



MADE IN EUROPE

The manufacturing partnership in Horizon Europe

Made in Europe

The manufacturing partnership in Horizon Europe (2021 – 2027)

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1 Summary

1.1 Draft title of the European Partnership

The “Made in Europe” Partnership

1.2 Lead entity (main contact)

The lead entity for the Made in Europe Partnership is the European Factories of the Future Research Association (EFFRA; www.effra.eu). EFFRA brings together companies from the entire manufacturing supply chain, including production technology providers and users of such machinery and equipment. On the academic and research side, all leading European research institutes, technical universities and other organisations are part of the community.

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1.4 Summary

European manufacturing is at the centre of a twin ecological and digital transition, being both driver and subject to these changes. At the same time, manufacturing companies must maintain technological leadership and stay competitive. The size and the complexity of the associated challenges - such as the integration of Artificial Intelligence, the use of industrial data, the transformation into a circular economy and the need for agility and responsiveness - requires pooling of resources and a novel approach of cooperation.

The Made in Europe Partnership will be the leading European lighthouse and driver of this change, bringing together the leading actors from manufacturing and relevant European industrial ecosystems, coming from academia, industry, non-governmental organisations and the public sector. The Partnership will serve as a platform for national and regional manufacturing technology initiatives and the required disciplines and technologies, creating economies of scale, common understanding and alignment of objectives and priorities. Strategic cooperation with key actors at national, regional and local levels will be developed, to ensure urgently required exploitation and implementation of research results.

Based on joined expertise and resources, the Made in Europe partnership will be the voice engine for sustainable manufacturing in Europe. It will boost European manufacturing ecosystems towards global leadership in technology, towards circular industries and flexibility. The Partnership will contribute to a competitive, green, digital, resilient and human-centric manufacturing industry in Europe.

2 Context, objectives, expected impacts

2.1 Context and problem definition

2.1.1 European Manufacturing challenged by international competition and environmental impact

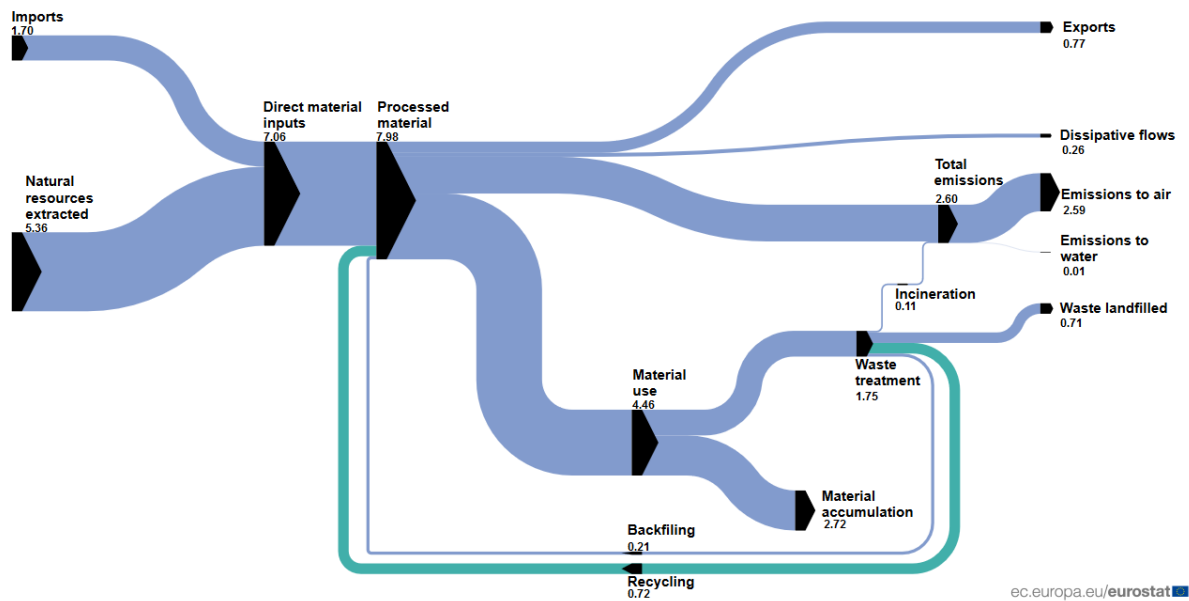
Europe is home to a competitive, wealth-generating manufacturing industry and of extremely comprehensive manufacturing ecosystems which accommodates complete manufacturing supply chains. Europe's manufacturing industry is the **backbone of the European economy**, bringing prosperity and employment to citizens in all regions of Europe.

The EU is a global market leader for high-quality products, and European Industry is the **world's biggest exporter** of manufactured goods. Manufactured goods represent 83% of EU exports. Thanks to the strengths of its manufacturing industry, the EU annually achieves a considerable trade surplus in the trade of manufacturing goods, which accounts for 286 billion euro in 2018¹. This healthy surplus generated by the manufacturing industry allows the EU to finance the purchase of other, non-manufactured goods and services, such as raw materials, energy (oil and gas), and services. The surplus in manufactured goods thus compensates the deficits which are generated by purchasing non-manufactured goods. However, the surplus generated by EU's manufacturing sector cannot fully compensate these deficits anymore: the overall EU trade balance (counting both manufactured goods and non-manufactured goods) changed from a surplus of 22 billion EUR in 2017 to a deficit of 25 billion EUR in 2018. From a macro-economic perspective, this is not a healthy situation in the long run, and shows the importance of a strong manufacturing industry.

Although Europe's industry is a world-wide technology leader in most manufacturing market segments, this position is constantly being challenged by **international competitors**. While being highly competitive, statistics show that the EU manufacturing industry constantly needs to keep up with international competition. Competitors, especially from Asian economies, have reached advanced levels, often supported by state-supported programmes. Furthermore, industrial structures are changing with significant foreign investments, including those by emerging economies, in Europe and in the US. And finally, such as large scale digitalisation, changes in trade rules, and global environmental concerns create new challenges.

European industry is also driving the **transformation to climate neutrality and sustainable circular economy**. While faced with increasing international competition, European manufacturing companies are at the same time in the process of constantly becoming "more productive with less", both in terms of material usage and energy consumption. The manufacturing industry is in a key position to enable the transformation to truly circular business models and the production of new environmentally friendly products in existing or emerging value chains. For 'true' circularity and zero-waste much has to be done, as illustrated by the graph below. Although the process has started, the speed of change needs to increase. The need to achieve circularity and minimal environmental impact implies radical innovations in manufacturing and related value chains to produce future green products.

¹ Eurostat.



Source: Eurostat; material flows true scale in Gt/year (billion tonnes per year) in 2017, EU27

2.1.2 Today's challenges and opportunities for Europe's manufacturing industry

Despite competitive pressures on a world-wide level, Europe can still be seen as the technology and sustainability leader in many areas. European companies have been successfully operating in global markets and are champions in a wide range of sectors. At the same time, their environmental impact is usually smaller when compared to non-European companies.

Nevertheless, the European manufacturing industry is currently going through an exceptional transformation process that is driven by several factors:

1. European society demands **minimal environmental impact** of industry. European industrial companies need to re-evaluate their resource efficiency and the carbon intensity of their entire supply chains. Changes of policy frameworks, markets and customer preferences induce structural changes in manufacturing value chains, for example the move to electro-mobility in the case of the automotive sector. On the other hand, increasing environmental consciousness is an opportunity for European-made environmental-friendly but high-priced products.
2. In addition, **Circular Economy models** and next-generation **sustainable materials and products** induce profound changes in manufacturing systems and their supply chains. This requires life-cycle thinking from product design and production, via use, to recycling and remanufacturing.
3. The current COVID-19 crisis manifested the **vulnerability of industries** and the **unpredictability of external shocks**. Such unpredicted external shocks can have many causes: be it a pandemic like COVID-19, a tsunami and nuclear accident (Fukushima 2011), a financial crisis, a possible trade war or any other event which cannot be known in

advance. These events once more show that the European manufacturing industry needs to become **resilient and agile**. It showcases the importance of possessing **flexible and reconfigurable production lines** within a country or region.

4. The COVID-19 crisis also demonstrated the dependence of European Industry on global sourcing. European industry needs to **regain or at least maintain manufacturing sovereignty** and sustain technological leadership in key areas. Improving the level of **sovereignty in key areas** and **critical value chains** takes time and calls for a coordinated European effort on manufacturing.
5. **Digitalisation and new technologies** offer immense opportunities which accelerate innovation and industrial transformation. Digitalisation is changing value chains, increasing the overall efficiency of manufacturing. Digital technologies need to be developed to fit industrial conditions.
6. The **data economy** will affect how to do business, create value, and connect to customers. Opportunities for growth will emerge for companies understanding the data economy and digital transformation also from the non-technological (i.e. business, human, legal, ethical) point of view. This process is still at the beginning; for instance, European companies have not yet embraced the potential of monetising the data they possess and work with it.
7. Nevertheless, at the same time, digitalisation also involves some threats which need to be mitigated: the more digital manufacturing companies become, the more vulnerable they are in terms of **cyber-security**.
8. **New business models** are emerging or are further developed. Suppliers of manufacturing solutions are increasingly becoming service companies, data and software companies, or they establish alliances with data companies and disruptive start-ups. Concepts, such as "manufacturing-as-a-service" and "collaborative product-service engineering" are taking shape.
9. The fast-moving transition towards smart autonomous systems and the increased use of Artificial Intelligence, Machine Learning and collaborative robots is changing the **interactions between humans and technology**. The European society – citizens, consumers and workers – is in the process of adopting and accepting these key technologies which are needed for industrial competitiveness.
10. Companies are concerned about shortages of **skilled personnel**, also considering an ageing workforce. In particular, for SMEs, the shortages of qualified staff and talents have become a major barrier and threat.
11. **International competition** is high, especially from Asia. In Asia and America, big public-private manufacturing partnerships are being launched (such as Made in China).
12. With the majority of the EU's population living in urban areas, environmentally friendly and low-emission production is more important than ever in order to fulfil local acceptance, regulations, etc. While manufacturing companies are locating or re-locating, **societal challenges** need to be considered simultaneously.

All these developments put Europe's manufacturing industry in a challenging position. While still competitive and at the forefront of technology, there is a risk that Europe loses its manufacturing leadership position to Asia and America if technology investments are not synchronised. In particular, the situation is challenging when considering the data and data platforms that are crucial for manufacturing competitiveness. Europe needs to accelerate innovation and investments as well as effectively roll out and adapt the resulting innovations over the many manufacturing companies in Europe.

2.1.3 Compared to the past, there is a need for a more ambitious and better-coordinated approach

In Europe, most of the research and innovation efforts are being done by European Industry; some 70% of Europe's research investments are performed by Europe's engineering and manufacturing companies. Pre-competitive collaborative research has a long tradition in Europe: companies operate within regional innovation and industrial ecosystems, often with world-class companies in the lead, and with many other companies (often SMEs) and research institutes being involved. Moreover, national and regional public initiatives provide support to these ecosystems, for example advanced manufacturing, smart manufacturing, or fourth-industrial-revolution initiatives in Member States. Cooperation between initiatives has been facilitated by the ManuFuture ETP, EFFRA and the Factories of the Future PPP. These initiatives have helped to gain new insights and innovations, which have been shared between Europe's regions.

Given the vast challenges which are described in the previous chapter, public and private actors need to reinforce cooperation to help Europe's manufacturing industry to overcome these challenges and embrace new opportunities. An **ambitious European partnership in manufacturing** is needed to:

- pool resources from scattered regional, national, and European manufacturing initiatives to support European manufacturing industry so that it can compete with competitors supported by vast investments done outside Europe;
- boost digital transformation and data-based business in manufacturing industries;
- speed up the transition to green and resource-efficient manufacturing value chains;
- roll out the developed technologies to companies, especially SMEs, in all regions of Europe;
- support the workforce in continuous learning and technology adoption.

The new Made in Europe roadmap is distinct from previous roadmaps by the Factories of the Future partnership. It is clearly targeted on the twin ecological and digital transitions. It is more ambitious in terms of technologies, sustainability and business approaches, and it aims at embracing additional opportunities arising from global trends, environmental needs, and changing consumer preferences.

Regarding the scope and sectors covered, the proposed Made in Europe Partnership will include activities to advance logistics and packaging, bottling and sorting, waste processing and sophisticated structures for the construction industry, which were not in the focus of the Horizon 2020 PPP Factories of the Future.

The Made in Europe Partnership – planned to be jointly implemented by the European Commission (DG RTD, DG Connect) and by EFFRA – becomes the centrepiece, which brings together companies, RTOs, academia, societal actors, and national/regional manufacturing initiatives. Particular attention is paid to smaller companies that need to be included in the transition to sustainable and digital. This comprehensive approach will bring together the amount and diversity of expertise, knowledge, and assets that single companies, single regional ecosystems, or even single national initiatives alone cannot achieve.

The European Partnership needs to address the entire manufacturing value chain in Europe and concentrate on spreading manufacturing excellence among companies, especially SMEs and including product design, engineering and manufacturing start-ups and scale-ups. The partnership will guarantee the competitiveness, sustainability and sovereignty of Europe's manufacturing industry, defend Europe's technology leadership in the world as well as the prosperity and well-being of employees, consumers, and society.

The Partnership will contribute strongly to the interaction among key players that steer and/or implement national and regional manufacturing innovation initiatives. New actors will be involved and listened to, such as local authorities in charge of attracting industry to cities and communalities.

2.2 Common vision, objectives and expected impacts

2.2.1 Vision for 2030

Europe's manufacturing industries' vision for 2030 is to **reinforce its global position in terms of competitiveness, productivity, and technology leadership**². The goal is to increase the **number and attractiveness of jobs**, while at the same time securing the **environmental, economic and social sustainability** for future generations in Europe. While global competition is increasingly challenging, Europe will reinforce its position because of its **technological leadership** and capacity to handle complexity and to fully embrace **digital technologies** which in return provide the basis to increasing services around manufacturing and along the product lifecycle.

Europe will specialise in the engineering of complex and highly interconnected value creation processes and systems. Its experience, creativity and unique tradition and identity will support the consolidation of European manufacturing. In 2030, the European manufacturing industry will be delivering **excellent solutions**, ensuring individual user-satisfaction (including customised products and services), high quality and environmental and social sustainability. Europe will be the leader in manufacture engineering for **highly personalised and complex products and services** in a broad range of sectors, including aeronautics, automotive, production equipment, renewable energies, space and defence, and customer goods.

In 2030, Europe will be at the forefront of **resource efficiency and circular economy** implementation, which will contribute to its competitiveness at the global level and support its environmental sustainability. Manufacturing systems in Europe will be flexible and resilient, with optimal balance and integration between humans and machines. The European workforce will develop new skills to be prepared to address these challenges.

Europe will be the **leading "solution provider"** in production technology, digitalisation, resource efficiency and circular economy implementation, which can only be achieved through the continuous development and exploitation of new technologies. Research and innovation will promote industrial digital transformation and thus enhance the competitive strengths of European companies, products, production systems, and services.

This vision focuses on **ensuring competitiveness and sustainability**, and supporting **resilient and adaptive** manufacturing ecosystems able to cope with external disturbances and rising environmental and social requirements. The transformation to a circular economy will need **innovative business models**, which will furthermore rely on the data economy.

