Advanced Manufacturing at the heart of a resilient, sustainable and competitive Europe

Recommendations by the EU Industrial Forum

Monday 12 June 2023

Disclaimer
This report reflects collective views of the Industrial Forum; the recommendations do not necessarily represent the position of individual members nor the position of individual Member States or the European Commission.

About the Industrial Forum
The Industrial Forum - set up by the Industrial Strategy - consists of a wide array of stakeholders, including industrial representations, Member States authorities, NGOs, research institutions and social partners representing different industrial ecosystems. The Forum's key tasks are to assist the Commission in tracking the implementation of the March 2020 Industrial Strategy and the May 2021 Industrial Strategy Update and contributing to the Commission's work on industrial ecosystems in the context of the recovery, and their green and digital transformation, with a focus on cross-border and cross-ecosystem collaboration.

More information about the expert group is available at
https://ec.europa.eu/transparency/expert-groups-register/screen/expert-groups/consult?lang=en&groupID=3743

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EXECUTIVE SUMMARY

Advanced manufacturing, at its heart, is about a revolution in both *what* we produce, and *how* we produce. It involves the integration and convergence of technologies like automation, robotics, artificial intelligence and digitally connected solutions, to enable the emergence of new industrial products, processes and business models.

Europe's ability to deploy these advanced manufacturing technologies rapidly and at scale is critical to its future success as a manufacturing powerhouse – attracting investments, generating jobs and tax revenues, and strengthening the economy's resilience in a period of profound geopolitical tensions and economic turbulence.

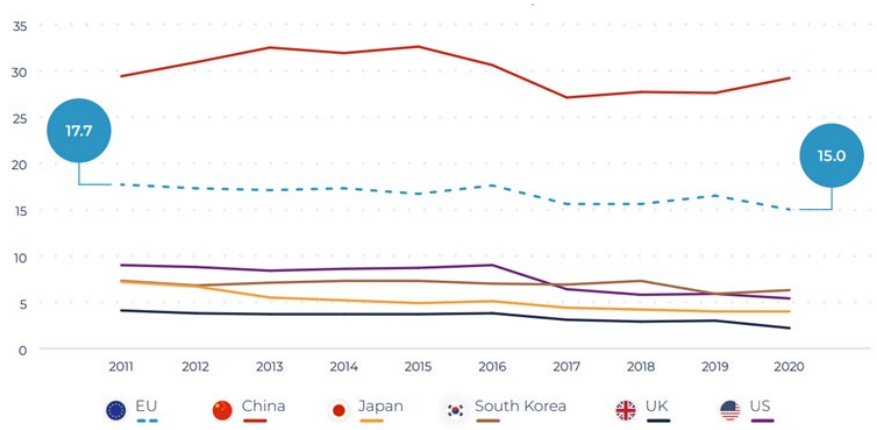
Crucially, this transformation of manufacturing is also a precondition for Europe's energy, climate and environmental transition. We must rapidly scale up the deployment of "clean tech" to stop our dependence on fossil fuels, decarbonise the economy and increase circularity. Just as important, we must make more with less. By realising deep efficiency gains across industrial ecosystems, advanced manufacturing will curtail industrial energy and resource use and allow Europe to deliver a sustainable and resilient energy system faster and more cheaply.

The transition to advanced manufacturing is crucial for every industrial ecosystem across Europe. Without these advanced industrial technologies there is, quite simply, no competitive renewable energy, no rapid decarbonisation of industry, no significant shift to a circular economy, nor indeed sustained economic resilience and competitiveness.

The European Commission has recognised the importance of Europe's strengths in advanced manufacturing for its climate and digital transition and future industrial resilience: *"The EU currently maintains sound technological leadership in Advanced Manufacturing, with European firms delivering a wide range of advance manufacturing equipment that are key enablers to production lines across the world."*[1]

[1] European Commission, Communication : Updating the 2020 New Industrial Strategy: Building a stronger Single Market for Europe's recovery, May 2021

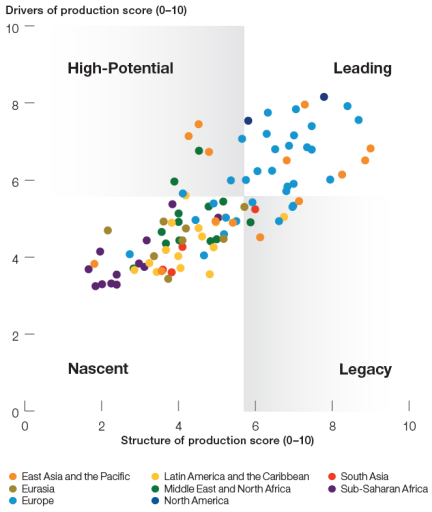
Exports of high technology manufactured goods (Global market share, %)



Source: ERT[2]

In fact, advanced manufacturing is a key strategic differentiator for Europe: 18 out of 25 countries which the World Economic Forum considers to be leading the change in manufacturing worldwide are in Europe.

Europe's leading position on "future of production" readiness



		Structure of Production		Drivers of Production	
Region	Country	Score	Rank	Score	Rank
Leading Countries					
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	Germany	8.68	3	7.56	6
	Ireland	7.34	10	6.85	15
	Israel	6.43	25	6.24	23
	Italy	6.99	15	5.90	30
	Japan	8.99	1	6.82	16
	Korea, Rep.	8.85	2	6.51	21
	Malaysia	6.81	20	6.51	22
	Netherlands	6.32	26	7.75	5
	Poland	6.83	19	5.83	31
	Singapore	7.28	11	7.96	2
	Slovenia	6.80	21	5.71	32
	Spain	6.05	29	6.23	24
	Sweden	7.46	8	7.40	9
	Switzerland	8.39	4	7.92	3
	United Kingdom	7.05	13	7.84	4
	United States	7.78	7	8.16	1

Source: World Economic Forum[3]

[2] Source: ERT, European Competitiveness and Industry Benchmarking Report 2022, data from World Bank and Eurostat

[3] World Economic Forum, Readiness for the Future of Production Report, 2018

However, the deployment of advanced manufacturing is not proceeding fast enough. Other markets are moving forward aggressively, and Europe's current position of strength could be easily eroded.

Why is this, and what needs to be done to ensure Europe takes advantage of its current lead to support its strategic political priorities? These were the core questions taken up by Task Force 5 of the Industrial Forum and addressed in this report.

The result is a comprehensive set of recommendations that are specific and actionable, covering seven broad areas:

1. EU sustainability goals

- Implement an ambitious "net-zero industry" plan for renewables and industrial efficiency technologies.
- Expand the use of REPowerEU
- Ensure thorough and timely implementation of the upcoming energy savings directives
- Make future rules on circularity of manufacturing processes and products fit for purpose
- Adjust public procurement guidance to accelerate the uptake of advanced manufacturing technologies
- Boost communications of the environmental benefits of clean technology solutions made in Europe

2. Access to capital

- Make better use of public investment in support of advanced manufacturing technologies
- Cautiously apply state aid instruments targeted at later stages in the innovation and deployment process of advanced manufacturing
- Ensure the upcoming EU Taxonomy delegated acts recognise the potential of advanced manufacturing technologies for sustainability

3. Supply chain resilience

- Ensure workable and proportionate rules on Due Diligence
- Accelerate ongoing negotiations on Free Trade Agreements (FTAs) with third countries and make sure that negotiated FTAs enter into force (such as the EU-Mercosur FTA).
- Strengthen EU semiconductor capacity and deepen global collaborations with partners with the EU Chips Act
- Provide incentives and funding to support actions to improve supply chain resilience, without directing specific outcomes
- Support local and regional industrial supply chains
- Leverage trade policy to secure access to critical raw materials

4. The EU Single Market and standardisation

- Narrow down the scope of the Single Market Emergency Instrument and promote mitigation measures for advanced manufacturing which would safeguard the Single Market freedoms
- Provide all information companies need to expand and/or export via a single platform
- Include a Single Market test in impact assessments of national laws to minimise gold-plating

- Ensure expertise and timely delivery in standard setting
- Enhance flexibility in standardisation requests
- Consolidate Europe's leadership in global standards setting
- Continue adhering to the New Legislative Framework
- Promote digital product standardisation

5. The data economy

- Protect intellectual property rights and trade secrets
- Support existing initiatives to create a strong European manufacturing data space
- Protect personal data
- Develop clear, focused criteria on high-risk AI, avoid unnecessary regulation of industrial AI

6. Skills

- Further expand efforts to strengthen skills and training in Europe
- Foster the harmonisation of VET practices and qualification systems
- Encourage more women and girls to take up STEM subjects and work in manufacturing
- Develop Pact for Skills partnership and propose a Blueprint Alliance for Advanced Manufacturing
- Foster an entrepreneurial culture in Europe
- Capitalise on European creative industries and creativity in general

7. Availability of data

- Identify a method for data collection in the advanced manufacturing category
- Generate trusted data sets at European level for advanced manufacturing deployment, global competitive position, and economic/environmental/societal gains

These recommendations are grounded in a thorough SWOT analysis of the state of advanced manufacturing in Europe and illustrated by means of several use cases across different industrial ecosystems that bring the transformative power of advanced manufacturing to life.

Europe needs a clear, ambitious and actionable strategy to capture the growth potential of the global manufacturing transformation, to keep up with accelerating global competition, and to take full advantage of the opportunities to strengthen its strategic autonomy and resilience while accelerating the green and digital transition. This report aims to kick-start that strategy.

CONTEXT

Origin of Task Force 5

The Industrial Forum was established to support the Commission in its analysis of industrial ecosystems and in implementing the updated EU Industrial Strategy, particular the twin digital and green transitions.

The Forum set up five task forces to address transversal topics of importance across industrial ecosystems.

Task Force 5 was charged with developing recommendations for speeding up the deployment of advanced manufacturing technologies and processes by EU industry; and for embracing new models of production (variously called “Industry 4.0”, “factories of the future”, etc.) where information technology and operational technology converge. In doing so, it works together with the other Task Forces and external stakeholders involved in the twin transition of industrial ecosystems.[4]

Objectives

- The output is a **blueprint for accelerating the deployment of advanced manufacturing,** particularly among manufacturing SMEs; for accelerating the digital and green transition in manufacturing and for safeguarding Europe’s global leadership in this field.
- Based on its report, the Task Force will **monitor key actions** in coming years to track continued momentum against the objectives outlined in the report, so that Europe can react in a timely fashion to future obstacles as they emerge and identify potential actions required.
- The Task Force also works closely with other Task Forces of the Industrial Forum, to act as **a knowledge hub** on manufacturing topics and ensure analysis and recommendations related to manufacturing are coordinated across the broader work of the Industrial Forum.

[4] https://single-market-economy.ec.europa.eu/industry/strategy/industrial-policy-dialogue-and-expert-advice_en

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European Commission	**DG GROW, CNECT, RTD, JRC, JUST, NEAR, ENER, SG, REGIO, DEFIS, EAC**

Ways of working

The Task Force work comprised four workstreams: defining the scope of advanced manufacturing, identifying the transformative potential of advanced manufacturing with practical use cases, identifying key opportunities and obstacles in Europe's manufacturing transition, and developing a broad policy consensus on "ready to implement" proposals to support that transition.

The overall work was chaired by the Co-Curators Orgalim and Cecimo, supported by other Task Force members leading specific workstreams. A wide range of Task Force members contributed to the workstreams both in writing and through multiple live and virtual meetings held throughout 2022 early 2023.

The European Commission participated actively in the process and provided extensive oral and written input on the drafting of the Task Force report.

