FORGING

WHITEPAPER WITH POLICY RECOMMENDATIONS

FROM INNOVATION TO INTEGRATION: FOSTERING SOCIETAL ACCEPTANCE OF EMERGING TECHNOLOGIES THROUGH VALUE-SENSITIVE INDUSTRY 5.0 POLICY IMPLEMENTATION

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EXECUTIVE SUMMARY

Industry 5.0 technological frameworks are significantly promising for Europe's future. However, their development must be aligned with societal values, environmental sustainability, and ethical principles to ensure they deliver truly inclusive and human-centric innovation. The EU-funded **FORGING project** responds to this challenge by designing frameworks and tools to guide **value-sensitive innovation,** supporting Europe's transition to **Industry 5.0**—a paradigm that promotes human-centric, resilient, and sustainable innovation ecosystems.

Yet, for innovation to generate real value, certain barriers need to be overcome, such as societal resistance and industry inertia, that can hinder the adoption of new innovative solutions. Societal resistance often stems from fear of change, lack of awareness, or mistrust in new technologies, leading to reluctance among consumers, communities, or regulators. Meanwhile, industry inertia arises from established business models, sunk costs, and rigid organizational cultures that favour maintaining the status quo over risking disruption. Therefore, to foster trust and societal acceptance, it is crucial to align technology-driven innovation with human values.

In response to this challenge, FORGING has built a multi-layered, multi-stakeholder approach that engages the full spectrum of the quadruple helix: academia, industry, civil society, and the public sector.

Funded by the European Union

In the three years of project implementation, the project brought together 500+ stakeholders through multiple series of co-creation workshops, foresight exercises, and use case co-development. These activities generated practical insights, tested methodologies, and helped structure a shared agenda for value-driven R&I.

This **White Paper** synthesizes the key outcomes of the project and formulates **22 strategic recommendations to foster the acceptance and adoption of results rooted in responsible innovation, to support the European Twin Transition strategy, and to promote human-centric approaches to the digital and green transitions, ultimately contributing to sustainable competitiveness.**

The FORGING recommendations are addressed to two main target groups:

1. **Policy makers and funding authorities;**
2. **Project owners and R&I support organisations.**

For each target group, the document proposes two clusters of recommendations:

- **Recommendations relating to Policy / Project Design and Implementation**
- **Recommendations relating to Stakeholder Engagement and Inclusion**

The following tables provide an overview of all recommendations, clustered per target group:

TABLE 1. OVERVIEW OF RECOMMENDATIONS FOR POLICY ACTIONS (TARGET GROUP: POLICYMAKERS)

Overview of Recommendations for Policy Actions (Target Group: Policymakers)		
Policy Design (D) and Implementation (I)		
N°	Type	Recommandations
R1	D	Prioritise policy instruments that are results-driven and oriented towards impact rather than overly focused on method and process stages. Enhance impact through early industrial alignment with concrete use cases and diversifying exploitation pathways.
R2	I	Take into account the interconnection of emerging technologies and adapt calls for proposals to this multidisciplinarity to foster innovation in technology.
R3	I	Encourage foresight approaches in policy design and open calls for proposals to project potential trajectories of R&I / technology development.
R4	I	Promote the use of the "Key Values" framework through public R&I programmes to integrate societal and environmental aspects, together with economic parameters, to foster and monitor responsible innovation, in line with industry 5.0 principles.
R5	D	Institutionalize co-creation practices by embedding co-creation methodologies into public innovation policy design.
R6	D	Enable long-term influence and awareness raising by valuing the long-term impact of co-creation and using tools to support this impact.
R7	I	Take account of long timespans in development of applications due to regulations and facilitate navigating the regulation landscape.
R8		Change the calculus around risk by creating incentives and an alleviated framework that allows for R&I and investment in areas of societal interest and ideally benefitting multiple use.
Stakeholder Engagement and Inclusion		
N°		Recommandations
R9		Encourage cross-community collaboration by actively involving stakeholders from the quadruple helix (academia, industry, civil society, and public administration). Support ecosystem-driven innovation by promoting diverse stakeholder participation and strengthening connections within ecosystems and among regional innovation clusters.
R10		Define schemes that increase societal acceptance by promoting human-centric technology development, in line with industry 5.0 principles, ensuring the inclusion of civil society representatives in technology design processes of innovation consortia and/or project activities
R11		Foster engagement of PPP and JU with societal actors to consider human-centric R&I development and support societal acceptance
R12		Enhance real-world application by facilitating and incentivising the involvement of more entrepreneurial and industrial actors in ideation phases and use case development.
R13		Foster inclusion of early career researchers by encouraging the participation of PhDs and junior scientists in collaborative R&I to promote awareness regarding societal and environmental value of technology development.

TABLE 2 : OVERVIEW OF RECOMMENDATIONS FOR PROJECT OWNERS (TARGET GROUP: RESEARCH AND INNOVATION ACTORS)

Project Design and Implementation	
N°	Recommandations
R14	Use societal foresight to understand potentials and impacts of emerging technology as basis for technology / R&I development and re-assess the trajectory all along the technology / R&I development
R15	Use Key Value Indicators (KVIs) in R&I or technology development to complement KPIs to monitor also ethical, societal, and environmental dimensions in projects, in line with industry 5.0 principles.
R16	Start from societal needs to develop real-world use cases, test technologies in real environments to increase scalability.
R17	Design for transferability by considering the adaptability of methodologies or tools to other sectors or technologies
Stakeholder Engagement and Inclusion	
N°	Recommandations
R18	Strengthen co-creation and quadruple helix stakeholder interaction in the development of technology-related (and other) projects to allow for early buy-in of potential users and higher probability of industry uptake and societal acceptance, taking also account of the gender dimension
R19	Ensure alignment with changing realities in R&I / technology development thanks to an iterative approach and exchange with stakeholders throughout project lifecycles.
R20	Enhance industrial and entrepreneurial participation by involving more industrial actors and setting up advisory bodies with entrepreneurial experience.
R21	Consider the fifth helix, i.e. the environment, in R&D development, notably for scalability and replicability in other geographic territories
R22	Ensure methodology supports facilitation and adaptation by equipping project teams with strong facilitation skills and piloting adaptable methodologies.

We invite policy makers, public authorities, funding organisations, innovation agencies, and research institutions to adopt and adapt the FORGING recommendations, and to join us in building a future where **innovation serves the common good through quadruple helix engagement at all stages of the innovation process.** The Quadruple Helix (4-H) innovation model is based on collaboration and highlights the interdependence of four key groups: industry, public administration, academia, and civil society.

INTRODUCTION

FORGING: BRIEF OVERVIEW OF THE PROJECT

Significant technological advances are rapidly emerging across fields such as human-machine interaction, cybersecurity and AI. These breakthroughs are expected to be highly disruptive, driving major transformations in society and the environment.

FORGING explored six technology frameworks [1] with high alignment to the principles of the Industry 5.0 concept which encompasses the elements of a sustainability, resilience, and human-centricity. Technologies and areas of application were highlighted in these frameworks especially for their anticipated positive societal and environmental impacts in addition to their technical potential.

However, the development and application of these enabling technologies also present a range of challenges.

To effectively support innovation, it is essential to use robust processes and tools that capture diverse ideas, reflect the priorities of individuals and communities, and identify the most promising opportunities. As organisations pursue digital solutions and the green transition, they are increasingly seeking partnerships to unlock greater collective value.

FORGING aimed at adding a layer of responsibility: fostering value-sensitive innovation through technology development, i.e. innovation that is responsible with regards to its impact on the society and respects environmental boundaries. FORGING has established a thorough co-creation process, implemented with experts from various backgrounds, bridging thus from academics to industry players and aiming at supporting Europe's leadership on responsible development of emerging enabling technologies.

This White Paper stems from observations made in the frame of the project activities and exchange with external experts.

OBJECTIVES OF THE WHITE PAPER

This document aims at:

- summarizing the project's key observations and lessons learnt, as well as good practices gathered through exchange with external experts;
- offering a perspective and recommended solutions on how to foster societal acceptance and the uptake of emerging enabling technologies by industry and society;
- providing recommendations for informed policy making and project development.

The White Paper is thus addressed to a wide audience: not only policy makers and project owners, but also the broader community of stakeholders involved in the development and implementation of innovation projects.

The objective is to explore key elements and impact dimensions of the industry 5.0 concept, through a clear and accessible narrative supported by the actionable recommendations here provided. The highlighted good practices have been selected for their transferability potential.

