VDMA

European Office

Strategic Planning Horizon Europe - VDMA-recommendations

The view of the mechanical engineering industry

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I. Manufacturing and Engineering: drivers of change

Europe's industry has to adapt to changing global markets, new technologies and the overall need to produce and consume in a sustainable way. Mechanical engineering is a provider of cross-cutting technology for a wide range of industries, but it is also a strategic value chain of its own in terms of employment, value added and R&I-investments. Our sector is at the heart of the transition toward a sustainable European economy and facing new challenges, but also new opportunities. Horizon Europe, and in particular pillar two, could play an important role to support this change by providing inspiration, support and the platform for European collaboration.

Being part of value chains and innovation networks, manufacturing and manufacturing equipment companies are facing similar societal, ecological and technological challenges as industry as a whole. However, due to the structure of the sector - which is characterized by a high share of SMEs and heterogenous market conditions – its in particular the transition which is challenging the sector.

- **Maintaining leadership, competitiveness and resilience**

So far Europe's companies have been successfully operating in world markets and are champions in a wide range of markets and sectors. However, this position is challenged by global competitors and increasing technological and economical complexity. In order to maintain leadership and ensure stable employment, European mechanical engineering industry must address these challenges:

  - Mastering the transition: react to the fast change of economic patterns, customer expectations, global markets and value networks induced by new, sometimes disruptive technologies and societal changes.
  - Developing and adapting new technologies: upcoming technological options must be developed, deployed and successfully implemented.
  - Staying competitive , autonomous and resilient in global value chains: Consumers and business are benefitting from global trade and exchange of goods, services and ideas. However, increasing protectionism, unfair practices and trade barriers are making it more difficult to defend sovereignty and leadership.

- **Sustainable Production and Consumption**

There is no other way for industry to use natural capital in a responsible and ultra-efficient way, respecting the boundaries of our natural systems. Business models and technologies of the future will contribute to the UN-sustainable development goals - in particular to SDG 12 "responsible consumption and production" – and, of course, will have to match societal expectations and obligations (e.g. in terms of regulation, ethical standards and customer requirements).

- **Humans and Technologies:**

The fast-moving transition towards more autonomous and automated systems requires to shape the cooperation of human and machines. The new technologies needed for staying in the lead and to master societal challenges must be accepted by citizens, consumers and workers. In particular for SMEs, the shortcoming of qualified staff and talents has become a major barrier and threat.

II. Vision and objectives of our industry

By 2030, industry has made substantial progress towards a circular and carbon-neutral production (SDG 12,13,14,15), providing affordable, innovative and green products (SDG 1,3), based upon the understanding of both natural boundaries and the impact of technologies. Employees find meaningful and prosperous jobs (SDG 1,10, 8) and companies employ the people they need to thrive (SDG 9).

Horizon Europe has an essential role by guiding and supporting this transition. It can contribute by helping to achieve impact in the following areas:

II.1 Competitiveness and leadership: Objectives and impact needed

By 2030, European companies of all sizes are successfully present in world markets, a large number of them being champions in their respective markets (SDG 8). They are integrated both in international and regional value networks, and have access to first-class infrastructures, innovative technologies and relevant knowledge (SDG 9). Companies benefit from competitive, fair and accessible markets and are stable, profitable, non-dependant and innovative (SDG 9).

In order to achieve this objectives, **impact** needs to be achieved in the following areas:

- Increase of number of relevant new technological building blocks (materials, processes, methods), creation of knowledge and understanding
- Further increase in European manufacturing and engineering excellence (productivity, quality, resilience, ingenuity)
- Improve access to technologies for companies of all sizes and regions, through innovation networks, technology transfer and industry-relevant research actions.
- European companies have access to and benefit from competitive supply chains and supply options inside and outside Europe
- Significant progress in digitisation of companies which supports their business excellence - e.g. through use of AI, beneficial data exchange, better interoperability (e.g. OPC-UA).
- Encouraging investments in new products and processes, upscaling and start-ups

Related comment on Strategic Planning Annex 4; 2. EU Policy Objectives -"Competitive edge and autonomy of EU industry":

VDMA is fully aligned with the description of the policy objectives for competitiveness and industry. We would like to underline the need to ensure access to technologies for companies of all sizes.

However, "autonomy" could be misunderstood as a call for protectionism. The overall goal should rather be that European companies and consumers have choices and can benefit from competitive supply chains and supply options inside and outside Europe.

