Dear Colleagues,

The MANU*FUTURE* Platform is developing a Vision document for 2030 and a new Strategic Research and Innovation Agenda (SRIA).

Following the extremely fruitful collaboration in the past with your initiative, we would like to invite you to actively participate in this process, by sharing with us the views and requirements from your stakeholders.

Regarding the SRIA, we kindly ask you to provide us proposals for research priorities, aligned with the broad research **domains** that we identified in our VISION 2030 document (for a short description of these domains, please find below a copy of section 5.1 – "Science and Technology" of the current version of our VISION 2030 document):

1. New business logics and models
2. Agile manufacturing systems design and management
3. Digitalisation, Artificial Intelligence and Cybersecurity
4. Biotech transformation of products and processes
5. Manufacturing technology and processes
6. Robotics and flexible automation
7. Customer driven manufacturing
8. Human centred manufacturing
9. Circular economy, resource and energy efficiency
10. Nano-technology and new materials

Considering its scope, the MANUFUTURE SRIA will include research domains and areas with relevance and impact for the European Manufacturing Industry. For each of the selected research domains, **please propose up to 5 research priorities**, identifying the respective title, type of research and its description and justification. You can include priorities that you classify as Fundamental Research, Applied Research and Technological Development or Pilot implementation and Demonstration. If you consider that some of the research priorities you would like to propose do not fit under one of the indicated research **domains**, please include them in a specific table named "other".

These areas should naturally be relevant for your stakeholders but also **have a horizontal / cross-sectorial nature, which should be supported in the respective description and justification.**

Below, you find a template to collect your suggestions and an example to illustrate the requested information. Please duplicate this table for each one of the 10 selected research domains (if applicable) and add the information regarding your priorities (**up to 5**).

Please send us this information **until the 20th of June.**

After processing all the collected information, we will produce a draft version of the SRIA and send it to collect your final feedback. Your contribution will be duly credited in the final document.

If you have any questions and need more information, please don't hesitate to contact:

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With our best regards,

The MANU*FUTURE* Team

RESEARCH DOMAIN:		
RESEARCH PRIORITY TITLE	**TYPE (F /A / P) ***	**DESCRIPTION AND JUSTIFICATION (max 500 characters per priority)**

(*) F – Fundamental Research, A – Applied Research and Technological Development, P – Pilot implementation and Demonstration

Example:

RESEARCH DOMAIN: Robotics and flexible automation		
RESEARCH PRIORITY TITLE	**TYPE (F /A / P) ***	**DESCRIPTION AND JUSTIFICATION (max 500 characters per priority)**
Cognitive and intelligent robots	A	New methods, architectures and tools to enable robots to learn while in production. Robots and their sensors should evolve to a networked cognitive system, capable of learning from the human worker and from large volumes of relevant historic data, generated locally or by other cyber-physical systems. The objective is to significantly reduce the cost of programming and integrating robots and to support autonomous continuous improvement. The results of this research priority are relevant and applicable in many industrial sectors and companies, namely those dealing with a large product portfolio or customization.

(*) F – Fundamental Research, A – Applied Research and Technological Development, P – Pilot implementation and Demonstration

5.1 Science and Technology

The first building block for a successful manufacturing in Europe by 2030 is Science and Technology.

The competitiveness of companies and the sustainability of societies are strongly related to the continuous success in R&D&I investments. As detailed before, in the current competitive environment Europe will only be able to keep or improve its position in manufacturing and to secure the current level of employment if it will be able to ensure the global technological leadership. To this end, Europe will have to invest more in scientific research and technological development in key areas in:

- Applied Research and Manufacturing Technology, where Key Enabling Technologies (KETs) play a relevant role
- Basic Science
- Social Sciences and Humanities

Contribution from Applied Research and Manufacturing Technology

The main contribution from applied research and technological development to manufacturing competitiveness and innovativeness come from the fields of:

- **New business logics and models:** Mastering product complexity with on demand, personalized products will require new collaboration structures and networks. In a circular economy, customer service will reach a new level and new business models and logics will emerge beyond paradigms such as the sharing economy and the outcome economy. These will become game changers and will be enabled by disruptive technologies such as high-performance clouds, artificial intelligence & machine learning, data analytics, swarm intelligence, bio-processing, functional additive manufacturing, autonomous systems and many more.
- **Design and management of agile manufacturing systems**: New strategies, methodologies and tools to design and manage the manufacturing systems of the future will enable unprecedented levels of agility, modularity, flexibility and resilience. These will have to consider the capabilities of new digital and process technologies and enable the implementation of new business models and manufacturing strategies.
- **Digitalisation, Artificial Intelligence and Cybersecurity**: The digitalisation of industry, by means of cyber-physical production systems, modelling and simulation, cloud and edge based manufacturing, manufacturing as a service and smart manufacturing will change manufacturing paradigms and provide the means to address challenges such as mass customisation and the need for continuous improvements in flexibility, productivity, accuracy, security and sustainability, in cybersecure environments. It is crucial for the manufacturing community to develop or exploit the associated technologies (e.g. artificial intelligence, robotics, 3D printing, wireless connectivity, big data, digital platforms

& standards, digital value chains, as well as next generation connectivity, MEMS, smart sensors and actuators) to the best benefit of European production sector. AI will enable the extraction of knowledge from the huge amounts of data generated and captured at all levels from consumer behaviour, product utilisation, manufacturing and global supply networks. AI will support all human's activity in manufacturing with a special emphasis in analysis and decision making. Big data analytics, learning systems, analysis and decision-making support considering uncertainty factors.