TARGET AUDIENCE

- Policy makers on different levels: European, national, regional, local and funding authorities
- Project owners (R&I stakeholders) and organisations supporting technology-driven innovation policies and projects

POLICY RECOMMENDATIONS

As part of the FORGING project's mission to promote value-sensitive, human-centred, and sustainable innovation aligned with Industry 5.0 principles, this White Paper outlines two complementary sets of recommendations based on field experience, stakeholder engagement, and co-creation activities conducted throughout the project.

These recommendations are structured to address the needs of two key target groups:

- **Recommendations for Policy Actions**

Target Group: Policymakers (EU, national, regional levels)

These recommendations aim to support public authorities and funding bodies in designing and implementing innovation policies that are inclusive, responsible, and adaptable. They focus on integrating ethical, societal, and environmental values into R&I funding frameworks, fostering stakeholder diversity, and ensuring long-term institutional support for responsible technology development.

- **Recommendations for Project Development and Implementation**

Target Group: Project Owners, i.e. Research and Innovation Actors (project coordinators, researchers, innovators, consortium members)

These recommendations are tailored for actors designing or managing collaborative R&I projects. They provide actionable guidance on embedding co-creation, using the Key Value Framework (KV) [2], structuring stakeholder engagement, and ensuring the transferability and real-world relevance of outcomes.

Together, these perspectives reinforce the vision of FORGING: triggering the development of enabling technologies that respond not only to market demands, but also to societal challenges, ethical concerns, and environmental imperatives.

RECOMMENDATIONS FOR POLICY ACTIONS

(Target Group: Policymakers)

The recommendations addressed to policymakers within this White Paper fall into two complementary categories:

- Policy Design and Implementation

These recommendations focus on the **structural and strategic aspects** of public policy frameworks. They aim to support the creation of innovation programmes, funding schemes, and regulatory environments that are:

- aligned with Industry 5.0 principles,
- capable of integrating societal and environmental values,
- flexible and iterative to accommodate fast-evolving technologies.

This includes guidance on incorporating elements of the Key Value Framework (KV), simplifying framework conditions, and designing long-term support mechanisms for responsible innovation.

- Stakeholder Engagement and Inclusiveness

This second set addresses the **governance and participatory dimension** of innovation policy. It highlights the need for policies that:

- embed multi-stakeholder co-creation,
- ensure meaningful participation from the whole quadruple helix and in particular underrepresented actors (citizens/civil society, SMEs),
- and foster cultural sensitivity and cross-sectoral dialogue.

The goal is to ensure that emerging technologies are not only advanced and efficient, but also **socially accepted, ethically grounded, and co-shaped by those they may affect, directly or indirectly**.

POLICY DESIGN AND IMPLEMENTATION

R1. Prioritise policy instruments that are results-driven and oriented towards impact rather than overly focused on method and process stages. Enhance impact through early industrial alignment with concrete use cases and diversifying exploitation pathways.

We suggest a **shift in policy focus**: instead of placing excessive emphasis on how projects are carried out (i.e., methods, compliance steps, process formalism), policymakers should **prioritise what those projects actually deliver,** namely in terms of *societal, environmental, and technological impact*.

Why this matters:

- Many innovation programmes evaluate proposals mainly on **methodological soundness** and procedural alignment. While important, this can limit creativity and lead to projects that are excellent on paper but disconnected from real-world applications.

- Conversely, a **results-oriented approach** encourages applicants to demonstrate **tangible outcomes**, such as validated use cases, tested tools, societal value, and industrial relevance.

How this can be implemented:

1. Early industrial alignment

Projects should engage potential adopters (e.g. SMEs, industrial partners, public services, civil society) from the beginning to ensure that the innovations respond to concrete needs and constraints.

2. Concrete use cases

These help bridge the gap between abstract research and operational deployment. Supporting policies should favour proposals that **integrate real-life testing environments or pilots** early in the process.

3. Diverfified exploitation pathways

Beyond academic dissemination or commercial spin-offs, policies should promote **alternative routes** to impact — such as open-source tools, public sector adoption, community-driven innovations, or inclusion in educational frameworks.

=> make impact the primary metric for success, not just the quality of the process. Encourage experimentation, practical alignment, and varied forms of value creation.

BEST PRACTICE

R1. "Contributing to the wellbeing of citizens is our main goal – and this is a goal we share with our city government which is thus very supportive; we are somehow working as an outsourced development agency for the municipality. The tech development we are doing will not impact on their current policy mandate, but we have the chance that they have understood the long-term impact that may be visible only after their mandate." *Balázs Barta, Managing Director of PBN – advanced management (Hungary)*

"Policies are often too much short term focused, as the related budgets are too closely linked to funding cycles (e.g. EU framework programme, regional funding periods). KPIs are set for one or two years whilst they should rather focus on 5-10 years." *Joaquin Crespo-Martin, Strategic Foresight, Regional Development Agency of Aragon (Spain)*

"Traditional innovation frameworks are not enough – we need new innovation methods with a cross-sector component. The mission-oriented innovation approach that the EU has adopted will benefit Europe compared to the global framework. We have integrated this approach in the development of our regional smart specialisation strategy. New innovation methods need to start with the question "what do we want to solve" and take a challenge-based approach." See Blekinge's strategy for smart specialisation.pdf *Erika Augustinsson, Innovation Strategist at Region Blekinge (Sweden)*

"Our smart specialisation strategy has been written following the mission approach. It is designed with an integrative view, focusing on fifteen cross-cutting areas of research with the aim to overcome the predominant sectoral focus that was taken before. See https://fesr.regione.emilia-romagna.it/programmi-e-strategie/s3" *Paolo Rosso, Senior advisor at Regione Emilia-Romagna (Italy)*

R2. Take into account the interconnection of emerging technologies and adapt calls for proposals to this multidisciplinarity to foster innovation in technology.

It is necessary for policymakers and funding bodies to **recognise the increasingly interconnected nature of emerging technologies** and to **adjust funding programmes accordingly.**

Why this matters:

- Innovations today rarely emerge from a **single technological domain**. Instead, they often result from **cross-fertilisation** between multiple fields — for example, combining artificial intelligence with bio-inspired materials, or cybersecurity with human-machine interaction.
- Traditional calls for proposals are often siloed by discipline (e.g. "ICT", "Energy", "Health"), which can **limit innovative thinking** and prevent consortia from proposing holistic, cross-sector solutions.

How this can be implemented:

1. Encourage multidisciplinarity

Calls should allow and encourage applicants to **integrate multiple technological frameworks** and scientific disciplines within a single proposal.

2.Reflect the complexity of real-world challenges

Societal problems — such as climate resilience, sustainable mobility, or digital inclusion — require integrated approaches that span **technology, social science, ethics, and design.**

3. Foster innovation through flexibility

Funding instruments should provide the space to explore unexpected synergies between technologies, beyond rigid thematic boundaries.

In practice, this could mean:
• Designing open or cross-cutting calls that span several technological domains
• Allowing hybrid evaluation panels with **multidisciplinary expertise**
• Rewarding proposals that show how different technologies reinforce each other

BEST PRACTICE

R2. "A lot of « problems » can be relevant for a large variety of disciplines and sectors but a majority of funding calls target very narrow application fields. Open calls should be broader, e.g. targeting solutions for a societal challenge – topics, that allows for answers from different perspectives; this would allow to involve also intermediaries in addition to researchers, as then internal knowledge exchange and bridging between different fields of expertise can more easily be implemented. Such calls could also integrate meta-level topics such as skills development, research management." *Pol Torrent, Project Manager in the Internal Strategy Area at Vall d'Hebron Hospital (Spain)*

R2. "Wider interventions are necessary: over-defining the scope over the technology narrows the impact and often means failing to support broader innovation. It means you are not solving a problem in the best possible way. A challenge-led scope is often more relevant than a technology-led scope. An example of a too narrow focus could be to the funding of autonomous systems instead of just funding innovation on robotics." *Rich Walker, Director at euRobotics aisbl and Shadow Robot Company*

"We have tendency to work in our secure bubbles with people we know on processes we know. You need to combine top down and bottom up. Regional governments could create environments to bring different stakeholders together, creating new regional value chains, combine complementary expertise." *Peter Friberg, Senior strategist for regional development, Regional Executive Office at Region Jönköping County (Sweden)*

R3. Encourage foresight approaches in policy design and open calls for proposals to project potential trajectories of R&I / technology development

We advocate for integrating **foresight methods** into both **policy making** and **research funding processes**, to better anticipate the long-term direction and impacts of emerging technologies.