² http://www.manufuture.org/wp-content/uploads/Manufuture-Vision-2030_DIGITAL.pdf

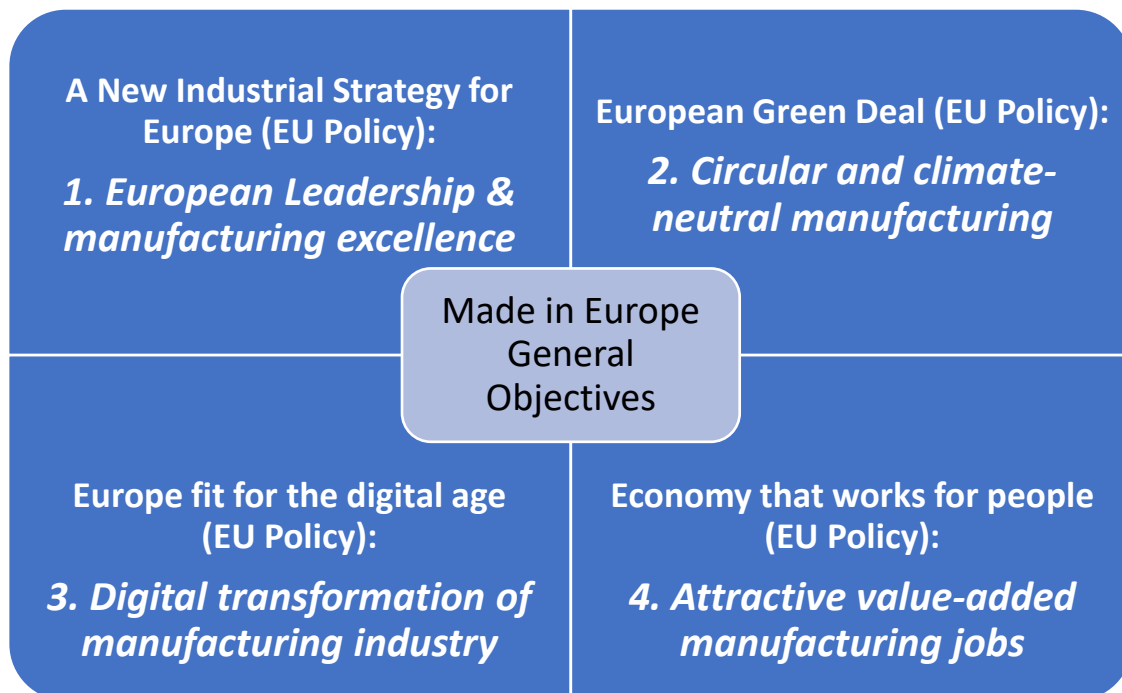
2.2.2 *General objectives of the Made in Europe Partnership: providing support to different EU policies*

The Made in Europe Partnership will take a leading role in the transition of manufacturing towards a sustainable, economically successful activity with proper consideration of the well-being of workers and society. Achieving these principles will require further digital transformation of the manufacturing industry.

Made in Europe Partnership has four General Objectives, namely:

1. ***Ensuring European Leadership & manufacturing excellence***
2. ***Achieving Circular and climate-neutral manufacturing***
3. ***Mastering the Digital transformation of manufacturing industry***
4. ***Creating Attractive added-value manufacturing jobs***

These four Partnership Objectives are related to different EU policies which address manufacturing: these are (i) the new industrial strategy for Europe, (ii) the European Green Deal, (iii) a Europe fit for the digital age and an Economy that works for people.



Graph: The four General Objectives the Made in Europe Partnership, in line with the EU’s political priorities which address manufacturing industries.

2.2.3 Specific objectives of the Made in Europe partnership

The following four Specific Objectives drive the Made in Europe Partnership, by providing a clear focus on the generation of **impact**. The specific objectives will be broken down in more detailed Research and Innovation Objectives, which will then become inputs for the preparation of future work programmes (See Annex 1 for the Research and Innovation objectives and Annex 2 for a list of Key Technologies and enablers).

2.2.3.1 Specific Objective 1: Efficient, responsive and smart factories and supply chains

Made in Europe aims to contribute to more efficient, responsive and smart factories and supply chains. Efficient and responsive production combines speed, precision, quality and reliability with flexibility and agility. Manufacturing companies need to produce from very small lot-sizes to big volumes and there is a growing need for the ability to quickly scale up from small to big lot-sizes whilst retaining the required quality in **zero-defect and first-time-right** production. Made in Europe will provide technologies and methods for zero-defect and zero-downtime high-precision manufacturing, including predictive quality and non-destructive inspection methods. It will also contribute to technologies for scalable, reconfigurable and flexible first-time-right manufacturing.

The manufacturing industry needs to respond quickly to market disruptions, changing customer demands, fluctuating characteristics of raw materials and components, and advanced emerging technologies that can be potential differentiators. Simultaneously, the manufacturing industry needs to increase quality and efficiency and reduce Total Cost of Ownership. Hence, upgradable and robust manufacturing systems and plants are necessary for **flexible, responsive and resilient manufacturing**. Here, Artificial Intelligence, advanced robotics and other digital technologies will help. Therefore, Made in Europe will drive research in AI for manufacturing that is geared towards concrete applications based on context-dependent data collection, and assurance of data quality.

Products are increasingly complex with increasing amount of electronics or micro-features and advanced (multi-)materials. Products are also becoming smarter, stronger, lighter and more miniaturised and functionally integrated whilst remaining safe and secure. Completely new solutions will be introduced when designing future **sustainable products** enabling durability, energy-saving, the replacement of scarce or hazardous materials. Manufacturing system capabilities need to follow product and material roadmaps to enable the viable and sustainable manufacturing of these high-tech products. Made in Europe will contribute with advanced manufacturing processes to a new smart and complex products and solutions. Made in Europe will enhance parallel product and manufacturing engineering and the design for end-of-life/re-use/recycling, which contributes to sustainable products, services and manufacturing networks.

Highly complex, low volume products are mostly manufactured in (regional) ecosystems with a large number of SME first- and second-tier suppliers for world-class OEMs. Such ecosystems require data spaces with standardised data formats for the exchange of design, manufacturing, logistics and other data. Made in Europe will contribute to **responsive value chains** by studying advanced data spaces to support smart factories sharing data with other organisations.

2.2.3.2 Specific Objective 2: Circular products & Climate-neutral manufacturing

Made in Europe aims at ultra-efficient, low energy, circular and carbon-neutral manufacturing. Made in Europe will exploit the possibilities offered by advanced materials, digital technologies and manufacturing technologies to achieve a considerable reduction of the ecological impact and CO₂-emissions. On an ecosystem level, **recycling and re-use** of materials and components will be increased while still raising the performance of the manufactured products.

With higher expected CO₂ prices and scarcity of key materials, the economics of manufacturing and materials use and re-use will change. This will have an impact on manufacturing technologies and will require **new, different manufacturing equipment**. Hence, Made in Europe will study advanced de-manufacturing, re-manufacturing and recycling technologies for a circular economy involving manufacturing with new and substitute materials.

Resource-efficient or circular approach necessitates the understanding of material flows and cooperation among organisations along the life-cycle and across sectors. This will require appropriate metrics and parameters which allow optimisation along the life-cycle. **Circular-by-design approach** needs to be applied including virtual end-to-end life-cycle engineering and manufacturing from product to production lines, factories, and networks. Moreover, digital platforms and data sharing solutions are needed to enable the management of circular product and production-systems life-cycles.

2.2.3.3 Specific Objective 3: New integrated business, product-service and production approaches; new use models

The service component of the revenues generated by products, in particular B2B products, continues to increase. Made in Europe will **couple** more tightly the design, manufacturing and (re-)configuration of products **with the services** that are associated to these products, considering also that these services evolve along the lifecycle of these products. In this context, product-service systems can be manufacturing systems that enable excellence and flexibility in future manufacturing, as well as high-value systems in areas such as mobility, energy, and health. Designing and engineering product-services, with growing amounts and value of software, requires interaction between many stakeholders from both the user- and supplier-side. Hence, the need for collaborative and digitalised ecosystems increases.

The increasing complexity of products, growing sustainability requirements, and the increasing innovation rate require that **product design and engineering are carried out in parallel with manufacturing system engineering and configuration**. In this context, the notion of Digital Twinning plays a role, where for each product design and each manufactured product a virtual/digital representation is maintained. Made in Europe will develop new technologies and methods for collaborative product-service engineering and manufacturing for customer-driven value networks.

In the future, efficient and smart factories can fully offer and deploy their capabilities in **dynamic and sustainable manufacturing ecosystems** where digitalisation delivers new ways

to interact with customers, consumers, and users. Made in Europe will contribute to making this a reality, and will define approaches for implementing manufacturing processes that are closer to customers or consumers (urban manufacturing).

While products become more and more customised, the **end-to-end integration of manufacturing networks** is important, including logistics, which is a critical factor for unleashing the potential of very flexible distributed production. Made in Europe will develop technologies and methods to enable dynamic and sustainable value networks by the continuous and secure integration of digital technologies (5G, distributed ledgers, AI, etc.) into legacy approaches, supporting hardware and software lifecycle optimisation of products and manufacturing systems. This will lead to transparency, trust, and data integrity along the product and manufacturing lifecycle.

2.2.3.4 Specific Objective 4: Human-centred and human-driven manufacturing innovation

Humans are at the core of the **innovation process**, increasingly supported by data analytics and decision support systems. Innovation is a process where different processes and disciplines (technological and non-technological) converge into concrete solutions and implementations. Made in Europe will develop new approaches and tools (including strategy management) that strengthen the capability of industrial actors to draw value from external sources of creativity, including start-up companies.

Design and development of advanced technologies will consider the **role of the workforce** at the earliest stages and will consider the available or required additional skills of the people involved. The full benefit of new tools based on advanced technologies can only be achieved by designing new work practices and by involving employees in the co-design. It is, for instance, of great importance to investigate how human knowledge and skills can complement Artificial Intelligence solutions and how smooth human-AI or human-robot interaction can take place. Made in Europe will improve human-device interaction using augmented and virtual reality and digital twins. It will also study human-technology complementarity in achieving excellence in manufacturing.

The implementation of innovative solutions is often subject to reluctance, either associated with potential failure or because decision-makers and/or the workforce are faced with the unknown. **Change management approaches** are required to provide clear insights into the risks and benefits that are associated with change while involving all stakeholders in the process. This should also be associated with anticipating the required skills. Intelligent technologies will need to adapt to their users, while also addressing privacy and understanding workers. It is also important to empower and engage workers to co-design future tools and work practices, and to consider personal preferences in the process of manufacturing innovation and change management. Made in Europe will define such change management approaches.

2.2.4 Contribution to European Union and United Nations policy objectives

The Made in Europe Partnership will support and directly contribute the following EU policies:

- (i) A New Industrial Strategy for Europe
- (ii) The European Green Deal
- (iii) Europe fit for the digital age
- (iv) An economy that works for people

Indirectly, the Made in Europe Partnership also contributes to the EU policies "Promoting our European way of life", "A stronger Europe in the world", and "A new push for European democracy".

The following sub-chapter will explain in more detail how the Made in Europe Partnership will significantly contribute to these EU policies; moreover they also contribute to the UN Sustainable Development Goals.

2.2.4.1 A New Industrial Strategy for Europe: European Leadership and manufacturing excellence, generating new products and new markets

The new EU Industrial strategy aims at improving the European industry's global competitiveness. Competitiveness is also a top priority for the Made in Europe Partnership. Any European manufacturing company has a constant need to strive for excellence and improvements in productivity and quality. This requires producing top quality goods, being highly efficient in terms of costs and resources, while being responsive to the market & customer needs, and using and offering creative and innovative solutions. More than ever companies can only achieve this via cooperation and strong integration in value or knowledge networks. The pre-condition for competitiveness is that European industry can act autonomously and has access to first-class technologies, advanced materials, processes and methodologies, preferably from European sources.

Innovative, sustainable and affordable products are only possible when reliable and performant manufacturing technology is available, which in turn ensures the integration of key technologies, fast and smooth upscaling and conformity with societal requirements. In future, products (incl. machines and components) will have to meet increasing requirements in terms of customisation, flexibility, transparency and environmental impact.

The Made in Europe partnership will provide full attention to the relationship between material and product innovation and production process innovation along their lifecycles. This involves closing the loop between product and production process innovation in the short-term (for example by 'design for manufacturing') as well as anticipating longer-term technology roadmaps for product sectors, aligning them with production technology roadmaps. Moreover, it will account for new servitisation business models where the design and manufacturing of products, the leasing and remote monitoring/maintenance and return of products leads to new paradigms. Hence, the impact of the partnership will be maximised across different product sectors from material producers up to OEMs and service providers.

Within Made in Europe, the **specific objective 1 ‘Excellent, responsive and smart factories and supply chains’** is the centre of focus with respect to contributing to the policy **‘New Industrial Strategy for Europe’**. The associated research and innovation actions will address key priorities such as:

- Zero-defect and zero-downtime high-precision manufacturing, including predictive quality and non-destructive inspection methods
- Advanced Manufacturing processes for smart and complex products
- Manufacturing for miniaturisation and functional Integration
- Scalable, reconfigurable and flexible first-time-right manufacturing
- Artificial intelligence for productive, excellent, robust and agile manufacturing chains - Predictive manufacturing capabilities & logistics of the future
- Data ‘highways’ and data spaces in support of smart factories in dynamic value networks

However, the other specific objectives contribute also significantly to the policy **‘New Industrial Strategy for Europe’**, for instance:

- Specific objective 2 ‘Circular products & Climate-neutral manufacturing’, with priorities such as:
 - Manufacturing with new and substitute materials
 - Virtual end-to-end life-cycle engineering and manufacturing from product to production lines, factories, and networks
- Specific objective 3 ‘New integrated business, product-service and production approaches; new use models’, with priorities such as:
 - Collaborative product-service engineering for customer-driven manufacturing value networks
 - Secure communication and IP management for smart factories in dynamic value networks
- Specific objective 4 ‘Human-centered and human-driven manufacturing innovation’, with priorities such as:
 - Human & technology complementarity and excellence in manufacturing
 - Technology validation and migration paths towards industrial deployment of advanced manufacturing technologies by SMEs

2.2.4.2 European Green Deal: Circular and climate-neutral manufacturing

The Made in Europe Partnership will be one of the key research & innovation programmes to accelerate reaching some of the essential goals of the European Green Deal: making the EU climate neutral by 2050, boosting the economy through green technology, creating sustainable industry and transport, and cutting pollution.

European Industry will undergo a drastic reform in the coming years associated with huge investments in new innovative technologies and integrated approaches. Climate change, resource scarcity and the impact of waste on the earth's ecosystems will change manufacturing paradigms. Made in Europe will develop new technologies and methods for circular, low-environmental impact and low-carbon approaches while increasing energy and resource efficiency in manufacturing. Energy and power technologies will further enable resilient and sustainable manufacturing, by deploying integrated approaches which cover life-cycles and link different sectors, disciplines and ecosystems. In addition, new production systems and concepts will be needed when manufacturing increasingly uses recycled materials or when remanufacturing happens.

The transformation to a circular economy will lead to the development and introduction of innovative business models, which will furthermore rely on the data economy. Likewise, environmental-friendly high-quality repairable products require manufacturing excellence and flexibility. The Made in Europe contributions to the European Green Deal go hand in hand with its contributions to the New Industrial Strategy for Europe and to a Europe Fit for the Digital Age.