This report reflects collective views of the Industrial Forum; the recommendations do not necessarily represent the position of individual members of the task force nor the position of individual Member States or the European Commission.

PART 1: What is advanced manufacturing and why does it matter?

The term advanced manufacturing may conjure up visions of automated assembly lines, with robots assembling cars, for example. Or of factories optimised and controlled from computer screens, of 3D printing of product parts, or of nanotechnology and biomedicine, as with the nanoparticles used in the mRNA Covid vaccines.

Advanced manufacturing does indeed encompass or enable all those things, but it is important to define it more precisely, to fully understand its role and appreciate its potential.

Establishing an agreed definition was therefore an important starting point for the Task Force, to set, the scope for this report.

Advanced manufacturing defined

Advanced manufacturing exists through advances and convergence of technologies including digitalisation. It enables:

- the creation of new production processes, and/or
- the manufacture of new types of products, and/or
- the emergence of novel business models.

Outcomes of advanced manufacturing include:

- products and services with higher added value,
- processes and products with increased environmental sustainability throughout the product life cycle, and
- industrial competitiveness and resilience, employment creation and improved job quality.

As such, advanced manufacturing cannot be looked as a vertical sector but rather as a transversal set of technologies, processes and products of relevance for numerous industrial sectors. Production processes such as automation or the application of artificial intelligence and cloud systems in manufacturing permeate all sectors, such as automotive, pharmaceuticals, chemicals and textiles.

The use cases that follow are intended to help bring the definition of advanced manufacturing to life, and to illustrate the transformative power of advanced manufacturing technologies in action across different industrial ecosystems in Europe today.

Use cases to illustrate the transformative power of advanced manufacturing across industrial ecosystems

Keeping Europe competitive in the wind turbine sector

Ecosystem	**Energy-Renewables**
Type	**Manufacture of new types of products**

The European wind turbine component suppliers are being challenged by low-cost competitors. How to stay competitive?

The digital advantage

European companies are exploring innovative and added-value strategies for differentiation, envisaging the digitalisation of wind turbine components and systems as a main source of relevant competitive advantage by means of design optimisation, operation and maintenance cost reduction and potential new services.

Wind turbine components manufacturers have already started to implement sensors and data collection systems in the wind turbines they are providing and installing. However, significant technology validation is still needed to achieve new products and services ready for commercialisation. Sensors and remote monitoring systems are yet to be extensively implemented in offshore energy generation facilities, as they currently provide little information that may be used in advance to any incident.

Reducing downtime

When it comes to monitoring components in an offshore wind turbine, the challenges are quite diverse. They concern the design of electrical infrastructure, structural design and material choice for aggressive environmental and seasonal conditions, but also site assessment and optimal set-up, substructures, installation methods, logistics, technical service access, operations & maintenance, and more. All these aspects have their importance in component reliability and resulting downtimes in wind farm operation.

Accelerating renewable energy uptake through electrical storage solutions in manufacturing

Ecosystem	**Energy-renewables, electronics, mobility-transport-automotive, electronics, textile**
Type	**Production process**

From disjointed to smart and connected energy use

To reach climate neutrality, it will be key not only to shift to renewable energy but also to cut total energy consumption by using energy more efficiently across various sectors. Today industry, energy, mobility, infrastructure, and buildings manage their energy use independently. However, if these sectors are connected through electrical and data technology, they can use energy more efficiently in their interactions. In manufacturing this sector coupling can be enabled by electrical energy storage devices such as industrial storage systems.

Accelerating the transition to net-zero industries

Industrial energy storage systems do for manufacturing what utility-scale storage systems do in combination with solar and wind farms across the grid: they provide stable power on an as-needed basis. An additional advantage is that they limit energy peak loads in factories, which occur with industrial machine startup. Historically, factories would manage short-term high-energy demand by briefly shutting down certain building services in cooperation with their energy provider and combined heat and power (air conditioning). By using more regular “peak shaving”, the gains in manufacturing efficiency generated by industrial power storage will lead to compensation of roughly 50% of total energy use. Because peak shaving also significantly reduces expenses for energy, it creates an important economic advantage.

Helping water utilities save water and energy

Ecosystem	**Digital**
Type	**Production process**

Water produced and 'lost' before reaching the customer is on average 23% of total net water produced by in the EU. In 2019 alone, EU wastewater treatment and discharge plants emitted 27 million metric tons of CO_2 and, altogether, water utilities account for 5% of the EU's electricity consumption. These figures underline the considerable potential for saving both water and CO_2 emissions in the water management sector. Advanced manufacturing technologies can help.

Optimising efficiency

Plant automation and optimisation integrating energy and process data generates significant cost savings. Optimising operating efficiency can save up to 10% of the total cost of production, while maximum production efficiency can save up to 20% of costs. In addition, digital platforms can tangibly reduce inlet water needs by as much as 20-30%.

Power monitoring systems also help, allowing energy management across different sites within a water utility and, in turn, estimated energy savings of up to 8%. Related benefits include improved response to power-related issues, reduced total cost of ownership and improved operational safety of power equipment.

In real time

Typically, this is done by implementing a Supervisory, Control and Data Acquisition system (SCADA) – a combination of software and hardware that receives operating (real-time) data about a process and associated equipment. This data is then used to control and optimise that process. SCADA systems can be installed in a single facility or be spread across a wide geographical area.

Cutting costs and waste through additive manufacturing

Ecosystem	**Aerospace & Defence**
Type	**Production process**

The aerospace and defence industry was a pioneer adopter of additive manufacturing (AM), recognising its potential to help overcome challenges from complex geometries to weight reduction. Today it is a major end-user of the technology.

Improving fuel efficiency

The aerospace industry is challenging the entire aircraft supply chain to deliver more fuel-efficient aircraft to reduce the impact of fuel costs on operations and the amount of emissions produced. Weight is a key focus, as even a small percentage savings in the mass of an aircraft can make a big difference in reducing the fuel consumed, emissions produced, and costs. For example, one kilogram removed from every plane of a 600+ fleet of commercial jetliners saves about 90,000 litres of fuel annually and reduces emissions by up to 230 tons of CO_2.

AM can help aerospace companies optimise design to reduce weight through:

- consolidation of several parts in an assembly into a single-build part
- creation of lightweight internal structures
- removal of excess material without compromising tensile strength and strength-to-weight ratios.

The benefits are seen not only in reduced costs and carbon emissions, but also in materials savings, and shorter development times. AM also enables performance enhancement and risk management, for example, by being able to include internal cooling features in thermally loaded components, or by eliminating traditional joining processes.

From simple to complex

Current AM applications in the aerospace and defence industry range from developing simple objects such as armrests, to complex parts such as liquid-fuel rocket engines, propellant tanks, satellite components, heat exchangers, turbomachinery, or valves. Furthermore, some leading aerospace manufacturers are already using this technology to fabricate end-use parts for lightweight wing assemblies in small aircraft and drones.

The future development of AM application in the aerospace sector will depend on research and skills development in some key areas such as accuracy and quality of production.

Use of predictive maintenance to improve machine performance and sustainability

Ecosystem	**Digital**
Type	**Production process**

Predictive maintenance (PdM) is a strategy that uses data analysis tools and techniques to detect anomalies in an industrial operation and possible defects in equipment and processes, so they can be fixed before they fail. It allows maintenance strategies by:

Increasing sustainability and business efficiency

PdM enables sustainability of manufacturing systems in different ways by eliminating the threat of equipment degradation, reducing downtime, the need of spare parts and waste of materials and energy.

PdM can help reduce the cost of repairs by identifying and addressing issues before they become more serious.

Furthermore, it increases the level of processes' safety by recognising potential safety hazards before they occur.

Better data-driven decision-making

PdM provides valuable data and analytics that can help inform decision-making and improve overall operations. In addition, it allows the development of new services with the collected data and derived models (for example: training of operators and local maintenance staff).

Revolutionising battery technology

Ecosystem	**Electronics**
Type	**Production process, Manufacture of new types of products**

To sustainably meet the needs for energy storage in an electrified future, we need a revolution in battery technology. In ten years, the battery market is expected to grow tenfold.

Alternative to graphite

One of the challenges of today's lithium-ion batteries is the use of graphite, which is either mined or made from other fossil-based materials.

What if you could replace graphitic carbon in lithium-ion batteries with something made from trees? A material designed by a Finnish provider of sustainable solutions is a hard carbon that is a bio-based alternative made from lignin – an existing by-product in the production of cellulose fibre. Lignin is renewable, traceable, and is already being produced in millions of tonnes in Europe – enabling the fast-growing battery business to become more sustainable.

Commercial scale

A mill in Finland added a pilot plant for refining the material and turning it into hard carbon to replace graphite in lithium-ion batteries following a 10-million-euro investment. At the pilot plant, the company is proving that it is possible to supply the market with hard carbon at a commercial scale. It estimates that it will be possible to produce tens of thousands of tonnes of hard carbon every year, per factory. The discussed facility is versatile and allows for development of different grades of material in collaboration with battery cell manufacturers. This means that the mill can meet the requirements for almost any type of lithium-ion battery in the future.

Car T cell manufacturing in health

Ecosystem	**Health**
Type	**Production process, Manufacture of new types of products**

For years, the foundations of cancer treatment were surgery, chemotherapy, and radiation therapy. Over the last two decades, through intensive research and clinical trials by bio-scientists, targeted therapies using CAR T-cells (chimeric antigen receptor T cells) have cemented themselves as standard treatments for many cancers.

CAR T cells are immune cells that have been modified to produce a cell that can be used in immunotherapy. Their use in cancer is to modify T cells (from the patient directly or through a donor) so that they recognise cancer cells more effectively and destroy them. They are engineered to recognise receptors unique to the target cancer, rather than healthy cells.

Companies are currently investing to develop specialised manufacturing facilities within Europe, including Novartis (France), Janssen (Belgium) and BMS (Netherlands). Manufacture is patient-specific and complex, and manufacturing investment indicates long term investment, skills development and integration into the European Union industrial base.

Over 100 companies worldwide are developing CAR T therapies, with 200+ active clinical trials of high significance for SMEs and translation of Europe's research base. The FDA and the European medicines agency have approved six CAR T-cell therapies to date (as of May 2022).

Making product passports possible

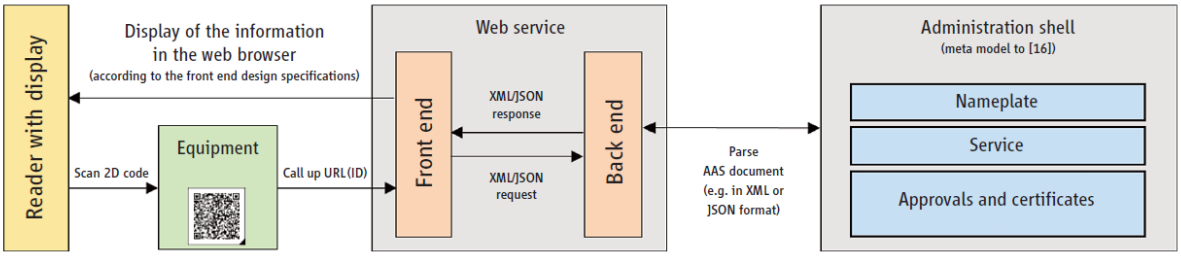
Ecosystem	Digitak
Type	Production process

Products today have a human-readable, analogue label. The label identifies the product manufacturer uniquely and has the function of a ‘product passport’, providing important information on the product's use and classification. The challenge facing manufacturers is that of conveying the growing volume of essential information concerning the product on the often-decreasing space available.

