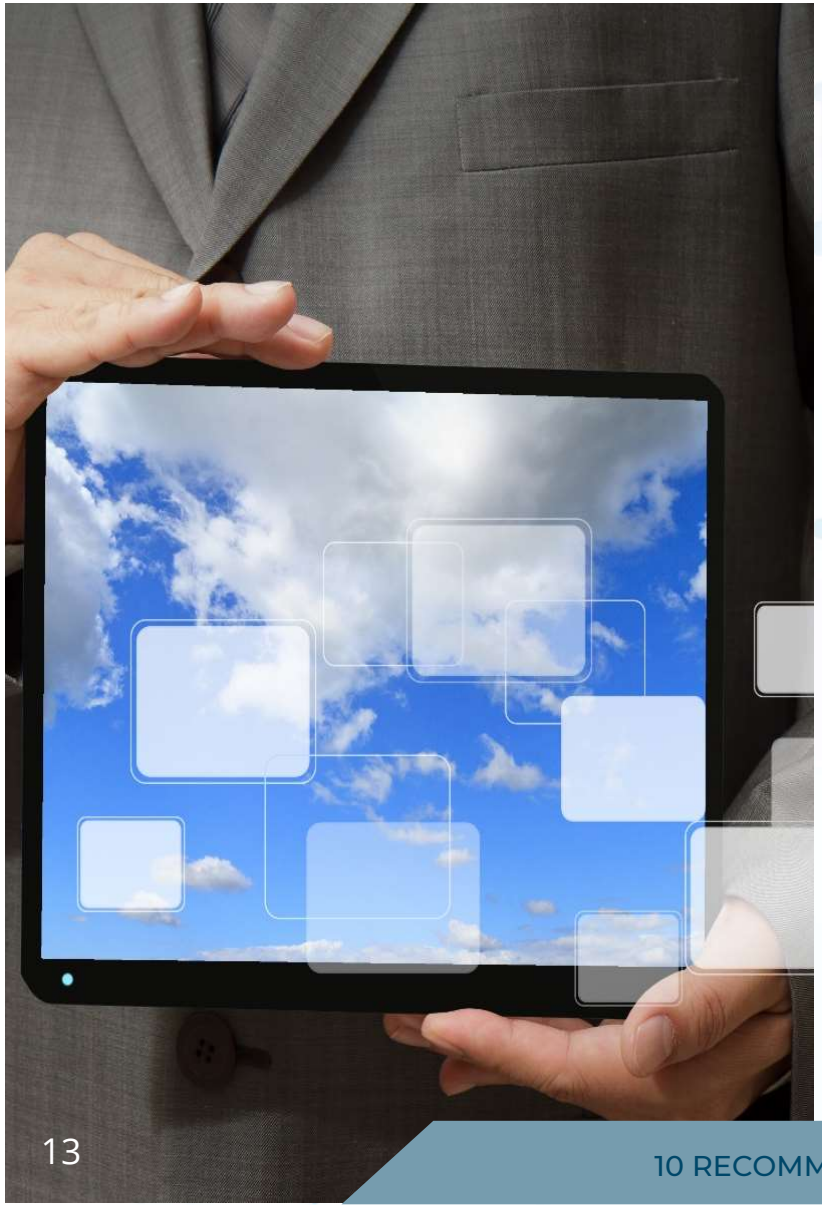
- Industries function most effectively when standards are in place to guide manufacturers, define interfaces and protect customers / consumers.
- Various bodies and organization are working to create these standards, they need to be completed and rolled out well to have a positive impact.
- Standards need to be aligned regionally (country & EU) and globally (US and RoW).
- Industries across different segments need to be integrated: mechanical, chemical, electrical, electronic, manufacturing, etc.
- Standards need to address application specific requirements, including qualification & certification: medical, space, aviation, automotive, industrial, defense, etc.

4. Create industry4.0/technology framework for successful Industry 4.0 engagements

Adopting proven industry4.0 patterns, establishing new procedures across the whole lifecycle of products from design, engineering to production at scale needs the management of change, new skills and cross-industry experience.



