

EFFRA VISION FOR A MANUFACTURING PARTNERSHIP IN HORIZON EUROPE

2021-2027



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THE PPP APPROACH: OPEN, TRANSPARENT, INCLUSIVE, AND POWERFUL

The Factories of the Future Public-Private Partnership (PPP) was launched a decade ago in response to a challenging economic and social situation in Europe. The Factories of the Future PPP is long-term investment and a tool through which Europe can maintain, gain or re-gain leadership in new technologies and approaches (e.g. industry 4.0). The overall goal is to jointly look for ways that public research funding can be better allocated and used. PPPs were created to re-engage industrial companies of all sizes and industrial-minded institutes into EU-supported R&D. The underlying assumption of PPPs is that if industry re-engages, the impact of public research is significantly higher.

Partnerships are light and open in terms of structure. They act in a transparent manner and define priorities in an open process in direct response to the needs of industry and society. Partnerships are open to all, there is no fee or artificial barrier to participation and calls for project proposals are completely competitive.

At the heart of a partnership is a multi-annual strategic research agenda which lays out and defines the research and innovation priorities. The annual open call topics are based upon these priorities.

Roadmaps are designed through an open and inclusive process involving public consultations and workshops; the outcome of which is examined and enhanced through a large expert community. Roadmaps serve a wide European manufacturing community as a basis for orientation and cooperation beyond European projects. Upon completion, roadmaps are presented to the European Commission and to the Member States. The Commission, in turn, administers the process of defining the topics for each annual call for project proposals.

The Factories of the Future PPP is a collaborative, multi-sector initiative, based on a partnership between the European Union and the European Factories of the Future Research Association (EFFRA). It aims to strengthen advanced manufacturing in Europe through collaborative European, pre-competitive research and innovation projects, where the best minds from companies, research institutes and universities work together on challenges with a European scale.

The general objective of the Factories of the Future PPP is to increase European industrial competitiveness and sustainability through research and innovation activities for the timely development of new knowledge-based production technologies, systems and activities beyond the factory floor. Ultimately, the Factories of the Future PPP is centred on production and related technologies (both physical and digital).

Towards a Manufacturing PPP in Horizon Europe

This document presents EFFRA's vision for Factories of the Future in Horizon Europe. This vision has been defined through an open and participatory process. It has been developed in tandem with the ManuFuture Vision 2030 document.

Work on the EFFRA vision commenced in the beginning of 2018 with many discussions with experts and workshops followed by numerous bilateral interviews



with stakeholders, and through an online public consultation. All these activities had the goal of extracting - from experts - industry trends and research need for the coming years.

This new EFFRA vision will build upon the successful approach of the Factories of the Future 2020 roadmap but will go further. The general trend is to further “leave the factory floor” and to look at the bigger picture: the manufacturing eco-system and how co-creation takes place through the different actors involved.

The following pages present, in more detail, EFFRA’s priorities for the Manufacturing PPP in the next EU Framework Programme Horizon Europe (i.e. FP9).

If Horizon Europe will be based on a similar model as Horizon 2020, the implementation process for the Manufacturing PPP would see the European Commission formulating the call topics in line with the framework presented here in this EFFRA document. The European Commission would then present these call topics to the Member States who have the final say.



Factories of the Future PPP

DG RTD prepares
FoF calls



Member States
make final
decision



DG CNCT prepares
FoF calls

IMPACT

COMPETITIVENESS, PEOPLE, PLANET, PRODUCTS OF THE FUTURE

The four main components of impact are in line with the 'challenges and opportunities' described in the FoF 2020 roadmap:



**Competitiveness
(Performance)**



People



Planet



**Manufacturing the
Products of the Future**

Competitiveness is and remains a top priority. However, the link with products of the future is now more important than in FoF 2020 (in particular considering the key priorities developed under the section 2 'Parallel product and manufacturing engineering').

COMPETITIVENESS



Any European manufacturing company has a constant need to strive for excellence. This requires producing top quality goods, being highly efficient in terms of costs and resources, while being extremely responsive to market and customer needs, and using and offering creative and innovative solutions. More than ever companies can only achieve this via cooperation and a strong integration in value or knowledge networks or eco-systems.

(Associated KPIs: improvement of productivity, quality, & response-time)

PLANET



Environmental sustainability was already high on the agenda in FoF 2020. Recent reports on climate change and the impact of waste on our society keep raising the importance of energy and resource efficiency in manufacturing, including the need for circular and low-footprint and low-carbon approaches. Energy and power technologies will further enable resilient and sustainable manufacturing, by deploying integrated approaches which cover life-cycles and link sectors, disciplines and eco-systems.

