The Future of Europe and Manufacturing

1. Introduction: The geo-economic strategic challenges for Europe and its Manufacturing Sector

The context which we are experiencing worldwide today, both economically and geopolitically, marks a clear turning point. The era of globalization as we knew it has come to an end. In its place, a new multipolar scenario is emerging, increasingly defined by the dynamics of "hybrid warfare" and systemic competition where technological leadership, information conflict, and economic power strategies are replacing traditional armed confrontation.

At the same time, the demographic changes projected for the 21st century represent an additional factor of instability and structural transformation. According to United Nations projections (World Population Prospects 2022), by the year 2100, China's population could shrink from over 1.4 billion to fewer than 800 million, directly impacting its labour force and the sustainability of its economic model. Sub-Saharan Africa is expected to grow by more than 2 billion people, posing enormous challenges in terms of development, urbanization, and political stability. The United States is expected to experience moderate growth, primarily driven by skilled immigration and relatively higher fertility rates compared to other developed countries (recent developments might, however, reduce skilled immigration and alter this trajectory. Europe, on the other hand, will face a structural demographic decline, exacerbated by low birth rates and a fragmented approach to migration management.

Within this new global order, three strategic assets are emerging as increasingly critical to national competitiveness and security:

- Technological innovation capacity
- Development and application of artificial intelligence and robotics
- Manufacturing strength – both in the civilian and military domains

China today exemplifies success in this reconfiguration. Through substantial investment (over 2.5% of GDP in R&D, according to OECD data) and a highly integrated state-industry ecosystem, Beijing has laid the groundwork to become the leading technological superpower of the future. The speed of its innovation cycles, its low-cost approach to AI deployment, and its increasing automation in manufacturing processes make China a strong competitor.

Historically a leader in innovation and defence technologies, the United States is now striving to rebuild its manufacturing base, which has been significantly shrunk since the post-World War II period. Through industrial policies such as the CHIPS Act, the Inflation Reduction Act, and more recently, tariff reforms, Washington is attempting to relocalize strategic production

and reinforce its technological and economic autonomy. These efforts, however, are currently facing difficulties in terms of the availability of a skilled workforce and of advanced manufacturing technologies.

Meanwhile, new emerging players—particularly India and Indonesia—are gaining ground, thanks to favourable demographics, accelerated digitalization, and targeted investments in infrastructure and human capital.

By contrast, Europe appears to be lagging behind. The Draghi-report, for example, identifies a lack of productivity increase which poses a risk for growth and ultimately, the European model. This is rooted, among others, in deep structural and financial limitations affecting both large manufacturing firms and young innovative startups[1] Without a unified and long-term strategy the continent risks being relegated to a peripheral role in global affairs. To reverse this trend, a radical shift in approach is needed, built upon:

- The revitalization of innovation capacity, currently underutilized and poorly coordinated among universities, research centers, and industry, and between European, national and regional policies and programmes and initiatives;
- The revival of the manufacturing sector, which once stood as a cornerstone of the European economy but has seen its contribution to GDP decline for over a decade (from 19% in 2000 to 14% in 2022, according to Eurostat).

In this paper, the ManuFuture ETP, outlines why and how Manufacturing Innovation can contribute to address the above-mentioned challenges and how Manufacturing R&I should be included as a key area in upcoming funding programs.

2. Manufacturing is one pillar of the bridging the innovation gap

The Draghi report has identified the 'innovation gap' compared to the United States and China as one of Europe's weaknesses, amongst other gaps. Besides structural issues such as the fragmentation of the single market and regulatory complexity, the report identifies three barriers to innovation that require manufacturing technologies to be overcome and boost innovation. Firstly, manufacturing technologies are needed to produce innovative products on a scale with the appropriate quality and at an affordable cost to bring them to the market. Secondly, they can help reduce the problem of demographic evolution by increasing productivity. Thirdly, human-centered manufacturing technologies can help reduce the skills gap.

