Policy brief

From Industry 4.0 to Industry 5.0

IndustriAll Europe's initial reaction

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Overview

Nowadays we are living in an interconnected world with data-driven industry. Indeed, the wide adoption of multiple digital technologies has led to a substantive shift in the way added value is created in industry. In this context, the paradigm of Industry 4.0 emerged more than a decade ago in Germany as a way to revamp its industrial policy and restore its competitiveness. It led many Member States, supported by EU programmes, to create new organisations and adopt business models such as 'factories of the future' and 'smart factories'[1].

The idea behind Industry 4.0 was to increase productivity and efficiency within processes, based on digital technologies and connectivity between devices which communicate autonomously with each other along the value chain. These digitally integrated systems were welcomed, as they increased productivity, flexibility, resource efficiency, and quality. They also led to a wave of robotisation in industries. However, the concept of Industry 4.0 is mainly focused on technology-driven organisational change (automation) with efficiency at its core.

It has been recognised that this technological change will also transform the workplace. It has led to discussions on the 'future of work', how to deal with the new technologies in the workplace, how advanced automation and clever robots would lead to massive job losses or new job opportunities, and the implication for society of this innovation development. To make the fourth industrial revolution successful for the European economy, all these aspects must be addressed. However, the Industry 4.0 paradigm does not take into consideration all of these societal aspects.

[1] A smart factory is a cyber-physical system that uses advanced technologies such as artificial intelligence (AI) and machine learning to analyse data, drive automated processes, and learn as it goes.

IndustriAll Europe’s initial assesment

Shift from Industry 4.0 to Industry 5.0

Industry 5.0 is a new industrial policy concept in which industry is the driving force for systemic transformation towards a more sustainable, circular, resilient and human-centred economy. It is built on the same digital technologies as Industry 4.0: the industrial Internet of Things, cloud computing, robotics, big data analytics, and wireless communication. However, it also integrates new breakthrough technologies, such as generative AI, quantum computing, blockchain, co-bots, Extended Reality, digital twins, machine-learning and smart materials.

It is the ambition of the new vision to support industry in better integrating European policies like the Green Deal, Net-Zero Industrial Act, sustainability due diligence, establishment of industrial transition pathways and other European initiatives which aim to reduce emissions and bolster the resilience of the European value chain. One of the most important paradigmatic characteristics of Industry 5.0 is the shift of focus from technology-driven progress to a thoroughly human-centric approach, as it aims to put workers in control of machines (and not vice versa), make the most of human capabilities, and move staff from repetitive jobs to more creative jobs that require problem-solving and organisational skills.

This new concept should lie beneath the European industrial policy. The essence of Industry 5.0 lies in the shift "*from efficiency to resilience*", which would serve as a crucial link between society and industry. It is also believed that social partnership and social innovation should underpin this new industrial policy. This new paradigm has been developed to take into account the societal aspects of the digital and green transformations that industry will face.

The Industry 5.0 Policy Brief[2] from the European Commission underscores the significant impact that industry can have in advancing societal objectives through environmentally friendly and sustainable manufacturing practices.

To successfully implement Industry 5.0, industries should implement a long-term industrial strategy with a comprehensive view of human, natural and financial capital in equal measure. The change in the industrial vision is through the entire production process, and deeper. It will require a business transformation that goes beyond the cost optimisation process and embraces a process-oriented approach to the whole system towards renewable energy, reuse and restoration of materials and natural resources.

To have a well-functioning industry in the long term, it is important to develop a strategy that resists any unexpected shocks that the value chain may face. To do so, human centricity, sustainability and resilience need to be applied to every process in the business chain and industrial strategy. Prioritising those aspects (human centricity, sustainability, and resilience) in an industrial strategy not only aligns with ethical and societal expectations but also ensures long-term viability, competitiveness, and success in an increasingly complex and uncertain value-chain.

Human-centric approach

In the context of Industry 5.0, there is a significant shift in the role and narrative around workers. Instead of viewing workers merely as a 'cost,' they are now considered an 'investment' for the company. This perspective emphasises the importance of investing in the skills, capabilities and well-being of the workers to achieve common objectives. In Industry 5.0, human capital is valued and appreciated, marking a departure from a balance between worker cost and financial revenue.