Within Made in Europe, the **specific objective 2 'Circular products & Climate-neutral manufacturing'** is the centre of focus with respect to contributing to the policy **'European Green deal'**. The associated research and innovation actions will address key priorities such as:

- Ultra-efficient, low energy and carbon-neutral manufacturing
- De-manufacturing, re-manufacturing and recycling technologies for the circular economy
- Manufacturing with new and substitute materials
- Virtual end-to-end life-cycle engineering and manufacturing from product to production lines, factories, and networks
- Digital platforms and data management for circular product and production-systems life-cycles

However, the other specific objectives contribute also significantly to the policy **'European Green deal'**, for instance:

- Specific objective 1 'Excellent, responsive and smart factories and supply chains', with priorities such as:
 - Zero-defect and zero-downtime high-precision manufacturing, including predictive quality and non-destructive inspection methods
 - Scalable, reconfigurable and flexible first-time-right manufacturing
- Specific objective 3 'New integrated business, product-service and production approaches; new use models', with priorities such as:
 - Manufacturing processes and approaches near to customers or consumers (including urban manufacturing)
 - Transparency, trust and data integrity along the product and manufacturing life-cycle
- Specific objective 4 'Human-centered and human-driven manufacturing innovation', with priorities such as:

- Technology validation and migration paths towards industrial deployment of advanced manufacturing technologies by SMEs

2.2.4.3 A Europe Fit for the Digital Age: Digital transformation of manufacturing industry, trusted and robust

The Made in Europe partnership aims to boost the digital transformation of the manufacturing industry. This transformation involves the deployment of a vast range of advanced technologies and organisational, human and skills-related enablers. For decades, manufacturing operations profited from increased physical automation of physical operations, and now the fourth industrial revolution brings new digital technologies (e.g. AI, IoT, CPS) into use and enables demand-driven operations and true flexibility in the manufacturing industry. In addition, new data-driven business models will emerge.

The 'digitalisation of manufacturing' is a key component of the transformation of the manufacturing industry. Digital technologies and approaches connect people, devices, machines and enterprises, including concepts such as the 'Industrial Internet', 'digital manufacturing platforms', the 'Industrial Internet of Things' (IIoT), artificial intelligence/machine learning, digital twinning, etc. The Partnership will bring together operational technology (OT) and information technology (IT) for manufacturing and will provide inspiring demonstrators, pilot sites, and field labs. The Partnership will support industrial Digital Innovation Hubs that fuel the digital transformation of manufacturing and engage SMEs in the digital transformation.

Within Made in Europe, all specific objectives contribute to the policy '**A Europe Fit for the Digital Age**'. The associated research and innovation actions will address key priorities, for instance:

- Specific objective 1 'Excellent, responsive and smart factories and supply chains', with priorities such as:
 - Zero-defect and zero-downtime high-precision manufacturing, including predictive quality and non-destructive inspection methods
 - Scalable, reconfigurable and flexible first-time-right manufacturing
 - Artificial intelligence for productive, excellent, robust and agile manufacturing chains - Predictive manufacturing capabilities & logistics of the future
 - Data 'highways' and data spaces in support of smart factories in dynamic value networks
- Specific objective 2 'Circular products & Climate-neutral manufacturing', with priorities such as:
 - Virtual end-to-end life-cycle engineering and manufacturing from product to production lines, factories, and networks
 - Digital platforms and data management for circular product and production-systems life-cycles
- Specific objective 3 'New integrated business, product-service and production approaches; new use models', with priorities such as:

- Collaborative product-service engineering for customer-driven manufacturing value networks
 - Manufacturing processes and approaches near to customers or consumers (including urban manufacturing)
 - Transparency, trust and data integrity along the product and manufacturing life-cycle
 - Secure communication and IP management for smart factories in dynamic value networks
- Specific objective 4 ‘Human-centered and human-driven manufacturing innovation’, with priorities such as:
- Digital platforms and engineering tools supporting creativity and productivity of manufacturing development
 - Improving human device interaction using augmented and virtual reality and digital twins.
 - Human & technology complementarity and excellence in manufacturing
 - Manufacturing Innovation and change management
 - Technology validation and migration paths towards industrial deployment of advanced manufacturing technologies by SMEs

2.2.4.4 An Economy that Works for People: Attractive value-added manufacturing jobs

With increasing challenges and introduction of new technologies, the need for adequate skill sets in manufacturing continues to grow. However, manufacturing companies currently face shortages of skilled workers. Insights into future job profiles and skills-related challenges and solutions need to be continuously planned for and responded to. While manufacturing is already under transformation to knowledge work, future innovations need to provide a better understanding as to how employees create and modify their jobs and how new technologies and social innovations are introduced and used by the current workforce. The twin ecological and digital transitions will require reshaping human-machine relations, preparing people with the right capabilities, and providing the right tools and interfaces. In this context, digitalisation can provide work communities with more productive tools. Operational technology (OT) employees need to receive proper training to use information technology (IT). With the speed of digitalisation, all employees need continuous training at work. Older employees, in particular, are at risk as they did not receive proper training in digital technologies while at school.

In addition to shortages of skilled workers, the shortage of experts such as data scientists and engineers is a major barrier for European companies.

Within Made in Europe, the Specific objective 4 ‘Human-centered and human-driven manufacturing innovation’ is the centre of focus with respect to contributing to the policy ‘**an Economy that Works for People**’. The associated research and innovation actions will address key priorities, for instance:

- Digital platforms and engineering tools supporting creativity and productivity of manufacturing development
- Improving human device interaction using augmented and virtual reality and digital twins.
- Human & technology complementarity and excellence in manufacturing
- Manufacturing Innovation and change management
- Technology validation and migration paths towards industrial deployment of advanced manufacturing technologies by SMEs

However, the other specific objectives contribute also significantly to the policy **‘an Economy that Works for People’**, such as

- Specific objective 1 ‘Excellent, responsive and smart factories and supply chains’, with priorities such as:
 - Artificial intelligence for productive, excellent, robust and agile manufacturing chains - Predictive manufacturing capabilities & logistics of the future
- Specific objective 2 ‘Circular products & Climate-neutral manufacturing’, with priorities such as:
 - Virtual end-to-end life-cycle engineering and manufacturing from product to production lines, factories, and networks
 - Digital platforms and data management for circular product and production-systems life-cycles
- Specific objective 3 ‘New integrated business, product-service and production approaches; new use models’, with priorities such as:
 - Collaborative product-service engineering for customer-driven manufacturing value networks
 - Manufacturing processes and approaches near to customers or consumers (including urban manufacturing)

2.2.4.5 Links to UN Sustainable development Goals

Beyond contributing to EU policies, the Made in Europe Partnership will also address the UN Sustainable Development Goals. It will make contributions to the following **5 SDGs**, which are relevant to the manufacturing industry:

SDG 4: Quality Education:

Made in Europe brings together companies with research institutes and universities and their experts on research and training. All parties will benefit from positive spill-over effects from their work under Made in Europe to the daily training and education of their employees.

SDG 8: Decent work and economic growth:

Manufacturing offers prosperous and meaningful employment, involving human-machine interaction. Made in Europe puts the human dimension central in manufacturing, ensuring that machines serve the purposes of humans. Companies of all sizes can employ the people with the expertise, skills and talents they need to be successful.

SDG 9: Industry, Innovation and Infrastructure:

In order to be successful, European companies of all sizes need to have access to first-class infrastructures, innovative technologies and collaboration networks. They need stable, profitable, non-dependent and innovation-friendly conditions. Made in Europe will provide access to technological excellence, to Europe-wide cooperation, contributing to a European manufacturing innovation space.

SDG 12 Responsible Production and Consumption:

Industry must make substantial progress toward circular and carbon-neutral production processes, while providing affordable, innovative and green products. Made in Europe will develop clean technologies, excellent engineering instruments for a circular economy and improve the understanding of both natural boundaries and the impact of technologies

SDG 13 Climate action:

Industry is responsible for around one third of greenhouse gas emissions, but is also producer of new, carbon-avoiding technologies. Made in Europe will contribute both by developing carbon-neutral processes and enabling the production of carbon-neutral products and services.

2.2.5 Expected impacts

The main expected impacts from the Made in Europe partnership arise from its contributions to EU policy objectives. **The partnership aims for a European manufacturing industry which**

- Is world-wide competitive, resilient and adaptive;
- Is technology-leading;
- Is resource-efficient and has integrated circular economy principles in all its activities;
- Leads in the implementation of digital solutions;
- Offers high-quality jobs to well-skilled people, in enterprises of all sizes;
- Brings prosperity to all regions of Europe.

In short, the Partnership aims for a **competitive, green, digital, human-centric manufacturing sector**.

Being a part of the Manufacturing industry, the Made in Europe-Initiative contributes the overall objectives of this sector in terms of CO₂-reduction, material & energy efficiency and competitiveness. In particular, Made in Europe is:

- fully committed to make manufacturing carbon-neutral by 2050
- fully committed to maintain an industrial share of the economy of 20%
- fully committed to reduce the use of primary materials by 20% in the next decade.
- fully committed to increase technological leadership and resilience of its ecosystems

The performance of the Made in Europe Partnership will be monitored through KPIs. KPIs will be monitored at macro-economic, programme, project and company level. The partnership will gather relevant industry data and will report on the KPIs and progress of their achievement. This will be reported in the annual Monitoring Reports and will be supported by annual surveys.

KPIs will be measured by data from expert sources for all relevant manufacturing segments. Programme KPIs will measure the effect of the Made in Europe partnership achieved via exploitation, deployment, and implementation of its results. It will be measured by expert estimates.

Marco-economic KPIs:

The following baseline values and KPIs will be collected from companies participating in "Made in Europe or related activities" (these can be either Made in Europe projects or related national/regional manufacturing programmes)

KPIs:	Source
Turnover of production technology vendors (incl industrial software)	Eurostat, industry data
Turnover of manufacturing companies (other than the above)	Eurostat, industry data
Market shares of production technology vendors	Eurostat, industry data
Market shares of manufacturing companies	Eurostat, industry data
Carbon emissions	Eurostat, other sources
Industrial waste generated	Eurostat
Degree of adoption of digital technologies in manufacturing companies	DG Grow statistics
Number of jobs associated to manufacturing	Eurostat

Company-specific KPIs:

The following baseline values and KPIs will be collected from companies participating in "Made in Europe or related activities" (these can be either Made in Europe projects or related national/regional manufacturing programmes)

KPIs:	Baseline:	Target (end of the partnership):
Turnover of production technology vendors	sales figures in 2020	10% higher sales, as compared to companies in the same market segment
Turnover of manufacturing companies (other than the above)	sales figures in 2020	10% higher sales, as compared to companies in the same market segment
Carbon emissions	CO2 emissions in 1990	60-70% reduction compared to 1990
Industrial waste generated	Waste generated in year 2020	Higher reduction, as compared to companies in the same market segment; 10-20% higher

Programme-specific KPIs:

KPI	Target
New circular value chains	100 cases where circular value chains are demonstrated
Deployment of industrial demonstrators	30 demonstrators which integrate technologies to reduce CO2 emissions of a given manufacturing process by 40% or more
New business model adopted	100 cases where new business models are demonstrated and deployed
Data analytics	100 industrial use cases demonstrated
Distributed control and decision-making architectures	50% demonstrators deploy these technologies
Contribution to standardisation, including the use and assessment of standards	100% of projects address standards (either contribute or use of standards)
Digital platforms	70% demonstrators deploy this technology
Artificial intelligence, machine learning	70 % demonstrators deploy these technologies
Simulation & modelling (digital twins)	70 % demonstrators deploy these technologies
Robust and secure industrial real-time communication technologies	80 % demonstrators deploy these technologies
Outreach to different industries	Each project or demonstrator addresses at least three end-user sectors
New job profiles	At least 80 new job profiles demonstrated
Increase of competence/skills/qualification	10.000 persons trained in new technologies and 100 online courses offered
Well-being in the factory; safety	50% demonstrators showcase a higher level of safety/well-being or work satisfaction of the workers (based on employee feedback)
Increase of corporate social, societal & environmental responsibility	100% of projects address social and/or environmental responsibility

Demonstrator-specific KPIs with baselines:

KPI	Baseline	Target (to be measured on the demonstrators)
Improvement of quality in the manufacturing process	Will be determined at the beginning of the Partnership or project	Scrap rate reduction of 20%; reduce by 10% the amount of labour on defect identification and finishing
Improvement of response-time	Will be determined at the beginning of the Partnership or project	Reduction of ramp up time by 20%-30%
reduction in use of material	Will be determined at the beginning of the Partnership or project	10-25% less material usage
reduction in use of energy	Will be determined at the beginning of the Partnership or project	10-25% less energy usage
reduction in use of water	Will be determined at the beginning of the Partnership or project	15-30% less water usage
reduction of waste generated	Will be determined at the beginning of the Partnership or project	20-30% less waste
increased use of renewable energy	Will be determined at the beginning of the Partnership or project	35% of used energy = renewable energy

General statement about baselines and KPIs: Retained project proposals will need to define clear targets such as baseline (AS-IS) values of the actual manufacturing or associated processes that are covered by the project proposal and targets defined in percentages that are significant for these covered processes and that do not only result from implementing state-of-the-art technologies or approaches.

Baseline values will be determined for each demonstrator case at the beginning of each project. Target KPIs values may differ depending on the particular scope of the call topic and may even be different from one demonstrator to another.

Projects will benefit from additional services specifically designed to this partnership, which will enhance the long-term impact of the projects. The private partner of the partnership provides these services, which will stimulate the dissemination and exploitation of project results.

Lastly, companies will profit from monitoring and assistance, in terms of Industry 4.0-readiness level or 'Factories of the Future maturity levels'. Methodologies and approaches³ will be developed and manufacturing companies across Europe will benefit from the achievements of the Made in Europe Programme.

³ There are already several existing or emerging maturity levels available:
[About 50 maturity scales described by the ADMA scan \(http://www.adma.ec/ \)](http://www.adma.ec/)
[The maturity levels described by the DigiMaturity tool \(https://digimaturity.vtt.fi/\)](https://digimaturity.vtt.fi/)
[The ConnectedFactories Pathways to digital manufacturing
https://www.connectedfactories.eu/pathways-digitalisation-manufacturing](https://www.connectedfactories.eu/pathways-digitalisation-manufacturing)

2.3 The Necessity for a European Partnership

European manufacturing is extremely diverse. Technologies are numerous, professions are distinct, application sectors differ from each other and range from food processing to clean-room environments. Yet, there are many topics and challenges which connect manufacturing experts across different disciplines. Therefore, there are also many different forms of cooperation on a European level for specific technologies/sectors, in addition to the cooperation that takes place on a national level.

In order to bundle and pool together such diverse expert groupings, a European manufacturing initiative is needed. It would unite all actors from the many communities and initiatives in joint cooperation on a European level. A co-programmed Partnership would suit best to realise this cooperation among the wide and dispersed manufacturing community.