[1] International Monetary Fund: Europe's Declining Productivity Growth: Diagnoses and Remedies

3. Challenges which require a boost in Manufacturing excellence

Manufacturing innovation is also needed to overcome the main economic, environmental and strategic challenges of Europe:

Circular Economy: "Manufacturing inside"

The implementation of a Circular Economy is one of the main objectives of the EU, contributing to both the protection of natural resources and resilience. The potential is huge:

- Only 12% of materials used in the EU originate from recycling, revealing substantial untapped potential for greater circularity in material flows.
- Lithium recycling in battery production, where achieving a 50% recycling rate could reduce the EU's import dependency by up to 25%.
- Automotive sector remanufacturing: the reuse of parts and implementation of closed-loop material flows could decrease CRM demand by as much as 40%.
- Electronic waste (e-waste) recovery projects have demonstrated promising results, with pilot recycling systems achieving up to 60% material recovery rates.
- Achieving a 20–30% share of secondary raw materials in manufacturing could play a key role in stabilizing EU supply chains[2].

However, the gap to reality is still large:

- Only 8.6% of global raw material use comes from recycled sources, while remanufactured products account for just 1.9% of the market[3].
- Over 98% of European Union's (EU) utilized rare earth elements are imported from China.

Manufacturing technologies are needed to close this gap, by increasing the productivity and quality of all so-called "Rs": from Re-use to Recycling, e.g. through efficient disassembly, sorting and re-manufacturing, through enabling use of secondary materials and by bringing "circularity by design" from the drawing board to the factory and the product.

Wealth

Manufacturing is a key generator of wealth and has a multiplying effect on other sectors:

- 2023: the U.S. manufacturing sector contributed approximately $2.5 trillion to the economic performance, accounting for about 10.7% of the nation's GDP. The EU

[2] Baldassarre, B., Keskin, D., Lüdeke-Freund, F., Calabrese, A., & Amato, A. (2024). *Circular economy for resource security in the European Union (EU): Case study, research framework, and future directions*. Ecological Economics, 219, 107992. https://doi.org/10.1016/j.ecolecon.2024.107992

[3] World Bank, 2022, https://www.worldbank.org/en/region/eca/publication/squaring-circle-europe-circular-economy-transition

manufacturing output was approximately $2.33 trillion, representing about 15% of its GDP[4].

- According to the National Association of Manufacturers, every $1.00 spent in manufacturing, had a total impact of $2.64 on the overall U.S. economy, in 2021[5].
- Research from the Institut der deutschen Wirtschaft indicates that a one-unit increase in demand for manufacturing products results in an additional 1.68 units of total economic output within the EU-27 countries[6].

This suggests that for every €1.00 spent in manufacturing, there is a total impact of €2.68 on the overall European economy, highlighting the sector's substantial influence. For every job directly created in manufacturing, an additional 2.2 jobs are generated in other sectors. This multiplier effect is double than that of non-manufacturing industries and three times higher than that of modern services[7]

Security/Defence

The White Paper for European Defence – Readiness 2030[8], published in March 2025, outlines a vision for reinforcing the European Union's defence industry, in response to escalating geopolitical and security uncertainties.

Besides the mobilisation of financing, which is proposed in this paper and its ramping up in member states, the white paper also highlights the importance of a "stronger and more resilient defence industrial base" and the need for an "ecosystem of technological innovation for our defence industries". The paper also demands "massive ramp-up of European defence industrial production capacity" and also suggests to "support the development of new and innovative industrial processes such as distributed design and manufacturing, additive manufacturing and the use of AI" to boost defence manufacturing.