- **Biotech transformation of products and processes:** New biological processes, technologies and value chains will allow the recovery of agricultural, forest and urban waste. Bio-manufacturing will open new opportunities for using biomass from different sources to produce chemical, pharmaceutical and food products with lower energy requirements and environment impact. Biotechnology will reduce Europe´s raw materials and energy requirements and boost the development of new energy harvesting and storage technologies.
- **Robotics and flexible automation**: Developments in robotics and automation will enable the simultaneous improvement of efficiency and flexibility. Collaboration and integration between humans and technology will augment human capabilities, instead of replacing them, allowing humans to concentrate on more added value, creative and socially relevant activities.
- **Manufacturing processes and technologies**: New manufacturing technologies, production processes and manufacturing systems engineering will reinforce the European capability to design, manufacture and **provide globally the best production equipment and systems**. More specific fields of engineering such as product design engineering, mechanical engineering, mechatronics, and electrical and electronic engineering will also contribute to better European products and factories, as well as to better services provided by European manufacturing industries.
- **Customer Driven manufacturing**: Future manufacturing will address the needs of each individual customer, through highly flexible and integrated manufacturing systems. Customers will be able to configure, personalise or customize the products they need, with an increasingly more important role in product conception and design. Advanced technology will enable manufacturing to better capture and integrate the customer preferences and requirements and to design better products.
- **Human centred manufacturing**: New technology will not replace humans in the creativity and decision power in key areas. Technology will support human activity and augment its capabilities to higher levels of effectiveness and added value. New interfaces between humans and machines and between machines will enable new levels of cooperation. Factories will be designed to provide an appealing and challenging environment for humans, attracting the best professionals and talents for European manufacturing.
- **Circular economy, resource and energy efficiency:** Solutions to minimise the costs and environmental impact of manufacturing, namely by reducing the consumption of resources like materials, water and energy. The shift towards a circular economy requires designing products that are easier to repair and maintain, upgrade and recycle, with and enlarged customer service. Processes,

technologies, skills and facilities devoted to maintaining, repairing, upgrading, remanufacturing and/or recycling products and their components is another major challenge for future European manufacturing. Remanufacturing facilities will operate together with or be embedded in manufacturing plants to manage the whole life cycle of products. New solutions for optimal energy efficiency, recovery, harvesting and storage are needed to enable Europe leadership in resource efficiency and sustainability.

- **Nano-technology and new materials:** Materials engineering and nano-technology will play a key role in relation to the physical properties of the European products and components, as well as the processes needed to manufacture, re-manufacture and recycle them. Utilisation of diverse advanced materials and their combination in manufacturing value chains will be enabled by material encoded data, contributing to the circular economy challenges. Besides, the full life-cycle of products and processes must be considered and therefore, technologies related to engineering, joining, disassembling and recycling will strongly contribute to the environmental sustainability and competitiveness of European industry.

Contribution from Basic Science

Basic Science has been the engine and the foundation for innovative solutions through decades and, in manufacturing, it is expected to be even more in the years to come. Europe is a strong global player in basic science but the connection between basic science and more applied research and technology development needs to be reinforced in the field of manufacturing.

The future of manufacturing will rely on interdisciplinary scientific discoveries. To keep the forefront, scientific disciplines need to interconnect in a much higher degree: applied mathematics and computer sciences will impact manufacturing networks, industrial cybersecurity, complex manufacturing processes and systems modelling, a renewed era of artificial intelligence and learning systems, novel human-technology interaction. Physical sciences (e.g. materials, Nano/micromaterials, functional materials, magnetics, superconductivity, fluids, plasma, quantum science) as well as chemical sciences (e.g. new polymers, batteries) and biotechnology and life sciences (e.g. new synthetic biological processes, biopharmaceuticals, new sensors and actuators) will impact on many fields, related to the properties of materials, the way they are processed and integrated in new products and devices.

A key element for the successful uptake of scientific results will be the establishment of communities or ecosystems, of networks of diverse types of scientists and technologists where both the needs and challenges from the technology market side as well as the promising technological and non-technological outcomes of relevant scientific fields can be shared and discussed, aiming at using them to the benefit of European industry.

Contribution from Social Sciences and Humanities

In an increasingly sophisticated society, also reflected through more complex manufacturing value networks, most of the challenges cannot be faced by stand-

alone scientific disciplines nor solely by technologies. Human behaviour, perceptions, emotions, consumer preferences and design, as well as social aspects related to the type of society we want for Europe and globally, the relationships between stakeholders, etc., require approaches that will combine technical aspects, as described in most of the previous paragraphs, as well as knowledge related to humanities and social sciences.

Relevant challenges include making European products more attractive and offering better places to work, or, in other words, being able to generate positive emotions to the people involved in one way or another with manufacturing. This leads to considering aspects not only of marketing or communication, but also arts for product design or architecture for plants and working space design. Also, the role of the manufacturing worker will be changed from typical operations towards new and more sophisticated activities (e.g. product conception, user support services, monitoring, process design, teaching robots, developing, configuring and supporting IT solutions), increasingly in cooperation with advanced support systems, such as cooperative robots or AI enabled technologies.

The fields of economics and management provide insights about the future business environment, logics behind and related models. Other crucial topics for a competitive future industry are entrepreneurship, industrial relations, management and production management, networked enterprises. In addition, there is a need to address the framework conditions of our economy and industry, to set European (and worldwide) standards, to address working conditions, etc. Law and Political sciences, as well as Ethics will play a role in these subjects.

Finally, an aspect of relevance to European manufacturing relates to the perception of manufacturing, the role of women and men in the factories, how to make these factories more attractive to young talents, life-long training of industrial workers, fostering entrepreneurship. Education, psychology and sociology will have a key role.