As compared to standard Horizon Europe calls, a Partnership approach provides the following advantages:

- A Partnership will enable **a structured and strong cooperation**, between on the one hand the European Commission and the Member States (public side) and on the other hand the association that represents the manufacturing research and innovation community (private side). This Partner association will not only **mobilise the stakeholders on a continuous basis** for providing guidance regarding the most critical challenges that need to be addressed by the Partnership; the Partner association moreover **increases the efficiency of the stakeholder community** in tackling these challenges, not only in projects funded via the Partnership, but also in projects that are either publicly funded via other programmes or privately financed, in particular in the stages that are **close to the commercialisation and up-scaling phase** of the developed technologies and approaches.
- A Partnership will **create the expected impacts** to address the challenges faced by the European manufacturing industry. Challenges such as the twin ecological and digital transitions can only be successfully mastered through coordinated, strategic cooperation on a European level.
- A Partnership will **provide strategic orientations** for the whole European manufacturing community, i.e. beyond the direct participants in the partnership themselves, through EU-wide definition of priorities, roadmaps, and inspiring cross-border initiatives. The Made in Europe Partnership will act as a “manufacturing lighthouse”, which will give strategic guidance to decision-makers on a commercial, academic, and political level.
- A Partnership will **align and coordinate R&I efforts across Europe**. We need a common understanding and aligned investments, e.g. for sustainable manufacturing, standardised approaches in data sharing, development of manufacturing skills, human-technology systems, worker issues, and training arrangements.
- A Partnership will **lead to Calls for Proposals that are relevant to the manufacturing sector**. The roadmap-based approach proved to work well for the manufacturing community up to now. Before the existence of the FoF PPP, call topics were considered to be too academic and less industry-relevant, hence the impact was rather small.

Companies were not prepared and did not know when relevant calls would appear. Calls were only known to a small, select group of people. It is thanks to call topics based on a strategic roadmap developed through industry and research collaboration, that they became of higher quality and attracted higher industrial participation than in the past. When projects are executed today, they are more industry-oriented and with a higher industry participation, which in turn increases their impact in terms of industrial competitiveness, sustainability, skills, etc.

- A Partnership will **act as a unifying mechanism**, which would otherwise not exist. It creates trust between actors, which leads to better cooperation and more impact. The Partnership allows to best leverage for the collective expertise and assets across its participating organisations to support companies in commercialising innovation.
- A Partnership will **offer Europe counterbalance against initiatives of global competitors**, e.g. Made in China 2025, via a visible, strategic initiative on manufacturing. By bringing together the best European actors, Europe's industry will be able to stay on eye-level with global competitors, which benefit from huge internal markets and state support for manufacturing. No Member State alone will be able to make the necessary investments or provide the excellence needed.
- A Partnership will **offer Europe a mechanism to strengthen the sovereignty of its manufacturing sector**. Cooperation on a European level will reduce external dependencies of the European industry. The partnership will provide strategic orientation, inspiration, and the best available technology for the manufacturing sector.
- A Partnership will **support other, strategic initiatives**. Manufacturing is not only an essential part of several strategic value chains, but also a strategic sector on its own. To support European initiatives such as battery production, Industrial Internet of Things, or the automotive sector, a strategic, European initiative on manufacturing is essential.
- A Partnership will **foster cross-fertilisation among national programs and projects**. National and regional initiatives are highly important; in addition to that, a European-level manufacturing initiative for applied collaborative research is needed. The Made in Europe Partnership will be the platform for national initiatives to learn from each other, in a way to compete with each other and achieve cross-fertilisation. Moreover, cooperation on a European level enables researchers from less industrial regions/cities to get in touch with researchers from more high-tech regions/cities.

2.4 Partner composition and target group

The Made in Europe Partnership will address the wider manufacturing stakeholder community in its full complexity and richness. Consequently, the target group is very broad.

Industry:

- Producers of production technologies, such as machine tools, robotics, handling and logistics solutions, etc.
- Producers of industrial information technologies including IoT enabled devices and software in the cloud or embedded on the edge.
- Manufacturing companies in various application sectors, such as automotive, aerospace, consumer goods etc
- Industry-driven clusters and associations
- All company sizes, from start-ups over SMEs to multinationals
- etc

The scope of the Made in Europe Partnership will be broader than the Factories of the Future PPP in Horizon 2020. While the sectors that were as in the Factories of the Future PPP will continue to be served, in addition more application sectors will be added, such as:

- Manufacture, processing and packaging of food products and beverages, including bottling and sorting
- Manufacture of textiles and wearing apparel
- Manufacture of furniture and products of wood
- Manufacture of paper and paper products
- Manufacture of rubber and plastic products
- Manufacture of sophisticated structures dedicated for the construction industry
- Waste processing
- Repair and installation of machinery and equipment

Research Technology Organisations /Academia:

The Partnership will attract and involve Research Technology Organisation and Universities which perform applied research.

Compared to the past, the Partnership will not involve only technology experts, but will also include experts from other faculties in management, social science etc.

Expert contributions coming from other relevant perspectives:

Expert opinions from other organisations will be welcome (beside industry and academia). Trade Unions, Labor organisations, Foundations, Standardisation bodies, local authorities and other organisations will contribute too.

Regarding geographical coverage, the Made in Europe Partnership will aim at finding the right balance between not compromising on the excellence criteria, but still doing an “extra effort” in countries which so far have been under-represented in EU research.

Looking at the international level, dialogues and interchanges will happen at the level **CIRP**⁴ and the **World Manufacturing Forum**⁵. These interactions of world-wide level will be both a chance to showcase what the European Made in Europe Partnership is doing and a opportunity to find international partners in areas where this makes sense from a European perspective.

The Economic weight of the target group:

The Made in Europe Partnership will address some 12-14 manufacturing sectors which generate an economic outpour of approximately 3200 billion Euros and employ some 16 million employees.

This is a much wider outreach compared to the Factories of the Future PPP in Horizon 2020, which addressed 5-6 sectors with an economic output of some 2000 billion Euros and 10 million employees.

Excellence

While excellence will be the main criterion in the open competition for project funding, the Made in Europe Partnership will actively support the involvement of partners from countries, which so far have been under-represented in EU research. In an excellent consortia, industrial partners with well-balanced capability learn, take over and commercialise technology and knowledge from research institutions, while contributing their specific expertise to the research project. Similarly, partners from the countries mentioned above, capable of performing relevant tasks in the project, will improve their excellence in the collaboration with other excellent partners.

Ensuring Impact beyond 2027

EFFRA and its members will be safeguarding all outputs and insights which stem from Made in Europe Partnership activities. Even beyond 2027, when the Partnership will formally end, EFFRA and its members are engaging in further exploiting the results that will be produced in the years 2021-2027.

The long-term impact of manufacturing industry lies in the creation of sustainable growth and jobs. Europe needs to drive for manufacturing innovation as it has a strategic importance for wellbeing, environment and business, both direct and indirectly. Made in Europe will have an important role in combining the scattered efforts in Europe and help European manufacturing value chains and the regional and local manufacturing innovation ecosystems to take the necessary steps towards sustainability and competitiveness. As the manufacturing sector is capital-intensive and dominated by SME's, the business impacts of the partnership will take time. Also, while steps towards climate neutral industry needs to be fast, reaching an high level of circularity means a system-level-change that is time-intensive. Therefore, impacts of the partnership shall extend well beyond 2021.

⁴ <https://www.cirp.net/>

⁵ <https://www.worldmanufacturingforum.org/>

3 Planned Implementation

3.1 Activities

Activities are foreseen at five different levels:

3.1.1 Made in Europe projects

Stakeholder engagement and input-collection for call topics:

The association EFFRA has organised a series of workshops, conferences and consultations to identify opportunities for European industry and identify research challenges that need to be tackled. The collected expert knowledge is summarised and formulated in this present document on the future scope of the Made in Europe Partnership. In the annex of this document, the structure of the Strategic Research and Innovation Agenda is described. This structure is the result of a public consultation which took place in autumn 2018 and beginning of 2019.

During spring/summer 2020, EFFRA carried out a second consultation. More information and possible updates about this consultation can be found [here](#).

The consultation requested responses from two perspectives:

- (i) the perspective of experts and their respective organisations (companies, research institutes, universities etc) and
- (ii) the perspective of projects, herewith drawing the relation to recent and ongoing developments.

Similar to consultations carried out by EFFRA in the past, these consultations are open. Anyone can contribute. The input that is provided by the respondents remains available and editable by those that contributed. It is therefore possible that based on the received input, stakeholders are asked to elaborate their feedback in order to improve its usability for the development of the SRIA.

Experts were asked to

- indicate the Objectives and the Research & Innovation Objectives that they would like to see addressed during the first three years of the partnership .
- for those Objectives and the Research & Innovation Objectives that were indicated as relevant, experts are asked to explain in a few sentences:
 - which technologies and approaches they would see as essential for the research and innovation activities
 - which other boundary conditions or activities would be essential in order to achieve impact
 - what would be the Key Performance Indicators in order to measure the impact and what would be the target values for these KPIs.

In addition, Project coordinators were asked to describe

- what the project has contributed essentially
- which future developments are in particular necessary, drawing from the 'lessons learnt' in the project

Beyond companies, research institutes, universities etc, the consultation also reached out to members state representatives and National Contact Points, as well as sectoral organisations and the associations linked to other Partnerships that are in preparation.

The received input will be used for the compilation of the detailed Made in Europe Strategic Research and Innovation Agenda (SRIA). The input will provide insight in the prioritisation of the research & innovation objectives, the focus in terms of specific challenges and enablers, as well as impact (and associated KPIs).

TRL levels addressed

Based on the feedback from the wider manufacturing community, regarding TRL levels addressed, there is a wish that the majority of calls shall cover TRL 5-6, with exceptional calls on TRL 3-5 and TRL 6-7.

Regarding the size of projects, the Made in Europe partnership shall cover both, big and small projects, to reflect the different needs and characteristics of the manufacturing industry needs: while SMEs prefer smaller projects, in other specific cases bigger projects are needed for having higher impacts on a specific technology or challenge. Also, the "cascading of funds" will be used where deemed necessary, to reach out to even more SMEs.

Dissemination and promotion of published calls; special focus on newcomers (especially from EU-13 countries) and SMEs

All actors involved in the Made in Europe Partnership will engage in promoting collaborative research opportunities. Special attention will be given to countries and regions, which were in the past underrepresented in European research. Moreover, manufacturing SMEs will be a special focus group that will be systematically approached in order to get involved in calls. EFFRA will be actively disseminating Made in Europe partnership and associated calls in events that have high participation of EU-13 countries. The open portal will highlight success stories from SME participation and help newcomers to enter into project proposals. Digital Innovation Hubs and similar regional ecosystems shall be contacted in order to stimulate participation of newcomers and small companies.

3.1.2 New approach for the dissemination of project results

The European manufacturing community has over the past years gained experiences in helping projects to disseminate results and help in any aspects linked to commercialisation. The Made in Europe Partnership will build on these past efforts and boost them further. Marketing structures will be set up in order to help with the matchmaking: to bring exploitable results to those companies which were searching a desired solution/technology.

3.1.3 Beyond project work: increasing impact by creating insight across the programme, creating synergies among the projects and stimulating cross-Partnership cooperation

One of the roles of EFFRA is to ensure that projects do not stay “within silos” but that they engage with related work beyond the specific project. Many activities will be carried out on top of the work done by the individual projects, stimulating the sharing of information with many companies and organisations within and outside the Partnership.

The annual Made in Europe Community Days and thematic events.

Made in Europe project results will be made visible and widely disseminated during the annual ‘Made in Europe Community Days’. This yearly event will build on the successful annual events organised by EFFRA, where project representatives meet and share the outcome of their projects, not only with other key actors in projects from the Made in Europe Partnership (such as industrial companies that host demonstrators or pilots), but also beyond the partnership.⁶

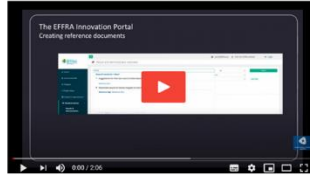
In addition, EFFRA will organise thematically focused events, for instance focussing on circular economy, artificial intelligence, etc... all this according to the requirements and the key priorities of the programme. These events will be organised in cooperation with other Partnerships when appropriate.

Information sharing and community building via the EFFRA Innovation Portal

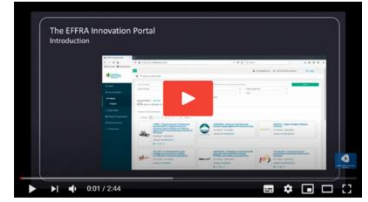
The main goal of the EFFRA Innovation Portal is to provide an online resource for sharing information about any research and innovation work (including associated results and demonstrators) in the area of manufacturing. The EFFRA Innovation Portal includes all Factories of the Future Partnership projects and also includes projects from other programmes and initiatives on manufacturing.

⁶ The concept of “Community Days” has proven to be very successful in the past, as demonstrated in the Factories of the Future PPP . Projects are invited to demonstrate their results, which is interesting for companies, business angels and investors. During thematic parallel sessions, links to other partnerships are established, as for example done during the in 2019, with dedicated workshops organised with the Big Data community, the 5G community and so on.

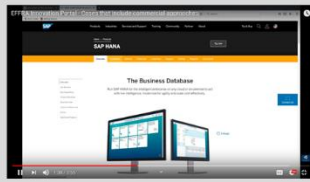
EFFRA Innovation Portal - Creating reference documents



EFFRA Innovation Portal - Editing projects and results



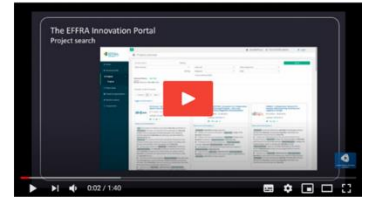
EFFRA Innovation Portal – Cases that include commercial approaches



EFFRA Innovation Portal - Imports from the EU Open Data Portal



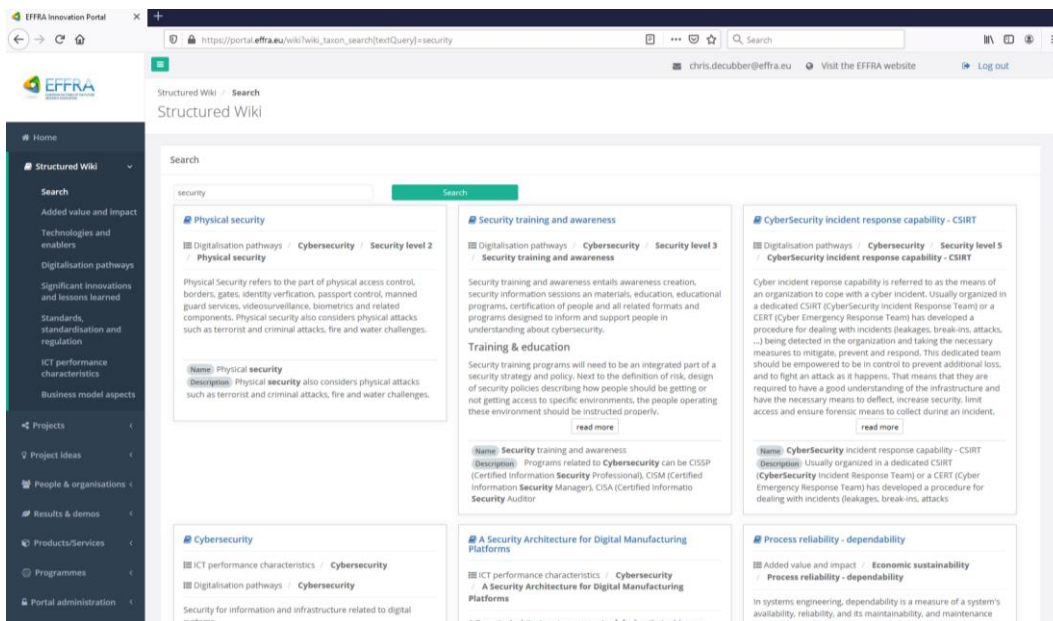
EFFRA Innovation Portal - Project Search



Recently published video tutorials about the collection and sharing of information via the EFFRA Innovation Portal

The Portal is equipped with a powerful search engine, which supports the free text indexed search. The search engine retrieves projects and results or demonstrators.