4. The case for Manufacturing Innovation in the next Multi-Annual Framework

In recent years, the EU has recognized the importance of manufacturing as a foundation for resilience and prosperity. However, supporting manufacturing as an economic activity and operation is not enough: for Europe´s future it will be crucial to regain leadership in manufacturing technologies and increase competitiveness not only in specific end-products, but also in the technologies which enable the scaling up of productive, clean manufacturing in Europe, namely advanced production, digital and materials technologies. To achieve this, the innovation system

[4] Euro Area Manufacturing Output 1991-2025
[5] https://nam.org/mfgdata/facts-about-manufacturing-expanded/
[6] Manufacturing in Europe, Institut der deutschen Wirtschaft Köln
[7] UNIDO: The multiplier effect of industrial jobs
[8] European Defence Readiness

in the EU must be updated and consider the crucial role of manufacturing as an innovation and productivity enabler.

Science based innovation is a key component of industrial competitiveness and autonomy, requiring a continuum from scientific research till market uptake.

The acceleration of technological development and the explosion of domains calls for larger investments, as well as a much more efficient and effective innovation system, capable of achieving a real and substantial economic and social impact at an affordable “price/cost” ratio (RoI). However, as the Draghi report states, EUs innovation system currently does not match global benchmarks, and an urgent update is required.

This update must significantly speed up the innovation process by bridging the gap between science and markets. While a comprehensive approach covering the innovation continuum is needed, the specific requirements of the innovation phases and the specific needs of sectorial applications must also be considered.

On the other hand, we are addressing different types of activities, such as basic science, applied research, demonstration and pilot lines, industrialization, market uptake, etc.) which have quite different characteristics such as objectives, expected results, KPIs, protagonists and timings. All this cannot be addressed with a single approach or model: it needs to be segmented but, at the same time, to have strong and fluid interfaces and global coordination.

One of the key aspects of designing such a research and innovation “system” and related policies and programmes is precisely the capability to segment where is absolutely crucial while also implementing interfaces to avoid “silos”.

It is also important to highlight the fact that, the more we advance along the innovation cycle, from research to market uptake, the more specific to a given sector and the less transversal the challenges and results become.

Therefore, considering all these aspects, ManuFuture suggests the following architecture for R&I support in the next Multiannual Framework, including the following elements (figure 1):

- Fundamental research is a bottom-up, exploratory, not thematically guided and transversal activity, with potential spill-overs to many different sectors and applications. Therefore, it is sensible to consider its development within an autonomous programme (such as ERC). Nevertheless, some fundamental research can be targeted to concrete challenges in specific sectors, through, for example, thematic calls. However, iwould be completely inadequate to drive fundamental research mainly through sector, value-chain- or area-specific challenges.
- On the other side of the innovation cycle (industrialization, market uptake, etc.) a similar approach applies, stating that these activities are closely linked to sectors and value-chains. Thus, they should be promoted and supported within in the scope of specific programmes/initiatives and a strong leadership and involvement from industry.

- Europe needs to have a strong, properly funded, complete and coherent entrepreneurship and start-ups programme across the innovation cycle. The existing EIC programme architecture, comprising instruments such as the Pathfinder, Transitions and Accelerator, is the appropriate solution. This should have both bottom-up calls and thematic calls focusing on specific challenges.
- Last but certainly not least, Europe also needs a strong programme to support pre-competitive applied research to bridge the pre-commercialisation gap between fundamental research and deployment. During this phase, the technological complexity requires collaboration of various actors, and the high financial risks are still too high for private actors alone.
- **Particular attention should be given to the applied research in Advanced Manufacturing Technologies** as they cover two different segments:
    - Applied research in advanced manufacturing technologies has a strong cross-sectorial nature. Developing technologies related to manufacturing only within the context of sector-, value-chain- or area-specific-initiatives would lead to high inefficiency due to e.g. replication or a lack of critical mass. These technologies should be developed in close collaboration with the main application areas, reflecting their cross-sectorial nature, and be complemented by cross-fertilization mechanisms, including open-innovation concepts, dissemination and further exploitation. Collaborative research should remain a key instrument for implementing applied research particularly within the manufacturing community. This unique European approach involves the cooperation of industry and research institutions, including universities, for precompetitive research. It has a multinational character within the European structure, and it provides several advantages such as cross fertilization and cohesion. The cooperation of industry and research communities should be strengthened and simultaneously simplified as much as possible.
    - Sector-, value-chain-andarea-specific programmes can be fine-tuned to address specific challenges and conditions.
- Another important element of a R&I&I system is a network of Research and Technology Infrastructures, capable of mobilizing and supporting companies with functions such as research and technology development, dissemination and demonstration, test before invest, education and training, etc.
- Finally, there must be a coordination layer above all this, to make sure that the necessary interfaces are in place and working properly, and to monitor, assess and evaluate the global performance.