Industry 5.0, centred around human-centric principles and positioning the workforce at the core of production processes, can play a vital role in tackling ongoing societal challenges. By amplifying the role and impact of industry on society, Industry 5.0 can effectively link the social (human-centric) dimension to the twin transition, including both environmental sustainability and digital innovation. This entails strengthening collaborative approaches and advocating for industrial democracy. In an industrial democracy, workers and local communities are acknowledged as crucial stakeholders in company decisions, fostering a more inclusive and participatory approach to industrial practices.

Technology, in this new concept, should serve people, not the other way around. This means adapting manufacturing technology to the diverse needs of industry workers, empowering them rather than requiring continuous adaptation to evolving technology. Workers play an active role in the design and deployment of new industrial technologies, including robotics and artificial intelligence (AI), contributing to a more inclusive and worker-empowered working environment. The goal is **to empower and engage workers** within a connected industrial environment. In practical terms within industrial settings, this translates to adapting manufacturing technology to accommodate the needs of workers, rather than

[2] See more: https://research-and-innovation.ec.europa.eu/knowledge-publications-tools-and-data/publications/all-publications/industry-50-transformative-vision-europe_en

expecting workers to constantly adjust to evolving technology. This approach fosters a more inclusive working environment and fades away from technological determinism[3]. Achieving this requires close collaboration between workers and the design and deployment of new industrial technologies, including robotics and AI. A common expectation in this respect is that Industry 5.0 will enable a shift in workers' activities, from operational to supervisory, coordination and planning tasks, and from manual to data-driven and more analytical tasks. However, despite the strong focus on man and machine working together and workers in control of machines (and not vice versa), it is important to identify the risks of further digitisation of working life: polarisation between high-skilled, well-paid jobs in industry and low-skilled, low-paid in related services, increase of the digital divide, advanced surveillance and monitoring of workers, AI able to generate content and automate non-routine tasks (and thus taking over work from high-skilled workers) and reduced autonomy of workers as they have to follow instructions from digitised systems.

In this context, the **skills dimension** represents a crucial dimension. The rapidly evolving landscape of technology requires an evolution in skill sets. As technologies advance, there is a corresponding demand for a dynamic and adaptable workforce equipped with the necessary competencies to navigate and leverage these advancements effectively. This underscores the importance of continuous learning, upskilling, and reskilling initiatives.

Resilient approach

Promoting resilience in the European economy and shifting towards new, more robust economic models is enhanced in the Industry 5.0 paradigm. The resilience pillar refers to the balanced trend towards increasingly globalised production with strategic value chains that have the flexibility to respond to disruptions and other unexpected events. By diversifying supply chains, implementing robust risk management protocols, and fostering innovation and adaptability, companies can better endure shocks and recover more quickly when disruptions occur.

The **resilient approach** in the concept of Industry 5.0 prioritises regeneration, re-use, re-manufacture and circular economic practices within the economic model. This stands in contrast to the current focus on short-term overproduction and consumption driven by the existing growth model developed with the fourth industrial revolution.

The Covid-19 crisis highlighted the value-chain fragility that exists due to the highly globalised economic model of the present day. The current economic model relies on a growth-oriented model with a short-term view, which is not helping to achieve the European sustainable and climate neutrality goals.

The discourse surrounding the need for new business models goes beyond the concept of economic growth. The notion of going **beyond growth** seeks to redirect policymaking towards achieving just economic, social, and environmental objectives, rather than treating growth as the ultimate goal. These new economic narratives regarding growth, ultimately aiming to manage and anticipate the change and

[3] Read more: https://www.socialeurope.eu/why-ai-might-not-take-your-job-just-yet and https://news.industriall-europe.eu/Article/901

transformation, are at the centre of Industry 5.0. The new model that should be adapted to the European economy as part of industrial policy implies a change in the business model to reach strategic autonomy and a resilient value chain through **the due diligence** of the supply chain. Building resilience in the supply chain requires a long-term perspective and planning. The new model should be based on the principles of fairness, resilience, sustainability, circular economics, and a new economic model and regenerative economics[4].

Industry 5.0 and due diligence are linked by their common goals of promoting safety, compliance and accountability within organisations. By leveraging advanced technologies and adopting best practices in health and safety management, companies can demonstrate due diligence in meeting their legal and ethical responsibilities to protect the health and safety of their workers. Industry 5.0 technologies enable greater transparency and traceability within the supply chain. This transparency enhances due diligence by providing visibility into the origin and production conditions of raw materials, as well as the performance of suppliers and subcontractors.