Why this matters:

- Technological innovation often evolves in **non-linear, uncertain, and fast-moving ways.**
- Policies and funding schemes that focus only on short-term outputs or existing market applications **risk missing transformative trends** and may reinforce outdated models.
- Foresight helps policymakers and project owners **look ahead**, explore multiple future scenarios, and prepare for a range of technological and societal outcomes.

How this can be implemented:

1. Foresight in policy design

Encourage policymakers to use foresight tools — such as **scenario planning, horizon scanning, Delphi studies** — to inform strategic agendas, priority setting, and policy framing.

2. Open future-oriented R&I calls

Calls for proposals should invite applicants not only to solve today's problems, but to **explore possible trajectories** of technology development and their implications (ethical, social, environmental, economic).

3. Flexibility to evolve with findings

Embedding foresight in projects creates space for **learning loops and adaptive design**, where early signals can influence the project's direction and its potential impact.

How to implement it?

- Include **scenario-building or horizon scanning** components in project calls
- Support **exploratory research** on potential applications and risks of emerging technologies
- Reward projects that consider **multiple futures,** not just immediate outputs
- Enable **adaptive project design** that evolves based on foresight findings

BEST PRACTICE

R3. "Foresight has to be done all the time. Maybe new financing instruments are necessary to take that into account – the policy frame needs to be adapted. On a regional level we try to build incentives for foresight in the base funding: we increase base funding for science park and innovation stakeholders and within that context demand a foresight process. Then you can work on one of the directions that you find in the foresight exercise." *Erika Augustinsson, Innovation Strategist at Region Blekinge, Sweden*

"All technologies can have societal relevance. But on policy level we need to ensure that technologies cannot be misused. Especially in tense geopolitical situations, there needs to be a framework that allows the assessment of technologies before they enter the (European) market. This is part of the risk assessment at EU level for so-called strategic technologies. Public authorities need to have such assessment tools and the awareness that it is necessary." *Kathleen D'Hondt, Policy Advisor, Dep. Work, Economy, Science, Innovation, Social Economy (WEWIS) - Flemish Government (Belgium) and Coordinator Vanguard Initiative Smart Health Pilot*

The Millenium Project has, among other relevant publications, issued a report entitled "Work/Technology 2050: Scenarios and Actions". It is a report on an international study that produced three detailed scenarios, on the basis of workshops conducted in 29 countries, and a very large number of actions that were assessed by hundreds of futurists and related experts in over 50 countries. See https://millennium-project.org/publications/worktechnology-2050/ The initiative is also working on technology-related challenges specifically, notably as part of its work on what has been defined « Global Challenge 6: How can global information, communications technologies, artificial intelligence, big data, and cloud computing work for everyone? » - see https://millennium-project.org/challenges-overview/global-challenge-6/#1716123640160-6b5b660f-6347 and « Global Challenge 14: How can scientific and technological breakthroughs be accelerated to improve the human condition? » - see https://millennium-project.org/challenges-overview/global-challenge-14/

R4: Promote the use of the "Key Values" framework through public R&I programmes to integrate societal and environmental aspects, together with economic parameters, to foster and monitor responsible innovation, in line with industry 5.0 principles

We encourage policymakers and funding agencies to adopt a **"Key Values" framework** in the design, evaluation, and monitoring of public Research & Innovation (R&I) programmes. This framework complements traditional economic indicators by integrating **societal and environmental values** into the innovation process.

Why this matters:

- Public R&I programmes often rely on **Key Performance Indicators (KPIs)** that measure success in terms of productivity, growth, or scientific output.
- However, innovation also has **societal and ecological consequences** — and these are not always captured by KPIs.

The "Key Values" framework introduces **Key Value Indicators (KVIs)** that help evaluate whether innovation is **ethically sound, socially accepted, and environmentally sustainable.**

How this can be implemented:

1. Broaden assessment criteria

Encourage public R&I programmes to go beyond market-oriented metrics by incorporating indicators such as:

o Equity and inclusion
o Trust and ethical integrity
o Environmental footprint and resource use
o Contribution to social well-being

2. Support responsible innovation monitoring

Use KVIs as tools to track whether innovation projects align with Industry 5.0, which promotes:

o Human-centricity
o Sustainability
o Resilience

3. Empower project owners

Offer guidance and tools (like FORGING's toolbox) to help researchers and innovators **define their own KVIs,** based on the context and stakeholders they serve.

=> To **foster innovation that creates true societal value**, by embedding ethics, social impact, and environmental responsibility into the DNA of research and innovation policies — not as an add-on, but as **core drivers of success.**

BEST PRACTICE

R4. The Aragón Social Responsibility Plan (Plan RSA) is a regional initiative, originally designed and managed by the Instituto Aragonés de Fomento (IAF), that promotes socially responsible practices across Aragón-based companies, nonprofits, and public bodies (aragonempresa.com). Participants commit to transparency, undergo training, complete a self-assessment, and receive personalized improvement reports. Organizations that demonstrate sustained efforts in areas like labor-life balance, equality, volunteering, cultural engagement, and alignment with the UN Sustainable Development Goals can earn the basic RSA Seal or, at a higher level, the RSA+ Seal (fundaciondfa.es). From June 2025 onwards, management of the Plan shifts to the Dirección General de Política Económica, which will oversee enrolments, renewals, awards, and the RSA+ designation (aragonempresa.com).

"It is crucial to consider different elements such as environmental, circular economy, ethics, green and digital transition... through the involvement of different stakeholders. Not only in R&I policies but any kind of policy." *Joaquin Crespo-Martin, Strategic Foresight, Regional Development Agency of Aragon (Spain)*

"Responsible R&I needs to be embedded, not added at the side. In a funding call, it needs to be integrated in the question that you ask and fully relevant to the specific call, ideally the whole programme. It cannot be just a side question, but has to be an integrated component" *Rich Walker, Director at euRobotics aisbl and Shadow Robot Company*

The Green Book, provided by HM Treasury, is a comprehensive guide for appraising and evaluating policies, projects, and programmes within the UK government. It emphasizes the importance of considering costs, benefits, and trade-offs to ensure effective decision-making and value for money. But it integrates also supplementary guidance, e.g. on:

- Wellbeing: the guidance explains how to incorporate wellbeing into the appraisal process, including how to assess and monetise wellbeing impacts where possible.

- Climate Change and Environmental Valuation: the document supports the appraisal of climate risks and the integration of climate resilience into policies, programs, and projects. It is produced in consultation with various environmental and climate change bodies.

- Valuation of Energy Use and Greenhouse Gas Emissions: it provides specific guidance on valuing energy use and greenhouse gas emissions in appraisals.

HM Treasury, The Green Book (11/2020, updated 08/2024), https://www.gov.uk/government/collections/the-green-book-and-accompanying-guidance-and-documents

R5. Institutionalise co-creation practices by embedding co-creation methodologies into public innovation policy design.

This recommendation calls for **co-creation to become a standard practice in how public innovation policies and funding programmes are designed, implemented, and evaluated.**

Why this matters:

- Traditional innovation processes often follow **top-down approaches**, limiting the involvement of those affected by technological developments.
- Co-creation brings together **diverse stakeholders** — including citizens, civil society, industry, academia, and policymakers — to collaboratively shape innovation.
- Embedding co-creation in policy ensures that **emerging technologies align with societal needs and values**, fostering trust and societal acceptance.

How this can be implemented:

1. Embed co-creation in programme design

Encourage **co-creation activities in the design of innovation technologies**, such as participation of public authorities' representatives in:

o Scenario-building workshops
o Citizen panels
o Multi-stakeholder dialogues
o Participatory design processes

2. Allocate resources and time

Realise from own participation that co-creation requires funding and time but allows for "out of the box thinking", strengthens connections with stakeholders from a variety of backgrounds and triggers real innovation.

3**. Support capacity-building**

Equip researchers, innovators, and policymakers with skills and tools to facilitate co-creation effectively (e.g., facilitation methods, conflict mediation).

4**. Monitor co-creation outcomes**

Use indicators to assess how co-creation has contributed to shaping project outcomes and enhancing societal relevance.