Digital Nameplate

In its function as a ‘product passport’, the Digital Nameplate contains the legal and normative product identifiers in digital form within a QR code. This information can be accessed through the QR code and displayed to the user on a smartphone or tablet PC, directly and without the need for a network connection. The scope of the information is defined in the VDE V 0170-100 industry standard.

The solution has several benefits over traditional nameplates and instructions. Firstly, the Digital Nameplate can accommodate new EU requirements for product information, such as the



product carbon footprint. Secondly, the Digital Nameplate enables considerable time and cost savings, due to the possibility of providing instant updates in all language versions. Thirdly, as no proprietary standards are involved, the solution is easily available and acceptable to multiple customers. Finally, the Digital Nameplate is more sustainable than traditional solutions, as it allows for the elimination of paper documentation.

Schematic of a Digital Nameplate[5]

[5] The basic idea is to link the OT and IT levels (operational technology and information technology). Each asset of the OT level (hardware and software) becomes an I4.0 component by linking it to the so-called Asset Administration Shell (AAS), which creates a general interoperability between all I4.0 components. The AAS represents a framework format for describing assets in a standardised form, and thus functions as a digital twin of the asset.

Mapping carbon footprint along the manufacturing value chain

Ecosystem	**Digital**
Type	**Production process**

Visibility on carbon emissions across the value chain

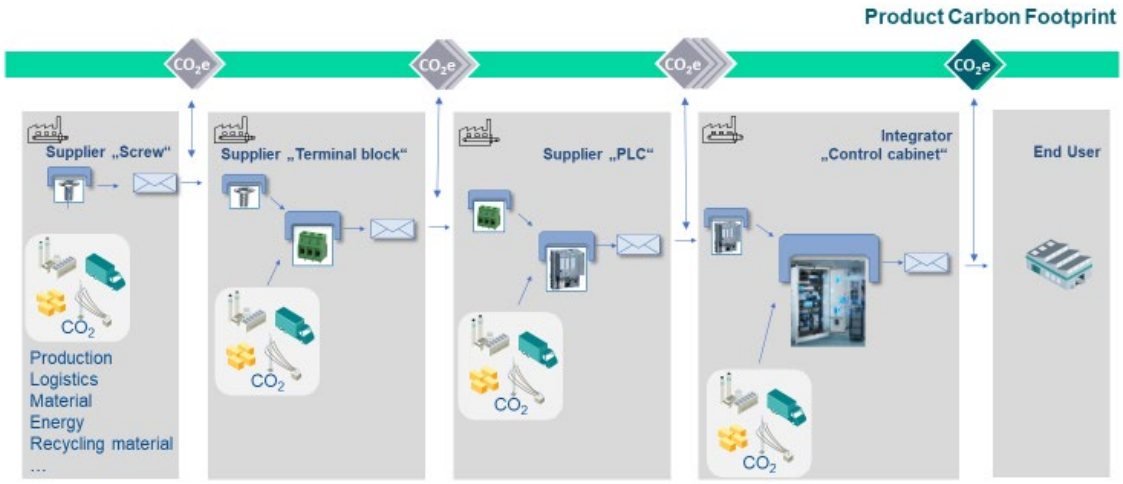
Businesses want to understand carbon footprint data of their products and services. Enabling visibility on where emissions are created is a precondition for companies (and customers) in various industries to play their part in reducing net-carbon emissions to zero by 2050.

The technological solution for this is the Asset Administration Shell (AAS): a digital twin that enables full transparency of energy demand and carbon emissions along the lifecycle of an industrial asset such as a machine or other equipment.

Standard for assessing carbon footprint

The AAS is a technological industry standard that allows businesses to exchange and retrieve information about a product's carbon footprint along the different stages in its manufacturing and processing. This enables businesses to assess and compare the carbon footprint of own and purchased products along the entire supply chain.

Mapping a product's carbon footprint along the manufacturing value chain: example of a control cabinet



Source: [Industrial Digital Twin Association]

Enabling biomanufacturing of Vitamin B2

Ecosystem	**Agri-food**
Type	**Production process**

Vitamin B2 (riboflavin) is an essential component of a balanced diet for humans and animals and is used in a variety of applications in the food, feed and pharmaceutical sectors. Manufacturing it used to require a complex, multi-step chemical synthesis involving the use of hazardous agents and resulting in low yield (~60%). Today almost all vitamin B2 used for human and animal nutrition as well as in health applications is produced biotechnologically in a single step process, saving on fossil raw materials, water and emissions.

Clear environmental advantages

This biomanufacturing process starts from vegetable as carbon sources and uses a genetically modified bacterium (Bacillus subtilis) or fungus (Ashbya gossypii). Life Cycle analyses demonstrated notable reductions in fossil raw material use (>70%), wastewater (>65%), and in exhaust emissions (~50%)

Overall, the ecological fingerprint clearly shows the environmental advantages of biotechnological production. In addition, the products have an excellent safety profile, due to the use of a one-step process and a production microorganism with a long history of safe use, using only renewable raw materials through the entire process. European companies have led the way to completely and sustainably transform commercial vitamin B2 production.

Applying artificial intelligence to improve production of building materials

Ecosystem	**Construction**
Type	**Production process**

AI tools for the production of plywood and laminated veneer lumber increase energy-efficiency, raise yields and reduce waste.

Improving quality

The quality of plywood can be improved if individual veneer sheets can be traced from the beginning to the end of the production process. However, the journey of veneer sheets from log to plywood requires many steps, making it impossible to use stickers or other marking means as tags.

Instead, identification by means of cameras and artificial intelligence has been developed, which is also cheaper in terms of operating costs than, for example, the use of RFID tags.

The veneer sheets photographed at the beginning and end of the production process can be identified using an AI algorithm, which enables obtaining information about the changes caused by the process in an individual veneer sheet.

Enabling pay-per-use of agricultural machinery

Ecosystem	**Mobility – Transport – Automotive, Agri-Food, Digital**
Type	**Novel business model**

Agriculture requires some big, expensive machinery that is often only used for a few days a year. It is costly for the farmer and inefficient in terms of resource use. With the help of enabling technologies, pay-per-use becomes a viable alternative.

A new business model

An Austrian producer of agricultural machinery uses IoT and blockchain to enable the use of agricultural machinery in a pay-per-use business model.

The company's rental equipment is equipped with a range of sensors, which can detect how the equipment is being used: for example, whether a tractor is being used for transport or work in a field. This information is continuously being sent back and allows the company to apply varying hourly rates on the rental of its equipment, depending on the time the machinery was used in a given role.

The system is further integrated with a blockchain-based asset lifecycle management system that enables billing, payment, and accounting to run fully autonomously without human intervention.

Streamlining administration

Among the benefits of the solution for the company is the possibility to cut workload on a rental by about a third, as multiple administrative tasks are eliminated. Also, the technology enables the company to improve its risk assessments and residual value calculations for each vehicle.

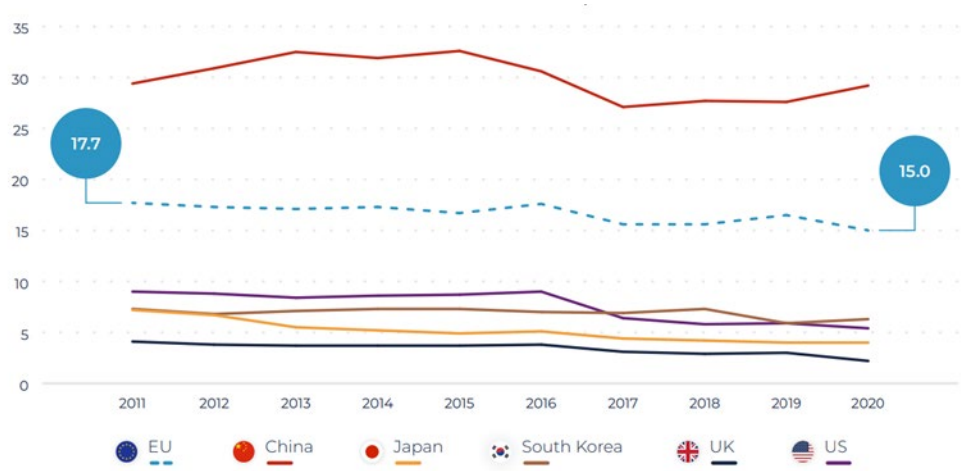
As for the farmer, multiple renters no longer have to buy or lease machinery (which often costs in excess of €100,000), allowing them not to tie up capital in multiannual loans, or burden their cashflow by monthly lease payments.

PART 2: The state of advanced manufacturing in Europe today

Europe's relative competitive position

The European Commission has recognised the importance of Europe's strengths in advanced manufacturing for its climate and digital transition and future industrial resilience: "The EU currently maintains sound technological leadership in Advanced Manufacturing, with European firms delivering a wide range of advance manufacturing equipment that are key enablers to production lines across the world."[6]

Exports of high technology manufactured goods (% of global market share)



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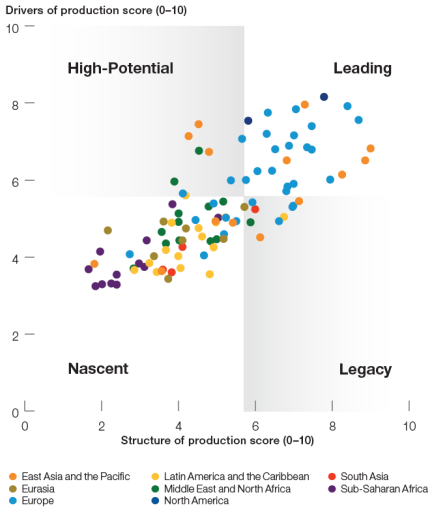
Europe's leading position on "future of production" readiness



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	France	6.87	18	6.89	14
	Germany	8.68	3	7.56	6
	Ireland	7.34	10	6.85	15
	Israel	6.43	25	6.24	23
	Italy	6.99	15	5.90	30
	Japan	8.99	1	6.82	16
	Korea, Rep.	8.85	2	6.51	21
	Malaysia	6.81	20	6.51	22
	Netherlands	6.32	26	7.75	5
	Poland	6.83	19	5.83	31
	Singapore	7.28	11	7.96	2
	Slovenia	6.80	21	5.71	32
	Spain	6.05	29	6.23	24
	Sweden	7.46	8	7.40	9
	Switzerland	8.39	4	7.92	3
	United Kingdom	7.05	13	7.84	4
	United States	7.78	7	8.16	1

Source: World Economic Forum[8]

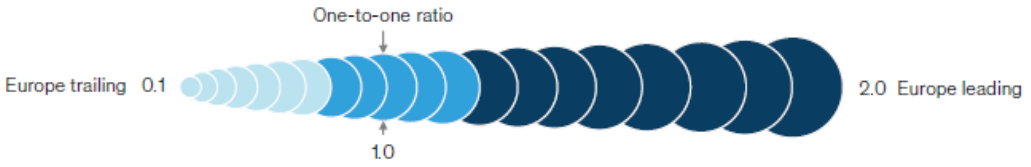
However, the deployment of advanced manufacturing is not proceeding fast enough. Other markets are moving forward aggressively, and Europe's current position of strength could be easily eroded.

Future competitiveness is at risk for sectors not transforming their manufacturing models fast enough. McKinsey estimates that if Europe fails to deploy series of key industrial technologies at scale, corporate value added of €2 trillion to €4 trillion a year is at stake by 2040 – equivalent to half of (Europe's) GDP growth to 2040 and six times the annual expected cost of the net-zero transition[9].