The quality of the search and the returned information is dependent on the quality of the short descriptions of the projects and the associated results and demonstrators. The quality can be significantly raised by providing specific information via the structured lists. These are also accessible via the **structured wiki**.

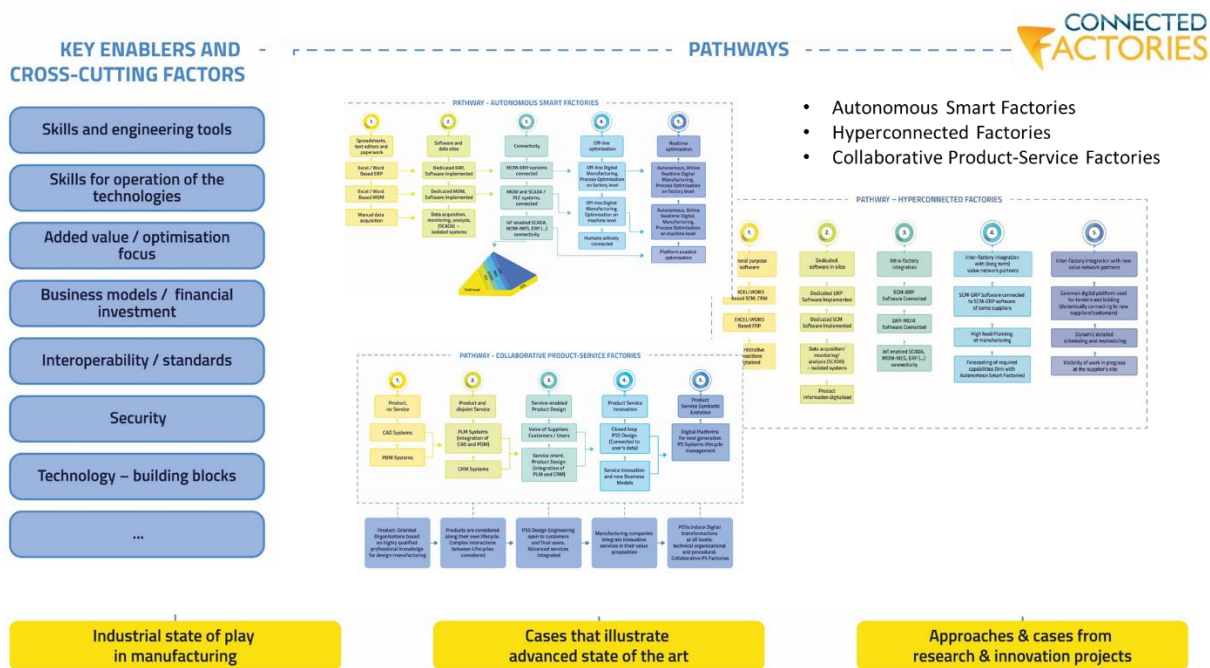


References of public project deliverables that were submitted via the EC funding and tenders portal are also available, herewith leading the users to the specific pages on Cordis where the public deliverable can be downloaded.

EFFRA will offer the possibility to follow projects and subscribe to digest mails that bring together news items generated by the projects.

Developing a structured insight into the overall transformation of manufacturing industry across the Factories of the Future/Made in Europe programme and other manufacturing research & innovation programmes:

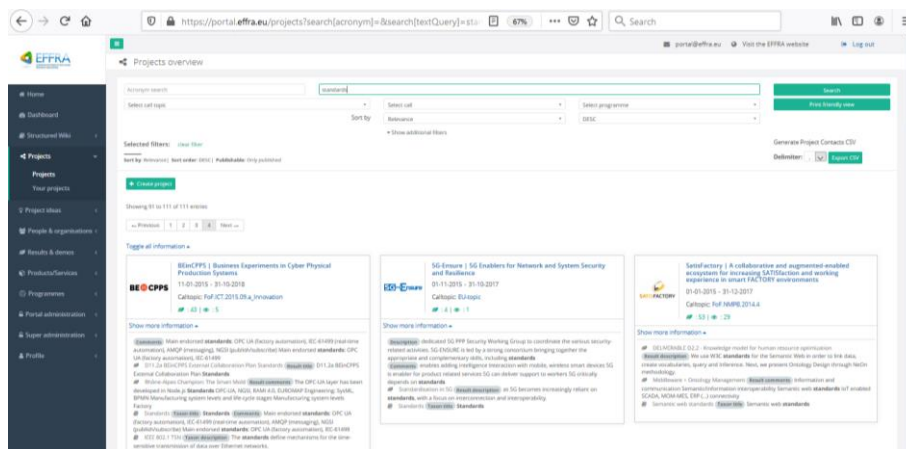
The development of Pathways to digitalisation of Manufacturing is an activity that was developed by the Connected Factories Coordination action. The approach of positioning research and innovation results and demonstrators/pilots on different pathways is progressively extended across the existing FoF programme. The methodology is now also introduced in the ECSEL Joint Undertaking via the [Lighthouse Industry 4.E](#) and interactions with SPIRE projects about these pathways also took place, which shows how these activities support the cooperation among different PPPs. This will become one of the approaches to establish strategic intelligence across the planned Made in Europe Programme and cooperate with other Partnerships.



The structured approach to monitoring cross-cutting factors & enablers and the collection of cases & demonstrators across many programmes and initiatives, including Digital Innovation Hubs, is a key activity, in particular addressing the need for synergies across the Horizon Europe Programme.

Standardisation

EFFRA collects information about standardisation from the projects on a continuous basis (see also the section on Standards in the deliverable on cross-cutting aspects from the ConnectedFactories CSA <https://www.connectedfactories.eu/cross-cutting-factors>) and works towards more cooperation in this field⁷. EFFRA will enhance the depth of this information collection and dissemination throughout the Made in Europe Partnership. The section on standards and standardisation of the structured wiki on the EFFRA Innovation Portal that also serves as a mapping framework of project’s activities and results, is being extended and fine-tuned in the course of 2020, taking into account work of the Industry 4.0 Standardisation Council and associated work on standards categorisation on international level.



The above screenshot is taken from this [search](#)

Skills and human aspects

Similar to standardization and many other key enablers or factors, strategic intelligence will be built in the domain of skills and humans in manufacturing. Information will be collected, structured and disseminated (both, through meetings and the Portal). The collected information will support the work of the associated working groups and advisory board (see governance).

The following [search](#) on ‘human’ in the results and demonstrator section illustrated the results of past work:

⁷ EFFRA acted for example as advisory board member in the [Bridgit2 project](#) which developed this website <https://www.standardsplusinnovation.eu/>

The screenshot displays a web portal interface for 'Results & demonstrators'. The left sidebar contains navigation options: 'Results & demonstrators', 'Your results', 'Your demonstrators', 'Products/Services', 'Programmes', 'Portal administration', 'Super administration', and 'Profile'. The main content area shows a grid of project cards, each with a title, project name, type, and update date. Below each card is a 'Show more information' link and a detailed description.

Project Title	Project Name	Type	Updated At
MAS BioRing The MAS BioRing - A wearable ring for measuring physiological human data	Project: SO-PC-PRO	Type: [Green Checkmark]	Updated at: 21-06-2018
Mass Balance System Assembly Demonstrator 3: Human-Robot Collaboration - Mass Balance System Assembly	Project: SYMBIO-TIC	Type: [Green Checkmark]	Updated at: 22-06-2018
SatisFactory - Knowledge model for human... DELIVERABLE D2.2 - Knowledge model for human resource optimization	Project: Satisfactory	Type: [Green Checkmark]	Updated at: 22-06-2018
Model for human behavior Human capabilities measurement	Project: INCLUSIVE	Type: [Green Checkmark]	Updated at: 23-06-2018
Human-Machine-Interfaces for direct inte... D5.5 Human-Machine-Interfaces for direct interaction with the factory environmen...	Project: COMPOSITION	Type: [Green Checkmark]	Updated at: 23-06-2018
HUMAN-264500 Periodic Reporting for period 1 - HUMAN (HUMAN MANUFACTURING)	Project: HUMAN	Type: [Green Checkmark]	Updated at: 25-05-2019
Augmented Reality software for user assi... Augmented Reality software for user assistance in a manufacturing work cell	Project: HORSE	Type: [Green Checkmark]	Updated at: 21-11-2019
ZHQ Lombardy Champion - Zero-Hours Quality	Project: BEHCPPS	Type: [Green Checkmark]	Updated at: 19-07-2019
D5.2 Big data mining and analytics tools II	Project: COMPOSITION	Type: [Green Checkmark]	Updated at: 18-12-2019

3.1.4 Reinforced cooperation with national manufacturing initiatives

Besides the execution of Made in Europe call topics within the framework of Horizon Europe, the cooperation with manufacturing initiatives of individual member states initiatives is crucial.

In many member states, national partnerships between public and private are taking place. At the level of ManuFuture and EFFRA, these national initiatives have informally cooperating with each other for many years.

Within the framework of the Made in Europe Partnership, this cooperation will be reinforced and formalised. EFFRA will sign a series of **Memorandum of Understandings** with national and regional initiatives. As EU member states differ in specialisation of industries, the Memoranda of Understanding will need cover different elements of cooperation.

Beyond this bilateral cooperation between the Made in Europe Partnership and individual national initiatives, a **Made in Europe Council of National Initiatives** will be established. The Council of National Initiatives will have an advisory role to support EFFRA and the Made in Europe partnership aligning its actions. In addition, the Council members will spread out information of Made in Europe all over Europe.

All these activities will not only lead to a higher impact of both Made in Europe and the national initiatives, but it will also avoid a repetition of efforts.

3.1.5 Combining regional funding and resources

Another important means to increase the impact of the Made in Europe Partnership consists in better anchoring its activities on a regional and local level. Existing cooperation will be reinforced. EFFRA and its members are already interlinked with the Smart Specialisation

policy (notably the Smart Specialisation Platform for Industrial Modernisation) and with RIM plus activities. More means will be invested in this cooperation, especially in linking up to research infrastructures and pilot facilities that support the research & innovation activities of the Made in Europe Partnership. Demonstrating and deploying Made in Europe research results on a regional and local level will ensure further take-up and commercialisation. Moreover, it will lead to more regional and structural funds being invested in manufacturing related activities.

The Vanguard initiative, with its currently 30 manufacturing-intensive NUTS-2 EU regions, provide a perfect means to disseminating projects results stemming from Made in Europe work and bring them one step further to commercialisation. A strategic partnership between Made in Europe and the Vanguard initiative will be developed.

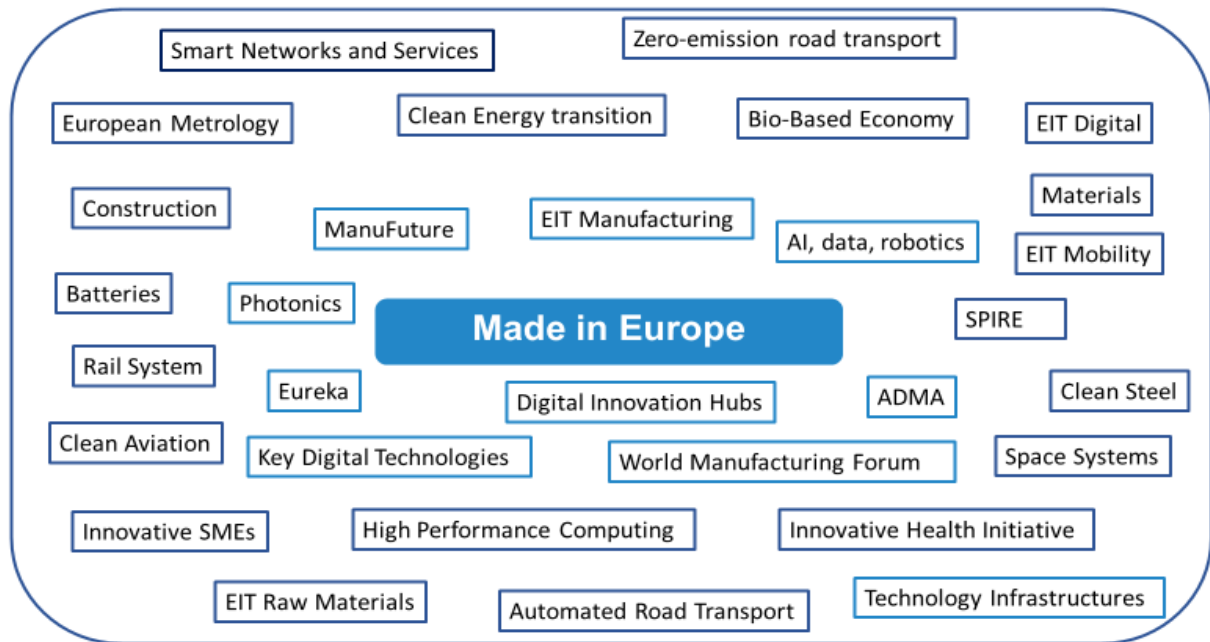
3.1.6 Cooperation with other European or international initiatives

The Made in Europe Partnership - as the lighthouse for applied manufacturing research, technology development and innovation in Europe - will exchange and align strategic concepts with the ETP ManuFuture and the EIT Manufacturing, which complement the Partnership in technological foresight and in manufacturing-related education and business creation. For example, the ambitious goals of EIT KIC Manufacturing to enhance entrepreneurship and new business based on manufacturing innovations, can be nourished with research results from Made in Europe calls.

Beyond these manufacturing initiatives, further cooperation between the Made in Europe Partnership and other initiatives are envisaged and will be ensured. The Made in Europe Partnership will engage intensively with both, technology-focused initiatives and application-oriented initiatives.

At international level, the **World Manufacturing Forum** and **CIRP** will allow dialogues and collaboration with non-European players.

The following graph will give an overview of initiatives which relate to the Made in Europe Partnership and with which collaboration in one form or the other will be sought:



One should distinguish here between different activities, which all require another form of engagement:

a. Cooperation with the EIT Manufacturing initiative:

The Made in Europe Partnership and the EIT Manufacturing are two distinct initiatives with different goals and rules. EFFRA is in close contact with the EIT Manufacturing in order to ensure complementarity and cooperation, in particular regarding the further deployment of the technologies and approaches that are developed and demonstrated by Made in Europe and the mobilisation of education and training networks in support of this deployment.