=> **To institutionalise co-creation** as a core component of responsible innovation policy, ensuring that technological development is **inclusive, transparent, and aligned with the values and expectations of society.**

BEST PRACTICE

R5. "Using co-creation and stakeholder engagement is common in our region. We have established a "Regional pact for labor and climate" that has been signed by 50+ stakeholders in the region, including local authorities, and it is the source of any implementation (Regional Pact for jobs and the climate | European Committee of the Regions)." *Paolo Rosso, Senior advisor at Regione Emilia-Romagna (Italy)*

"It would be interesting to see policy makers take part in co-creation processes, e.g. with Living Labs (especially policy makers on lower administration level); it would allow them to connect to the different stakeholders, e.g. in community events. The insights gained into the way things are done in different worlds (technology vs social work) would allow them to become part of the transformation model. At our living lab managed by Suara, we work on such co-development models with local policy makers, and it is a great success." *Jordi Picas i Vilà, Director of Innovation, Suara (Spain)*

R6. Enable long-term influence and awareness raising by valuing the long-term impact of co-creation and using tools to support this impact.

This recommendation calls for **policymakers and funding agencies to recognise, support, and track the long-term influence of co-creation activities in innovation projects,** ensuring that their impact extends beyond the immediate project lifecycle.

Why this matters:

- Co-creation generates lasting value by:

o Building trust and networks among stakeholders
o Shaping innovation trajectories that reflect societal needs
o Raising awareness about the societal and environmental implications of technology

- However, the impact of co-creation is often undervalued or not tracked, as current project evaluations mainly focus on short-term deliverables.

How this can be implemented:

1. Value long-term outcomes

Recognise that co-creation's impact may appear after project closure, for example:

o Changes in organisational culture and ways of working

o New cross-sector collaborations

o Adoption of responsible innovation practices

2. Use tools to support and track impact

Provide or encourage the use of:

o FORGING's toolbox and actor cards to continue co-creation practices

o Monitoring tools to assess the spread of co-creation methods within organisations or regions

3. Enable post-project activities

Support the creation and participation in informal **networks or forums (e.g., the FORGING Forum** [3]**)** where stakeholders can exchange knowledge and co-create beyond project funding.

4. Highlight co-creation in evaluations

Include indicators or qualitative assessments that capture the **long-term value of stakeholder engagement and societal alignment.**

=> To **embed a culture of co-creation and societal alignment in innovation ecosystems** by valuing and tracking the **long-term influence of co-creation,** ensuring its benefits continue to shape technologies, organisations, and policies over time.

BEST PRACTICE

R6. "In order to stimulate collaboration across Europe, cross-regional initiatives are needed, e.g. initiatives to support innovation funding agencies working together. A number of such initiatives exist, such as Vanguard, EUREKA or EPPermed. Vanguard is trying to launch its own inter-regional call (Vinnovate) and EPPermed offers the so-called « reverse tech transfer path » where end users bring in their needs for innovation, so innovators can adapt their R&D accordingly." *Jolien Roovers, Policy Advisor at Department of Work, Economy, Science, Innovation and Social economy (WEWIS), Flemish government (Belgium)*

R7. Take account of long time spans in development of applications due to regulations and facilitate navigating the regulation landscape.

It seems really important to **acknowledge and address the regulatory challenges that can slow down the deployment of emerging technologies**, while supporting innovators in **understanding and navigating complex regulatory frameworks.**

Why this matters:

- Many emerging technologies face **lengthy approval and compliance processes** before they can be deployed (e.g., health, energy, data-driven technologies). This does not always align with the fast pace of emerging technology development.
- Regulatory frameworks vary across regions and sectors, creating **complex and fragmented landscapes** that slow down the transition from innovation to application.
- If not considered in project planning, these timeframes can create frustration, delays, and missed opportunities for economic and societal impact.

How this can be implemented:

1. Policy design should consider regulatory timelines

o Align funding durations and expectations with realistic approval processes.

o Avoid unrealistic expectations of immediate deployment for regulated technologies.

2. Support regulatory navigation

o Provide guidance, toolkits, and training on **compliance pathways** for emerging technologies. A European Regulations Helpdesk, equivalent to the existing IP Helpdesk, could be considered.

o Facilitate dialogues between innovators, regulators, and policymakers to anticipate regulatory bottlenecks.

o Create shared pathways for technology validation and deployment.

3. Foster regulatory experimentation

o Encourage regulatory sandboxes or pilot frameworks that allow safe and controlled testing of emerging technologies while respecting safety and societal values.

4. Facilitate harmonisation

o Support efforts to align regulations across EU regions to reduce fragmentation and speed up responsible deployment.

=> To **accelerate the responsible deployment of emerging technologies** by acknowledging regulatory realities, equipping innovators to navigate them efficiently, and fostering collaboration between regulators and innovators — ensuring technologies reach society safely and effectively.

BEST PRACTICE

R7. "There are many regulations in Europe and regulations on national or regional levels add an extra layer; especially micro-companies and SMEs need help to navigate this to enhance efficiency and competition of the companies. In our region we have created an office with 3 staff members to support the regional SMEs not only for regulations but anything they need. The questions are treated in collaboration with administrative staff on local and regional level to be able to answer the questions coming in. More than 400 companies asked questions in the last month." IAF Conecta is a personalised support space for businesses, offering guidance on investments, innovation, and growth. It connects companies with specialized support entities, provides information on grants and financial aid, and advises on administrative procedures (https://www.iaf.es/paginas/iaf-conecta)
Joaquin Crespo-Martin, Strategic Foresight, Regional Development Agency of Aragon (Spain)

R7. "We need to distinguish between procurement guidelines and regulations; there is often a miscommunication about it. A regulation helpdesk or similar tools can be useful to help people navigate the landscape. Making standards accessible and understandable is the point."
Rich Walker, Director at euRobotics aisbl and Shadow Robot Company

In a webinar organised by FORGING on "Shaping a more responsible future with Tech. Cybersecurity – How to face technological, economic, social and ethical challenges", one of the topics heartily discussed was that cyberthreat is a well identified issue and an EU legislation framework has been set up to address it, with for example the well-established NIS2 Directive and the Cyber Resilience Act entering into force. However, with the technology development evolving very quickly, it was questioned if the legislative and regulative measures are keeping up pace. (12/2024)

The « Letta report » regarding the future of the European Single Market highlights, among many other things, the need to simplify the complex and bureaucratic regulatory framework within the EU to prevent companies and investments from leaving the European Union. This simplification is seen as crucial for reducing fragmentation and enhancing competitiveness. Enrico Letta, Much more than a Market, 04/2024

Have your say (open until 3 October 2025): The European Commission has launched a call for evidence and a public consultation on the future European Innovation Act, which is also aimed at fostering a more innovation-friendly regulatory policy and investment environment across the EU. More information: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14593-European-Innovation-Act_en

R8: Change the calculus around risk by creating incentives and an alleviated framework that allows for R&I and investment in areas of societal interest and ideally benefitting multiple use.

Why this matters:

- **Emerging technologies often involve high levels of uncertainty and risk**, particularly in early stages of development and when addressing societal challenges (e.g., environmental sustainability, public health, digital inclusion).
- The **current risk frameworks and funding conditions often discourage investment and R&I in these areas**, as the return on investment may not be immediate or easily quantifiable.
- Many innovations addressing societal needs can have **multiple applications across sectors (multi-use), increasing their overall value if risks are shared or managed effectively.**

How this can be implemented:

- **Create incentives for responsible innovation**

o Develop **funding instruments and fiscal incentives** that reduce the perceived and actual risk of investing in technologies with high societal value (e.g., green tech, inclusive digital tools).
o Encourage projects that target societal challenges, even if the commercial returns are longer-term.

- **Develop risk-sharing mechanisms**

o Use **public-private partnerships or blended finance** to spread risk across multiple actors, encouraging participation from industry, especially SMEs and startups.
o Create **innovation sandboxes or regulatory pilots** to allow safe experimentation.
o Consider **pre-commercial public procurement** for early stage investments

- **Adapt funding and regulatory frameworks**

o Simplify processes and reduce administrative burdens for innovation aligned with societal goals.
o Allow for flexibility in R&I project design and delivery to adapt to uncertainties typical of emerging technologies.

- **Promote multi-use benefits**

o Support projects that can demonstrate **cross-sectoral applications of technologies,** increasing their impact and value proposition.
o Encourage open standards and interoperable solutions to facilitate wider adoption.