(Associated KPIs: reduction in use of resources (water, material, energy), reduction in generated emissions (including carbon) & reduction of waste generated)

PEOPLE



While the Factories of the Future PPP has been active, the need for adequate skill sets in manufacturing has continued to grow. 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 are creating and modifying their own jobs in their network and how new technologies and social innovations will be introduced and used by the current work force. The technological transition will require to reshape the human-machine-relation and to prepare people with the right capabilities and to provide the right tools and interfaces. In addition, the shortage of experts, data scientist and engineers is a major barrier for European companies.

(Associated KPIs: new job profiles, well-being in the factory, safety, competence and qualification growth, social and environmental responsibility)

PRODUCTS OF THE FUTURE

The following phrase from the FoF 2020 document is still extremely relevant:

“In the pursuit of long term strategic competitiveness, Europe must lead in the creation of value through the design and production of the products of the future which satisfy not only the ever changing needs of society, but also offer the potential of opening/creating new markets in Europe and abroad. High value-added manufacturing should be a distinctive priority for European industry, producing an increasing number of high tech and smart products, including KET-enabled products.”



Innovative, sustainable and affordable products are only possible when reliable and performant manufacturing technology is available which ensures the integration of key technologies, fast and smooth upscaling and conformity with societal requirements. The Manufacturing PPP will provide more attention to the relation between product innovation and production process innovation along their all life cycle. 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. Hence the impact of the partnership will be maximised across different product sectors.

(Associated KPIs: associated product sectors addressed (for example innovative products on the market), and insight generated in application or manufacturing innovation across different product sectors)

CO-CREATION THROUGH MANUFACTURING ECO-SYSTEMS

KEY PRIORITIES UNDER A COMMON HEADLINE

EXCELLENT, RESPONSIVE AND SMART FACTORIES

Scalable first-time right manufacturing

Excellent 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.

Agile and robust optimal manufacturing

The manufacturing industry needs to respond quickly to changing customer demands, fluctuating characteristics of raw materials or components, and advanced emerging technologies that can be potential differentiators. Simultaneously, the manufacturing industry will increase quality and efficiency, while reducing the total cost of ownership. Hence upgradable, evolvable, and robust manufacturing systems and plants are necessary for flexible and responsive manufacturing.

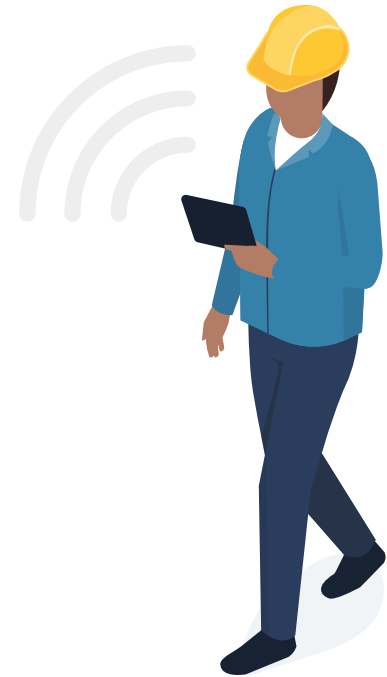
LOW-ENVIRONMENTAL FOOTPRINT, CUSTOMER-DRIVEN VALUE NETWORKS

Demand and customer-driven manufacturing networks

Digitalisation delivers totally new ways to interact with customers, consumers and users. While products become more and more customised, the end-to-end integration of manufacturing networks is important. The need for realising digitalised customer-driven value networks is high on the agenda of the PPP and there is a substantial ongoing effort to realise this. Future research and innovation should aim at assuring that excellent, responsive, and smart factories (section 2.1) can fully offer and deploy their capabilities in dynamic and sustainable manufacturing eco-systems. Therefore, more insight needs to be developed on the role of logistics, which is a critical factor for unleashing the potential of very flexible distributed production.

Sustainable symbiotic manufacturing networks

The new possibilities offered by advanced materials, digital technologies and manufacturing technologies should be exploited; generating a considerable reduction of the ecological footprint, CO₂-emissions and improvements in the recycling, use and re-use of resources on an eco-system level while still raising the performance of the manufactured products. For approaching an ultra-resource-efficient or circular approach, the understanding of impact, cooperation and resource-use must be improved along the life-cycle and across sectors. This will require the identification of appropriate metrics and parameters which allow optimisation along the life-cycle. Furthermore, factories and value chains will have to adapt to renewable and distributed power generation, requiring new, flexible, ultra-efficient and resilient solutions. Dynamic and sustainable value networks need to be further enabled by the continuous and secure integration of digital technologies (5G, distributed ledgers, AI, etc) into legacy approaches, supporting hardware and software life-cycle optimisation both of products (consumer or B2B) and manufacturing systems.