- Reuse and apply knowledge of experienced local up to global consulting partners helps accelerating the introduction of industry4.0 scenarios, establishing new data and software-driven capabilities within the end-to-end processes of manufacturing companies and sites.
- Learn from and adopt technology frameworks of proven Industry4.0 deployments reduces the risk of adoption and accelerates the transformation to an advanced manufacturing enterprise.
- Evaluate and adopt frameworks for faster time to market and gaining best practices, get access to industry experts to drive forward the transformation into an open, advanced and agile enterprise.



5. Share knowledge about the applicable technologies available today

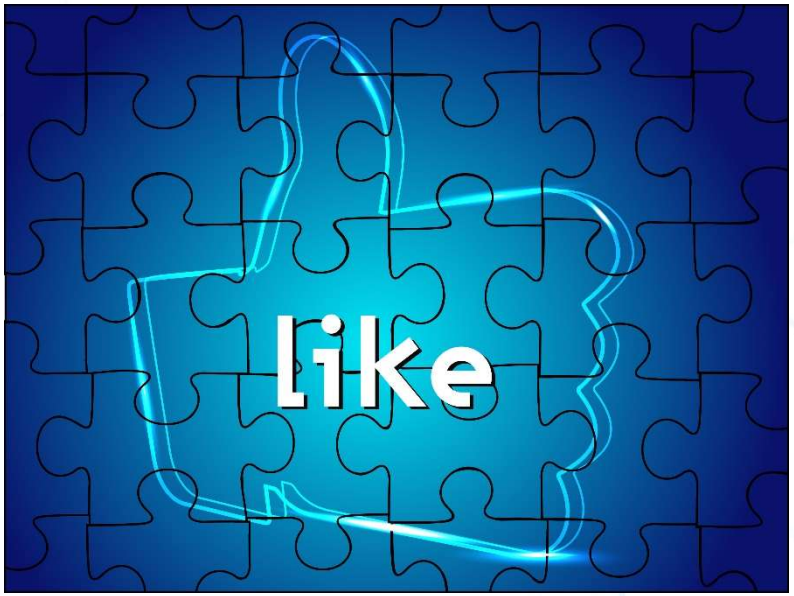
Europe is facing many different challenges related to a transformation of an industrial society into a knowledge-based society which is on the EU Agenda for roughly already two decades. The challenges are in the implementation and the use of new technologies which are actually not completely new, but differently assembled to a bigger picture by sub-summarizing them more globally as IoT, Big Data, Cloud Computing, Digitization, Artificial Intelligence, Digital Learning, and so on.

- Although the purely technological developments are already on a high level in many companies in Europe and worldwide, companies still struggle in their implementation to foster a more sophisticated use of those technologies.
- This requires a profound understanding of the technology basis, the creation and processing of data and their evaluation, and a social corporate responsibility.
- The transfer of knowledge is one of the keys to create an acceptance of technologies within the companies, but also within the communities. This is part of the Corporate Social Responsibility, and it requires an understanding on how to communicate even complicated and uncomfortable issues, for example in the case of data generation, data mining, and data protection.
- It is part of a continuous and long-term learning curve on how to educate companies employees and the broader public, which will result in a better acceptance of technologies and in a decrease in resistance against new technologies. Sharing of knowledge should be provided in a safe and ethically with integrity way to allow techies and non-techies to understand what is going on and how to use technologies for a better good.
- This naturally will result in sustainable and worthy business development.

6. Mass personalization/customization realized without waste

Batch size one realized through machine-to-machine and machine-to-product connectivity. Output quality from one machine is input quality to next operation.

- AM is a technology that offers the promise of mass customization if various requirements can be met.
- Secure business portals for ordering customized parts that are linked to production facilities, that include delivery and payment.
- Efficient CAD-CAM process to combine customer orders into AM nested build files that ensure suitable cost per part and build quality.
- Production systems must be able to process custom products and batches through different production workflows efficiently and fast, keeping track of customized products throughout the process.



- AM factories must deliver market acceptable cost per part and quality with customized parts and changing workflows.
- Distributed manufacture would be a strong benefit with global order and local production.