One example of a regenerative economic model is the concept of "**Doughnut Economics**". It includes two concentric circles: the inner circle represents a social foundation, ensuring that everyone has access to life's essentials, while the outer circle represents an ecological ceiling, preventing humanity from exceeding planetary boundaries. The area between these boundaries forms a doughnut-shaped space, fostering both ecological sustainability and social justice. It is a way of thinking about regenerative and distributive society rather than profits.

The European vision should include the concept of “competitive sustainability” in its industrial policy. The transformation that the industry is facing due to the twin transition needs to have a holistic and systematic approach. Industry 5.0 entails new approaches to policy but also to finance investment and corporate governance: it is a response that ensures medium and long-term prosperity and the health of the value chain. It has a positive connotation in terms of productivity and spillover.

a. Workers’ resilience

Industry 5.0 has a very broad understanding. **Workers’ resilience** is included within the resilience pillar. Consequently, a guiding principle could be the preservation of workers' employability in the labour market, through the provision of continuous opportunities for lifelong training and education, upskilling and reskilling.

Placing humans at the centre of the strategy ensures that their needs, well-being, and capabilities are considered at every stage of the value chain. By investing in the skills, health, and safety of workers, companies can cultivate a motivated and productive workforce, which is crucial for maintaining operational efficiency and adaptability in the face of challenges.

Ensuring the safety and well-being of workers goes beyond physical health considerations in the workplace. Mental health and well-being must be given equal importance in the design of digitalised

[4] Industry 5.0: A Transformative Vision for Europe, ESIR Policy Brief no.3, 2021

working environments. The application of Industry 5.0 could have a positive impact on the health and safety of workers through further automation of arduous and strenuous jobs or by making use of smart wearables (exoskeletons, VR goggles, wearables to monitor worker health and safety). While digitalised working practices introduce new risks, such as the potential for burnout resulting from an always-connected culture, digital technologies offer opportunities to help workers better manage these risks and their impact on mental health. Industry 5.0 could provide ways to integrate workers' needs in the design of such technologies and companies' strategies. This type of human-centric approach promotes the use of collaborative robots (**cobots**) to work alongside human workers, increasing productivity while ensuring safety in the workplace.

Cobots are designed to work safely in close proximity to humans, reducing the risk of injuries associated with heavy lifting, repetitive tasks or dangerous operations. By automating high-risk activities, cobots help to minimise the likelihood of accidents and create a safer working environment for workers.

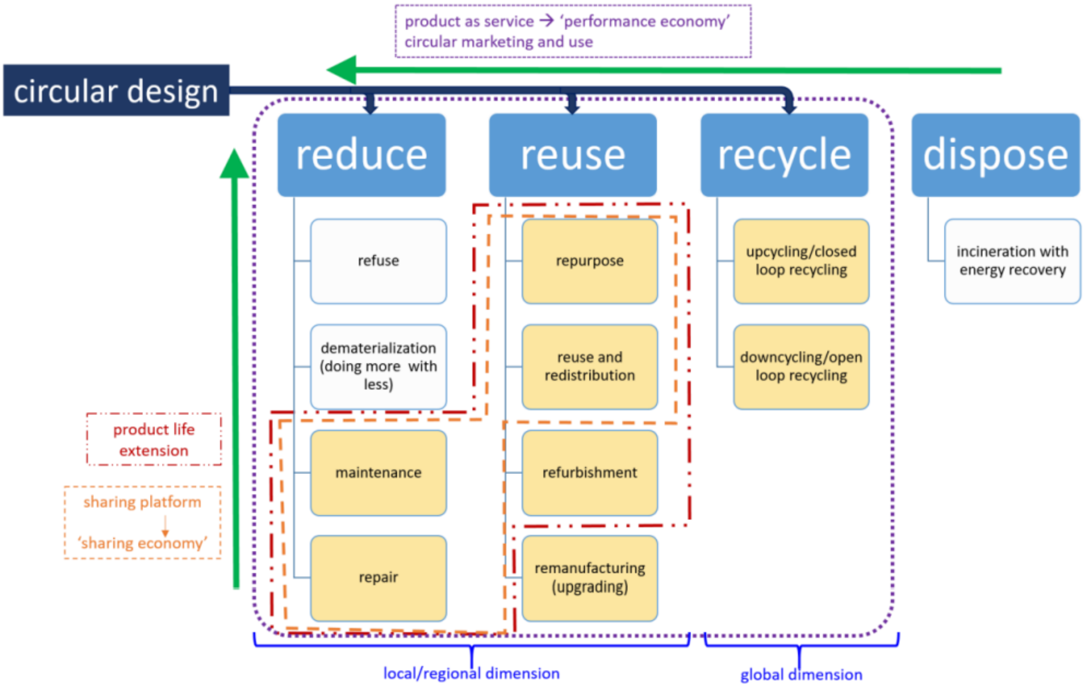
This approach is likely to bring economic benefits and cost savings by increasing productivity and reducing health and safety issues or accidents that may occur.