While Europe retains a strong competitive position in some of the technologies identified in the study, especially those where it has historical strengths (next-generation materials, clean tech, process automation), it needs to recognise the real risk of losing ground to other major markets moving faster.

[8] World Economic Forum, Readiness for the Future of Production Report
[9] McKinsey, Securing Europe's competitiveness: Addressing its technology gap

Relative European position in specific transversal technologies vs leading or second-best region



Transversal technologies	Keywords	Innovation[2]	Production[3]	Adoption[4]	Average
Next-level automation	Industrial, collaborative, and professional robots; additive manufacturing; virtualization	0.6	1.0	0.7	0.8
Future of connectivity	5G, Internet of Things	0.7	0.7	0.3	0.6
Distributed infrastructure	Cloud, edge computing	0.2	0.1	0.7	0.3
Next-generation computing	Quantum computing, neuromorphic software	0.5	n/a	n/a	0.5
Applied AI	Robotic process automation, optimized decision making, natural language processing, computer vision, speech technology	0.5	<0.1	0.8	0.4
Future of programming	Software 2.0, no-code and low-code programming	0.3	<0.1	n/a	0.2
Trust architecture	Blockchain, zero-trust security/cybersecurity	0.3	0.3	0.6	0.4
Bio Revolution	Biomolecules, biosystems, bio-machine interface, biocomputing	0.8	0.4	0.5	0.6
Next-gen materials	Nanomaterials, composite materials	0.7	2.0	1.2	1.3
Future of cleantech	Solar power, wind energy, hydropower, nuclear, electric vehicles, hydrogen	1.3	0.4	1.2	1.0
Average		**0.6**	**0.6**	**0.7**	

Source: McKinsey[10]

[10] McKinsey, Securing Europe's competitiveness: Addressing its technology gap

Europe therefore needs a clear, ambitious and actionable strategy to capture the growth potential of the global manufacturing transformation, to keep up with accelerating global competition, and to take full advantage of the opportunities to strengthen its strategic autonomy and resilience while accelerating the green and digital transition.

Mapping Strengths, Weaknesses, Opportunities and Threats

Such a strategy needs to start with mapping the drivers which determine the state of advanced manufacturing in Europe today and its prospects in the future.

This section of the report does just that, through a comprehensive SWOT analysis, conducted on a horizontal level and backed up by detailed analyses for separate use cases shown in Part 1 (see Annex).

In this way we identify the key enablers and obstacles to accelerating the deployment of advanced manufacturing across industrial sectors.

Strengths	**Weaknesses**
Globally competitive industrial base in key manufacturing sectors and manufacturing technologies	Decreasing EU influence in global standard setting, increasing policy obstacles to industry contribution to European standard development
Harmonised EU Single market: Despite its well-known barriers, the EU is a unique market area and a 'home market' of 27 countries	Access to raw materials, feedstock and components
First-class R&D ecosystem and EU innovation funding	Access to skills profiles required now and in future, with changing demographics towards a lower employment-age population. Europe's population pyramid shows substantially lower population in the coming 10-15 years
Strong European training and skills infrastructure and strong in higher education with a high penetration of tertiary education	Uptake of new technologies or new business models in Europe is slower than other regions. Although the EU has as many start-ups, fewer achieve competitive market position and scale-up.
Strong industry demand for advanced manufacturing (reducing need for subsidy-driven operation)	Low awareness of advanced manufacturing benefits among customers
Increasing recognition of the need for of innovation-friendly regulatory instruments (eg. new legislative framework)	Data sharing fragmentation and constraints across actors and sectors
Multinational companies headquartered in Europe which are competitive in global	Market surveillance not functioning as it should, no level playing field within Europe or worldwide

value chains plus significant RoW company investment and employment in Europe Substantial public capital available at EU and national level to support the EU economy and incentivise investments (e.g. Recovery and Resilience Facility) Increased public-private partnerships to address transition and scale up of advanced manufacturing plus SME-specific grant programmes (e.g. EIC) High social standards and political stability of the EU	National and EU projects are not strongly oriented towards SME participation. EU manufacturing projects are under-funded relative to other sectors Lack of incentives for rapid translation of first-class R&D/tech to market No EU-wide capital market Small company acquisition, especially from outside Europe, by large companies before independent maturation to market in some cases Lack of cross-regional and cross-ecosystem collaboration Modest R&D&I budget for advanced manufacturing in Europe compared to investments done by international competitors
Opportunities	**Threats**
EU sustainability goals, RePower EU and the twin transition: ambitious implementation and joint review of progress along with corrective actions, when necessary, will open new market opportunities for advanced manufacturing in the EU and globally Advanced manufacturing can unlock energy and material efficiency in industry Improved policy coordination at EU-level (i.e. industrial, innovation, skills and capabilities, energy, trade, single market) for a coherent framework for all stakeholders whilst achieving the desired outcome Innovative and disruptive SMEs are emerging, with strong knowhow Implementation of advanced manufacturing accelerates digitalisation of industry across ecosystems, ensuring competitive position New servitisation / sharing business models opportunities emerging globally	Slow, complex and costly pathways to market for advanced manufacturing technologies: regulatory burden and over-regulation is a disincentive for Europe compared to other global regions, slowing investment and market uptake Incoherence between different pieces of legislation, such as chemicals Energy dependency and structurally higher energy prices will weaken competitiveness and investment in Europe compared to other markets European ‘decoupling’ from important third markets (limiting access to global value chains and export markets) Long term stability of raw materials access Taxonomy-driven investment: despite its potential to contribute to energy efficiency and reduced material consumption, advanced manufacturing is not yet considered as sustainable under the EU taxonomy framework

Achieving a higher level of resilience, security and efficiency, reducing costs, increasing visibility in supply chainsIncreased skills base for employees with higher quality of employment, both for newly created jobs and re-skilling across Europe. Policy and investment focus on production of semi-conductors in Europe, unlocking further advanced manufacturing capability Greater political focus on more localised supply chains within secure global networks creates competitive opportunity for advanced manufacturing industrial voluntary data sharing and use across different sectors. Fostered by the new frameworks for industrial data sharing and use (e.g. Manufacturing data space) Advanced manufacturing is a crucial contributor to health security and PPR Organised representation of workers and industry allows for negotiations to make transition fair and effective	Fragmented market for risk capital, in particular for scale-ups. Investment early in creation of competitive position is focused outside Europe Data restrictions, data overregulation, EU fragmentation in national data regulations Personal data leakages: Personal data could leak as they are frequently collected along industrial data. Increasing protectionism across major global markets contributing to supply chain challenges, and a lack of level playing field Indiscriminate use of state aid risks causing long-term distortions of competition within the single market IP and cybersecurity threats for more complex online process (Operational Technology security, standardisation problem) disincentivises investment, especially in SMEs Foreign/climate policies leading to global trade disputes Low attractiveness of industrial jobs Global competitors' investment into market positioning for advanced manufacturing and weaker end-user market compared to other regions

The table above identifies opportunities and obstacles for accelerating the deployment of advanced manufacturing in Europe. Building on these, the next section puts forward the most important steps that policy makers and other stakeholders can take.

PART 3: A blueprint for accelerating the deployment of advanced manufacturing

This part of the report lists a set of recommendations for policy makers and stakeholders to accelerate the uptake of advanced manufacturing technologies across industrial ecosystems. The recommendations aim to take advantage of the opportunities and to tackle the obstacles previously identified in the analysis of advanced manufacturing in Europe in Part 2.

Building upon several emerging themes, relevant for both manufacturing in general and specific use cases different ecosystems, the Industrial Forum has identified the following priority areas that are of key importance for accelerating the deployment of advanced manufacturing:

- EU sustainability goals
- Access to capital
- Supply chain resilience
- EU Single Market and standardisation
- Data economy
- Skills
- Availability of data

Each of these recommendations describes a context and rationale of a specific enabler or obstacle for accelerating advanced manufacturing and provides specific and “ready to implement” proposals.

RECOMMENDATIONS

1. EU sustainability goals: leverage the power of advanced manufacturing 'made in Europe' to accelerate Europe's green transition.

The EU's ambitious goals defined under different frameworks such as the Green Deal, Fit for 55 Package or the Circular Economy Action Plan not only represent a huge opportunity and incentive for a wide scale deployment of advanced manufacturing technologies, but their success is also highly dependent on that deployment. To ensure this win-win-we recommend:

1. **Implement an ambitious "net-zero industry" plan for renewables and industrial efficiency technologies**. As competition between major markets is increasingly about greening their economies, our future competitive advantage will depend on access to clean energy sources and on low-emission, highly resource efficient manufacturing. Advanced manufacturing is needed to ensure clean technologies required for renewable energy can be competitively produced in Europe. Just as important, energy and material savings across industry will allow a faster and more affordable path to decarbonisation than relying on the uptake of renewable energy alone. Therefore, in the context of its efforts to accelerate Europe's transition to net-zero industry, the EU should elevate the importance of the energy and resource efficiency potential of advanced manufacturing technologies and processes.

2. **Expand the use of REPowerEU.** The REPowerEU initiative to scale up manufacturing of key technologies needed for our future energy system is welcome. However, strong links to a de-carbonised and energy-efficient process industry, as well as equipment, components and various related initiatives (e.g. maintenance and repair) will be required to deliver on the initiative. National REPowerEU plans should support industry-driven and cross-sectoral initiatives accelerating the transition from the production and usage of fossil energy to clean and renewable energy and involve a broad range of businesses in the value network including advanced manufacturing and digital businesses. To alleviate the impact of high energy costs on advanced manufacturing, the initiative should financially back local electricity production, e.g. on-site solutions and tie it with a swift implementation of other initiatives such as the "Solar Rooftop Initiative".

3. **Ensure thorough and timely implementation of the upcoming energy savings directives.** The revised Energy Efficiency Directive will set ambitious annual energy savings obligations applicable from 2024 onwards. The Energy Performance of Buildings Directive sets out how Europe can achieve a zero-emission and fully decarbonised building stock by 2050. The speedy implementation of these directives will create important market incentives for advanced manufacturing technologies that are essential to achieve these targets and drive active energy savings in buildings, industry and transport.

4. **Make future rules on circularity of manufacturing processes and products fit for purpose.** As indicated in the Strategic Research and Innovation Agenda of the Made in Europe Partnership in Horizon Europe11, ‘’with higher expected CO2 prices and scarcity of key materials, the economics of manufacturing and materials use and re-use will change. The integration of de-manufacturing, recycling technologies, and life-cycle analysis approaches will become key to recovering and reuse of materials from high-end products and capital goods”. For example recycling steel saves 72% of the energy needed for primary production (i.e. 4,697 kWh per tonne). The adoption of recycling procedures should be further promoted and supported with national or local financial and technical support via facility centers such as that provided by the Vanguard Initiative. Beside sustainable manufacturing processes, the manufactured products themselves need to be designed sustainably. This direction is already being set by the proposed Ecodesign for Sustainable Products Regulation (ESPR) as a key measure to further optimise the way resources are used throughout the economy and society, while opening up new business opportunities. Digital solutions, such as the Digital Product Passport, will play a key part in this. Crucially, confidential business data within the scope of the Digital Product Passport must be protected; and incoherence with other legislation, such as chemicals, remains a risk with a disproportionate impact on the competitiveness of economic actors which must be avoided.