7. Processes reinvented through advanced ana

Advanced analytics enable shift from detect to predict, to go from sorting quality to produce quality. Continuously analyze machines and equipment to move from reactive to predicted maintenance and to have machine learning as an integrated part.

- Advanced analytics need to understand the root causes, monitor the symptoms, estimate the health, predict the future outcome and propose a suitable action or control change. This can be for the machine, the part, and the production line.

- The aim should be for a digital twin that simulates the physical system, is constantly tuned to the physical system and can be used to predict the future behavior of the physical system because then suitable corrective actions can be taken timeously.
- Predictive maintenance exists for conventional manufacture but there is some way to go to achieve the same level in AM.

- AM part quality depends on the powder, the process, the machine, the operator, the post processing, and may other factors. All these need to be monitored (including new monitoring and sensors) , the data needs to be combined and tools are required to predictively control the manufacturing process to achieve the highest possible quality level.

8. New and Advanced production Technologies and methods

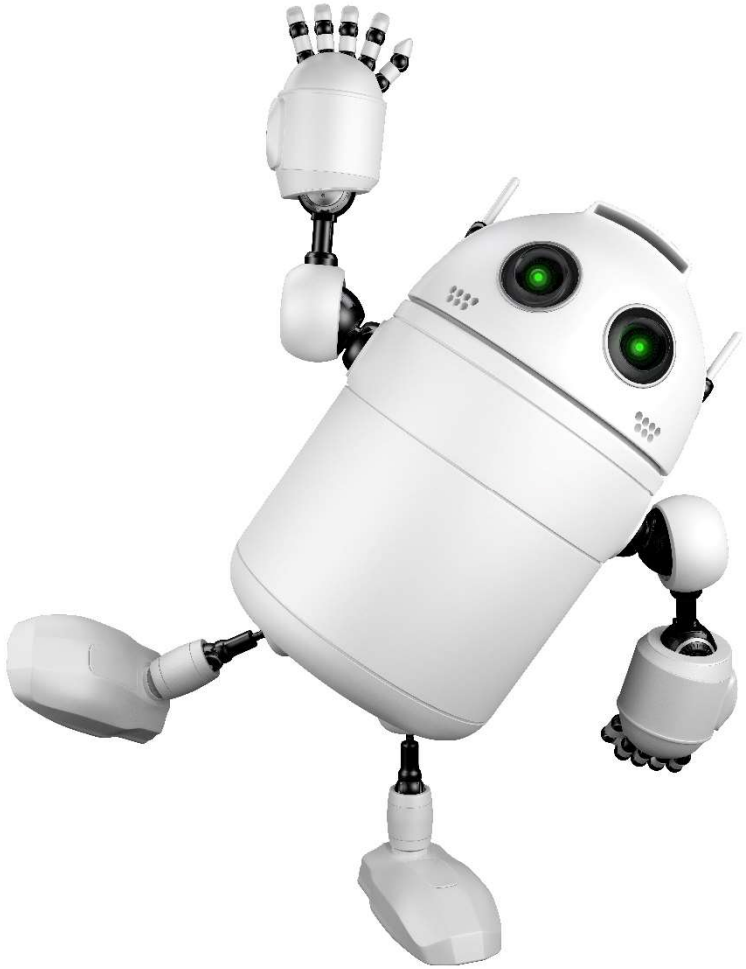
Additive manufacturing with integrated and accelerated manufacturing technologies.