=> To **redefine how risk is perceived and managed in R&I,** enabling greater investment and experimentation in areas that serve societal interests, while supporting innovations that can benefit multiple sectors and contribute to sustainability and resilience.

BEST PRACTICE

R8. "Policy makers need to reduce the risk observed by R&I stakeholders by removing legal risks (e.g. create regulatory sandboxes), creating tax incentives on R&D or investigating commercial routes, for example through pre-commercial procurement." *Rich Walker, Director at euRobotics aisbl and Shadow Robot Company*

"We cannot only focus on competitiveness and excellence. We should consider more the "multi-use aspect" – how to do investment so innovations can benefit different causes (such as dual use). For this, new co-working practices and multi stakeholder engagement are necessary. In our region we look at different application areas and urgent challenges so they can be addressed at the same time." *Erika Augustinsson, Innovation Strategist at Region Blekinge, Sweden*

STAKEHOLDER ENGAGEMENT AND INCLUSION

R9. Encourage cross-community collaboration by actively involving stakeholders from the quadruple helix (academia, industry, civil society, and public administration). Support ecosystem-driven innovation by promoting diverse stakeholder participation and strengthening connections within ecosystems and among regional innovation clusters.

Why this matters:

- Today's societal and technological challenges are too complex for any single actor to solve alone.
- The **quadruple helix model** brings together four key groups — researchers (academia), businesses (industry), citizens and NGOs (civil society), and government (public administration) — that are relevant to co-create solutions.
- This collaboration ensures that innovation is **socially relevant, accepted by communities, and responsive to real needs.**

How this can be implemented:

1. Broaden stakeholder engagement: Include diverse voices — not just researchers and companies, but also citizens, community organisations, and local governments.

2. Strengthen innovation ecosystems: Connect local and regional clusters so they share knowledge, resources, and networks.

3. Facilitate practical cooperation: Use living labs, joint workshops, and open forums to test ideas and co-design solutions.

4. Align policy and funding: Design R&I programmes that reward collaboration across sectors and regions instead of working in silos.

=> To build **vibrant, connected innovation ecosystems** that deliver responsible, impactful solutions aligned with **Industry 5.0 principles** — human-centred, sustainable, and resilient.

BEST PRACTICE

R9. "Co-creation is critical, it creates ownership. You have to consider the impact on the people whose job you are changing and take them into account – you need to get the buy-in from users." *Linda Newnes, Professor of Cost Engineering at University of Bath, Co-Director of the Foundry and Director of the Centre for People-led Digitalisation (UK)*

"When involving the quadruple helix, shared goals and ambitions can be set. This is key for any policy or strategy you want to carry out. A regional cluster should speak with one voice, avoiding many cluster organisations that focus on one tech or one sector only but grouping them. This is the case already on other countries, such as France." *Joaquin Crespo-Martin, Strategic Foresight, Regional Development Agency of Aragon (Spain)*

R9. "We have implemented the "Forum YOUZ" which is dedicated to the engagement of young stakeholders. We organise meetings across the region where the young population can discuss about the regional policies, give suggestions, recommendations. It is a way to stimulate the participation of civil society and get the point of views of individuals, in contrast to consultations with representatives of organisations." See https://www.art-er.it/en/projects-and-activities/youz-emilia-romagna-youth-forum *Elisabetta Maini, Head of Research Innovation European Networks at Regione Emilia-Romagna (Italy)*

R10. Define schemes that increase societal acceptance by promoting human-centric technology development, in line with Industry 5.0 principles, ensuring the inclusion of civil society representatives in technology design processes of innovation consortia and/or project activities.

Why this matters:

- Emerging technologies can bring societal and environmental benefits, but **lack of societal acceptance can hinder their deployment.**
- Technologies designed without considering users' needs, ethical concerns, and societal values may face resistance or fail to address real challenges.
- **Industry 5.0 emphasises human-centric, sustainable, and resilient innovation**, prioritising societal well-being alongside economic goals.
- Including **civil society representatives (citizens, NGOs, community organisations)** in technology design strengthens societal relevance, trust, and acceptance.

How this can be implemented:

1. Educate the society about benefits of policy actions and/or R&I project results:

- Involve citizens in policy consultations and actions

2. Create inclusive (funding) schemes:

- Require or encourage the inclusion of civil society organisations as partners in consortia for R&I projects.
- Support projects that engage citizens in co-design and testing phases.

3. Embed human-centric design principles:

- Focus on technologies that enhance human capabilities and well-being rather than replacing them.
- Incorporate societal needs, preferences, and concerns from the outset.

4. Facilitate structured dialogue:

- Use workshops, surveys, and co-creation labs to gather input from diverse societal actors.
- Involve end-users in iterative testing and feedback loops.

5. Monitor societal impact:

- Track how projects address societal challenges and contribute to well-being, equity, and sustainability, **using the Key Value Framework /Indicators (KV)**.

=> To **build technologies that people trust and embrace**, ensuring innovations are not only technically advanced but also aligned with societal values, needs, and ethical expectations, in line with **Industry 5.0 principles.**

BEST PRACTICE

R10. "If you aim at societal acceptance, innovation in technologies need to solve a problem people want to solve." *Rich Walker, Director at euRobotics aisbl and Shadow Robot Company*

"In our city, we have deployed the Szombathely 2030-programme, which was launched bottom up. 1000 citizens were consulted on the development programme. We also aim at involving end users in the development of tech solutions, notably citizens. When you are focusing on societal needs (something that is considered a "pain point", such as a high traffic road) a simple demonstration action creates awareness and acceptance by civil society. For example, we have created a bus stop with a green roof to creating awareness about environmental solutions. It can be simple." *Balázs Barta, Managing Director of PBN – advanced management (Hungary)*

One of the FORGING lessons is the key role of Social Sciences and Humanities (SSH) to make technology development responsible, inclusive, and responsive to society. The project indicates SSH integration cannot be a marginal or an add-on process, but a key feature of R&I design, implementation, and evaluation.

R11. Foster engagement of PPP and JU with societal actors to consider human-centric R&I development and support societal acceptance.

Why this matters:

- **Public-Private Partnerships (PPPs) and Joint Undertakings (JUs)** play a major role in advancing large-scale R&I initiatives in Europe.
- These structures often focus on technological and industrial challenges, sometimes overlooking **societal perspectives and human-centric considerations.**
- Involving **societal actors (citizens, NGOs, civil society organisations)** ensures that research and innovation outcomes are **aligned with societal needs, values, and expectations,** fostering trust and acceptance.

How this can be implemented:

1. Open PPPs and JUs to societal actors:

- Include civil society organisations and citizen representatives in governance structures, advisory boards, or working groups of PPPs and JUs.
- Encourage project calls within PPPs/JUs to include societal stakeholders in consortia.

2. Promote human-centric R&I:

- Embed human-centricity as a criterion in project evaluation, ensuring technology serves human well-being, equity, and empowerment.
- Encourage consideration of **societal impacts and ethical dimensions** alongside technological and economic KPIs.

3. Facilitate co-creation and dialogue:

- Organise workshops, foresight exercises, and scenario discussions with societal actors as part of PPP/JU activities.
- Create channels for **ongoing input and feedback** from societal actors during project lifecycles.

4. Strengthen societal acceptance:

- Building trust through active societal engagement will **facilitate the uptake of technologies,** reduce resistance, and align innovations with societal challenges (health, sustainability, resilience).

=> To ensure **Europe's major R&I partnerships and missions deliver innovations that are trusted, socially accepted, and human-centric,** aligning with **Industry 5.0 principles** while maximising societal value.

BEST PRACTICE

R11. "We would like to work with societal actors but in PPPs, time is the problem. If there is a Coordination and Support Action (CSA) that supports the PPP, the notion of citizen engagement could be embedded (it has to be embedded as requirement in the call)." *Rich Walker, Director at euRobotics aisbl and Shadow Robot Company*

R12. Enhance real-world application by facilitating and incentivising the involvement of more entrepreneurial and industrial actors in ideation phases and use case development.

Why this matters:

- Research and innovation often **struggle to move from lab to market,** limiting societal and economic impact.
- Early involvement of **entrepreneurs, SMEs, and industrial actors** ensures that research outcomes are aligned with **practical needs, market realities, and user requirements**.
- It increases the chances of **successful deployment, scale-up, and societal uptake** of innovative solutions.

