European Commission

Research and Innovation

The Demographic Turn

Actions Needed for Research, Innovation and Policy in Europe

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Manuscript completed in December 2025

PDF	ISBN 978-92-68-35043-0	doi: 10.2777/8349625	KI-01-25-245-EN-N

Luxembourg: Publications Office of the European Union, 2025

EUROPEAN COMMISSION

The Demographic Turn

Actions Needed for Research, Innovation and Policy in Europe

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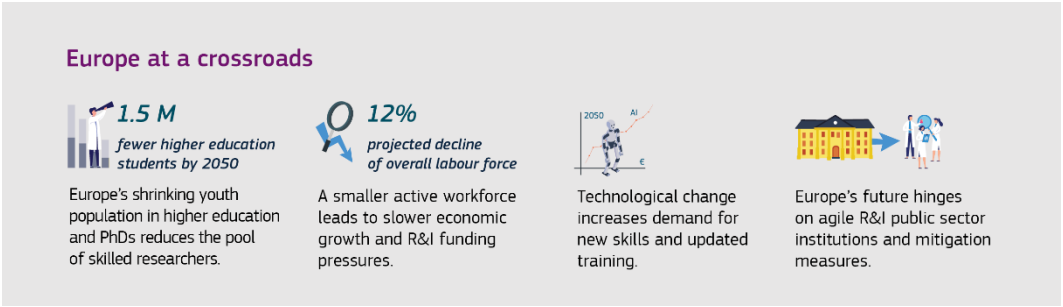
This report was prepared as part of the Framework Contract Foresight on Demand II

2025 Directorate-General for Research and Innovation EN

Contents

Executive summary

The Demographic imperative: a structural paradigm shift. Europe stands at a defining historical juncture. As we look towards 2050, the continent confronts a profound demographic transformation characterised not merely by an ageing population, but by a structural contraction of the working-age base. This report demonstrates that demographic change acts as a potent stressor that will fundamentally reshape the operating environment for the Research and Innovation (R&I) system in the European Union (EU). The traditional "pipeline" model of human capital - predicated on an era of demographic expansion and a steady influx of young talent - is becoming obsolete. Simultaneously, the foresight scenarios indicate that the fiscal capacity of states to fund public research risks being squeezed by the rising costs of pensions and healthcare associated with an ageing society.



The challenge is dual and urgent. Europe must rapidly increase productivity and innovation to sustain its economy with fewer hands, while simultaneously securing the social licence and skilled human capital required to drive this transition without fracturing society. This imperative is underscored by the recent Draghi report on European competitiveness, which frames the situation as an "existential challenge". With the EU workforce projected to shrink by close to 2 million workers annually by 2040, the report warns that productivity growth is no longer merely an economic objective but the sole available engine to maintain Gross Domestic Product (GDP) and living standards. The Draghi report argues that unless Europe radically changes its industrial focus to close the innovation gap, it will face a painful trade-off: becoming unable to simultaneously finance its social model, meet climate targets, and preserve its strategic independence. Inaction risks a future where R&I becomes a luxury Europe can no longer afford, or a tool captured entirely by short-term commercial interests.[1]

[1] M. Draghi, *The future of European competitiveness*, Luxembourg: Publications Office of the European Union, 2025, doi:10.2872/9356120.

Why foresight?

*Develop **plausible yet challenging future scenarios** for the European R&I system under the influence of demographic changes*

*Assess the **implications for R&I**, including productivity challenges, funding models, and socio-spatial transformations*

*Provide strategic and timely **policy recommendations***

Foresight methodology: navigating radical uncertainty. To systematically assess these structural impacts and generate policy actions that remain effective regardless of future volatility, the Demographic Turn project employed a multi-stage strategic foresight methodology designed to move beyond simple trends extrapolation. The process began with extensive desk research to identify weak signals and critical uncertainties, leading to the selection of the degree of automation in research and the dominance of public versus business research providers as the critical variables for the subsequent scenario development process.

Through a series of expert workshops, the study co-created four plausible, challenging, and contrasting scenarios for 2050. These narratives are designed not as predictions, but as neutral analytical frameworks that challenge current strategic assumptions and compel policymakers to stress-test their value-driven positions against divergent, equally plausible structural realities:

Scenario 1: Corporate ascendancy.