What we propose: To include the objective to strengthen Europe as a leading knowledge location for engineering, design and manufacturing excellence.

II.2 Carbon-Neutrality and Zero-Eco-Impact: Objectives and impact needed

By 2030, our societies have substantially reduced the use of natural capital. Industry has played a core role and has minimised resource and energy consumption (SDG 7,14,15) and moved towards carbon-neutrality (SDG 13). Circular economy and sustainable products (SGD12) have become reality, e.g. by using secondary materials in product design and productions processes.

At the same time, European industry has gained a world-wide competitive advantage, creating competitive products and benefitting from the scaling potential of a European single market for a circular economy. The manufacturing equipment industry has benefitted in two aspects: As a solution provider, companies have expanded their competitive advantage through technological progress and new business models. As a user of resources, companies have safeguarded resource supply and identified substitution materials.

Research & Innovation programmes can support this by developing cross-cutting solutions (processes, equipment, platforms, methodologies) which increase the resource efficiency/ circularity in industrial value chains and product-life cycles, creating synergies and cooperation between sectors and along new value chains.

In order to achieve this objectives, **impact** needs to be achieved in the following areas:

- progress towards a cost-efficient carbon-neutral production sector, by further improving processes, using synergies and value network optimisation
- increased resilience of manufacturing processes to energy scarcity and adaption to decentralised, multiple energy sources
- substantial number of industrial processes using qualified secondary or substitute materials
- closing gaps between sectors, value chains, data value chains and supply/demand, creating new market places and platforms for materials, metrics, indicators, standards
- new solutions for “remove, reduce, reuse, repair, remanufacture, recycle”
- substantial number of new, industrially scalable repair, disassembly, re-manufacturing and recycling processes
- increase of data and information flows and intelligence (traceability, design and engineering, data integrity between sectors and along value chains, new, affordable, qualified sensors)

Related comment on Strategic Planning Annex 4: EU Policy Objectives - “Climate-neutral, circular and clean industry”:

VDMA is fully aligned with description of the policy objectives for a “Climate-neutral, circular and clean industry”. We would like to underline the need to develop new technologies and solutions.

What we propose: To use a wide definition of circular economy which includes not only reuse, repair, remanufacture, recycle, but also “reduce” and “remove”. The biggest impact potential and the biggest challenges in industrial value chains are not where resources are recovered, but where use is reduced, minimised or even made obsolete.

II.3 Humans and technology: Objectives and Impact needed

For VDMA, humans, machines and progress are intrinsically linked[1]. Humans have always have been designing, building and using machines for improving their lives and overcoming challenges. Also now, upcoming technologies offer new opportunities and options. On the other hand, technological progress raises fears and new questions. It is therefore essential to shape the human-technology relation in a sound, meaningful and ethical way.

In 2030, the understanding and mastering of technologies among citizens, employees, companies and authorities has substantially increased. Humans remain the masters in human-machine collaboration, exploiting the synergies, building upon humans' expertise and allowing new dimensions of creativity. Industry offers employment which is prosperous and meaningful (SDG 1, 8, 10) and companies of all sizes can employ the people with the expertise, skills and talents they need to be successful (SDG 9).

In particular, the following tangible **impacts** are needed:

- Raising awareness of and trust in new technologies, increasing the understanding of new how technologies work and what are their implications
- Ensuring that the use of new technologies is safe, economically sustainable and following ethical guidelines
- Qualifications, skills and knowledge of workforce are matching the requirements of a globalised, digitised and sustainable economy
- Optimised and sensible human-machine cooperation is established, leading to productive, safe, meaningful and gratifying employment

Comment on Strategic Planning Annex 4: Contribution to inclusiveness

VDMA supports the policy objectives In particular, we support the view that empowerment and access to technologies is key.

However, in our view the impact of R&I-programmes on inclusiveness and social objectives is rather indirect. Horizon Europe can deliver building blocks and understanding, but it seems overambitious to aim at a major contribution on inclusiveness.

What we propose: To highlight the potentials of human-machine cooperation for sustainable progress and to need to make Europe a place which is open and positive about new technologies.

[1] https://mensch-maschine-fortschritt.de/about-this-project/

III. Technologies and Enablers. Orientation on key priorities

In order to respond to the challenges and to achieve these objectives, a wide range of enablers and advancements are needed, both technological and non-technological.In the following chapter, we highlight the research areas which we consider as most relevant because they:

- close gaps in strategic value chains
- are of a size and complexity which requires European and multidisciplinary collaboration
- promise substantial impact and spill-overs

Because of the cross-cutting nature of manufacturing, the development of manufacturing technologies needs collaborative research and dialogue. Therefore, also the needs for more intensive cooperation are indicated.