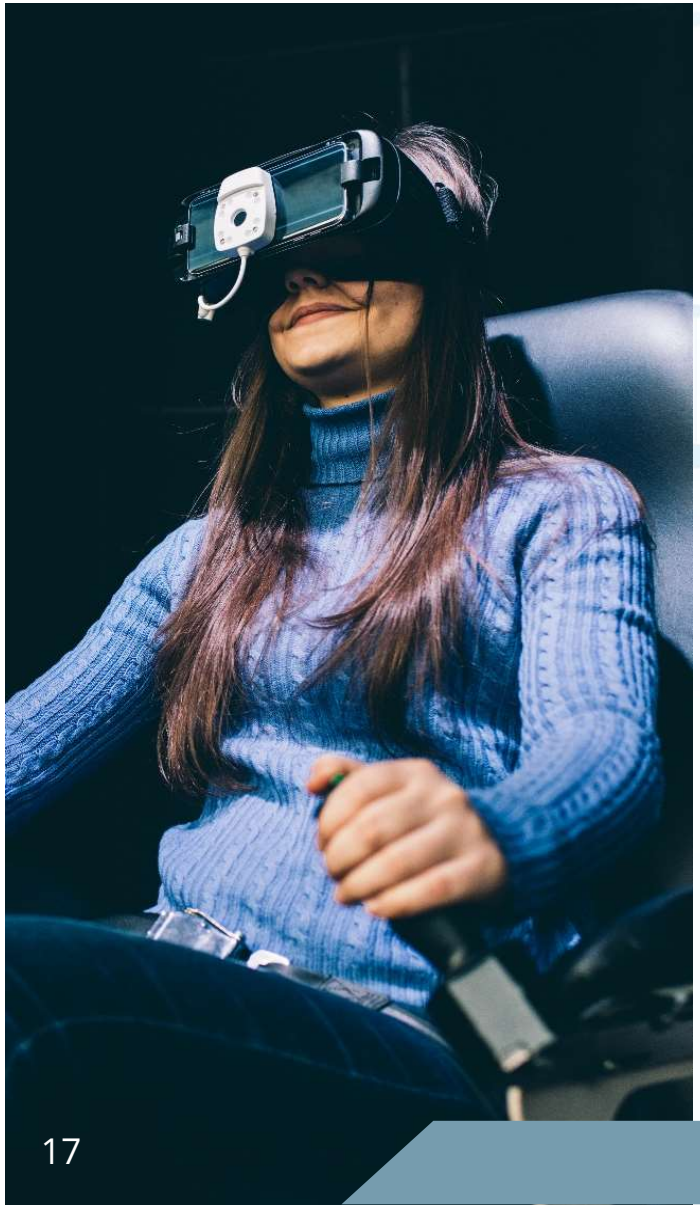
- For sustainable success as a manufacturing technology AM needs to be able to offer cost per part in the range of established technologies e.g. milling, injection molding. One of the strongest levers for lower CPP is high productivity i.e. high build speed of the AM-system, which has to be enabled by e.g. novel light engines, recoating systems, control systems or all of those in combination.

- The automation that has become standard in subtractive manufacture must be applied in AM to minimize cost per part (total cost of operation), and maximize revenue for AM manufacturers.

- Successful AM is more than just the printer, advanced technology periphery equipment must also be established to ensure success of AM, such as automated powder handling systems, automated unpacking, part handling systems, post-processing systems, etc.

- AM can normally meet product material requirements but as sustainability becomes more important, lower carbon footprint production is needed including renewable source powder and lower consumable consumption.





9. Human machine interaction

Sensors and Virtual/analytical tools to support Industrial automation via Digital performance management. The key is to provide the right information to the right people at the right time and the right place. This will enable and empower the operation to take on key responsibilities.

- Skill and Competence-Management is essential same as Augmented Reality and connected devices via IoT.
- Employees received the Theories within Online / (virtual) Classroom Training and the environment knows about the current and predicted state of the infrastructure.
- This leds into an AI supported Skill & Competence Management which seamlessly shows employees current status & gaps via HMI.
- With this view employees in case of trouble easily get the context sensitive knowledge / training / learning in the moment of need or use (social / virtual available) Experts from their network to have a look to the problem through their eyes and solve it.
- Multiple reduction of travel, solving and down times support Sustainabilty and reduce the Total Cost of Ownership (TCO) and secures Quality Assurance (QA).
- To deploy the right information, to the right person, in the right format and at the right time to take the right action requires a careful design of the technology stack, the integration of many systems, and the solution defined using use cases and persona.
- The HMI must be as tailored, intuitive, live, available and mobile as possible.
- Therefore Smart Factories combing as many Industry 4.0 areas as possible (Digital Twin, Robotics, Sensors, IoT, Additive Manufacturing, AI) including Cybersecurity must be part of Basic vocational education and to be made accessible via Augmented Reality.