A world where fiscal pressures force the state to retreat, leaving private capital to dominate R&I. While efficient, this system sidelines public interest and basic research in favour of short-term commercial gain and proprietary knowledge.

Scenario 2: Inclusion and purpose.

A future defined by a shift towards social equity and post-growth models. However, this scenario is challenged by "digital fatigue," slow scientific momentum, and a struggle to rebuild trust in institutions amidst populist sentiment.

Scenario 3: Splinters & stratification.

A fragmented global order drives defensive, isolated R&I policies. Europe focuses on security and "technological catch-up" within a walled-off "Splinternet," leading to duplicated efforts and deep regional inequalities.

Scenario 4: Hybrid hubs.

A resilient, autonomous EU that leverages dispersed networks and strong human-AI synergy. This scenario balances strategic autonomy with regional specialisation, maintaining competitiveness through coordinated investment.

1.1. Strategic implications – the system under stress

The scenario analysis revealed that demographic change acts as a stress multiplier across four critical dimensions of the R&I ecosystem, creating specific tensions that require immediate resolution:

Human capital

(education)

The traditional public university model is in decline as the "human pipeline" of young graduates narrows. The system faces a critical skills gap unless it pivots from a linear degree model to a cyclical, lifelong learning infrastructure that prevents the mass obsolescence of the existing workforce.

Financial stability

(funding)

As healthcare and pension costs squeeze state budgets, there is a high risk that fundamental, curiosity-driven research — the "seed corn" of future innovation — will be sacrificed for short-term, applied projects. The challenge is to protect public-interest science from becoming purely transactional while leveraging private capital for development.

Regional cohesion

(socio-spatial)

Unchecked, R&I activity tends to concentrate in "superstar" hubs, exacerbating brain drain and leaving peripheral regions vulnerable to economic decline. However, demographic shifts offer an opportunity to build a "network of excellence," using regional specialisation (e.g., the Silver Economy) to distribute resilience across the continent.

Market dynamics & trust

(valorisation)

As healthcare and pension costs squeeze state budgets, there is a high risk that fundamental, curiosity-driven research — the "seed corn" of future innovation — will be sacrificed for short-term, applied projects. The challenge is to protect public-interest science from becoming purely transactional while leveraging private capital for development.

1.2. Key findings – four strategic mandates

To address these structural vulnerabilities, the policy recommendations presented here were not merely brainstormed but rigorously "wind-tunnelled" against divergent futures to ensure robustness. The analysis concludes that the European R&I system requires a structural overhaul, identifying four cross-cutting strategic mandates required to future-proof the ecosystem:

The protection mandate

In scenarios of fiscal volatility or corporate dominance, fundamental, curiosity-driven research is the first casualty. To prevent the R&I system from becoming purely transactional, a legislative funding floor is recommended to insulate long-term scientific inquiry from short-term budgetary cycles. This structural ring-fencing mechanism ensures Europe retains the capacity to generate the radical, currently undefined ideas needed for future breakthroughs, rather than merely optimising existing solutions.

The adaptation mandate

With careers spanning 50 years, the linear education model must change. The system should shift to a cyclical human capital model, institutionalising a European framework for lifelong learning and sabbatical funds. This infrastructure treats upskilling not as a personal burden but as a systemic necessity, akin to a pension scheme. It provides the agility to pivot the workforce from declining sectors to emerging ones, preventing mass skills obsolescence in an ageing workforce.

The cohesion mandate

Centralised "superstar" hubs are efficient but brittle in a fragmented world. To counter brain drain and enhance autonomy, Europe should trade some short-term efficiency for resilience by establishing a European Network of Regional Innovation Campuses (ENRIC). These distributed nodes anchor talent in peripheral regions and focus on smart specialisation (e.g., the silver economy), turning local diversity into a strategic asset and ensuring that no region is left behind in the transition.

The trust mandate

Demographic shortages necessitate the rapid automation of research and industry, but this risks a severe societal backlash if perceived as unethical. The system must secure a "social licence" by integrating citizens directly into the R&I process through agile regulatory networks and ring-fenced citizen science funding. This ensures that technology serves human needs and that the pace of innovation does not outstrip society's willingness to accept it.