How this can be implemented:

1. Facilitate industry and SME engagement early:

- Design calls and project structures that encourage the participation of industrial partners, startups, and SMEs in the ideation phase.
- Support mechanisms such as innovation vouchers, matchmaking platforms, and hackathons to connect researchers with entrepreneurs.

2. Incentivise participation:

- Provide **financial or procedural incentives** for industrial actors to participate in co-creation, scenario building, and pilot projects.
- Recognise and reward contributions of entrepreneurial actors in shaping and testing use cases.

3. Focus on real-world use cases:

- Prioritise projects that develop and validate **concrete use cases with industrial relevance,** ensuring feasibility and scalability.
- Encourage testing innovations in **real-life environments** to gather feedback and demonstrate impact.

4. Bridge research and market:

- Support pathways from research to market, including **IPR guidance, incubation, and acceleration programmes.**
- Foster public-private cooperation for knowledge transfer and deployment.

=> To **accelerate the practical deployment of responsible innovations,** ensuring that research results translate into **solutions with real societal and market impact**, aligned with the principles of Industry 5.0.

BEST PRACTICE

R12. "Co-creation with industry is essential to allow for industry adoption – it can also involve local councils or similar organisations. You have to go through co-creation (coming from research) and then take it to co-development (implementation with real industry involvement in use cases). In the frame of the Centre for People-led Digitalisation we have worked on nine case studies with manufacturing companies, both on co-creation and co-development – see https://www.p-ld.co.uk/case-studies" *Linda Newnes, Professor of Cost Engineering at University of Bath, Co-Director of the Foundry and Director of the Centre for People-led Digitalisation (UK)*

"Our regions are small and rural, and we often collaborate across regions to be able to address a larger geography. We are currently developing a programme that gathers more innovative companies into groups that represent S3 areas, also integrating science parks, corporates, clusters and research organisations. Each group is coordinated by a stakeholder who takes the lead to define with the group how innovation in the area can be sustainable. This pushes stakeholders, namely companies, to become more strategic level actors within the larger geographic region." *Peter Friberg, Senior strategist for regional development, Regional Executive Office at Region Jönköping County (Sweden) and Erika Augustinsson, Innovation Strategist at Region Blekinge, Sweden*

The "Strategic Industry Roadmap 2025" of the European Quantum Industry Consortium strongly emphasizes the need to bridge the gap between R&D and market, especially by supporting startups, SMEs, and larger industrial players in early-stage development.

It also calls for public-private collaboration, including engaging end-users and industry in defining use cases. The roadmap advocates for funding reform (e.g. EIC expansion, co-investment models) and testbed access to help entrepreneurs validate ideas in real-world settings. See https://www.euroquic.org/strategic-industry-roadmap-2025/

R13. Foster inclusion of early career researchers by encouraging the participation of PhDs and junior scientists in collaborative R&I to promote awareness regarding societal and environmental value of technology development.

Why this matters:

- Early career researchers (PhDs, postdocs, junior scientists) represent the **next generation of innovators and technology developers.**
- Including them actively in collaborative R&I projects helps build **awareness of societal, ethical, and environmental dimensions of technology** from the start of their careers.
- It fosters a culture of **responsible, value-sensitive innovation** in future scientific leaders and promotes interdisciplinary learning.

How this can be implemented:

1. Encourage participation in collaborative projects:

- Design R&I programmes that **explicitly support and encourage PhD students and junior researchers** to take active roles in multi-stakeholder projects.
- Offer opportunities for **meaningful contribution to co-creation activities, scenario planning, and stakeholder engagement.**

2. Promote training and capacity-building:

- Integrate **societal and environmental responsibility training** into doctoral and early researcher programmes.
- Provide mentorship opportunities linking early career researchers with societal actors and industry partners.

3. Recognise and value contributions:

- Acknowledge the input of junior scientists in project reporting and dissemination activities.
- Create award schemes or visibility opportunities for early career researchers demonstrating societal impact.

4. Build a responsible innovation mindset:

- By participating in co-creation and value-sensitive design processes, early career researchers develop **skills to align technology development with societal needs and environmental sustainability.**

=> **To nurture a new generation of researchers who develop technologies with societal and environmental values in mind**, ensuring future innovations align with **Industry 5.0 principles: human-centricity, sustainability, and resilience.**

BEST PRACTICE

R13. The Draghi Report, authored by Mario Draghi, former President of the European Central Bank and former Italian Prime Minister, outlines a comprehensive strategy to enhance European competitiveness. Beyond other important observations and recommendations, the report elaborates about the fact that Europe's aging population and shrinking workforce poses significant challenges. Draghi indicates that, without addressing these shifts, Europe risks a decline in its economic dynamism and innovation capacity. Mario Draghi, The future of European competitiveness (09/2024). https://commission.europa.eu/topics/eu-competitiveness/draghi-report_en

RECOMMENDATIONS FOR PROJECT DEVELOPMENT AND IMPLEMENTATION

(Target Group: Project owners - Research and Innovation Actors)

The following recommendations aim to support **researchers, innovators, consortia coordinators, and project teams** in designing and implementing **collaborative research and innovation (R&I) projects** that align with **responsible, human-centric, and sustainable innovation practices**, in line with **Industry 5.0 principles.**

Based on lessons learned throughout the FORGING project, these recommendations are grouped into two complementary areas:

- **Project Design and Implementation**

These recommendations guide project owners on integrating **foresight, Key Value Indicators (KVIs), societal needs, and adaptability** into the design and implementation of R&I projects. They focus on ensuring that projects:

- Anticipate and remain aligned with evolving societal and technological trends.
- Address real-world needs to increase the **scalability and societal relevance** of innovations.
- Create outputs and methods that are transferable across sectors and contexts.

- **Stakeholder Engagement and Inclusion**

These recommendations focus on **how project owners can actively engage stakeholders and industry throughout project lifecycles** to increase societal acceptance, foster early industry buy-in, and ensure real-world applicability of project outcomes. They include:

- Strengthening **co-creation and quadruple helix stakeholder interaction.**
- Embedding iterative approaches and continuous stakeholder dialogue.
- Involving **industrial and entrepreneurial actors** in ideation and advisory roles.
- Considering the **environment ("fifth helix")** as a central element of technology development.
- **Equipping project teams with facilitation skills to support adaptable and participatory methodologies**.

R14. Use societal foresight to understand potentials and impacts of emerging technology as basis for technology / R&I development and re-assess the trajectory all along the technology / R&I development.

Why this matters:

- Foresight methods (e.g., scenario planning, horizon scanning) help anticipate future trends, risks, and societal expectations.

How this can be implemented:

- Use scenario-based planning to design projects aligned with likely future developments.
- Regularly revisit and adapt project direction based on new signals and stakeholder input.
- Ensure your project remains relevant and responsible in a changing environment.

=> To ensure **technological development is future-proof,** ethically grounded, and responsive **to societal expectations and emerging risks,** by systematically integrating foresight and re-evaluation across the entire innovation lifecycle.

BEST PRACTICE

R14. In its « Recommendations for Responsible Innovation », the OECD indicates "Responsible innovation is trustworthy technology development guided by democratic values, responsive to social needs and accountable to society. Adopting a responsible innovation approach in the development of emerging technologies can help align research and commercialisation with societal needs." The OECD has specifically developed a guide with *Recommendation of the Council on Responsible Innovation in Neurotechnology,* see https://www.oecd.org/en/topics/responsible-innovation.html

The EU-funded project "Eye of Europe" aims to enhance the integration of foresight practices into Research and Innovation (R&I) policy making across Europe. The project envisions a more cohesive and influential R&I foresight community that contributes significantly, as a collective intelligence, to shaping and guiding policy decisions. Find more information: https://www.futures4europe.eu/project/Eye_of_Europe_6ft5d You may join the Futures for Europe Community here: futures4europe.eu

R15. Use the Key Value Indicators (KVI) to complement KPIs, monitoring ethical, societal, and environmental dimensions in line with Industry 5.0 principles.

Why this matters:
Traditional KPIs (e.g., productivity, technical milestones) often overlook societal and environmental impacts.

How this can be implemented:

- Identify and apply KVIs that track societal value, ethical alignment, and environmental sustainability.
- Use KVIs in project monitoring and evaluation to ensure human-centric and sustainable technology development.
- Communicate value beyond financial metrics to funders and stakeholders.