IV.1 Technological Building Blocks of the Future

Miniaturisation and Functional Integration

Making components smaller by integrating more functions in surfaces and in concentrated spaces is a cross-cutting enabler for a broad spectrum of applications - ranging from sensors, micro-mechanical systems, microfluidics, low-energy components , smart surfaces or bio-hybrid components. Products must become smaller, lighter, more robust and more energy-autonomous. Integration of features in devices enables the decoupling of resource use and added value. **This requires not only new, precise, scalable and reliable micro- and nanomanufacturing processes, but also further integration of physical processes with digital technologies**

This area needs close cooperation with the intervention areas 4.2 "Key Digital Technologies" (manufacturing of key digital components); 4.3 "Advanced Materials" ("new materials in prodcution processes") and might benefit from dialogue with intervention area 4.4 "Emerging Enabling Technologies".

New production and (dis)-assembly processes

In industrial environments, advances in digital technologies will only deliver the full range of results in terms of productivity, resource-efficiency and flexibility, if they are aligned with physical production processes. **New production processes are needed to open innovations spaces for new solutions and products, whilst ensuring scalability, affordability and reliability.** In addition, the move towards a circular economy and less material use will require new product/service-functionalities, production and re-production (reduce, re-use, disassembly, sorting, recycling) solutions . Production technologies such as laser-based production, additive technologies, nano-and microproduction, machine vision/inspection, machine learning, robotics, automation and handling will continue playing essential roles.

This area needs close cooperation with the Intervention areas; 4.3 "Advanced Materials" (use of new materials in production processes), 4.5 "Artificial Intelligence and Robotics" and might benefit from dialogue with intervention area 4.4."Emerging Enabling Technologies".

Cyber-physical production systems: Agility, Resilience, Adaptivity

Personalised and living products, changing markets and customer expectations and competitive pressure requires adaptability and speed, ensuring availability across the value chain. are subject to constant changes in input and output variables and general conditions. **This requires the permanent adaptation of the entire value-adding-system**.

This area needs close cooperation with the Intervention area 4.5 "Artificial Intelligence and Robotics". Dialogue with sector-oriented clusters (e.g. mobility, food, health) is needed to identify manufacturers needs and common piloting/demonstration activities could provide validation and facilitate uptake of new manufacturing technologies.

Machine learning/AI in manufacturing enterprises

The use of AI in industrial value chains promises big potentials in terms of competitiveness and sustainability. By using its advantage of still having excellent and worldwide competitive industries, Europe can still win the global AI-race in this discipline. However, the use of AI in real processes has to meet the highest standards with regard to safety, reliability, quality and precision. Furthermore, AI in industry requires the capability to work with small and/or heterogenous data sets, using context knowledge and transfer learning. **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.

This area needs close cooperation with the Intervention area 4.5 "Artificial Intelligence and Robotics".

New Engineering, Design and Development methods and tools

In future, European companies will have to excel in problem-solving. While operational excellence in production is still essential, differentiation will be created through the orchestration of innovation. Therefore, there is a need to enhance the engineering/design capabilities and efficiency of European innovators - engineers, designers, material scientist, entrepreneurs. This will also contribute to reducing the skills and knowledge gap and to easing the shortage of engineers and data experts. **This requires progress in knowledge management, system engineering and understanding of system behavior**, e.g. through improving modelling and simulation, delivering integrated, easy-to-use tools and more efficient testing/validation methods.

This area needs close cooperation with the Intervention areas; 4.3 "Advanced Materials" (use of new materials in engineering), 4.5 "Artificial Intelligence and Robotics" and might benefit from dialogue with intervention area 4.4."Emerging Enabling Technologies".

IV.2 Supporting the Transformation: Cooperation, Business Models and Society

New ways of cooperation and new business logics

The intensification of horizontal cooperation is decisive for matching customer needs. For example, it is important to investigate the technical, legal and organizational aspects of business ecosystems and develop systems for their description and design. Digital platforms create more efficient and transparent markets. They offer companies new ways to cooperate with customers and industry partners. Especially small and medium-sized companies benefit from improved global visibility for their own company and possible cooperation partners in the market. Furthermore, products will become more and more adaptable during their entire life-cycles. This will enable new business

models, adaption of functionalities and efficiencies, but raises also new challenges in terms of digital/physical integration, data handling and engineering processes-

This area needs cooperation with the Intervention areas; 4.5 "Artificial Intelligence and Robotics". Dialogue with sector-oriented clusters (e.g. mobility, food) is needed to identify manufacturers needs and common piloting/demonstration activities could provide validation and facilitate uptake of new manufacturing technologies.