EFFRA and the EIT Manufacturing will be jointly identifying Made in Europe research results which can take advantage of EIT Manufacturing programmes and tools. In particular, joint efforts will be made to foster the manufacturing workforce with the right skills for the future and support further investments in research outcomes.

b. Cooperation with other complementary manufacturing initiatives & activities and European level:

- Digital Innovation Hubs that are active in manufacturing. Made in Europe will develop innovative solutions that are rolled out to a large amount of manufacturing companies, especially SME, through Digital Innovation Hubs. At the same time, DIHs can provide input of SME needs to Made in Europe.
- Eureka (including the Eureka SMART and the ITEA3 Cluster programme)
- The INTERREG Europe programme
- ADMA, aiming at the harmonisation of the assessment and transformation processes while supporting manufacturing companies in becoming a ‘Factory of the Future’
- Relevant ERA-Nets
- any IPCEI that might emerge if it has a link to manufacturing

Coordination work planned:

A continuous dialogue with these initiatives to compare roadmaps, indicate inspiring examples that provide a common state-of-the-art awareness and pointers to existing experience that can be multiplied across sectors, search for complementarity and engage in further cooperation opportunities.

c. Cooperation with technology-focused or input related (material/energy) activities:

Cooperation will be developed with following partnerships/areas/organisations:

- **AI/Big Data/robotics:** The proposed Partnership on AI, Data & Robotics will develop technologies that are crucial for manufacturing industries. Made in Europe will enhance the use of these technologies in the manufacturing sector. Cooperation between the two partnerships will focus on AI-enabled, adaptable, resilient factories and supply networks; advanced robotics solutions and human-robot collaboration in factories; data-driven business models and data-sharing solutions for manufacturing industries. Collaboration with the AI, robotics and manufacturing DIHs will also be enhanced.
- **Photonics:** Lasers are prominent enablers in advanced manufacturing, including additive manufacturing, surface treatments and texturing, joining technologies and also measuring technologies for high-precision manufacturing. The Made in Europe will integrate these photonics-based enablers into many applications, serving a variety of manufacturing sectors.
- **Embedded Systems/Smart Components:** Made in Europe will facilitate collaboration with the planned Key Digital Technologies partnership about common issues such as the industrial need for reliable and cybersecure solutions and trusted low-power components; AI, machine learning and machine vision systems for production; Circular production of intelligent systems; Connectivity and interoperability across industrial systems etc.
- **Security:** Made in Europe will build on the existing cooperation with ECSO and the experience generated by the recently started 'Security for manufacturing projects' that have already brought together the manufacturing and cybersecurity community.
- **5G:** as already showcased at EFFRA workshops on 5G and manufacturing, 5G will be a major enabler for exploiting the massive amount of data that is collected by embedded systems and sensing devices. Vast amounts of feed digital twins and allow for real-time monitoring and optimisation.
- **Materials:** Advanced materials are major enablers of high-performance and sustainability in many manufacturing sectors, reducing energy consumption and enabling circular economy. This brings about important challenges in terms of the competitive manufacturing of these products.
- **ISO standardisation (OPC-UA, Data eco-systems):** Interoperability in digitalised manufacturing, quality uniformity of materials for additive manufacturing are examples of challenges that to a large extent depend on standardisation.

Coordination work planned:

The forms of collaboration will take many forms such as common meetings and conferences, dissemination of results, scoping of joint topics of interest, policy papers, white papers, contributions to standards etc. Continuous dialogue on priorities and results, work done or work in the pipeline, establish feedback loops and provide information on manufacturing requirements, for e.g. materials/AI/5G/security etc. Manufacturing is both user and integrator of these technologies/inputs.

- d. Cooperation with application sector application-oriented initiatives and other horizontal initiatives:

Sectors specific initiatives:

- **Transport (automotive, aerospace, space, trains, waterborne etc):** The synergy between product development processes and production engineering and manufacturing is one of the challenges that is addressed by Made in Europe. The interaction with such “application sector” initiatives will focus on the anticipation of requirements and the awareness of available technologies that can have an impact on different sectors at the earliest stages
- **Process Industry:** Process industries will work more tightly with the value chains to ensure that the materials developed by the process industries will be suitable for the circular economy. The Process industry partnership and Made in Europe will collaborate to strive towards circularity, integration and data sharing along the supply chain and facilitation of innovative reuse, re-manufacturing and recycling solutions.
- **Health:** tracking and tracing of production, rapid response and reconfiguration and rapid upscaling of manufacturing capabilities (as illustrated by the Covid-19 situation) are key characteristic of future manufacturing.
- **Energy and renewable energy:** MIE will generate the manufacturing systems that can produce the energy-systems of the future. From another perspective, energy technologies that reduce energy consumption in manufacturing.

Coordination work planned:

Continuous dialogue on priorities and piloting activities will be facilitated. Exchanging inspiring examples will be brought forward to stimulate uptake and wide deployment of results. Made in Europe will provide high-performance manufacturing solutions needed by these application sectors.

Other horizontal initiatives:

- ERC projects
- ERASMUS Plus
- The EIC
- RecoverEU

These programmes touch upon manufacturing, although they have other priorities. Continuous dialogue on similar activities and identification of cooperation will be developed.

Others:

- **Battery value chain:** Collaboration with MIE is particularly important to reduce dependency on imported raw materials and intermediate products for battery production and to improve the environmental footprint of battery production. Advanced manufacturing technologies are to be developed for reliable, cheap large scale production.
- **Living and working in a health-promoting environment:** MIE has a big interest in working together with the Horizon Europe Health Cluster on health and safety related topics at the work place.

Coordination work planned:

Continuous dialogue on priorities and identification for cooperation.

3.2 Resources

The Made in Europe Partnership is embedded in a network of thousands of industrial companies in Europe, which annually invest dozens of billion Euros into research and innovation.⁸

The funding that will be invested in overcoming the challenges and opportunities identified by the Made in Europe Partnership, will concentrate on collaborative research between companies, institutes and universities. The activities financed by partners, directly or indirectly associated with the Made in Europe Partnership and its research and innovation framework, will be following:

- Costs incurred by companies associated to the financing of demonstrators or pilot lines;
- In-kind contributions to the funded projects (on the basis of non-reimbursed eligible costs), with lower funding rates for higher TRLs;
- Private company research funding directly or indirectly linked to the Made in Europe R&D&I framework;
- Additional investments being done by companies where the trigger of the investments will come from technology advances provided by Made in Europe Partnership projects;
- Private funding which companies invest in national and regional initiatives that relate to the Made in Europe Partnership-

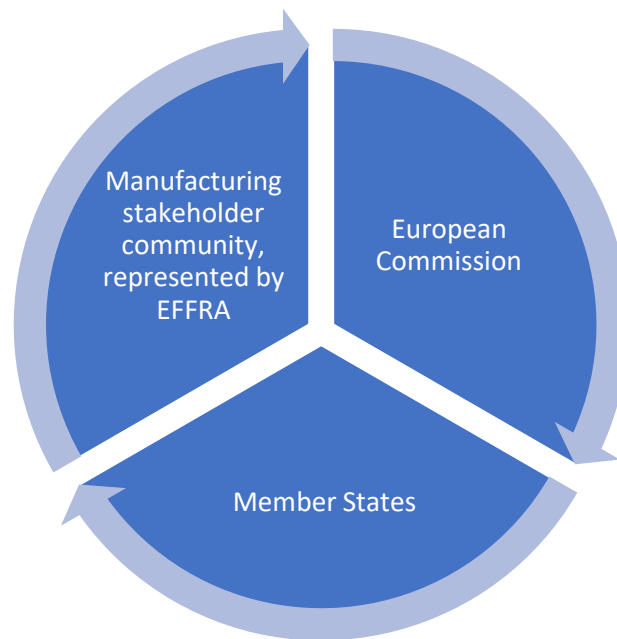
At this moment of time, it is not possible to exactly quantify the levels of investments. During the execution of the partnership, a methodology will be developed.

3.3 Governance

Made in Europe calls will be open and competitive. There will be no artificial barrier or fee to participate in the programme.

The governance consists of a continuous interaction between three groups of actors: (i) the wider manufacturing stakeholder community, (ii) the European Commission and (iii) the member states:

⁸ https://iri.jrc.ec.europa.eu/scoreboard/2019-eu-industrial-rd-investment-scoreboard#field_report



Each actor involved has a specific role:

- i. EFFRA is unifying the broader manufacturing community and is expressing the interests of the manufacturing industry needs (EFFRA will take into account any expert knowledge, irrelevant of whether this organisation is a direct EFFRA member or not); moreover, EFFRA accompanies projects once they are launched.
- ii. The European Commission, which organises the Made in Europe call topics process, the selection for evaluators and execution of the projects.
- iii. Member states will be included in the broader governance of the partnership by adequate mechanisms.

It is extremely important that as many actors as possible are heard and can express themselves. EFFRA will bring together manufacturing expertise from various sectors, for example:

- machinery and other technology providers (machine tools, robotics and other suppliers of production equipment)
- industrial ICT solution and software providers
- automotive, aerospace and consumer goods industry i.e. the users of production equipment
- component suppliers
- material providers (steel, chemicals, power manufacturers for additive etc)
- Research and Technology Organisations (RTOs)
- Universities active in applied research or education related to manufacturing
- industry associations and clusters, which provide access to 100.000s of SMEs which are part of the EFFRA network.

The **interactions between the European Commission and EFFRA** will be organised through the **Made in Europe Partnership Board**. Manufacturing experts from EFFRA and European Commission officials will meet regularly to jointly decide how the Strategic Research Agenda will be transformed into actual Made in Europe calls topics.

Moreover, EFFRA will organise four working groups, which will feed the Made in Europe Partnership Board with input and will accompany the projects. The four working groups will relate to the four objectives of Made in Europe:

- A Working Group on Excellent, Responsive and Smart Factories and Supply Chains
- A Working Group on Circular Products & Climate-neutral manufacturing
- A Working Group on New Integrated Business, Product-Service and Production Approaches; new use models
- A Working Group on Human-centred and human-driven manufacturing innovation

As the manufacturing industry is faced with constant movements and changes, a **Strategic Advisory Group** will be set up. Its role will be to give advice on a strategic level and analyse how market conditions are changing, also due to external shocks (take as an example the COVID crisis) and the Made in Europe programme needs to take into account such developments into account. In this group, any aspects will be looked at, which are not covered by the four Working Groups. Moreover, opportunities in the EIC and in Recover EU will be looked at.

As explained above, connections to national and regional manufacturing innovation experts and decision makers will be enhanced by the new Council of National Initiatives (see also section 3.1.2).

In summary, the different bodies that will make Made in Europe operational will be following:

- **The Made in Europe Partnership Board**
 - Developing call topics, overseeing the development of the Partnership, ensuring consistency in the execution of the developed roadmap
- **The four Working Groups**, related to the four objectives of the Partnership
 - feeding the Partnership Committee
 - cross-fertilisation between projects within the respective objective area
 - ensuring cooperation with other initiatives
 - Working Group on Excellent, Responsive and Smart Factories and supply chains: reaching out to partnerships and initiatives in the transport industries; on logistics; the work on manufacturing data spaces etc
 - Working Group on Circular products & Climate-neutral manufacturing: reaching out to other partnerships and initiatives, for example on the process industry etc
 - Working Group on New integrated business, product-service and production approaches; new use models: reaching out to partnerships ICT related initiatives in on 5G etc
 - Working Group on Human-centred and human-driven manufacturing innovation: reaching out to AI&robotics&big data, to social and human sciences etc
- **The Strategic Advisory Group**
 - advice on strategic long-term directions

- exploitation of results
- providing “outside-the-box-thinking” and considering ideas which did not emerge in one of the four working groups
- **The Council of National and Regional Initiatives**
 - Ensuring that the European and the national work cross-fertilise each other
 - working on regional funding, allowing research results to get rooted on a regional level
 - work mainly on a national and regional level;
 - in cooperation with ManuFuture
 - in cooperation with Digital Innovation Hubs

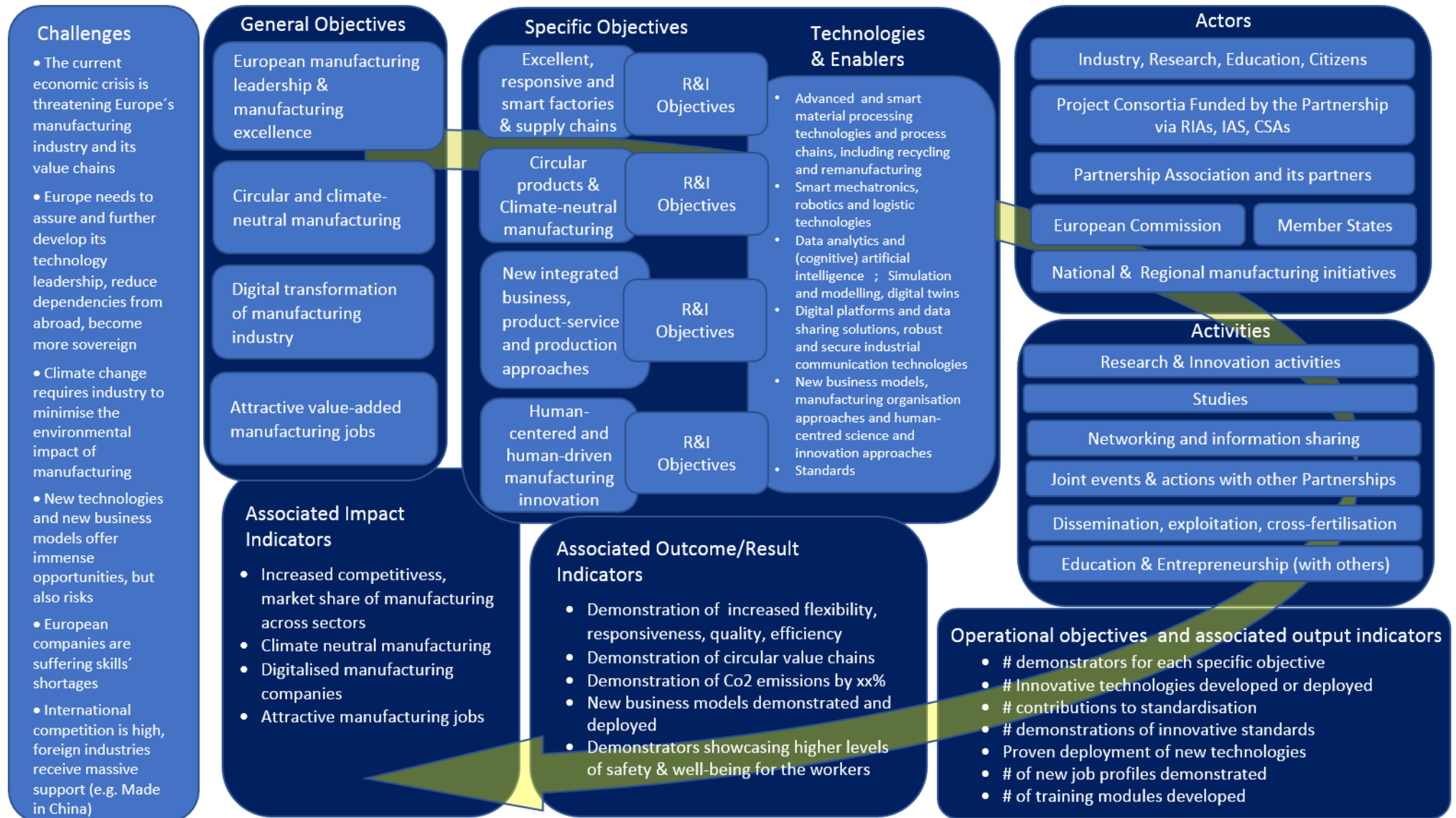
3.4 Openness and transparency

The Made in Europe Partnership needs to be designed in a way to allow **full openness and transparency**. This is not only important in terms of fairness, but also in terms of quality: the whole process needs to attract the best experts in the field and allow “outside of the box” thinking.

Unlike some other initiatives where only certain pre-selected organisations can benefit, the Made in Europe Partnership will be completely open: any organisation that has a legal entity and complies with Horizon Europe rules can apply for Made in Europe Partnership projects.

Openness and transparency will be ensured at all stages of the process, within the framework that legal requirements allow. This concerns both the competition stage as well as the execution of the projects. Project results will be available on an open portal and will be widely disseminated.