PARALLEL PRODUCT AND MANUFACTURING ENGINEERING

Integrated end-to-end life-cycle engineering from product to production lines, factories and networks

The increasing complexity of products, growing sustainability requirements and the increasing innovation-rate requires that product design and engineering are carried out in parallel with manufacturing system engineering and configuration. Manufacturing and engineering processes need to be substantially improved and heavily virtualised in order to save resources; avoiding the need for physical test-runs or mock-ups. Artificial Intelligence shall be introduced to accelerate the design and engineering processes and to enable design for life-cycle, scaling up from laboratory or R&D scale to pilot scale and further if needed. There is a strong need for new approaches and new tools in engineering and design capabilities. The objective is to increase the productivity of engineers, designers, material scientists, and decision-makers, and to shorten time-to-market and to make better products.

Concurrent, holistic and collaborative product-service engineering

The service component of the overall revenue generated by products, in particular B2B products, continues to increase. The design, manufacturing and (re-) configuration of these products should be more tightly coupled to the services that are associated to these products, considering that these services evolve along the life cycle of these products. In this context, product/service systems can be manufacturing systems that enable excellence and flexibility in factories of the future, as well as high value systems in areas such as mobility, energy, and health. The process of 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 ecosystem.



Manufacturing smart and complex products

Products are increasingly complex, feature an increasing amount of electronics or micro-features and are increasingly composed of advanced (multi-)materials - becoming stronger, lighter and smarter whilst remaining at least as safe or secure as previous versions. Completely new solutions will be introduced when designing future sustainable products enabling durability, energy-saving, the replacement of scarce or hazardous materials etc. Manufacturing system capabilities need to follow product and material roadmaps in order to enable the viable and sustainable manufacturing of these high-tech products.

HUMAN-DRIVEN INNOVATION

Co-creation in European knowledge networks

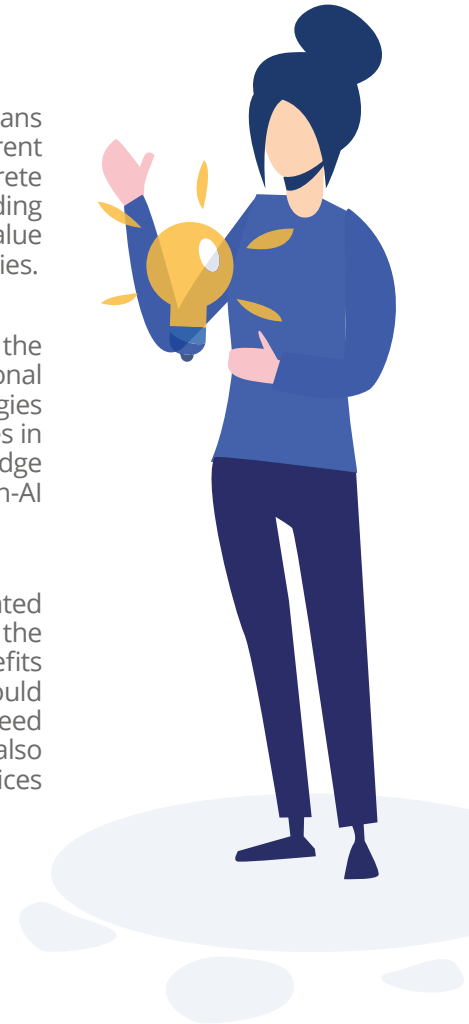
Although increasingly supported by data analytics and decision support systems, humans are still at the core of the innovation process. Innovation is a process where different processes and disciplines (technological and non-technological) converge into concrete solutions and implementations. There is a need for approaches and tools (including strategy management) that strengthen the capability of industrial actors to draw value from the strong European network of creativity potentials, including start-up companies.

Human & technology complementarity

Design and development of advanced technologies should consider the role of the workforce at the earliest stages and should 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 the employees in the co-design. It is of great importance to investigate how human knowledge and skills can complement Artificial Intelligence solutions and how smooth human-AI interaction can take place.