5. **Adjust public procurement guidance to accelerate the uptake of advanced manufacturing technologies.** Public procurement should prioritise circular economy business models and related capabilities, particularly in SMEs, in manufacturing; it should include new methodologies, such as Building Information Modelling in building renovation strategies; and it should include quality (wellbeing, air quality), sustainability and flexibility criteria in the tendering process. More cooperation and exchanges among Contracting Authorities is necessary. A reflection on the role of CA’s is needed to create demand for certain strategic (end) products. It includes a cultural change, embracing risk and uncertainty and seeing public procurement as a tool of investment instead of just looking for the lowest price suppliers.

6. **Boost communications of the environmental benefits of clean technology solutions made in Europe,** at the same time as advancing the assessment and guidance on how to reduce environmental impact.

2. Enable access to capital.

EU programmes dedicated to manufacturing research and innovation – including Horizon Europe, the EIT Manufacturing partnership and the Made in Europe co-programmed public-

[11] EFFRA, MADE IN EUROPE: The manufacturing partnership in Horizon Europe -Strategic Research and Innovation Agenda (SRIA), pg.10-15, available here.

private partnership – are success stories which have developed several advanced manufacturing projects. Nevertheless, the amount of advanced manufacturing investment committed by international competitors, such as China and USA, is higher and more focused on the topic. For instance, the Chinese National Advanced Manufacturing Investment Fund alone allocated around €9 bn to different issues such as industrial restructuring, robots and AI development[12]. Another example is the recently launched US National Strategy for Advanced Manufacturing which lists strategic objectives that will be funded with public money and help the US strengthen their global leadership. Such initiatives contribute to the risks of Europe losing market leadership in the long run. Europe needs to facilitate the investment – both public and private – that is needed to deploy advanced manufacturing technologies at scale. To ensure the access to capital required for the advanced manufacturing transition across the entire industrial base and especially among smaller companies and SMEs, the following will be crucial:

7. **Make better use of public investment in support of advanced manufacturing technologies.** The EU should continue investing in the Made in Europe co-programmed public-private partnership (and its continuation in the next work programme) dedicated to R&I in the advanced manufacturing sector. The EU should also monitor and promote coordination between different funding sources to further foster the development of manufacturing business ecosystems. For example, we recommend using the European Innovation Council and Important Projects of Common European Interest, where appropriate, to focus on projects with a Technology Readiness Level (TRL) 8-9, and using EIT Manufacturing, Made in Europe and other opportunities under the Horizon Europe programme for projects with a TRL 6-7. The latter should increase the number of cascade funding call for proposals to increase the reach of EU funding and allow SMEs to connect with the European project network. This monitoring and coordination activity can help finding potential gaps in the funding programme (e.g. not enough funds allocated to a specific sector), a clearer overview of the funding allocated to advanced manufacturing, and an overview of the opportunities offered to SMEs. More focused topics would be welcome to increase the success rate for SMEs. In addition, as the InvestEU guarantee agreement with the EIB group includes advanced manufacturing among the priority areas for investments for both EIF (equity and debt) and EIB products (debt), we recommend developing synergies between the Made in Europe partnership projects, the EIT Knowledge and Innovation Communities (KICs) and the InvestEU implementing partners on projects with TRL 7-9. This cooperation could support the market uptake of solutions developed under the Made in Europe Partnership.

   EU funding also needs to continue going beyond research and innovation to roll out advanced manufacturing technologies in the market. For this costly investment, the EU needs more funds and more complementarity between EU, national and regional initiatives. The existing European Innovation Council funds for breakthrough technologies could be further increased and the joint grant/investment funding procedures should have fewer delays.

   Crucially, public investment will be required for upgrading Europe's existing industrial base with digital and advanced technologies, so-called "brownfield" projects. Public support remains limited despite the fact that such projects are typically small-sized from a financial perspective and could require comparatively smaller funding for their digital

[12] Advanced technology landscape and related policies in China, European Commission

and green transformation. Yet in aggregate, they will deliver faster and more cost-effective progress on deploying advanced manufacturing technologies than "greenfield" projects.

8. **Cautiously apply state aid instruments targeted at later stages in the innovation and deployment process** to help overcome underfinancing – being careful to avoid distortions in the Single Market. We recommend developing a clearer and harmonised definition of Mid-Caps[13] and large corporations, to be used at least by all European institutions and bodies. In particular, the current definition of Mid-Caps in the EC State aid Risk Finance Guidelines is currently not aligned with other EU sources (e.g. European Investment Bank) and does not capture the real value and size of the companies falling in this category.

9. **Ensure the upcoming EU Taxonomy delegated acts recognise the potential of advanced manufacturing technologies for sustainability.** The Taxonomy, and more specifically its Climate Delegated Act, currently do not recognise the enabling role that advanced manufacturing technologies play in climate mitigation and hence is actively steering private investment away from them. We recommend that the Commission design a technology neutral section on advanced manufacturing as an enabling activity (as per Article 16 of the EU Taxonomy Regulation) for climate change mitigation and a circular economy in manufacturing. The existing methodology in the climate delegated to act on manufacturing of low carbon technologies (3.6) can serve as a model to also ensure technology neutrality. Several NACE codes, such as C25, C26, C27 and C28, could be associated with this category.

3. Supply chain resilience: Support diversified access to raw materials, components and feedstock

The updated EU Industrial Strategy recognises the importance of secure and resilient raw materials access, and the recently established European Raw Materials Alliance and upcoming proposal for a European Critical Raw Materials Act are welcome initiatives. Further – and more immediate – measures would greatly help, however. The current geopolitical context exacerbating the ongoing effects of the pandemic has created unforeseen economic challenges and, for European manufacturers of advanced industrial technologies, strengthening and diversifying their supply chains is key. To enable them to do so and ensure stable and predictable access to raw materials, the following will be crucial[14]:

10. **Ensure workable and proportionate rules on Due Diligence**, particularly for smaller companies. Due diligence rules must consider sectoral specificities in advanced

[13] As suggested by the Manufuture report: EU State Aid Strategy for Research & Innovation - ManuFUTURE HLG

[14] Access to competitive steel, which is an essential material for the production of advanced manufacturing solutions, and the current EU steel safeguard measures have been discussed in the Task Force. Due to diverging views among task force members, the report refrains from making a recommendation on this point.

manufacturing, where supply chains are often highly complex and difficult to monitor, especially beyond companies' direct contractual relationships with suppliers. They should foresee dedicated support schemes to assist SMEs; and limit the scope to internationally recognised human rights. Public authorities should play a proactive role in supporting companies to implement their due diligence legal obligations, e.g. through a dedicated Business and Human Rights Helpdesk. Member States should avoid a patchwork of national rules. A risk-based approach to due diligence as provided by international standards such as the UN Guiding Principles for Business and Human Rights, the OECD Guidelines for Multinational Enterprises and the ILO Declaration on Multinational Enterprises must be implemented and further developed in the Directive.

11. **Accelerate ongoing negotiations on Free Trade Agreements (FTAs) with third countries and make sure that negotiated FTAs enter into force (such as the EU-Mercosur FTA).** FTAs are essential to broaden the access of advanced manufacturing technology industries to important raw materials and will lead to a stronger level-playing field in competing with companies outside of Europe.

12. **Strengthen EU semiconductor capacity and deepen global collaborations with partners with the EU Chips Act.** All industrial sectors, from automotive and machinery to healthcare, rely heavily on the availability of semiconductors. The Commission's clarifications on state aid possibilities for large semiconductor investments based on TFEU Art. 107 (3) (c) will facilitate new necessary investments in Europe, but should not set a precedent for picking winners in other industrial domains.[15] A successful EU Chips Act should also strengthen EU's collaboration with partners, such as the UK, Switzerland, the U.S., Japan, South Korea, Singapore, Taiwan, and others; taking into account the importance of European independence in the semiconductor sectors. This is key to ensure the stability of the global-by-nature chip supply chain together with more investment in all stages of the semiconductor value chain.

13. **Provide incentives and funding to support actions to improve supply chain resilience, without directing specific outcomes**. Health and agricultural technology manufacturers may not build redundancy into their value chains to an optimal extent without public financing, especially in light of the cost of qualifying additional suppliers and partners from a regulatory perspective. The EU can help to de-risk such action by providing financial and other support, for instance lifting tariffs and other trade restrictions that affect advanced manufacturing in regulated industries.

[15] it is important to recall that the economics of semiconductor manufacturing are peculiar of the sector and are not necessarily the same in other industrial segments. The use of TFEU Art. 107 (3) (c) as legal basis for aid for semiconductors should not set a precedent for ''picking winners'' in other industrial domains. The EU should continue to invoke this provision in the Treaties only in the presence of market failures.

14. **Support local and regional industrial supply chains.** Extending the initiatives and pilot projects of the Vanguard Initiative and ensuring that the Digital Innovation Hubs across Europe are successful. These networks can promote the benefits of using advanced manufacturing technologies to mitigate supply chain disruption. For example, companies that currently rely on complex and distributed supply chains could be helped to drastically simplify their work by testing and integrating technologies that enable, for example, on-demand and flexible production.

15. **Leverage trade policy to secure access to critical raw materials**. The European Critical Raw Materials Act should emphasise the need for increased attention in guaranteeing access at competitive prices to key materials used in advanced manufacturing. The act should leverage trade policy to secure a stable and sufficient supply of critical raw materials and ensure that trade defensive measures, including investment screening and export controls, are effectively enforced and do not excessively hinder access to raw materials.

4. Strengthen the Single Market and standardisation

The European Single Market has been a flagship achievement of the EU, supporting the competitiveness of European businesses and boosting the EU as a key global market and export leader. To ensure that the Single Market remains a success story, the EU institutions together with member states should spearhead the design of an all-encompassing programme to deepen the Single Market, overcome national interests and stimulate genuine progress in the free movement of goods, services, capital, people and data. Initiatives launched in 2021 to strengthen the Single Market's resilience in the wake of the Covid-19 pandemic are welcome. However, technical, legal, and bureaucratic barriers remain, which prevent the Single Market working optimally and increase cumulative costs for the European advanced manufacturing sectors.

Examples of barriers in the Single Market

Use of the "Green Dot" logo: There are conflicting regulations on the use of the "Green Dot" logo within the EU. In some EU countries (e.g. Spain), use of the sign is mandatory on certain products. In others, instead, the use of the logo may lead to financial penalities (e.g. France). These conflicting requirements create unnecessary costs and risks for manufacturing businesses.

Use of the "Tri-man logo": In France, there is an obligation to use the "Tri-man logo" and include sorting instructions on the packaging and in user manuals. Manufacturers need to change all their packaging to add this information solely for this national market. As the sorting of instructions is not harmonised across the EU, this information could also lead to confusion in other Member States.

Implementation of EU Classification, Labelling and Packaging (CLP) Regulation and REACH: A number of Member States have implemented legislation requiring companies

to provide information on products to be placed on their market, which are misaligned with existing CLP and REACH provisions. Examples include: Belgium, Sweden, Croatian, Denmark, Latvia, Finland.

Single Market barriers

It should remain a key priority for EU to remove all barriers to cross-border business operations and intra-EU investments, forming a fully-fledged Single Market for all economic activities. This means developing a true Union for Energy, Environment, Digital and Capital amongst others.

To ensure the four freedoms and remove various barriers, we recommend to EU and national policy makers:

16. **Narrow down the scope of the Single Market Emergency Instrument and promote mitigation measures for advanced manufacturing which would safeguard the Single Market freedoms**. The horizontal nature of advanced manufacturing and its relevance across industrial ecosystems should be taken into consideration when defining crisis-relevant goods and services, to avoid the disruptions caused by policy responses to the Covid-19 pandemic. This was not the case in 2020, for example, for companies working in the additive manufacturing sector, limiting the action of those companies that wanted to support hospitals in need of valves or personal protective equipment.