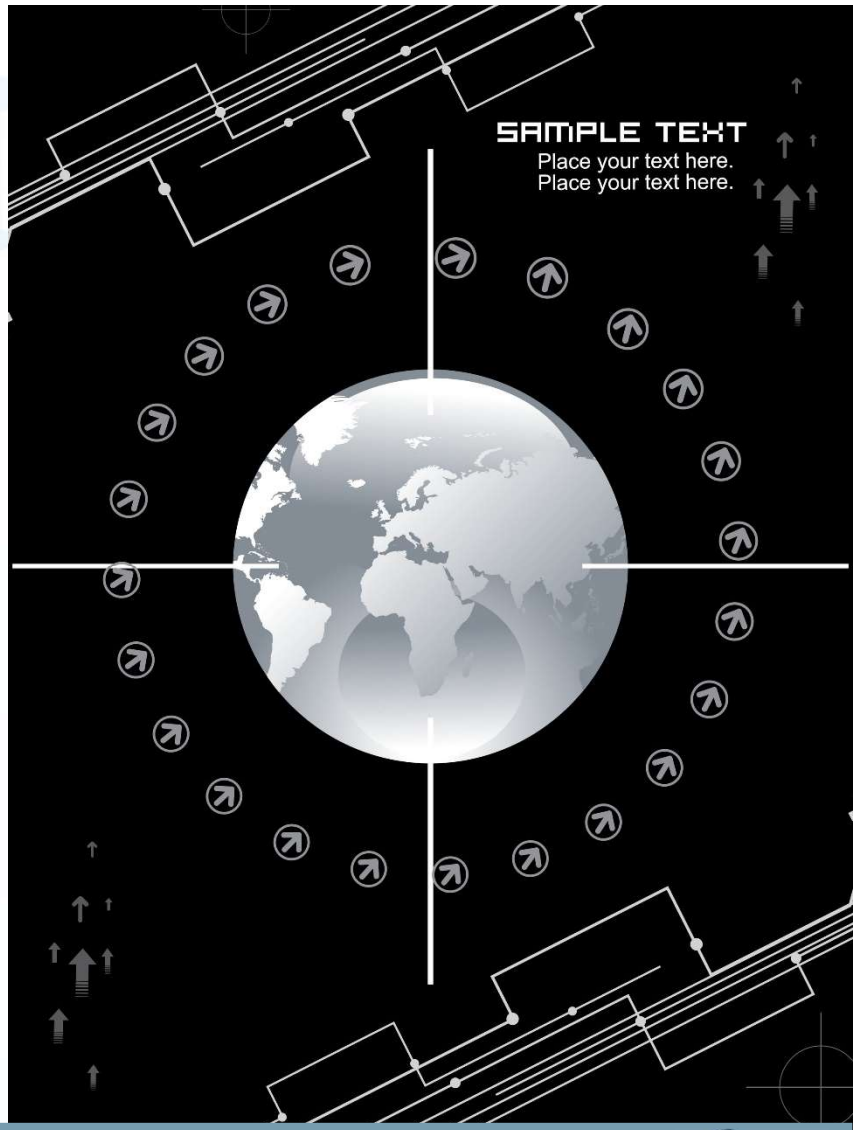
10. Integrated digital Logistic systems

Seamless information flow from cradle to grave with customer service in focus.

- AM manufacture is part of the digital supply chain that offers customization, just in time, and at the required location. This means that a digital thread of the AM part design, manufacture, testing, delivery, installation and use is vital.

- Integration between OEMs, service providers and suppliers (consumers/producers) is critical, based on cyber secure and trust based integrated solutions, which could include technologies like block chain for financial integration. This will blur partner and competition lines.

- Solutions are required to protect and manage intellectual property for all parties, this most cover all regions and the globe.