Managing constant change

The implementation of innovative solutions is often subject to reluctance, either associated to potential failure or because decision makers and the workforce are faced with the unknown. 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 take into account personal preferences in the process of change.



ENABLING TECHNOLOGIES AND APPROACHES

Hardware-related technologies are at the centre of manufacturing innovation and innovative products. They, cover a vast range of applications and manufacturing sectors along the value chain. However, innovation is only successful if these technologies are integrated with, and complemented by, advanced digital technologies (often embedded in the hardware) and soft or organisational strategic enablers and approaches. The integration of technologies and multidisciplinary collaborative action generating a broad impact are key characteristics of the Factories of the Future PPP.

The following set of enabling technologies and approaches play a key role for realising the key priorities:

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 the Factories of the Future PPP and 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. 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 a 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.

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.

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.

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.

Energy and power supply technologies: storage, distribution and management solutions

Factories and value chains of the future will be sourcing energy from renewable and distributed power generation, requiring new, flexible, ultra-efficient and resilient solutions.

Simulation and modelling (digital twins) covering the material processing level up to manufacturing system, and factory and value network level

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.



Robust and secure industrial real-time communication technologies, and distributed control architectures

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.

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

As described in 'Factories 4.0 and beyond'¹, data analytics, artificial intelligence and the deployment of digital manufacturing platforms are enabling the provision of services that support manufacturing in a broad sense. The next partnership should 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.

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 solutions².

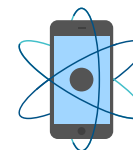
This set of enabling technologies provides clear pointers to existing PPPs or initiatives that focus on particular enabling technologies, for example: photonics, electronic systems and components, 5G, Cybersecurity, Big Data and AI, Robotics, and HPC.

¹ www.effra.eu/factories-future-roadmap

² www.effra.eu/pathways-digitalisation-manufacturing

OVERALL FRAMEWORK FOR PARTNERSHIP UNDER HORIZON EUROPE

The above sections result in the following overall framework for the Manufacturing PPP under Horizon Europe:



Impact

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

Co-creation through Manufacturing Eco-systems

- ◆ **Excellent, responsive and smart factories**
Scalable first-time right manufacturing
Agile and robust optimal manufacturing
- ◆ **Low environmental footprint, customer-driven value networks**
Demand and consumer driven manufacturing networks
Circular economy (symbiotic manufacturing networks)
- ◆ **Parallel product and manufacturing engineering**
Concurrent, holistic and collaborative product-service engineering
Virtual end-to-end life-cycle engineering from product to production lines, factories and networks
Manufacturing smart and complex products
- ◆ **Human-driven innovation**
Co-creation in European knowledge networks
Managing constant change
Human & technology complementarity

Enabling Technologies & Approaches

- ◆ Advanced and smart material processing technologies and process chains
- ◆ Smart mechatronic systems, devices and components
- ◆ Intelligent and autonomous hand and robotics, assembly and logistic technologies
- ◆ De-manufacturing and recycling technologies
- ◆ Energy and power supply technologies
- ◆ Simulation and modelling (digital twins)
- ◆ Robust and secure industrial communication technologies, distributed control architectures
- ◆ Data analytics, artificial intelligence and deployment of digital platforms
- ◆ New business and new organisational approaches

CONCLUSION AND OUTLOOK

The Factories of the Future PPP in Framework Programme 7 and in Horizon 2020 proved to be a strong and important initiative for the manufacturing community. Expectations are very high that at EU level, the community will be served with an even stronger initiative in the next EU Programme Horizon Europe.

Besides the Factories of the Future PPP there are also many other highly interesting workstreams and initiatives. Above all, the work of the ManuFuture European Technology Platform (ETP) needs to be mentioned in this context. In addition, EIT Manufacturing will commence its activities in the near future and will be up and running during the lifetime of Horizon Europe. EFFRA, the ManuFuture ETP, and EIT Manufacturing will work together in a complementary way.

As in the past, EFFRA will also continue to collaborate with other Public Private Partnerships. Looking at

both enabling technologies as well as sector-specific applications, EFFRA will continue consolidating links to technology-oriented and application-oriented PPPs. As in the past, joint workshops will be organised, existing memoranda of understanding (MoUs) will be developed further and further cooperation and complementarities will be sought.

Lastly, the work of EFFRA is based on the work of institutes, companies, universities, associations, and other organisations that are rooted at national and regional level. The national/regional level on the one hand and the European level on the other hand, influence each other and this interaction ensures a constant process of improvement, with the final goal of allocating resources in the best possible way.



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