17. **Provide all information companies need to expand and/or export via a single platform.** While information is available through different channels, it can be challenging for any company, particularly SMEs, to have a clear overview of the rules, procedures, benefits and opportunities available at the EU and national levels. In particular these may relate to:

    - Requirements regarding technical approval
    - Regulatory fragmentation
    - Requirements regarding registration of the company
    - VAT and tax rules and documentation
    - National funding
    - Applying for and obtaining permits needed for investments projects

    Solutions like the Single Digital Gateway should be better advertised and promoted among the industry communities.

18. **Impact assessments of national laws should include a Single Market test to minimise gold-plating.** In transposing EU directives related to manufacturing at

national level, Member States often go beyond what is required by the EU law ('gold-plating'), undermining the Single Market.

Standardisation

Standardisation, as a crucial tool for the functioning of the New Legislative Framework, has been a core aspect of Europe's success, including harmonised standards giving presumption of conformity with EU legislation. However, the diminishing engagement and role of industry in the standard development bodies (both European and International) is weakening the New Legislative Framework, decreasing the ability of the EU to maintain its in standards setting. This could leave a vacuum for other players to set the standards. One of key challenges for Europe is to acknowledge that increasingly standards are being developed in international standardisation bodies (ISO, IEC, ITU) and international consortia, where harmonised standards are not foreseen, alongside the three formal European standardisation organisations (ESOs). Although the EU standardisation strategy addresses some of these issues, it is important to adapt to these challenges. Therefore, European policymakers need to:

19. **Ensure expertise and timely delivery in standard setting**. For the European Standardisation system (ESS) to remain successful and to continue supporting the functioning of the Single Market, harmonised standards must remain relevant to market needs and must allow for new advanced manufacturing solutions to be rolled out quickly on the market. Thus, they should be developed in strong cooperation with industry experts and other relevant stakeholders. This should not, without due reason and justification, exclude EU residents or participants from outside of the EU. European standards need expertise from across the globe in order to build truly state-of-the-art specifications and for these standards to have broad, international uptake.

    The EU needs to take advantage of the speed and expertise which is being generated in consortia and reconcile this with the strength of the ESS and the role of harmonised standards - which will remain core to the Single Market. Strategic objectives for the ESS should reflect the transversal importance of advanced manufacturing technologies for Europe's industrial base. In particular, it would be crucial to develop European standards for data logistics, ICT and additive manufacturing.

    Article 5 of Regulation 1025/2012 requires the ESOs, of which the National Standardisation bodies (NSBs) are an integral part, to "encourage" participation of societal stakeholders. While the ESOs have made important efforts to facilitate participation of Annex III organisations, barriers for national trade unions to participate at national level remain. These are for example (a) in some countries, high participation fees, (b) limited pro-active outreach to societal stakeholders for existing or new relevant standardisation activities, (c) lack of or limited dialogue between NSBs and national Trade unions.

    Finally, the implementation of the Standardisation Strategy will need to focus on the bottlenecks in the framework for the commissioning, evaluation, and citation of harmonised European standards. The EU High-Level Forum on European Standardisation (HLF) should be used as a platform to directly bring together all stakeholders in standardisation, including Annex III organisations, especially when

setting agendas and developing actions, whether of political or technical nature. Given that the HLF brings together a group of highly qualified and knowledgeable experts in the field of standardisation, we urge the Commission to use this platform in an advisory capacity.

20. **Enhance flexibility in standardisation requests.** Quick adaptation of standards to market innovation and stakeholders needs requires flexibility in several aspects. As such, it is important to:

    - Accelerate the creation of harmonised standards: delays in producing harmonised standards can unnecessarily complicate national enforcement, especially as market surveillance authorities would be confronted with market access legislation (e.g. dealing with accessibility and accessibility requirements). Thus, a lack of progress on harmonised standards can create fragmentation that proves to be difficult to manage, confuses consumers and technology business alike, and makes trade within the EU more complex than it ought to be.

    - Accommodate updates of harmonised standards: any standardisation request must accommodate updates with respect to both revisions of harmonised standards already listed and initial editions of standards not yet listed in the Official Journal of the EU, especially relevant for new fields of technology. Such flexibility can be arranged for by frequent updates of the standardisation request or by flexibility built in such requests.

    - Flexible Annual Union Work Programme: similar flexibility is needed for new standardisation projects beyond the confirmed Annual Union Work Programme.

    - Synchronise the lifetime of standardisation requests with the legal act: The lifetime of a standardisation request should be as far as possible synchronised with the legal act

21. **Consolidate Europe's leadership in global standards setting.** Standards have become a powerful tool to steer global technological and industrial leadership. International competitors (e.g. China) have adopted a more strategic approach for developing and promoting their respective standards at international level within different sectors, including advanced manufacturing.

European industry players find it increasingly complex to participate in standard-setting processes due to financial constraints, given the high direct and indirect costs incurred from the participation in standardisation activities. In order to effectively compete with a state-centric approach (e.g. China), public authorities at both the European and national level should financially support and enhance the participation of European companies, particularly SMEs, and other stakeholders (e.g. trade unions) in standardisation fora. The allocation of dedicated funding at the national and European levels and direct assistance would be the optimal policy

action to allow European companies to effectively lead on standardisation activities and consolidate Europe's leadership in global standards setting.

The EU needs to use the Standardisation Strategy and other tools such as the US-EU Trade and Technology Council (TTC) to keep an active role in standard-setting and in the development of strategies that promote technological and industrial interests through standards. The TTC has the potential to be an agile instrument that will help the transatlantic partnership to drive technological innovation among other things. In particular, it should increase joint investment and cooperation in standard development activities and projects in areas such as AI, semiconductors, and advanced manufacturing.

Finally, the High-Level Forum on standardisation should ensure European engagement in standard setting and coordinate effective representation of European interests in international standardisation fora.

22. **Continue adhering to the New Legislative Framework.** The New Legislative Framework (NLF) is an essential tool to support the proper functioning of the European Single Market for Goods. It is a success story for the Single Market that remains fit for the future, including in supporting the deployment of advanced manufacturing technologies. Policy makers should continue adhering to key principles of the NLF as it has provided legal certainty while being innovation friendly and extend the NLF principles to auxiliary software and digital processing services.

23. **Promote Digital Product Standardisation.** Advanced manufacturing product Standardisation and product certification (based on existing standards) needs to be more digitally supported. For instance, companies should have the ability to submit the product data as part of the product certification process. This would create a stream of "historical data" that could accelerate the certification process of other products that display multiple similarities. Existing standards do not currently support the use of historical data. Developing standards based on such data would be particularly relevant for the advanced manufacturing sector as it would enable it to achieve a more up-to-date, competitive, and flexible product standardisation and certification system, which can result in a more efficient and resilient manufacturing ecosystem.

5. Data Economy: facilitate data opportunities and address the challenges

Industrial data sharing is fundamental to the effective uptake of advanced manufacturing technologies, enabling increased productivity and efficiency, greater visibility and resilience in supply chains, and supporting further digitalisation and decarbonisation. Concerns and challenges around data – over-regulation, data costs, IP and cybersecurity, for example – are among the main reasons for the current underusage of advanced manufacturing solutions in Europe.

In particular, data flows (and data storing), essential for higher manufacturing productivity, need to become more affordable within the EU. High marginal costs are among the most critical obstacles to digitalisation of manufacturing processes inside and between companies.

We recommend:

24. **Foster trustworthy industrial data sharing and use.** The Data Act should leave room for industry-driven data-sharing models and commercial incentives for investment in data-based business models in manufacturing. Mandatory industrial data sharing should be targeted to demonstrated market failures. As currently drafted, the act introduces extensive new design, transparency and data access obligations imposed on data holders (including manufacturers), which will have substantial costs for them.

    The Data Act should also envisage a temporary exemption period during which manufacturers can establish, test and commercially exploit their data-based business models.

    The Cyber Resilience Act should become lex generalis concerning baseline requirements for the cybersecurity of connected products, software embedded into a product, industrial control systems and intellectual property. It should explicitly articulate its relationship with other legislation incorporating similar requirements (e.g. the NLF), and stipulate which legal act prevails. Any future cybersecurity policy actions should differentiate between Information Technology (IT) security and safeguarding of Operational Technology (OT) and hardware machines in the factory. For this reason, we recommend taking into account a sound plan of action related to OT security.

25. **Protect intellectual property rights and trade secrets.** The Data Act and the Ecodesign for Sustainable Products Regulation's Digital Product Passport should exclude IPR and trade secrets data from theirscope. Measures related to the information requested for market surveillance authorities must respect confidentiality related to trade secrets, IPRs, security laws and export control legislations (including dual use). Where IP is derived from disruptive, high cost and high-risk industrial commitments towards advanced manufacturing, it should be possible to protect and enforce protection of such IP. Where sustainable manufacturing innovations are not competitive against low-cost traditional production, the industry needs incentives to enable further investment in innovation and the implementation of advances into European manufacturing practices over the long term. IP is a major tool for this. IP is also a major contributor to AM partnerships and collaboration, which accelerate innovation and commercialization of new technology solutions.

26. **Support existing initiatives to create a strong European manufacturing data space.** Common digital standards are key to create scalable manufacturing data usage and optimally use existing platforms. For example, production information is provided via OPC UA Technology (IEC 62541) and is standardised in Companion Specifications. Together they are the Global Production Language (GPL). Information regarding product lifecycle data can be provided with the Asset Administration Shell (AAS) and is being standardised in Submodel Templates. With the right policy conditions, these

complementary technologies and standardised information can enable manufacturing data exchanges within and between business ecosystems. The Commission should embed OPC UA, its Companion Specifications, and AAS and its Submodel Templates, into the work and outputs of the European Manufacturing Data Spaces. The EU should also support use of the AAS as a technical solution for the digital product passport in the context of the Ecodesign for Sustainable Products Regulation.

27. **Protect personal data.** Personal data is frequently collected along industrial data. Therefore, personal data collection and storage should always be subject to a concrete and transparent purpose and observe all relevant GDPR requirements in place, including the principle of data minimisation.

28. **Develop clear, focused criteria on high-risk AI, avoid unnecessary regulation of industrial AI.** The AI Act should set clear and simple risk classification rules for defining high-risk AI. This will avoid bringing administrative and financial overburdens in applying AI in manufacturing and limitations that would discourage investments in the research, innovation and development of AI technologies. Such rules would allow that once identified, high-risk AI applications must undergo third party assessment in efforts to guarantee full compliance of the technology with fundamental and privacy rights. On the other hand, non-risk AI should be subject to self-assessment by companies. Also, the interplay between the AI Act and the relevant sectoral legislation (i.e. Machinery Regulation) should avoid the duplication of conformity assessment procedures and the overlap of regulatory requirements provided that fundamental rights' of workers are safeguarded. Finally, entities such as the European Digital Innovation Hubs should play a crucial role in helping local networks to raise industry awareness about AI, testing and integrating solutions and developing the necessary set of skills for the workforce.

6. Prioritise addressing the skills shortage.

The EU can be considered a knowledge hub in advanced manufacturing, given its high level of technology expertise and its base of research skills that supports improvements in several areas of the sector. Nevertheless, the advanced manufacturing industry continues to experience a wide skills gap, which slows down market growth, innovation and international competitiveness. This is particularly acute for smaller companies, and in regions undergoing transformation of manufacturing base towards digital and green outcomes. One of the main causes of skills shortages is that advanced manufacturing technologies are evolving faster than the development of the required skills through the education and industry pathways. To reduce the skills gap, it is critical to:

29. **Further expand efforts to strengthen skills and training in Europe**:

- Mobilise universities and centres of excellence to contribute to an advanced manufacturing skills 'roadmap/framework', with strong industrial integration, particularly through centres of excellence already dedicated to advanced

manufacture (eg National Institute for Bioprocessing Research and Training, Ireland).