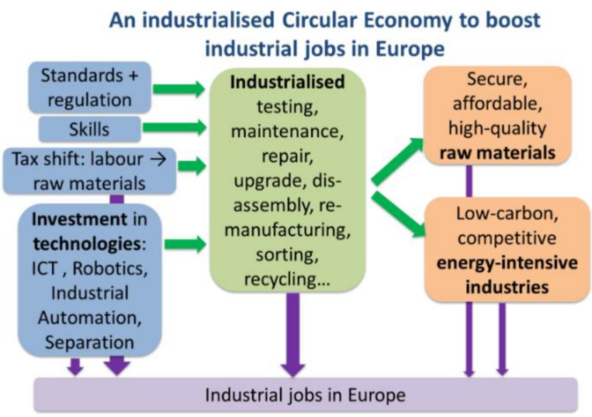
Sustainable approach

The recent European ambition to reach the 2030 targets needs an ambitious industrial plan alongside net-zero and energy objectives, to ensure the maintenance and creation of good quality industrial jobs in transforming existing and emerging new industries and to reach carbon neutrality by 2050. Industry 4.0 is not the fit-for-purpose framework to address these challenges in the context of the climate crisis and planetary emergency that we are currently experiencing. The shift to Industry 5.0 will serve to reach the EU climate targets. Industry 5.0 sees industrial production delivered through enhanced resource efficiency, adoption of a full product life-cycle approach and improved environmental performance.

The sustainable approach has at its core a **circular economy**. A regenerative, circular economy presents opportunities for more distributed, diverse, and inclusive industrial models, putting emphasis on the use of renewable energy and circular value chains. Industry 5.0 is oriented towards facilitating the transition to regenerative, and circular economic pathways. A circular economy could facilitate the cutting of greenhouse gas emissions, reducing the raw materials demand and feeding the industrial production system with parts of existing materials and products, keeping the value, materials and energy embedded in industrial products in use for far longer and creating an industrial symbiosis. Circular economy policies should underlie the industrialised processes: implementing circular economy principles can yield positive effects on European industry, enhancing competitiveness by aligning with customer expectations and current trends.

The circular economy model has a positive employment potential:





Based on certain studies, transitioning to a circular economy in Europe could yield a modest positive impact on job creation. Moreover, many emerging activities in the circular economy (waste collection and management, disassembly, re-manufacturing…) are labour-intensive and provide job opportunities for lower- and middle-skilled workers.

Industry 5.0 requires social governance 5.0

Industry 5.0 alone is at risk of remaining an academic concept. What is needed within companies and industries is a new type of thinking related to their business strategy: corporate and social governance 5.0.

Industrial policy should be more focused on ‘breaking’ the supply chain dependencies in behavioural, regulatory and design areas.

Corporate governance 5.0 should look at Industry 5.0 as a means to apply the compliance process in a sustainable and resilient way having the human in mind. This requires a change in mindset in corporate governance which is mainly focused on quarterly results. Indeed, Industry 5.0 means integrating sustainability and societal aspects into business strategies, making CSR along the value chain an effective management tool (instead of only for window-dressing), replacing the focus on short-term shareholder value by long-term objectives regarding social, social-economic and environmental objectives. By embracing the Industry 5.0 principles and leveraging technology for social impact, organisations can create positive change and contribute to a more sustainable and equitable future.