- For manufacturing, as well as for many other areas, these goals call for a combination of policies, programmes and initiatives at European, national and regional level, ensuring the mobilization of all relevant stakeholders and resources, the principle of subsidiarity and that a significant number of companies, sectors, regions and countries are impacted and benefit from the investments made in research and innovation.

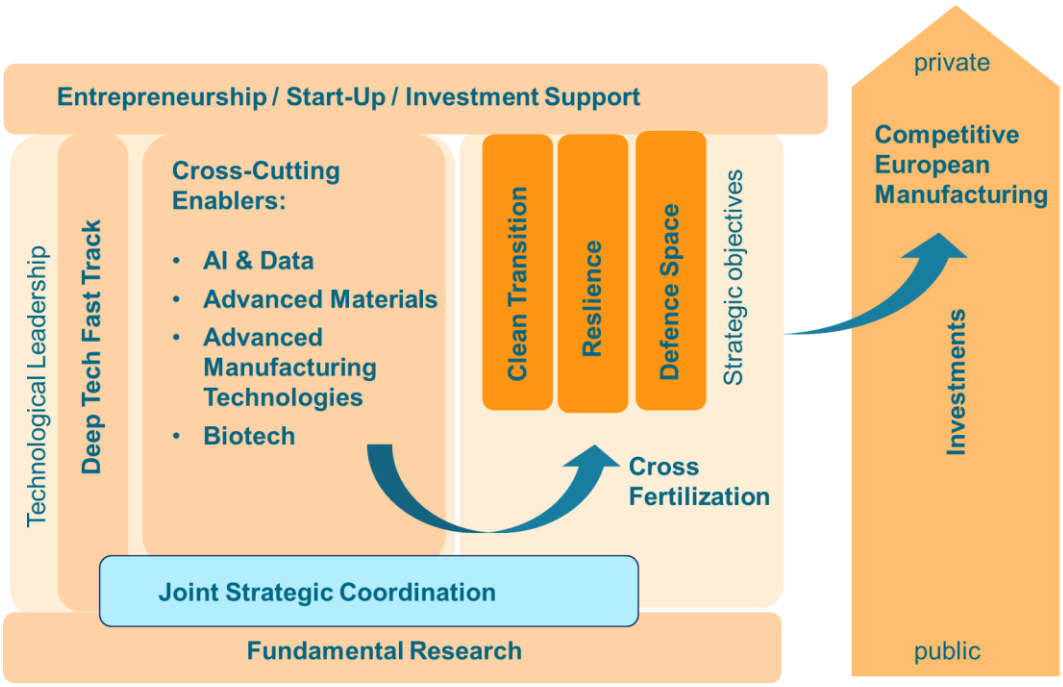

Figure 1

Conclusion

Advanced Manufacturing technologies are needed to achieve the objectives of the European Union such as growth, circularity, security and defence, and as cross-cutting enablers for many strategic European sectors. These technologies are not static, but must be advanced and be constantly innovated, to stay globally competitive, scale up and reduce cost. Therefore, innovation in Manufacturing Technologies is an area that needs to be addressed in a specific, transversal, technology-leadership and resilience programme, which cross-fertilizes with EU's strategic sectors, covering the innovation continuum between fundamental research and market uptake.