Summary overview and Intervention Logic:



4 ANNEX 1: Draft Strategic Research & Innovation Agenda of the Made in Europe Partnership

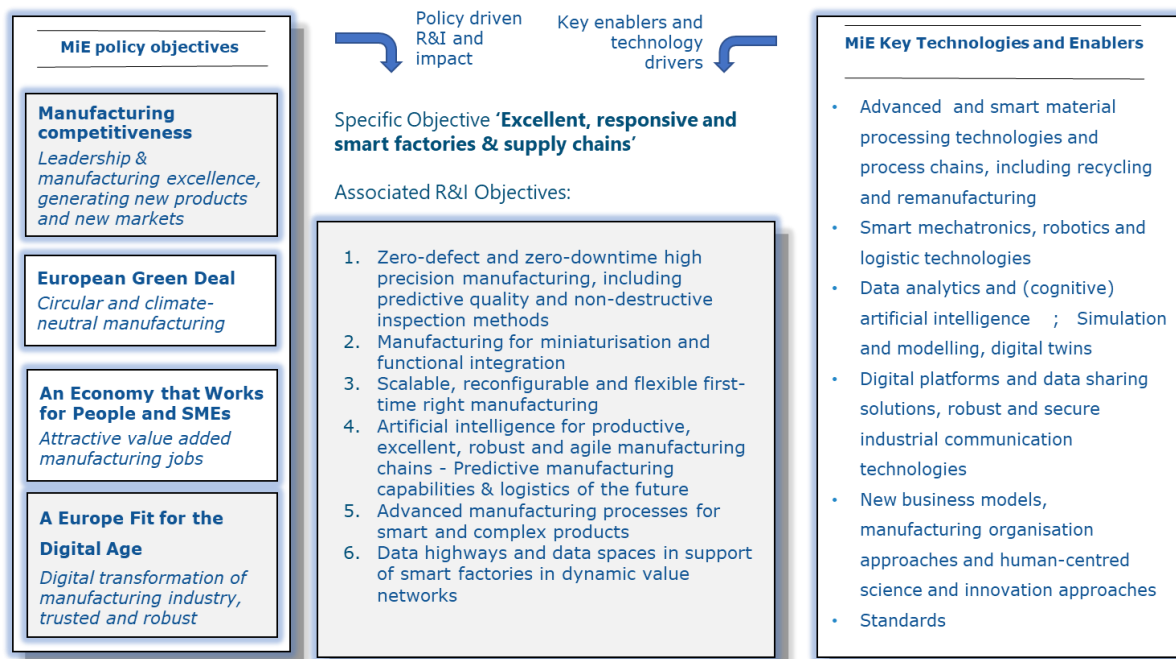
This section provides more insight in how the Specific objectives and the associated Research & Innovation objectives need to be further developed and detailed into the Strategic Research and Innovation Agenda: What are the specific key enablers and technologies that need to be focused on and what is the specific impact envisaged?

Research & Innovation Objectives will be associated to resources (funding and investments) via call topics. The amount of resources associated with the Research & Innovation Objectives can differ significantly, making that some Research & Innovation Objectives are addressed in more calls.

Consultations will support the development of the strategic research and will be carried out in spring and summer 2020.

4.1 Research & Innovation Objectives under Specific objective 1 ‘Excellent, responsive and smart factories & supply chains’

Overview:



4.1.1 *R&I Objective 1.1: Zero-defect and zero-down-time high precision manufacturing, including predictive quality and non-destructive inspection methods*

Priority:

- Excellent, responsive and smart factories

Enablers:

- Advanced and smart material processing technologies and process chains
- Smart mechatronic systems, devices, and components
- Data analytics, including artificial intelligence and deployment of digital platforms for data management and sharing (data integration)
- Migration approaches from as-is situation towards innovative solutions
- Simulation and modelling (digital twins) covering the material processing level up to manufacturing system and, factory level
- Innovative sensors, sensor materials and innovative inspection methods (machine vision in combination with AI)
- In-situ online inspection

Impact:

- Competitiveness, maintaining leadership
- Manufacturing the Products of the Future
- People
- Planet

4.1.2 *R&I Objective 1.2 Manufacturing for miniaturisation and functional Integration*

- Making components smaller and smaller by integrating more functions in surfaces and in concentrated spaces is a cross-cutting enablers for broad spectrum of applications
- Ranging from sensors, micro-mechanical systems, microfluidics, low-energy components, smart surfaces or bio-hybrid components. Products will become smaller, lighter, more robust and more energy-efficient – or even energy autonomous.
- Integration of more and more features in devices reduces the overall number of products and enables the decoupling of resource use and added value

Enablers:

- New and improved micro- and nanomanufacturing processes which are precise, repeatable, fast and easy to be scaled up
- Further integration of physical processes with digital technologies in-situ inspection methods

Impact:

- Enabling new applications, e.g. in tracking, logistics, production,
- Enabling light-weight, multifunctional products and components, increase resource efficiency,

4.1.3 *R&I Objective 1.3: Scalable, reconfigurable and flexible first-time right manufacturing*

Associated key priorities:

- Scalable first-time right manufacturing

Enablers:

- Intelligent and autonomous handling and robotics, assembly and logistic technologies
 - Smart mechatronic systems, devices and components
 - Advanced and smart material processing technologies and process chains
 - Simulation and modelling (digital twins) covering the material processing level up to manufacturing system level (also supporting virtual commissioning), including hybrid models: scientific knowledge (physical laws) and contextual data and knowledge (AI)
 - Robust and secure industrial real-time communication technologies, and distributed control architectures
 - Interoperability, architectures (OPC-UA, etc.)
 - in-situ, real-time process monitoring
 - Data acquisition, cleaning analytics, artificial intelligence, and deployment of digital platforms for data management and sharing, on edge and on cloud, aiming at high predictability, repeatability
 - Migration approaches focusing on technological issues
- Impact:**
- Competitiveness of European Companies and SMEs. Lowering barriers
 - People

4.1.4 *R&I Objective 1.4: Artificial intelligence for productive, excellent, robust and agile manufacturing chains*

Priority:

- Excellent, responsive, and smart factories
- By using its advantage of still having excellent and worldwide competitive industries, Europe can still win the global AI-race in this discipline. Research for AI in Industry must be geared towards concrete applications in business and industry, on the basis of context-dependent acquisition, selection and assurance of data quality.

Enablers:

- Data acquisition, cleaning, Data analytics, including artificial intelligence, both on edge and cloud, and deployment of digital platforms for data management and sharing
- AI in industry requires the capability to work with rather small data sets, using context knowledge and transfer learning
- use of AI in real processes will have to meet the highest standards with regards to safety, reliability, quality and precision. AI algorithm robustness, as a combination of explainability and repeatability, is one of the main challenges
- Simulation and modelling (digital twins) covering the material processing level up to manufacturing system level (also supporting virtual commissioning), including hybrid models: scientific knowledge (physical laws) and contextual data and knowledge (AI)
- Advanced and smart material processing technologies and process chains
- Smart mechatronic systems, devices, and components
- Robust and secure industrial real-time communication technologies,
- Migration approaches from as-is situation towards innovative solutions

Impact:

- Manufacturing the Products of the Future
- Competitiveness, maintaining European leadership in manufacturing and equipment
- Productivity, new business models,
- People Creating new jobs

- Planet (new levels of resource efficiency, better decisions)

4.1.5 *R&I Objective 1.5: Advanced manufacturing processes for smart and complex products*

Priority:

- Parallel product and manufacturing engineering
- Manufacturing smart and complex products (i.e. Smart mechatronic systems, devices and components)
- Sustainable symbiotic manufacturing networks (also addressing design for end-of- life/re-use/recycling)

Enablers:

- Advanced and smart material processing technologies and process chains
- Application of functional printing to manufacture the products of the future, including in-mold electronics and printed electronics (e.g 3D printed, screen printed, etc) as a mechanism of adding value to the mechanical components.
- Material identification/characterisation and processing technologies (additive manufacturing, structuring, joining, assembly, shaping and functional materials).
- Nano- and micro-manufacturing (miniaturisation, sensors materials, functional surfaces)
- New, emerging and converging of technologies (biohybrid etc.)
- Intelligent and autonomous handling and robotics, assembly and logistic technologies

Impact:

- Manufacturing the Products of the Future
- Competitiveness
- Planet
- People

4.1.6 *R&I Objective 1.6: Data ‘highways’ and data spaces in support of smart factories in dynamic value networks*

Associated key priorities:

- Excellent, responsive, and smart factories
- Sustainable and dynamic value networks
- Parallel product and manufacturing engineering

Enablers:

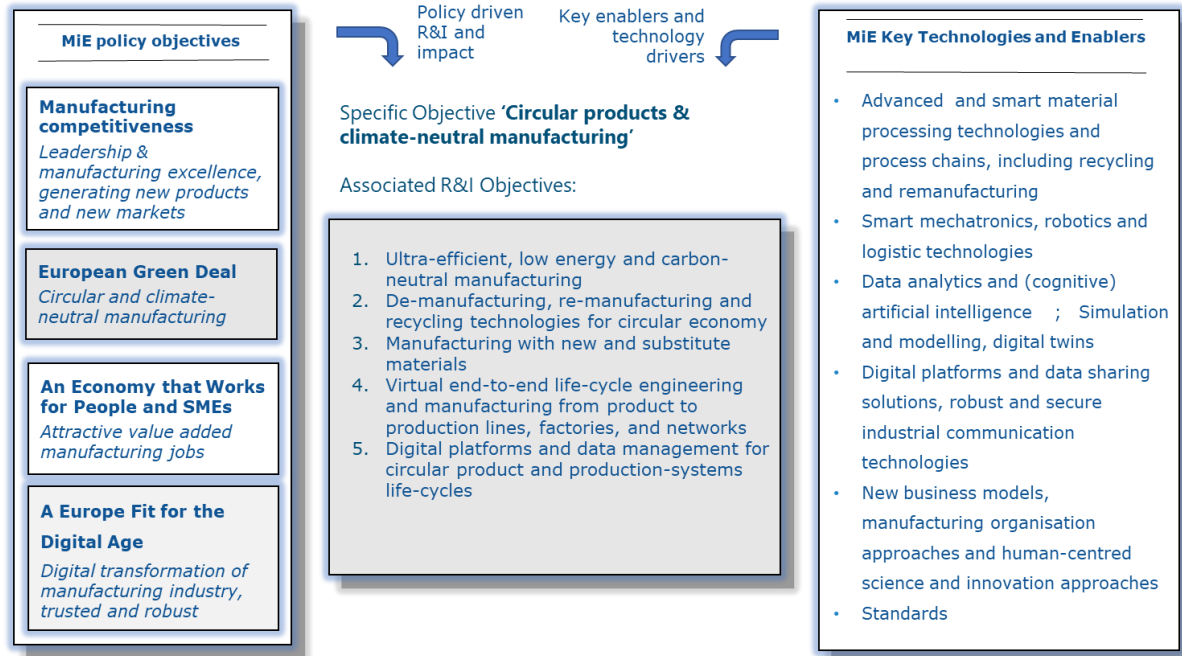
- Robust and secure industrial real-time communication technologies,
- Data analytics, artificial intelligence, and deployment of digital platforms for data management and sharing
- Migration approaches from as-is situation towards innovative solutions

Impact:

- Manufacturing the Products of the Future
- Competitiveness
- People
- Planet

4.2 Research & Innovation Objectives under Specific Objective ‘Circular products & Climate-neutral manufacturing’

Overview:



4.2.1 R&I Objective 2.1: Ultra-efficient, low energy and carbon manufacturing

Priority:

- Sustainable and dynamic value networks
- Sustainable symbiotic manufacturing networks

Enablers:

- Simulation and modelling (digital twins) covering the material processing level up to manufacturing system, factory, and value network level
- Data analytics, artificial intelligence, and deployment of digital platforms for data management and sharing
- Robust and secure industrial real time communication technologies, distributed control architectures
- New business and new organisational approaches, including links with regulatory aspects
- Migration approaches from as-is situation towards innovative solutions
- renewable energy generation, energy storage and energy harvesting/recovery can contribute to reducing energy consumption and accelerate the transition towards a carbon-efficient economy.
- solutions which enable machines and factories to master the increasing complexity of flexible and distributed power generation.

Impact:

- Planet
- Competitiveness

4.2.2 *R&I Objective 2.2: De-manufacturing, re-manufacturing and recycling technologies for circular economy*

Priority:

- Parallel product and manufacturing engineering
- Manufacturing smart and complex products (i.e. Smart mechatronic systems, devices and components)
- Sustainable and dynamic value networks
- Sustainable symbiotic manufacturing networks (understanding life-cycle-impacts)

Enablers:

- De-manufacturing and recycling technologies (re-use, disassembly, sorting, recycling, tracking, sensing, actors)
- Advances in general purpose production technologies such as Laser-based production, Additive Technologies, Nano- and microproduction, Machine Vision/Inspection, Machine learning, Robotics, Automation and Handling.
- Advanced and smart material processing technologies and process chains (additive, joining, assembly, shaping, structuring, surface tailoring, etc.) whilst ensuring scalability, affordability and reliability
- Smart mechatronic systems, devices and components
- Simulation and modelling (digital twins) covering the material processing level up to manufacturing system, factory and value network level
- Innovative sensors, sensor materials, sensing solutions (Machine vision)
- In-line inspection
- Market places for secondary materials, components and products
- New business and new organisational approaches, including links with regulatory aspects such as data ownership, liability, and safety
- Migration approaches from as-is situation towards innovative solutions

Impact:

- Planet
- Competitiveness
- Manufacturing the Products of the Future
- People

4.2.3 *R&I Objective 2.3: Manufacturing with new and substitute materials*

Priority:

- Integrated end-to-end life-cycle engineering from product to production lines, factories, and networks
- Manufacturing in a sustainable Economy
- Managing constant change

Enablers:

- Advanced and smart material processing technologies and process chains
- Migration approaches from as-is situation towards innovative solutions
- Qualification, Ensuring quality

- Market places and businesses cases secondary and substitute materials
- Impact:**
- Planet (novel materials allow easy reprocessing, repair and recycling)
 - Competitiveness

4.2.4 *R&I Objective 2.4: Virtual end-to-end life-cycle engineering and manufacturing from product to production lines, factories, and networks*

Priority:

- Parallel product and manufacturing engineering
- Virtual end-to-end life-cycle engineering from product to production lines, factories and networks
- Human-driven innovation
- Co-creation in European knowledge networks
- Sustainable symbiotic manufacturing networks (also addressing design for end-of- life/re-use/recycling)

Enablers:

- Simulation and modelling (digital twins) covering the material processing level up to manufacturing system, factory, and value network level, with a focus on:
 - Advanced and smart material processing technologies and process chains
 - Smart mechatronic systems, devices and components
- Migration approaches from as-is situation towards innovative solutions (addressing interoperability issues in production design workflows using multi-stage, multi-material, multi-process, and multi-vendor simulation tools)
- Robust and secure industrial communication technologies,
- Data analytics, artificial intelligence, and the deployment of digital platforms for data management and sharing
- Interoperability and data integration
- New business and organisational approaches, including links with regulatory aspects such as data ownership, liability, and safety
- Migration approaches from as-is situation towards innovative solutions

Impact:

- Manufacturing the Products of the Future (collecting data from the use of products and providing feedback to design and manufacturing stages)
- Competitiveness
- People
- Planet

4.2.5 *R&I Objective 2.5: Digital platforms and data management for circular product and production-systems life-cycles*

Priority:

- Parallel product and manufacturing engineering
- Manufacturing smart and complex products (i.e. Smart mechatronic systems, devices and components)
- Sustainable and dynamic value networks