Conclusion. These mandates are mutually reinforcing: Europe cannot achieve strategic autonomy without regional cohesion, and it cannot successfully automate its economy without the trust of its citizens. This report details the pathway for implementing these mandates, offering an approach to convert demographic pressure from a systemic

vulnerability into a catalyst for a more resilient, autonomous, and deeply human-centric European R&I ecosystem.

Glossary

Adaptation mandate	One of the four core strategic recommendations identified in the report. It calls for a structural shift from a linear "pipeline" career model to a "cyclical" one, institutionalising lifelong learning to prevent skills obsolescence in an ageing workforce.
Asynchronous expert consultation	A phase of the project conducted online, allowing experts to brainstorm, prioritise, and validate actions independently and iteratively, reducing groupthink and logistical constraints.
Brainstorming of actions	The initial step of the asynchronous validation phase where experts generated concrete strategic responses to the challenges and opportunities identified in the scenarios.
Cohesion mandate	One of the four core strategic recommendations. It advocates for prioritising distributed resilience over pure efficiency by establishing regional innovation hubs to anchor talent in peripheral regions and counter brain drain.
Corporate ascendancy (scenario 1)	A future trajectory where fiscal pressures force the state to retreat from R&I funding, leaving private corporations to dominate the sector. This leads to high efficiency but sidelines public interest and basic research.
Delphi method	A structured communication technique used in the validation phase, relying on a panel of experts who answer questionnaires in two or more rounds. After each round, a facilitator provides an anonymous summary of the experts' forecasts and reasons, encouraging convergence towards a consensus or stable divergence.
Digital fatigue	A phenomenon described in scenario 2, where parts of the population (particularly the elderly) become sceptical or exhausted by the pace of digitalisation, leading to disengagement from technological systems.
Drivers of change	Influential forces (demographic, economic, technological, etc.) that shape or transform a system. In this project, drivers were analysed using the PESTLE framework.
European Network of Regional Innovation Campuses (ENRIC)	A proposed policy initiative to create specialised innovation nodes in peripheral regions, connected digitally to central hubs, to support the Cohesion Mandate.
Futures wheel	A structured brainstorming method used in the Implications Workshop. It is designed to identify the direct (first-order) and indirect (second- and third-order) consequences of a specific phenomenon (e.g., trend or scenario), mapping the "ripple effects" of change.
Hybrid hubs (scenario 4)	A future trajectory describing a resilient, autonomous EU that leverages dispersed networks and strong human-AI synergy, balancing strategic autonomy with regional specialisation.
Inclusion and purpose (scenario 2)	A future trajectory defined by a shift towards social equity, ethical technology, and post-growth economic models, but challenged by slow scientific momentum and social distrust.

Mandatory funding floor	A key policy proposal within the protection mandate, requiring legislation to set a minimum percentage of budgets dedicated exclusively to fundamental, non-applied research to protect it from fiscal volatility.
PESTLE (Political, Economic, Societal, Technological, Legal, Environmental) analysis	A framework used during the desk research phase to scan the external environment by categorising trends into: Political, Economic, Societal, Technological, Legal, and Environmental factors.
Protection mandate	One of the four core strategic recommendations. It aims to insulate the "seed corn" of fundamental research from short-term economic fluctuations and corporate dominance.
Research and innovation (R&I)	The ecosystem comprising higher education institutions, public research organisations, private research & development departments, start-ups, and policy bodies involved in the creation and application of new knowledge.
"Rip van Winkle" technique	A foresight exercise designed to disrupt linear thinking and overcome cognitive bias towards the status quo. Inspired by the literary character, it asks participants to imagine waking up in a distant future (e.g., 2050) after a long sleep. To understand this new reality, participants are allowed to ask only a limited number of closed ("yes" or "no") questions. This constraint forces them to prioritise their inquiries, thereby revealing their deep-seated, often hidden assumptions and critical uncertainties about the future trajectory.
Silver economy	The market dedicated to the needs of older people, including health tech, care services, and adapted consumer goods. It is identified as a key driver for future R&I markets.
Splinternet	A concept prominent in scenario 3, describing the fragmentation of the global internet into separate, mutually inaccessible ecosystems controlled by different geopolitical blocs, restricting the flow of data and research.
Splinters & stratification (scenario 3)	A future trajectory characterised by global geopolitical fracture, technological isolation, and defensive R&I policies, leading to duplicated efforts and deep regional inequalities.
Trust mandate	One of the four core strategic recommendations. It focuses on integrating citizens into the R&I process (e.g., through Citizen Science) to ensure technological advancements align with human needs and values.
Weak signals	Early, often ambiguous indicators of potential change that may mature into significant trends or issues in the future.
Windtunnel-ing	A critical methodology used in the final phase of the project. It involves stress-testing proposed strategies against multiple contrasting scenarios to see if they remain effective under different future conditions.
2x2 Matrix method	A scenario generation technique used in this project. It intersects two critical axes of uncertainties to create four distinct quadrants, which form the basis of the four scenarios.