Social governance, within the context of Industry 5.0, embodies the principles and practices aimed at fostering fair, inclusive, and responsible interactions within a company. In the era of Industry 5.0, organisations are increasingly expected to go beyond traditional corporate governance to address broader societal concerns and contribute positively to the communities in which they operate.

Learning organisation

The introduction of Industry 5.0 concepts will have a deep impact on work organisation and skillsets. There will be a new division of tasks between digital technologies and workers. Indeed, manual and physical tasks will be increasingly automated. On the other hand, tasks that require social, organisational and creative skills, as well as analytical and highly technical jobs, will continue to be done by workers. To be able to integrate new technologies in the work organisation, to prevent a lack of human skills and to make the most of the available human capital, it is important that companies turn into ‘*learning organisations*’.

The concept of learning organisations enhances empowering workers and gives them the correct tools to adapt to industrial change. Every organisation should be designed to maximise learning, creating an environment where workers’ knowledge can unleash their full potential. This approach not only increases productivity but also contributes to environmental sustainability, aligning with the evolving landscape of work in the digital era.

The learning capacity of an organisation is understood as the ability to compete through learning. It is related to skills, upskilling, reskilling and organisational practice that a company can apply under Industry 5.0 to support individuals and collective leading.

Company example: Schneider Electric

Industry 5.0 is already applied in some companies: an example is Schneider Electric. The company, already in 2022, recognised that the traditional approaches to industrial development were not designed to meet the new challenges and requirements posed by climate change, energy crisis and geopolitical tension.

The company has acknowledged the role of Industry 5.0 and the collaborative approach that there should be between humans and robots as leverage to contribute to the sustainability goals. [5]

Robots are integral to the interconnected systems of Industry 5.0, equipped with sensors and machine learning capabilities. This collaboration not only boosts manufacturing productivity but also prioritises worker safety in the companies' sites, it reduces waste and mitigates adverse environmental impacts. The incorporation of advanced robotics showed an easier development of efficient and sustainable manufacturing practices. In terms of energy efficiency, Schneider Electric uses robotic systems that significantly contribute to reducing energy consumption in manufacturing processes by automating various tasks. Furthermore, robotics naturally consume less energy due to their capability to operate under minimal lighting, with reduced reliance on air conditioning or heating systems. Consequently, the energy requirements for completing tasks are minimised, contributing to overall energy efficiency in manufacturing operations.

However, the challenges expressed by the company are several: conventional regulations and incentives often focus on a singular aspect. To effectively drive industrial transformation, holistic industrial approaches are essential, addressing various sides simultaneously. Another challenge lies in the lack of an encouraging market environment for small and medium-sized enterprises (SMEs) due to mismatches in demand and supply. On the demand side, there is an insufficient emphasis on manufacturing activities and inadequate resource allocation for transformation initiatives, highlighting the need for strategic intervention to stimulate demand and support SME participation in the evolving industrial landscape.

Conclusion

Industry 5.0 is a revolutionary concept and far removed from the traditional economic model. Despite this, it will not be substituting Industry 4.0 as a chronological continuation or alternative, but it will be contributing to the fourth industrial revolution by ensuring a framework for industry that combines competitiveness and sustainability, allowing industry to realise its potential by putting human-centricity at its core. Industry 5.0 displays a way of framing how European industry and emerging societal trends and needs will co-exist.

The comprehensive transformation necessary to unlock the complete potential of Industry 5.0 is fundamentally horizontal. It demands a profound business-level innovation and turn-over, involving the design of products, services, and systems. This transformation extends beyond the mere cost optimisation or linear approaches, it pleads for a transition towards business models and systems oriented towards regeneration, and a sustainable and human-centric approach. This approach aims to restore, renew, and revitalise not only energy and materials, but also natural ecosystems. It signifies a departure from traditional linear models towards circular, restorative and regenerative practices, aligning Industry 5.0 with sustainable, human-centric and resilient principles.

[5] https://blog.se.com/sustainability/2023/04/25/industrial-robotics-provides-immense-contributions-to-achieving-sustainability-goals-as-industry-5-0-emerges/

Open questions to be addressed:

- What does Industry 5.0 look like in workplaces?
- How can it be encouraged?
- How can companies invest in human-centricity?
- How can Industry 5.0 contribute to the climate-neutrality goals?
- How will workers benefit from Industry 5.0?
- How can we measure the business strategies that apply Industry 5.0? New indicators?