=> To **move beyond narrow performance metrics** and systematically monitor the **societal, ethical, and environmental value** generated by innovation projects, in line with **Industry 5.0 objectives.**

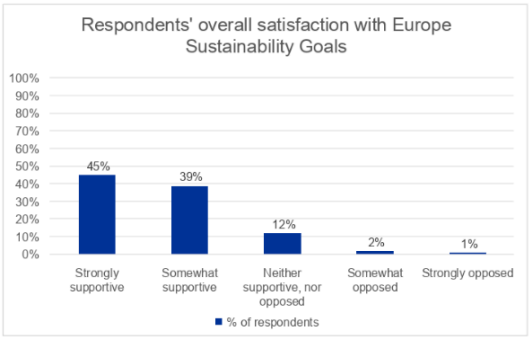
BEST PRACTICE

R15. #WeAreEurope is an independent association that brings together professionals committed to the common goal: of defending the fundamental values of the European Union and working towards a fairer, greener and more democratic future. In the analysis of its "2025 post-Omnibus CSRD business survey", it shares, among others, the following results:

Overall feeling about European Union's Sustainability Goals

#WeAreEurope

To what extent would you say your company is supportive of EU's sustainability goals (like, carbon reduction, zero pollution 2050, stop to biodiversity loss)?



Key take-aways

In a context where some countries like the US are against ESG being on the agenda of companies, the survey shows that such feeling is **not** shared within our sample of European companies.

84% of respondents are **supportive** of the EU's Sustainability Goals and only 3% are opposed to them.

Total number of answers: 1062
Breakdown by company size, sector size, functions, regions and maturity available in dedicated sections

R16. Start from societal needs to develop real-world use cases and test technologies in real environments to increase scalability.

Why this matters:

Developing technologies that address actual societal challenges enhances relevance and adoption.

How this can be implemented:

- Identify societal challenges and needs before designing technical solutions.
- Develop and test concrete use cases with potential end-users.
- Pilot technologies in real-life environments to gather feedback and refine scalability strategies

=> To **increase the relevance, legitimacy, and adoption** of emerging technologies by ensuring they **directly respond to real-world challenges** and are validated through real-life testing with users.

BEST PRACTICE

R16. "As an example, the Flemish Institute of Biotechnology (VIB) deploys an active strategy for end-user driven R&I projects in collaboration with industry. In their programme they identify end users' needs, match them to researchers working at VIB and then work in co-creation to increase market readiness and societal impact. See https://vib.be/en/research-and-impact/grand-challenges-program#/."
Kathleen D'Hondt, Policy Advisor, Dep. Work, Economy, Science, Innovation, Social Economy (WEWIS) - Flemish Government (Belgium) and Coordinator Vanguard Initiative Smart Health Pilot

"We have developed a test infrastructure that is called the "Silver Club", it is like a living lab to test digital devices and elderly-friendly solutions. The Silver Club provides quality time,
development, and a sense of belonging to its members through participation in business and product development processes. It gives the voice to elderly which appreciate that their opinion is being valorised. In addition, we have a "Teaching and Learning Factory" for demonstration, testing and new application development: companies from different countries can test their solutions there, we also offer presentation to venture capital firms." See https://www.youtube.com/watch?v=RxK0MzQkiPo *Balázs Barta, Managing Director of PBN – advanced management (Hungary)*

R17. Design for transferability by considering the adaptability of methodologies or tools to other sectors or technologies.

Why this matters:
Transferable methods and tools amplify impact and usability across sectors or geographic boundaries.

How this can be implemented:

- Document methodologies clearly to enable yourself or others to apply them in different contexts.
- Consider cross-sector relevance when developing tools or frameworks.
- Seek early feedback from stakeholders in other sectors to enhance adaptability.

=> To **amplify the scalability and long-term impact** of methods, tools, and solutions developed in projects by making them adaptable and reusable across **multiple domains or territories.**

BEST PRACTICE

R17. " « Worked examples », that is good quality case studies, help a lot to see "how something is done". Educating people in the art of the possible is very helpful – you need to map existing material and create awareness. Simple tools are needed that show the use in practical sessions (good quality templates, right thinking tools to use them). It would be most effective if such tools came from business support organisations or organisations already working on innovation (e.g. Innovate UK in the UK, Knowledge transfer networks)." *Rich Walker, Director at euRobotics aisbl and Shadow Robot Company*

STAKEHOLDER ENGAGEMENT AND INCLUSION

R18. Strengthen co-creation and quadruple helix stakeholder interaction to foster early user buy-in and increase industry uptake and societal acceptance, considering gender dimensions.

Why this matters:
Early and diverse stakeholder involvement enhances societal trust and industry relevance. Co-creation fosters a shared sense of responsibility.

How this can be implemented:

- Include academia, industry, public administration, and civil society (quadruple helix) in project activities.
- Actively engage underrepresented groups, ensuring gender balance in participation.
- Co-create solutions with stakeholders to align innovations with their needs.

=> To foster **early alignment, societal trust, and shared ownership** of innovation outcomes by embedding **inclusive, multistakeholder collaboration** from the start — including often underrepresented voices.

BEST PRACTICE

R18. "The thinking process happening at the beginning of a project shapes everything – it is important to spend enough time on it. Anticipate the scenario of application and shape the tools, accordingly, anticipating possibly the disruption. It is relevant to include experts from implementation science or with background in science of technology studies – they will be great to provide inputs on the processes. It is of utmost importance to ensure that social sciences are taken into account for tech development to foster societal acceptance." *Pol Torrent, Project Manager in the Internal Strategy Area at Vall d'Hebron Hospital (Spain)*

R18. "Living Labs are an ideal environment to work on societal challenges through tech innovation: living labs represent the quadruple helix, you can involve staff members, university, tech companies, administrations, and the users in a co-design process and then a joint application.

This allows you to work on solutions focusing on real needs: living labs are a "show room" for the innovations piloted. The solutions can be tested in a safe place, the living lab, before they are deployed outside (e.g. at home)." *Jordi Picas i Vilà, Director of Innovation, Suara (Spain)*

"As part of our work on loneliness with the elderly population we have purchased a humanoid. It was created with a female face and this very strongly helped building trust. We are now working on the ethical aspect of the deployment, explaining to users the method we are using and the data generated." *Balázs Barta, Managing Director of PBN – advanced management (Hungary)*

"For societal stakeholders, the challenge is time and resources, especially that it is unrewarded time. If you want societal engagement you need to accept to ask people to do unpaid work for you, and you need to expect that they might say no. It is comparable to volunteering. You need to integrate the engagement into something that is worth for them to spend the time, for example a university / science stand at a community event. Consider allocation of money when you design a project." *Rich Walker, Director at euRobotics aisbl and Shadow Robot Company*

R19. Ensure alignment with changing realities in R&I / technology development using iterative approaches and stakeholder exchanges throughout project lifecycles.

Why this matters:
Innovation ecosystems are dynamic, requiring continuous alignment with evolving needs.

How this can be implemented:

- Structure projects with phases for reflection and adaptation.
- Use stakeholder feedback to adjust project goals and methods as contexts evolve.
- Embrace flexibility to stay aligned with societal, technological, and regulatory changes.

=> To make R&I projects **resilient, adaptive, and aligned with fast-evolving contexts,** ensuring sustained relevance and responsiveness throughout the project life cycle.

BEST PRACTICE

R19. "-You need to confront innovative ideas and ask innovators to look at harsh realities – not all innovations are valuable. Inside an existing company, it is often better to innovate in order to improve workflow processes, rather than starting from a technology just because it is trendy. We offer trainings for businesses on tech development for this matter and presentations about future technologies and how they will impact life."
Balázs Barta, Managing Director of PBN – advanced management (Hungary)

R20. Enhance industrial and entrepreneurial participation by involving industrial actors and establishing advisory bodies with entrepreneurial experience.

Why this matters:
Entrepreneurs and industrial partners provide market insight and practical perspectives.

How this can be implemented:

- Invite industry stakeholders to participate in ideation, co-creation, and pilot phases.
- Establish advisory boards with entrepreneurs to guide market-oriented decisions.
- Co-design pathways for deployment and commercialisation of project results.

=> To **bridge the gap between research and market** by involving actors who bring **practical, business-oriented perspectives,** thus increasing the chances of **real-world deployment and commercialisation.**

BEST PRACTICE

R20. "Our team is composed of diverse profiles – about half of the staff members has engineering background, the other half has a SSH background. In our Advisory Board there is a CEO of a large company, and we have a lot of companies visiting – we develop about 15-20 business contracts every year. This is also relevant for our ecosystem development activity which includes product development for start-ups (with prototyping being possible)."
Balázs Barta, Managing Director of PBN – advanced management (Hungary)

R21. Consider the fifth helix (the environment) in R&D, especially for scalability and replicability in other geographic territories.