Industrial Foundations of a circular and resource-efficient economy

For approaching an ultra-resource-efficient and circular economy, the understanding, cooperation and resource-use has to be improved along live-cycles and across sectors. **This will require to identify appropriate metrics and parameters which allow understanding and optimization between sectors, disciplines and along the life-cycle.** Dynamic and sustainable value networks need to be further enabled by the continuous integration of data and digital technologies (5G, distributed ledgers), supporting hardware and software life-cycle optimization both of products and manufacturing systems.

This area needs close cooperation and common action with the intervention area 4.9 "Circular Industries" and Cluster 6. Dialogue with sector-oriented clusters (e.g. mobility, food, health, textile) is needed to identify manufacturers needs and common piloting/demonstration activities could provide validation and facilitate uptake of new manufacturing technologies.

Energy efficiency and power supply in manufacturing

For manufacturing technologies, reducing CO2-emmission both in the processes, but also in the use of energy is both an opportunity and a challenge. What is needed is to develop solutions which enable machines and factories to master the increasing complexity of flexible and distributed power generation. In the manufacturing processes itself, renewable energy generation, energy storage and energy harvesting/recovery can contribute to reducing energy consumption and accelerate the transition towards a carbon-efficient economy.

This area needs close cooperation and common action with the Intervention area 4.9 "Circular Industries" and Cluster 5.

Human-Technology Cooperation

Future tasks in planning and executive activities place new demands on skills and abilities. Complexity, abstraction and problem-solving requirements represent key competencies in the future. Lifelong learning becomes a prerequisite for mastering ever-changing intelligent systems.

This area needs cooperation with the Intervention areas; 4.5 "Artifical Intelligence and Robotics".

Comment on Strategic Planning Annex 4, I.4.1: "Key R&I Orientations" /Manufacturing Technologies

VDMA agrees with the priorities listed in the orientation paper.

However, the priorities mentioned in the orientation paper do not address physical manufacturing processes. The impacts needed, however can only be achieved by further developing manufacturing and engineering processes and encouraging the integration of digital and physical world.

We propose to include the following priorities:

- Developing advanced manufacturing processes and technological building blocks in order to ensure technological leadership and a circular and resource-efficient economy in areas such as miniaturisation/functional integration or efficient sorting/disassembly processes, developimg technological enablers such as nano-/micromanufacturing, laser-manufacturing, additive technologies, Machine Vision/Inspection/Sensing, Machine learning, Robotics, Automation and Handling.

- Technologies for a Circular Economy must include the concepts of "remove" (making use of resources or even products obsolete) and "reduce" (achieving functions with smaller, less and integrated devices or product/service combinations).

- Developing Engineering, design, knowledge Management and testing/validation methods and tools in order cope with complexity and to make Europe a leading location for creativity, ingenuity and excellent solutions.

IV. Principles & Instruments

IV.1 Principles

The support of collaborative, precompetitive applied research is one of the strongest assets of EU Research. Strategic investments in collaborative R&I are crucial to ensure future competitiveness and sustainability. VDMA suggests to prioritize collaborative research actions with clear European added-value and consider an increased use of lean, bottom-up procedures, which promote the collaboration of start-ups/SME's with larger enterprises on one hand, and with universities and Research institutes on the other hand.

IV.2 Instruments

Horizon Europe needs the involvement of industry to ensure validation, upscaling of results and encourage private R&I investments. It is therefore essential to establish a structured dialogue with industrial stakeholders, for example, through technology platforms (ETPs) or public-private partnerships.

Public-private partnerships are an efficient instrument to increase impact. The definition of criteria, targets and mutual commitments must take place in a fair and consensual manner. Partnerships with industry in particular, must be kept specific, target-oriented and simple.

VDMA is a founding member of the “Factories of the Future” - public/private partnership. Our member companies have been active in several others such as the Robotics-PPP and Photonics21-PPP. These partnerships have been successful for both sides. They have enabled a fruitful strategic policy dialogue, served as a low-barrier gateway to EU research for SMEs and have proved to be a very efficient method for knowledge-transfer to a wide range of enterprises.