- Sustainable symbiotic manufacturing networks (understanding life-cycle-impacts)
Enablers:
- De-manufacturing and recycling technologies / LCA
- New business and new organisational approaches (in particular metrics or Key Performance Indicators)
- Advanced and smart material processing technologies and process chains (additive, joining, assembly, shaping, structuring, surface tailoring, etc.)
- Advances in general purpose production technologies such as Laser-based production, Additive Technologies, Nano-and microproduction, Machine Vision/Inspection, Machine learning, Robotics, Automation and Handling.
- Smart mechatronic systems, devices and components
- Simulation and modelling (digital twins) covering the material processing level up to manufacturing system, factory, and value network level
Impact:
- Competitiveness
- Manufacturing the Products of the Future
- Planet
- People

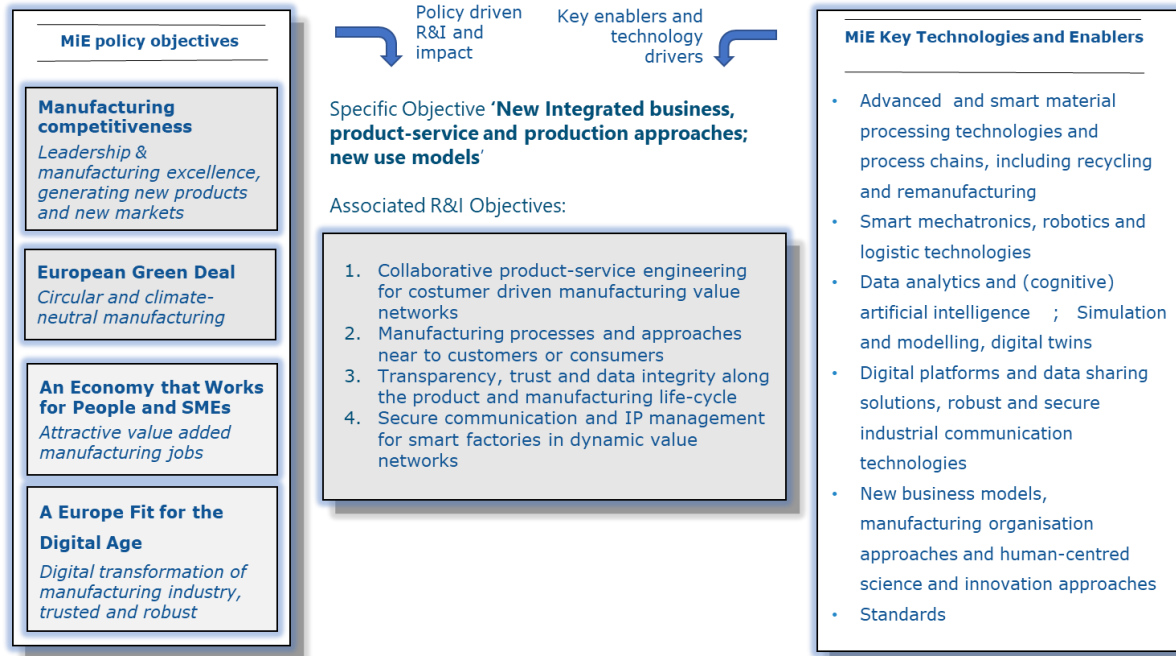
4.2.6 R&I Objective 2.6: Predictive Manufacturing capabilities & Logistics of the future

Priority:

- Demand and consumer-driven manufacturing networks

4.3 Research & Innovation Objectives under Specific Objective ‘New integrated business, product-service and production approaches; new use models’

Overview:



4.3.1 R&I Objective 3.1: Collaborative product-service engineering for customer driven manufacturing value networks

Priority:

- Concurrent, holistic and collaborative product-service engineering
- Co-creation in European knowledge networks
- Manufacturing smart and complex products (and managing complex development processes) that meet circularity and sustainability requirements.

Enablers:

- Simulation and modelling (digital twins) covering the material processing level up to manufacturing system, factory and value network level, with focus on:
- Advanced and smart material processing technologies and process chains
- Smart mechatronic systems, devices and components
- New business and organisational approaches, including links with regulatory aspects such as data ownership, liability, and safety
- Robust and secure industrial communication technologies,
- Data analytics, artificial intelligence, and deployment of digital platforms for data management and sharing
- Migration approaches from as-is situation towards innovative solutions

Impact:

- Manufacturing the Products of the Future
- Competitiveness (product customization in high volume advance manufacturing)
- People
- Planet

4.3.2 *R&I Objective 3.2: Manufacturing processes and approaches near to customers or consumers (including urban manufacturing)*

Priority:

- Demand and consumer-driven manufacturing networks

Enablers:

- Advanced and smart material processing technologies and process chains (additive, joining, assembly, shaping, structuring, surface tailoring, etc.)
- New business and new organisational approaches (in particular metrics or Key Performance Indicators)

Impact:

- Competitiveness
- Manufacturing the Products of the Future
- Planet

4.3.3 *R&I Objective 3.3: Transparency, trust and data integrity along the product and manufacturing life-cycle*

Priority:

- Sustainable and dynamic value networks
- Excellent, responsive and smart factories
- Parallel product and manufacturing engineering

Enablers:

- Robust and secure industrial real-time communication technologies, and distributed control architectures
- New business and new organisational approaches, including links with regulatory aspects such as data ownership, liability, and safety
- Interoperability,
- data integration, data governance
- Digital platforms
- identifying appropriate metrics and parameters which allow understanding and optimization between sectors, disciplines and along the life-cycle.
- Community building, cross-sector collaboration
- Migration approaches from as-is situation towards innovative solutions

Impact:

- Competitiveness
- People
- Manufacturing the Products of the Future

4.3.4 R&I Objective 3.4: Secure communication and IP management for smart factories in dynamic value networks

Priority:

- Sustainable and dynamic value networks
- Excellent, responsive, and smart factories
- Parallel product and manufacturing engineering

Enablers:

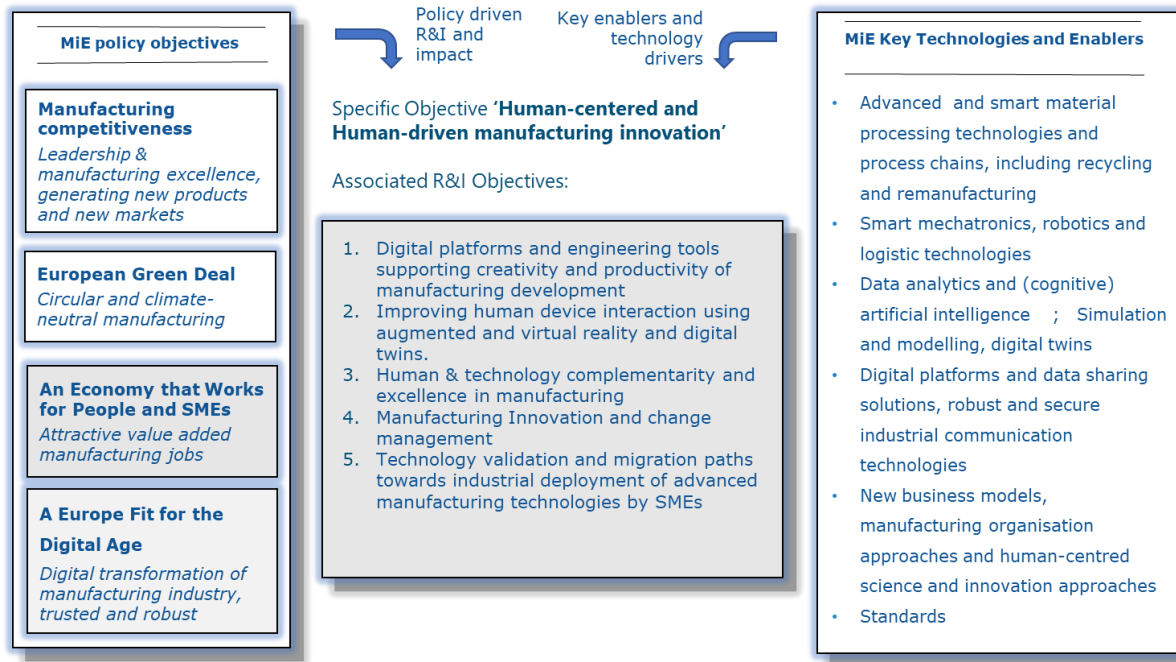
- Robust and secure industrial real-time communication technologies, and distributed control architectures
- New business and new organisational approaches; including links with regulatory aspects such as data ownership, liability, and safety
- Migration approaches from as-is situation towards innovative solutions

Impact:

- Competitiveness

4.4 Research & Innovation Objectives under Specific Objective ‘Human-centered and human-driven manufacturing innovation’

Overview:



4.4.1 R&I Objective 4.1: Digital platforms and engineering tools supporting creativity and productivity of research & development processes

Priority:

- In addition to operational excellence in production, European companies need to maintain leadership in problem-solving capacities and the orchestration of innovation.
- Human-driven innovation
- Co-creation in European knowledge networks
- Human & technology complementarity

Enablers:

- multidisciplinary approach, shaping the next generation of knowledge management, and system engineering,
- improving the understanding of system behavior,
- delivering integrated, easy-to-use tools and more efficient testing and validation methods.
- Simulation and modelling (digital twins) covering the material processing level up to the manufacturing system, factory, and value network level
- Low barrier, cost efficient tool for Data acquisition, data analytics, artificial intelligence, and the deployment of digital platforms for data management and sharing
- New business and organisational approaches, including links with regulatory aspects such as data ownership, liability, and safety

Impact:

- People: supporting creativity of engineers and designers, opening new room for innovation, adaption of skills to new job requirements, acceptance of technologies, embracing technological change, attractiveness of manufacturing jobs
- Competitiveness. enhance the engineering/design capabilities and efficiency of European innovators - engineers, designers, material scientist, entrepreneurs.
- reducing the skills and knowledge gap, easing the shortage of engineers and data scientists., increasing productivity of R&D&I
- Planet: accelerating the development of technological solutions,

4.4.2 R&I Objective 4.2: Improving human device interaction using augmented and virtual reality and digital twins.

Priority:

- Managing constant change
- Human & technology complementarity

Enablers:

- Simulation and modelling (digital twins) covering the material processing level up to the manufacturing system and factory level,
- Migration approaches from as-is situation towards innovative solutions

Impact:

- People
- Competitiveness

4.4.3 R&I Objective 4.3: Human & technology complementarity and excellence in manufacturing

Priority:

- Human & technology complementarity

Enablers:

- Smart mechatronic systems, devices and components
- Intelligent and autonomous handling and robotics, assembly and logistic technologies (including Assistive technologies)
- Simulation and modelling (digital twins) covering the material processing level up to manufacturing system, factory, and value network level

Impact:

- People (well-being, safety, performance)
- Competitiveness

4.4.4 R&I Objective 4.4: Manufacturing Innovation and change management

Priority:

- Managing constant change
- Human & technology complementarity

Enablers:

- Migration approaches from as-is situation towards innovative solutions (blending social innovation with technological innovation)

Impact:

- People
- Competitiveness

4.4.5 R&I Objective 4.5: Technology validation and migration paths towards full industrial deployment of advanced manufacturing technologies by SMEs

The use of projects that feature cascade funding.

Priority:

- Managing constant change
- Human & technology complementarity

Enablers:

- Migration approaches from as-is situation towards innovative solutions
- Low-barrier, low cost, high productivity solutions
- Improving instruments and tools for digital investment decisions

Impact:

- People
- Competitiveness (shorten time-to-market)

5 ANNEX 2 Key technologies and enablers of the Made in Europe Partnership

The integration of technologies and multidisciplinary collaborative are a key characteristics of the Made in Europe Partnership.

The following set of key technologies and enabling approaches will play a key role in achieving the main and the associated policy objectives of the Partnership.

5.1 Advanced smart material and product processing technologies, and process chains (additive manufacturing, joining, shaping, structuring, surface tailoring, etc.)

Advanced smart material and product processing technologies are at the centre of any manufacturing activity; they cover a broad range of manufacturing sectors and products. The combination of materials and process engineering (often supported by advanced simulation) with smart mechatronics (next enabler in the list below) is key. Bio-inspired or bio-integrated manufacturing is an example of new developments, while also, the so-called ‘traditional material processing technologies’, that have been incrementally but significantly improved towards ‘high performance’ material processing technologies over the past decades, play an important role in manufacturing innovation. ‘Younger’ technologies such as photonics or other physical or chemical processes must be integrated in hybrid, flexible, and robust process chains.

5.2 Smart mechatronic systems, devices and components

Smart mechatronic systems, devices and components are at the core of multi-technology approaches, where electronics and software (including (micro-)sensors and (micro-)actuators, local data processing or edge computing devices) are enhancing the accuracy, speed, energy-efficiency etc. of the manufacturing systems, and where these manufacturing systems are connected to ICT solutions and human decision makers in order to optimise the operation of the factories from a multitude of perspectives. Here open source solution and standards are gaining rapidly importance, as compared to vendor lock-in situations that happened sometimes in the past. Products offerings therefore become more data-driven value-added services as predictive maintenance, machine learning, all using data analytics.

5.3 Intelligent and autonomous handling, robotics, assembly and logistic technologies

Factory automation approaches – in synergy with the role of humans in the factory – are evolving rapidly, not least through advances in connectivity, data analytics and cognitive approaches. Advanced handling and logistic approaches within and around factories have a big impact on their performance.

5.4 De-manufacturing, recycling technologies, and life-cycle analysis approaches

These technologies, tools and knowledge-based methods should recover, re-use, and upgrade functions and materials from high-tech products (including capital goods). Product design and manufacturing engineering should anticipate end-of-life strategies.

5.5 Simulation and modelling (digital twins) covering the material processing level up to manufacturing system, and factory and value network level from design until recycling.

Advances in the physical understanding of the behaviour of materials and mechatronics systems and the associated models are enhanced by real time monitoring, data collection and artificial intelligence. Predictive model-based approaches will be deployed from machine level up to supply chain level.

5.6 Robust and secure industrial real-time communication technologies, and distributed control architectures and standardized equipment protocols as OPC-UA

This includes peer-to-peer communication approaches, distributed ledger technologies for industrial applications, wireless communication technologies, including 5G, etc., considering specific application requirements such as latency, safety aspects, etc.

5.7 Data analytics, artificial intelligence, machine learning and deployment of digital platforms for data management and sharing

Data analytics, artificial intelligence/machine learning and the deployment of digital manufacturing platforms are enabling the provision of services that support manufacturing in a broad sense. The Made in Europe Partnership will build on the actions that have been initiated at the end of Horizon 2020, aiming at a broad industrial application-oriented deployment of these technologies, taking account requirements of SMEs as well as the needs for sovereign European industrial data-ecosystems

5.8 New business and new organisational approaches, including links with regulatory aspects such as safety, data ownership, and liability

The introduction of innovative systems, products and services, where the product can be a manufacturing asset or an innovative consumer good, essentially relies on all of the above - mentioned technologies but need to be complemented by non-technological innovation. Sharing of data among people or legal partners in the value chain should consider regulatory

aspects and boundary condition. Also, the implementation of advanced solutions requires migration approaches or 'pathways' from as-is situation towards innovative solutions.

The described set of enabling technologies provides clear pointers to existing PPPs or initiatives that focus on particular enabling technologies, for example: photonics, electronic systems and components, 5G, Cybersecurity, Big Data and AI, Robotics, and HPC.