- Support companies in creating workplace learning opportunities and providing access to flexible and specialised trainings and life-long learning for all workers by investing in new modes of employee training, credentialing, and learning.

- Raise awareness of industry about existing or upcoming reskilling and upskilling opportunities developed by EU funded projects, for examples the Skills. move platform created by EIT Manufacturing or the International AM Qualification System developed by the SAM project.

- Increase awareness amongst younger generations (especially at high-school level) of the advantages they come with a career in the advanced manufacturing sector. The number of students choosing vocational training after high school is drastically decreasing every year. At university level, subjects like mechanical engineering are no longer among the top three choices for students. This trend could be reverted with the development of didactic procedures (e.g. gamification) that would help increase students' interest in scientific subjects and give them first-hand experience in areas such as CAD file development, repairing machinery, etc. Therefore, we recommend launching different calls for proposals at both national and European level that would help develop interactive didactic modules (e.g. gamification in e-learning) to be used in high schools to promote a career in the advanced manufacturing industry.

- Increase the number of training and education available in Europe by supporting Vocational Educational and Training (VET) providers with the development of new specialised courses, as well as the infrastructure that would facilitate online and blended learning, upgrading training facilities, and purchasing the needed technology and training material. This should include training and education on standardisation. Such courses, particularly regarding vocational career opportunities, should be better advertised by training providers, industries, and other relevant stakeholders as valuable professional options able to offer alternative career paths and well-paid jobs.

- Support long and short-term placement of skilled SME employees, enabling skills transfer across Europe. This should be embedded in a framework of rights for every worker to job-to-job transitions, through law or collective agreement according to national practice. European Enterprise Network and specialised centres could facilitate such programmes.

- Make sure that private sector and social partners are included at all levels to ensure that the measures are targeted and fit for purpose.

- Recognise the contribution of the worker (in terms of know-how input for industrial algorithms) and support their transition into the new industrial era by providing education, and training opportunities and quality employment. Since Advanced Manufacturing growth will depend, among other things, on the quality of input data and skilled workforce, social partners and industry should work together closely to ensure that this transition leaves no one behind.

30. **Foster the harmonisation of VET practices and qualification systems**, placing more importance on overcoming bottlenecks at national level, which often slow down the adoption of VET practices and qualification systems developed by EU funded projects. Put in place a framework for fostering acquisition and the recognition of micro-credentials. Micro-credentials are new types of qualifications and short-study courses that are emerging as a prominent way to align workers' skills with Europe's digital and green transition.

31. **Encourage more women and girls to take up STEM subjects and work in manufacturing.** Gender equality is not just a matter of human rights, but a fundamental question to ensure competitiveness, knowledge, and skills. Diverse companies are usually more competitive than their peers, and often haven an above-average profitability. As a significant share of the female population does not consider manufacturing as a potential career. The manufacturing industry needs to seriously address gender equality if it wants to play a key role to overcome future threats. For this reason, it is essential:

    - To facilitate access to gender-disaggregated data, and to establish a good enough track-and-trace methodology, that helps analysing access and advancement of women in the industry, particularly with regard to their professional advancement, including in leadership positions, and to the gender pay gap in the industry. This data should also allow to analyse possible incentives that could encourage women taking up particularly leadership positions in manufacturing.

    - To engage girls in STEM, by supporting, guiding, and advocating for action on STEM gender equality; updating the educational curriculum that encourages scientific and technological vocation among girls and young women; providing tools, information, contacts to educational centres and families; giving visibility to role female models and developing ambassador programmes where female STEM undergraduates give talks at high schools and middle schools.

    - To not only attract more women and girls into manufacturing, but also to retain them there and to create equal career opportunities and attractive mentoring programmes. New leadership models need to be promoted and benchmarking models on equality and inclusion for the manufacturing industry need to be built.

    - At company level senior leaders should actively promote gender equality and the recruiting and selection processes should be finetuned along gender mainstreaming guidelines. Gender specific career paths should be developed and promoted Companies need to have clear equality policies in places, with the appropriate training of workforce and management.

    - Companies should work on an inclusive work environment that ensures a more balanced division of family responsibilities, with the same conditions for both women and men, such as paternity and maternity leave.

- Gender equality audits need to be established and goals for equal pay and equal representation need to be formulated and a reliable tracking of progress needs to take place.

32. **Develop Pact for Skills partnership and propose a Blueprint Alliance for Advanced Manufacturing.** A blueprint alliance for advanced manufacturing should be built on the work done by the Additive Manufacturing Blueprint Alliance and have a structure similar to the one developed for large and diverse sectors such as automotive and construction. Furthermore, a better cooperation between existing blueprints should be fostered in order to analyse and tackle those transversal gaps and opportunities. Such cooperation could be accelerated through a dedicated project that coordinates, supports and collects all the activities of the different blueprints (an example of such coordinated action is the project developed for the robotic sector Robotics Digital Innovation Network).

33. **Foster an entrepreneurial culture in Europe.** The entrepreneurial deficit in EU is an area of concern for the future economic and technological competitiveness. There are several business and cultural barriers that could justify this situation, for instance taxation or difficulties in scaling-up the business and a higher level of risk-averse culture. Providing solutions to foster digital entrepreneurship (e.g. access to information and funding available in all Member States) and the development of entrepreneurship skills, including through education, training programmes and facilitating peer-learning could help reversing this negative trend.

34. **Capitalise on European creative industries and creativity in general**. The Union's manufacturing industry can benefit from the presence of creative industries and creativity in general, provided appropriate links are made, for instance through the New European Bauhaus. In this context, it is important to foster creative jobs in manufacturing and enhance their attractiveness through public engagement.

7. Availability of data.

Multiple indicators show that Europe can be considered a strong player in the advanced manufacturing technologies and processes sector, while others point to the risks that this position is being eroded. To maintain a leading position, robust and up-to-date data is needed at European level to track strengths and weaknesses of this sector, and measure Europe's competitiveness in advanced manufacturing compared to other regions.

Due to the cross-cutting and horizontal nature of advanced manufacturing, there are currently no available indicators that could help quantify the "market size" of advanced manufacturing its cross-ecosystem contribution in terms of energy efficiency, creation of high-skilled jobs or reduction of environmental impact. For this reason, we recommend to:

35. **Identify a method for data collection in the advanced manufacturing category**. This should reflect the intersection of advanced manufacturing with multiple different industrial ecosystems, and should involve all the relevant players (industry, research community, social partners).

36. **Generate trusted data sets at European level for advanced manufacturing deployment, global competitive position, and economic/environmental/societal gains**. Collect data on the advanced manufacturing sector to identify the European industry's dependencies and strengths and quantify the sector's contribution to EU environmental, energy and competitiveness goals. General data that would be useful for this purpose includes:

- Throughput data at EU level since 2012;
- Data on trade: to measure market access to third countries;
- Data on infrastructure: to measure industrial access to needed ICT infrastructure -necessary for advanced manufacturing;
- Unit labour costs and particularly the rate of change in unit labour costs: to measure industry's competitiveness;
- Productivity by sector: This could also be a measure of automation and thus the application of advanced manufacturing;
- Industrial investments by sector; notably net investments: to measure new investments in capacity expansion and innovation. Industrial investments in "intangible goods" could also be interesting;
- Data on the potential of advanced manufacturing to increase overall sustainability in industry: data on the potential of advanced manufacturing to reduce energy use, waste and prevent pollution.

ANNEXES

1. SWOT analysis methodology

TF5 Members collected industry examples (use cases) that demonstrate how the deployment of advanced manufacturing technologies can improve the resilience of supply chains in the EU, develop new global market share and drive the digital and green transition across ecosystems. Furthermore, the TF5 dedicated particular attention to those strategic dependencies (e.g. raw materials and semiconductors) which could affect future EU leadership in this sector.

Individual SWOT analyses for each use case were supported by a general SWOT analysis that captures the common themes that emerge for advanced manufacturing. Interviews were conducted with both manufacturers of AM technologies and users of these technologies across different industrial sectors from February to end May 2022.

Separate SWOT analyses are structured around the following use cases:

- Additive manufacturing for aerospace
- Car T cell manufacturing in health
- Sustainable buildings in construction
- Additive manufacturing for medical devices
- Unified Water Operating Centres
- Digital nameplate for products
- Scaling up digitalisation of critical components in offshore wind turbines
- Batteries manufactured from trees
- Vitamin B2 production transformation from chemical to biological process

Ahead of conducting the analysis, SWOT participants (use case owners) were requested to use specific guiding questions as well as consider multiple factors (legislation, strategies, etc) listed below to help focus entries. The responses requested were short SWOT analyses, following a standardized format and with a maximum number of bullet points per response. Individual SWOT owners will be able to expand and use their SWOT analyses independently.

SWOT structure

Please consider factors below across the SWOT and mention others where needed: • EU Legislation • EU Strategies • EU Policy • Regulation • Standards • Market access/fragmentation • Skills • Research base • IP (& other incentives) • SME start up • SME growth and maturation • Large company uptake/investment • Scale up pathways • Investment (public and private)	**Strengths** • How is Europe favourable for the use case to gain EU and global market share and competitiveness?	**Weaknesses** • How does Europe underperform for this usecase? • What factors can Europe improve now to reach the full competitive potential of the usecase?
	Opportunities • What global market or industrial trends can Europe harness for this use case? *Market pull rather than technology push* • What factors can Europe use (and how) to maximise competitiveness of the use case? • What strategies or policy frameworks can Europe employ to best effect for competitiveness for the use case? • How can the usecase contribute to priorities in green and digital transition, resilience and supply chain security?	**Threats** • What and where are the global threats for European competitiveness and market share from the use case? • What factors are future threats from within Europe to usecase competitiveness?

SWOT participants were encouraged to look at advanced manufacturing in terms of its potential to contribute to Europe's competitiveness within the industrial strategy. In this context, participants focused on innovation, AM maturation, scale up and global market share. In addition, participants were invited to:

a) consider Europe's priorities of digital and green transition, supply chain resilience and security in their responses

b) address how these advanced manufacturing examples achieve economic impact at scale

c) address SWOT topics to include global factors that will influence European competitiveness (speed, scale up etc)

d) Social aspects of advanced manufacture – with specific reference to skills and employment

Specific aspects of the SWOT analysis were enriched with views from relevant stakeholders outside the Industrial Forum. For example, Ceemet has contributed to a section on 'access to skills' by providing a more employment/citizen aspect of a technology.

2. SWOT analysis per use case

Additive manufacturing (Aerospace)

Strengths	**Weaknesses**
• Europe is a technological knowledge hub AM in Aerospace, many European companies provide solutions in this sector (hardware, software, component development etc). • Large aerospace industry players have invested in research, standardisation and use of this technology (e.g. Airbus).	• Lack of research at EU level in some of the areas which limit the use of AM in aerospace (e.g. Production volumes, Accuracy in the production, Size of the part that can be 3D printed, Quality consistency, Scalability limitations and narrow range of materials). • Lack of qualified workers with design skills to allow lower-mass components with feasible complex designs.
Opportunities	**Threats**
• AM as an enabler of on-demand production increasing production efficiency, reducing logistics and transportation costs. • Improving aircraft sustainability by improving components design and producing optimized complex parts (fewer components, less material and waste).	• Compared to the European industries, Chinese and American enterprises have a much better-supported business ecosystem, which benefits from a direct public investment in technology development, digital infrastructure, standardization and market uptake. • Limited access to certain raw materials (e.g. titanium) could limit the development of AM applications.