CONCLUSION

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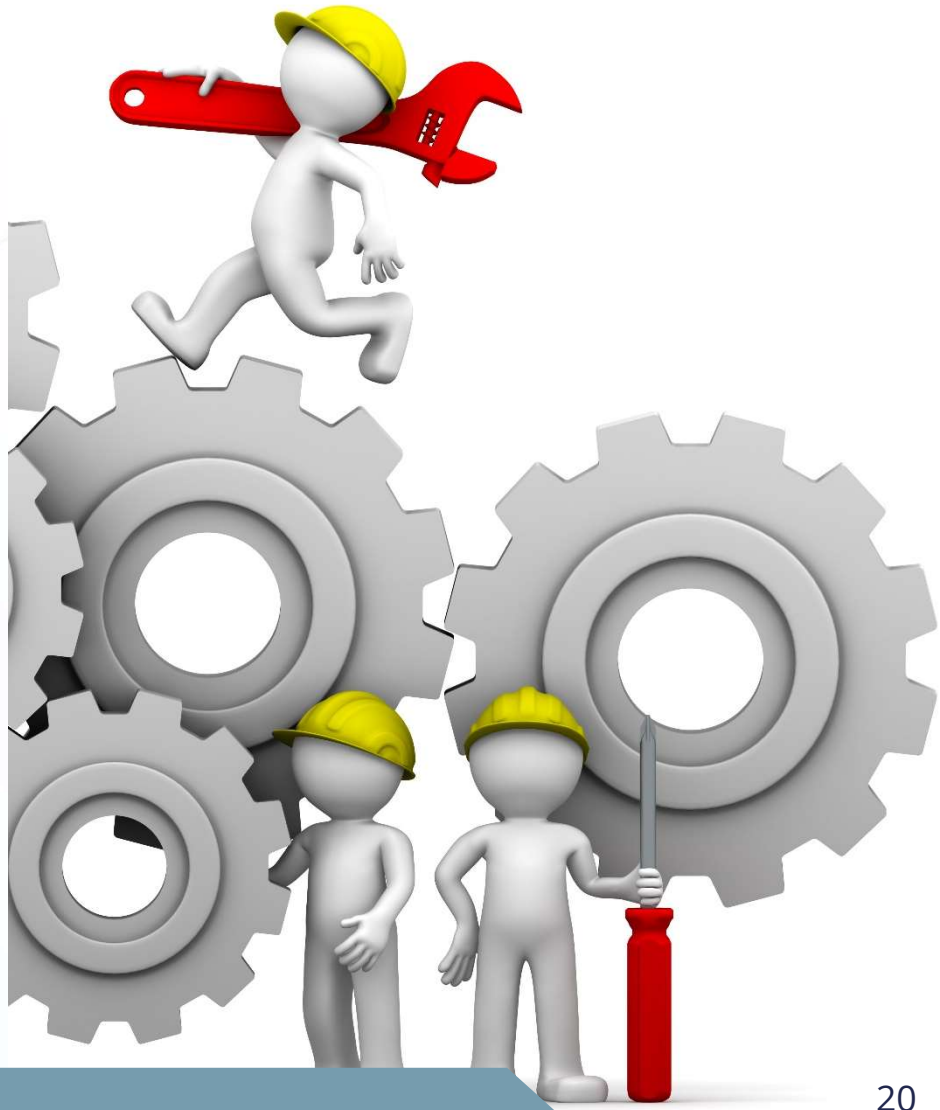
Technologies underwent a significant advancement in the last two decades. In order to create value and a competitive Europe, we need to implement these advancements into reliable and sustainable products. This requires an understanding not only of the different technologies themselves, but also on their impact on the companies and their business, their employees and the broader public. The manufacturing industry has not only to implement technologies and to use them in their production processes. Manufacturing industries also have to create a culture of collaboration, training, and education and to share their knowledge to a certain extent to enable business growth and technology acceptance. A direct consequence will be a continuous transformation of business and public.

This White Paper describes 10 theses as recommendations which will enable Europe to achieve a more competitive position in global business, to avoid brain-drain, and to bring Europe forward. The integration and implementation of advanced technologies in manufacturing processes results in operation technologies, information technologies, people and data to be connected along the entire manufacturing process. The transformation into a knowledge-based society is offering many opportunities to the manufacturing industry in improving its products, processes and procedures, its asset performance, its customer experience, and its workforce engagement. We truly believe that this will also result in a better resilience and flexibility to meet the challenges of the upcoming decades associated with sustainability, competitiveness, and workforce attraction.



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SOURCES

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