VDMA therefore supports in particular the partnerships approaches in Manufacturing (Made in Europe), AI, data and robotics and Photonics. From the candidates for new partnerships areas, VDMA welcomes the idea for a partnership in the area of waterborne transport.

V. Summary and recommendations:

In general, structure and priorities as described on the orientation paper are addressing the challenges of Europe and its industries. VDMA shares the view on the challenges as well as the objectives which industry and industrial research have to achieve.

However, with regard to the R&I-orientations, the set of enablers and accelerators is not complete. In particular, VDMA recommends to add the following priorities:

- Precompetitive research on future strategically important technological building blocks
- Stronger role of physical manufacturing processes and their integration with digital technologies, in particular in the intervention area 4.1. “Manufacturing Technologies”.
- Widening the scope of the circular economy-priority in the intervention area 4.1. “Manufacturing Technologies”

In order to focus and to ensure impact, a European dialogue between industry, research and policy makers is needed. VDMA therefore supports the approach to implement partnerships and European Technology platforms such as those for manufacturing (Made in Europe), AI and robotics and Photonics.

In general, VDMA considers collaborative, precompetitive applied research as one of the essentials and assets of EU Research. The emphasis of Horizon Europe must be on this area to ensure future competitiveness and sustainability.

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Annex: Manufacturing research and other intervention areas

Advanced Manufacturing technologies are applied in a wide range of industrial sectors where they enable product innovation, cost and resource efficiency, quality and volume production and contribute to achieving the challenges. This includes traditional sectors such as automotive, food, packaging or textiles, but also emerging and future value chains such as battery production, Power-to-X or the bio-economy. In addition. Manufacturing itself is part of strategic value chains such as the Industrial Internet of Things (IIoT) or new networks, e.g. as required by the Circular Economy.

Manufacturing is therefore of high relevance for other intervention areas/clusters and shares the challenges and objectives. It is therefore suggested to establish a dialogue on results and priorities. In some cases coordinated and common actions should be considered, in particular when upscaling and pilot lines are needed to validate and show upscaling potentials of manufacturing technologies. The following table provides an non-exhaustive suggestion.

Intervention Area	**Relevance: Manufacturing is a..**	**Potential actions:**
4.2 Key Digital Technologies	**provider:** manufacturing technologies for key components; **integrator:** CPPS, components, IT-solutions	Continuous dialogue on priorities and results, demonstrators and pilot lines
4.3 Advanced Materials	**provider:** industrial process technologies for new materials; **user:** new materials (lightweight, recyclable, secondary materials)	Continuous dialogue on priorities and results common action for upscaling of processes for new materials
4.4 Emerging Technologies	potential **user** of emerging technologies	Continuous dialogue on results
4.5 AI and Robotics	**user:** AI in Manufacturing; part of the community: Industrial Robots and AI are manufacturing topics **integrator** of AI-technologies in machines and processes	strategic dialogue needed
4.6. Next Generation Internet	**user**	observation
4.7 Advanced Computing	Manufacturing benefits indirectly	observation
4.8 Space	provider of high-performance manufacturing solutions	dialogue on priorities, potentially validation/piloting activities
4.9 Circular Industries	**Solution provider:** addressing the same challenge; complementing CE beyond materials streams **user:** of recycled materials, or recycling services	strategic coordination / sharing of activities,
4.10 Low-carbon and clean industries	addressing partially the same challenge **User** of products of energie-intensive industries (e.g. steel)	

Cluster/Intervention area.	Relevance: Manufacturing is…	Potential actions
Health /		
4.2 Living and working in a health-promoting environment	User of results Provider of improved manufacturing technologies	Dialogue on priorities, results ; validation
Cluster 5: Climate, Mobility, Energy	**Provider** of scalable manufacturing technologies	Dialogue on priorities, pilot lines & demonstrators
4.2.1 Establish a competitive and sustainable European battery value chain	**Provider** of scalable manufacturing technologies	Dialogue on priorities, **pilot lines & demonstrators**
4.3.1 Achieve global leadership in renewable energy	**Provider** of scalable manufacturing technologies	Dialogue on priorities, **pilot lines & demonstrators**
4.5 Develop low-carbon and competitive transport solutions across all modes	**Provider** of scalable manufacturing technologies	Dialogue on priorities, **pilot lines & demonstrators**
4.5.4 Enable low-carbon, smart, clean and competitive waterborne transport	**Provider** of scalable manufacturing technologies	Dialogue on priorities, **pilot lines & demonstrators**