Car T cell manufacturing (Health)

Strengths	Weaknesses
• The European ecosystem for start-ups and SMEs in immunotherapies is strong, with translational and start up mechanisms in place • Europe has established large companies active within investment and manufacture	• The EU is currently slower than FDA for medicines approvals, particularly for advanced cell and gene therapies. • Patient access is fragmented across 27 MS and makes the EU a secondary site for clinical trials and manufacture. This reduces long term investment decisions for manufacture and impacts SME growth, reducing patient access everywhere in Europe and diverting investment to other regions of the world at an important time to build critical mass
Opportunities	**Threats**
• Global trends is strong for CAR T therapies; McKinsey data suggests that clinical trials increased almost 20 fold from 2012 – 2019 to over 500, with an estimated FDA/EMA 21 approvals by 2024 (based on 2019 data). • Cross Border Healthcare creates a vital opportunity for patients and companies, as manufacturing sites cannot be established in all MS, especially in rare diseases.	• Access to capital (for manufacturing sites and SME investment), and faster market access outside Europe are the key global threats to development of European CAR T manufacturing capabilities. Europe has the capability to progress while the global market is established, however the speed of progression will dictates our level of global competitiveness.

Sustainable buildings (Construction)

Strengths	Weaknesses
• EU leadership on B2B digital solutions for vertical applications • Substantial capital allocated to EU govts to kick-start the EU economy COVID-19 (i.e. RRF) • Presence of EU regulatory incentives for building stock modernisation (i.e. EBPD)	• Under-usage of digital solutions (i.e. AI, IoT) in design, operation and maintenance of Europe's building stock. • Lack of digital skills at all levels in the construction industry
Opportunities	**Threats**
• Underdeveloped link between the green and digital transitions in public sector activities • Data cooperation to enhance access to and use of sustainability data such as that in buildings	• Failure to deliver on EU climate neutrality target if the enabling role of digital isn't properly recognised. Buildings account for 40% of all EU CO2 emissions, more than any other sector.

Unified water operating centres (Digital)

Strengths	Weaknesses
• EU leadership on B2B digital solutions for vertical applications • Substantial capital allocated to EU govts to kick-start the EU economy COVID-19 (i.e. RRF)	• Lack of climate change adaptation plans locally. Only 40% of cities over 150 000 inhabitants in the EU have one. • Lack of public government awareness of benefits of digital technologies for vertical applications
Opportunities	**Threats**
• Reduction of waste in water management thanks to digital. Water scarcity affects almost 20% of the EU. • Strengthening of water infrastructure resilience and productivity boost by 5-10% by 2025 thanks to digital.	• Continued fragmentation of water operations for water utilities in Europe leading to underperformance of water utilities. • Lack of usage of data generated in water operations, hampering Europe's quest for building a data economy.

Digital nameplate for products (Electronics and other)

Strengths	**Weaknesses**
• EU leadership on B2B digital solutions for vertical applications	• Slow uptake of digital compliance solutions among EU regulators
Opportunities	**Threats**
• Time, cost and resource savings thanks to digitalisation of compliance documentation	• Risk of documentation requirements excessively paper-based

Digitalisation of critical components in offshore wind turbines (Renewable energy)

Strengths	**Weaknesses**
• Competitive and well positioned European wind value chain covering all segments and components • Extensive installed fleet of windfarms in Europe (on shore and offshore) • Relevant progress of European initiatives in the definition and development of data sharing platforms and tools to ensure data sovereignty and security (IDSA, GAIA-X,...)	• Reluctance of Data owners (windfarm owners and operators, wind turbine OEMs) to share data collected from the wind turbines in operation. • Poor identification and assessment of the benefits of digitalization for data owners • Lack of definition of new (profitable) business models based on data collection, analytics and/or services
Opportunities	**Threats**
• Huge deployment of windfarms to deliver climate neutrality by 2050 (higher growth rates in offshore markets) • Digitalisation of wind farm operation and maintenance (O&M) will be a major driver of cost reduction, better performance and lower financial risk. • Digitalization opportunities in aging wind turbines fleet for life extension programmes • Substantial capital allocated to EU governments to kick-start the EU economy	• The pressure for cost reduction that prevents R&D efforts in the development of data analytics tools, and the introduction of digital innovations in components to provide higher added value to customers • Lack of the necessary skills combining digitalisation and wind technology expertise •

Vitamin B2: transformation from chemical to biomanufacturing (Agri-food)

Strength	**Weakness**
• Europe has significant strength in its research base for microorganisms applied into food and feed production • It has a strong industrial biotechnology ecosystem, from start-ups to established multinationals • Significant European food production industry increasingly using biomanufacture for sustainable transition	• Biomanufacturing in food is still an emerging production process compared to more established chemical manufacturing • Regulatory barriers exist within uptake of innovation through industrial biotechnology, with a process rather than product approvals pathway • Investment in significant biomanufacturer is primarily outside Europe.
Opportunity	**Threat**
• There is increasing EU consumer interest in sustainable products & processes • The global market for sustainably produced food ingredients is significantly growing • EU policy targets linked to Green Deal (e.g. reducing GHG emissions/fossil fuel use/biodiversity) are driving innovation and business focus	• Policymaker lack of recognition of biomanufacturing means that the sector risks being excluded or overlooked in key policymaking e.g. taxonomy supporting biomanufacture and sustainable financing • Regulatory pathways are not modernized and Europe falls significantly behind other global regions for market access, resulting in innovation and production switching elsewhere.

Batteries from trees (Electronics)

Strength	**Weakness**
• EU-based feedstock and operation • Strong IP ecosystem within Europe	• Slow market entry compared to existing anode competitor expansion • Lignin hard carbon requires customer adaptation
Opportunity	**Threat**
• Fast growing battery market with high demand for anode materials • Increased demand for sustainable battery materials with low Co2 footprint • In line with EU policies linked to Green Deal, Industrial Strategy, strategic action plan for batteries, and sustainable smart mobility strategy	• Rapid replication of technology once in market • Hard Carbon competitors strong within regions such as Asia • Potential local resistance from odorous process

Use of predictive maintenance to improve machine's performance and sustainability (Digital)

Strengths	**Weakness**
• Market leadership: European companies are among the strongest solution providers • Connection with ICT developers: Europe is one of the top players in developing ICT solutions for manufacturing	• Market uptake: Low uptake of the solution, particularly among SMEs, due to high costs • Skills: Skills shortage and low data literacy • Lack of vision and/or financial resources – traditional companies have difficulties in adopting Digital Factory solutions because of low interaction with innovators or leak of funds to support innovation
Opportunity	**Threat**
• Sustainability: Increases productivity and sustainability f manufacturing processes	• Data: Reluctancy among industries from the same ecosystem to share data on product maintenance • Legislation/standards: weak coverage of data/information ownership and relations with value generation

3. Summary of primary targets of recommendations

Recommendation	Commission	EU co-legislators	Member States	Industry	Research community	Trade unions
Implement an ambitious “net-zero” industrial plan for renewables and industrial efficiency technologies	X	X	X	X		
Expand the use of REPowerEU	X					
Ensure thorough and timely implementation of the upcoming energy savings directives			X			
Make future rules on circularity of manufacturing processes and products fit for purpose	X	X	X			
Adjust public procurement guidance to accelerate the uptake of advanced manufacturing technologies			X			
Boost communications of the environmental benefits of clean technology solutions made in Europe	X		X	X	X	X
Make better use of public investment in support of advanced manufacturing technologies	X		X	X	X	
Cautiously apply state aid instruments targeted at later stages in the innovation and deployment process	X		X			
Ensure the upcoming EU Taxonomy delegated acts recognise the potential of	X					

advanced manufacturing technologies for sustainability						
Ensure workable and proportionate rules on Due Diligence		X	X			
Accelerate ongoing negotiations on Free Trade Agreements (FTAs) with third countries and make sure that negotiated FTAs enter into force (such as the EU-Mercosur FTA)	X	X	X			
Strengthen EU semiconductor capacity and deepen global collaborations with partners with the EU Chips Act	X	X	X			
Provide incentives and funding to support actions to improve supply chain resilience, without directing specific outcomes	X		X			
Support local and regional industrial supply chains			X	X	X	
Leverage trade policy to secure access to Critical Raw Materials	X					
Narrow down the scope of the Single Market Emergency Instrument and promote mitigation measures for advanced manufacturing, which would safeguard the Single Market freedoms	X	X	X			
Provide all information companies need to expand and/or export via a single platform	X		X			
Impact assessments of national laws should include a Single Market test to minimise gold-plating	X	X	X			

Ensure expertise and timely delivery in standard setting	X		X	X		X
Enhance flexibility in Standardisation Requests	X		X	X		
Consolidate Europe's leadership in global standards setting	X		X	X	X	X
Continue adhering to the New Legislative Framework	X	X	X			
Promote Digital Product Standardisation	X		X	X	X	X
Foster trustworthy industrial data sharing and use	X	X	X	X	X	X
Protect intellectual property rights and trade secrets		X	X			
Support existing initiatives to create a strong European manufacturing data space	X	X	X	X	X	X
Protect personal data			X	X		
Develop clear, focused criteria on high-risk AI, avoid unnecessary regulation of industrial AI	X	X	X			
Further expand efforts to strengthen skills and training in Europe	X		X	X	X	X
Foster the harmonisation of VET practices and qualification systems			X	X	X	
Encourage more women and girls to take up STEM subjects and work in manufacturing	X		X	X	X	X
Develop Pact for Skills partnership and propose a Blueprint Alliance for Advanced Manufacturing	X		X	X	X	X

Foster an entrepreneurial culture in Europe	X	X	X	X	X	X
Capitalise on European creative industries and creativity in general	X	X	X	X	X	X
Identifying advanced manufacturing key indicators and economic activities	X		X	X	X	X
Identify a method for data collection in the advanced manufacturing category	X		X	X	X	X
Generate trusted data sets at European level for advanced manufacturing deployment, global competitive position, and economic/environmental/societal gains	X		X			

4. Links to other Task Forces

1. **TF 1: Systematic analysis of ecosystems:** The Forum will discuss the economic principles, the statistical methods and the data sources to monitor the implementation of the industrial strategy through the definition of performance indicators. TF 5 will need to coordinate with this work so that the monitoring of the competitive position in advanced manufacturing is connected and compatible.

2. **TF 2: Support development of transition pathways:** Advanced manufacturing is a key building block for many ecosystems. If Europe loses momentum on the manufacturing side, this will have a knock-on effect on the ecosystems as such. Focusing on advanced manufacturing as a part of the blueprint for pathways will allow the identification of joint needs for skills, competences, technologies and data.

3. **TF 3: Support for analysis of strategic dependencies:** In addition to the focus on current gaps and strategic dependencies, TF5 members believe the focus for the next stage of the analysis on dependencies should focus also on where the task force sees risks for future dependencies. As outlined before, a dedicated focus on where the risks and challenges might emerge regarding manufacturing is needed.

4. **TF4: Cross-border and cross-ecosystem investment needs and cooperation opportunities:** to remain a leader, Europe needs to pool its knowledge across borders and ensure both private and public actions around advanced manufacturing are coordinated where possible. Such coordinated action will enable a wide range of ecosystems to benefit. Turning it around, if Europe continues a fragmented approach with a lack of urgency, it clearly risks losing its global leadership in the coming decade.