2. Introduction

Europe is experiencing notable demographic changes that mark a definitive structural turning point; data indicates the EU's total population is projected to peak at 453.3 million as early as 2026, before entering a period of gradual but persistent decline . A key factor of this shift is not merely the ageing of the population—where the proportion of individuals aged 85 and above is expected to more than double to 10% by mid-century —but the simultaneous contraction of the productive base. The overall labour force is set to decline by 12%, removing approximately 25 million people from the workforce, while the pool of young talent shrinks significantly, with over three million fewer young people (under 20) in the EU by 2050. These converging trends place unprecedented pressure on the very foundations of the R&I ecosystem, which has historically relied on a steady influx of young talent and expanding public budgets.

The repercussions of this shift on the European talent pipeline are quantifiable and imminent. Projections indicate that the cohort aged 21 to 26—the primary pool for tertiary students and future researchers—will peak in 2035 before contracting sharply, shrinking by almost 2.5 million individuals by 2050. This loss of human capital coincides with a deteriorating economic dependency ratio: while there were 28 working-age individuals for every 10 retirees in 2022, this is expected to fall to just 19 by 2045. Consequently, the contribution of labour to economic growth is forecast to turn negative from the late 2020s onwards. As the total cost of ageing rises to a projected 25.6% of GDP, public R&I budgets will face fierce competition from non-discretionary welfare spending, challenging the very sustainability of the current funding model.

The data reveals that these pressures will be distributed unevenly, exacerbating regional disparities within the European Research Area. While some member states retain stable youth cohorts, major innovation engines like **Italy and Spain** are projected to lose over **100,000 individuals from their 20-year-old cohorts**—the traditional intake for universities—between 2025 and 2050. Furthermore, the economic reliance on R&I will intensify with the contribution of human labour to GDP growth forecast to **turn negative** from the late 2020s, **labour productivity** will become the unique driver of prosperity. This leaves the R&I system with the critical responsibility of delivering the technological gains necessary to offset a **12% decline in the total labour force**.

These figures expose the fragility of a European R&I model that has, for decades, predicated its success on two assumptions that no longer hold: an endless pipeline of young talent and the elastic capacity of public budgets. The data confirms that the 'human pipeline' is drying up just as the fiscal demands of the welfare state are peaking. This creates a structural vulnerability where the R&I ecosystem must not only compete for a shrinking pool of researchers but also justify its funding against the non-discretionary costs of the silver economy. While various pressures have already introduced changes, the system now faces a convergence of challenges, compounded by the rapid acceleration of artificial intelligence and digitalisation. Yet, despite the clarity of these quantitative warnings, a comprehensive discussion about the structural adaptation required from R&I organisations remains conspicuously absent.

This foresight project thus aims to fill this gap and imagine plausible futures of the European R&I system. These scenarios should be stimulating and inspiring and at least provide an

impetus for further engagement with the change. This seems entirely timely: the converging pressures of an ageing population, a shrinking workforce, technological and geopolitical shifts require more than incremental adjustments; in order to remain relevant, they need and deserve a radical reimagining of how Europe generates, funds, and applies knowledge.