Why this matters:

Sustainable product/services development needs to take account of the setting of the markets where the product/service is aimed at being deployed. This encompasses various aspects, such as economic, cultural, and societal characteristics. Environmental impacts and ecosystem considerations are essential for sustainable scaling.

How this can be implemented:

- Integrate environmental assessments in technology design and use case development.
- Adapt innovations to fit diverse economic, societal and ecological contexts when scaling to new regions.
- Ensure your technology supports sustainability goals aligned with Industry 5.0.

=> To ensure that innovations are **socio-economically viable, sustainable, and ecologically scalable,** by integrating environmental dimensions into the design, testing, and replication of technologies and practices.

BEST PRACTICE

R21. The Interreg Europe Policy Learning Platform offers services to policy stakeholders from regional or local levels to exchange good practices and lessons learnt. The “peer review” is a learning exercise that aims at sharing advise on the replicability of solutions in other territories. See https://www.interregeurope.eu/policy-learning-platform

The "Critical and Emerging Technologies Index" from the Belfer Center for Science and International Affairs at Harvard Kennedy School provides data on the national performance of 25 countries - including European ones - in the following key and future technology sectors: Artificial Intelligence, Biotechnology, Semiconductors, Space and Quantum.

In addition to the index, individual country reports with in-depth analyses are made available. An interactive dashboard also allows the individual sectors to be weighted differently and countries to be compared with each other. See https://www.belfercenter.org/critical-emerging-tech-index

The Australian Strategic Policy Institute's (ASPI) report aims to identify which countries and institutions are leading in high-impact research across 64 critical technological domains, including defense, space, energy, environment, artificial intelligence, biotechnology, robotics, cyber, computing, advanced materials, and quantum technologies. The methodology is based on the analysis of the top 10% of highly cited research publications in each critical technology. See ASPI's two-decade Critical Technology Tracker: The rewards of long-term research investment,.

R22. Ensure methodologies support facilitation and adaptation by equipping project teams with strong facilitation skills and piloting adaptable methodologies.

Why this matters:
Facilitation and adaptability are key to managing co-creation and participatory processes.

How this can be implemented:

- Train project teams in facilitation and participatory methods.
- Use adaptable tools that can be modified based on stakeholder characteristics, needs and context.
- Pilot methodologies in diverse settings to enhance effectiveness and resilience.

=> **To build internal project capacity for meaningful stakeholder engagement,** effective co-creation, and **context-sensitive adaptation**, thus improving innovation quality and uptake.

BEST PRACTICE

R22. The FORGING team has developed a Toolkit which gathers methods, processes and templates that can be relevant for different steps in responsible R&I projects that are designed and implemented in co-creation mode. The FORGING Toolbox is a helpful resource for anyone working with novel technologies. It provides tools and methods to support responsible technology development. It highlights the FORGING project's collaborative, interdisciplinary approach, shares useful tools and methods from the project, includes links to other resources that promote responsible innovation throughout the Value Sensitive Innovation Journey.
The toolkit is shared through open access here: https://forging-hub.eu/

CONCLUSIONS

This deliverable offers recommendations for policy makers and project owners in order to trigger responsible innovation, both through evidence-based policy making and project development and implementation. It aims to share lessons learnt and good practices stemming from observations throughout the project work and elaborated in exchange with participants in FORGING activities, as well as interested external experts.

In summary, the key recommendation to both target groups is as follows:

- to ensure that policy design and implementation / project design and implementation reflect an inclusive multi-stakeholder view, integrating the needs of all relevant parties to be effective, results-driven and impactful and foster acceptance, uptake and wider replication.

The White Paper has been designed in an easy-to-consult way and recommendations have been built with a view on actionability and transferability to other geographical, sectoral or technological contexts.

The White Paper is shared to a database of contacts throughout Europe and presented to an interested audience in the frame of a "Knowledge sharing online event" in September 2025.

Visit the FORGING website: http://forging-hub.eu/

If you are interested in more information about the state of European tech-driven innovation, see « The State of European Tech 2024 » : https://www.stateofeuropeantech.com/chapters/executive-summary

METHODOLOGY

The recommendations presented herein are based on a combination of:

- **Empirical insights** gathered over three years of project activities, including co-creation workshops, stakeholder forums, foresight exercises and use case investigation.
- **Internal project reflections** by the FORGING consortium partners, drawing on multidisciplinary expertise in research and innovation management, responsible research and innovation practices, ethics, technology foresight, and policymaking.
- **External consultations,** including a dedicated round of semi-structured interviews conducted with selected experts across academia, industry, clusters, public authorities, and civil society (participants in FORGING activities / FORGING Forum members and with representatives from relevant support organisations and initiatives). These interviews were designed to test, challenge, and refine the draft recommendations.
- **Desk research on policy frameworks,** academic literature, and case studies relevant to value-driven innovation, Industry 5.0, and emerging technology governance.

The interviews were conducted online in June and July 2025, following a common guide focused on four core themes: relevance and transferability of FORGING tools and methods, alignment with societal needs and environmental goals, practical implementation challenges, and policy suggestions.

Input from these contributors helped validate and enrich the recommendations, ensuring their applicability beyond the immediate FORGING community. The feedback from these exchanges is incorporated in the following chapters in the pink boxes below each recommendation.

The resulting document is shared following its dissemination plan. It is presented to an interested audience in the frame of a "Knowledge sharing online event" in September 2025.

This White Paper combines forward-looking guidance with practitioner-grounded feedback, supporting a more human-centric, resilient and sustainable innovation ecosystem aligned with Industry 5.0 values.

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We are especially grateful to the interviewees who participated in the final consultation phase, sharing their experience and insights to strengthen the relevance, usability, and ambition of the recommendations. Their contributions reflect a diversity of expertise across sectors and geographies and have played a vital role in shaping this collective outcome.
Our sincere thanks also go to the broader FORGING community — members of the Forum for Emerging Enabling Technologies, co-creation participants, representatives of collaborative projects and diverse activities — whose engagement throughout the project has been instrumental in advancing a shared vision for responsible, inclusive, and value-sensitive innovation in Europe.

Interviewees (alphabetical order):

- *Erika Augustinsson, Innovation Strategist at Region Blekinge (Sweden)*
- *Balázs Barta, Managing Director of PBN – advanced management (Hungary)*

- *Joaquin Crespo-Martin, Strategic Foresight, Regional Development Agency of Aragon (Spain)*
- *Kathleen D'Hondt, Policy Advisor, Dep. Work, Economy, Science, Innovation, Social Economy (WEWIS) - Flemish Government (Belgium) and Coordinator Vanguard Initiative Smart Health Pilot*
- *Peter Friberg, Senior strategist for regional development, Regional Executive Office at Region Jönköping County (Sweden)*
- *Elisabetta Maini, Head of Research Innovation European Networks at Regione Emilia-Romagna (Italy)*
- *Linda Newnes, Professor of Cost Engineering at University of Bath, Co-Director of the Foundry and Director of the Centre for People-led Digitalisation (UK)*
- *Jordi Picas i Vilà, Director of Innovation, Suara (Spain)*
- *Jolien Roovers, Policy Advisor at Department of Work, Economy, Science, Innovation and Social economy (WEWIS), Flemish government (Belgium)*
- *Paolo Rosso, Senior advisor at Regione Emilia-Romagna (Italy)*
- *Pol Torrent, Project Manager in the Internal Strategy Area at Vall d'Hebron Hospital (Spain)*
- *Rich Walker, Director at euRobotics aisbl and Shadow Robot Company*

REFERENCES

[1] The frameworks are: Human-centric solutions & human-machine-interaction; Bio-inspired technologies and smart materials; Real time-based digital twins and simulation; Cyber safe data transmission, storage & analysis technologies; Artificial intelligence; Technologies for energy efficiency and trustworthy autonomy. See https://forging-hub.eu/forging-technology-frameworks/

[2] The Key Value Framework is a methodology that integrates the notion of values into R&I activities. It sets indicators that encompass other than economic dimensions, e.g. societal and environmental ones.

[3] See https://forging-hub.eu/forging-target-groups/