The outset of this foresight exercise can be briefly outlined: by 2050, the demographic landscape of Europe will look fundamentally different from today: not only will there be more than 150 million citizens over 65, but on the other end, here will be much less young people entering tertiary education. For the R&I sector three main dilemmas can be depicted:

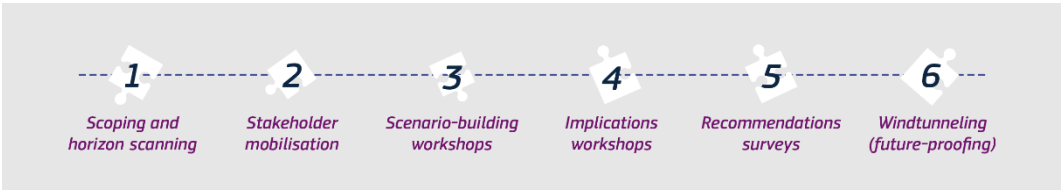
- The shrinking talent pool: The working-age population in Europe is projected to decline significantly. This reduction is not just a labour market statistic; it represents a direct threat to the "human pipeline" that fuelled scientific discovery over the past. In the near future, public and private sectors might fight harder for the scarce talent.
- The fiscal squeeze: As the population ages, the pressure on public finances rises too. Growing pension and healthcare expenditures while revenues may be less due to a more limited workforce and taxpayers. Defence, climate change – various policy areas compete about the budget available. Wil public R&I investments remain high on the agenda? This fiscal volatility requires new answers and approaches if long-term fundamental research should be maintained within the public sector.
- The productivity paradox: To maintain its economic standing and social model with a smaller workforce, Europe must achieve a dramatic leap in productivity. But can rapid automation of research as well as industrial processes counterbalance the demographic challenges? This technological acceleration carries the risk of widening the gap between the pace of innovation and society's ability to adapt and adopt.

In this context, the central premise of this study is not if the R&I system would change, but how. Will it be a reactive fragmentation driven by crisis, or a proactive transformation towards resilience? This report explores these possibilities through scenarios and shows opportunities of converting the demographic pressure from a systemic vulnerability into a catalyst for a future-oriented European R&I system.

This report is structured to guide the reader from the methodological foundation to concrete policy action. Chapter 2 outlines the multi-stage foresight methodology employed to navigate these complexities. Chapter 3 presents the four plausible scenarios for 2050, offering distinct narratives of how the European R&I system might evolve under different structural conditions. Chapter 4 translates these narratives into operational realities, not only mapping specific challenges and opportunities but also proposing potential strategic answers across four critical dimensions: education, funding, socio-spatial cohesion, and market dynamics. Finally, chapter 5 synthesises these findings into actionable recommendations for policymakers, proposing four strategic mandates to future-proof the ecosystem.

3. Methodological approach

To navigate the complexities of demographic change, the project adopted a structured foresight architecture designed to translate broad uncertainties into actionable strategy. The project utilised a hybrid and multi-stage strategic foresight methodology to systematically assess the impact of demographic change on the European R&I system. The process was designed to move from broad trend identification to the generation of prioritised, validated strategic actions. The methodology integrated qualitative expert workshops with structured, asynchronous validation processes based on the Delphi technique.



The foundation of the study was built on a rigorous scanning phase, moving from wide horizon scanning to the isolation of critical variables. The initial phase focused on building a comprehensive knowledge base and scoping the analysis. This involved extensive desk research to identify trends, weak signals of change, and uncertainties with a significant potential impact on European demography and the R&I sector within the 2025–2050 time horizon. All data were systematically categorised according to the PESTLE framework (Political, Economic, Societal, Technological, Legal, Environmental). Key findings from the desk research and statistical data were then supplemented by a pre-workshop expert survey, which incorporated elements of the "Rip van Winkle" technique. The primary goal of this analytical phase was to identify the most critical and independent uncertainties that would act as the foundational axes for scenario development. This led to the selection of two dominant uncertainty dimensions: the degree of automation in research and the primary research providers (public vs. business).

At the heart of the methodology lay the creation of divergent futures, designed to stretch current thinking beyond linear projections. The workshop employed the 2x2 matrix method, utilising the two critical uncertainties identified in the scoping phase to define four distinct quadrants. Participants were divided into groups, each assigned one quadrant, and tasked with developing a plausible and challenging scenario narrative. This process involved systematically enriching initial scenario outlines by integrating selected future disruptions and elaborating the broader PESTLE context. The resulting four scenarios provided a crucial set of contrasting backdrops for subsequent strategic analysis, enabling the project to test the resilience of current assumptions and strategies.

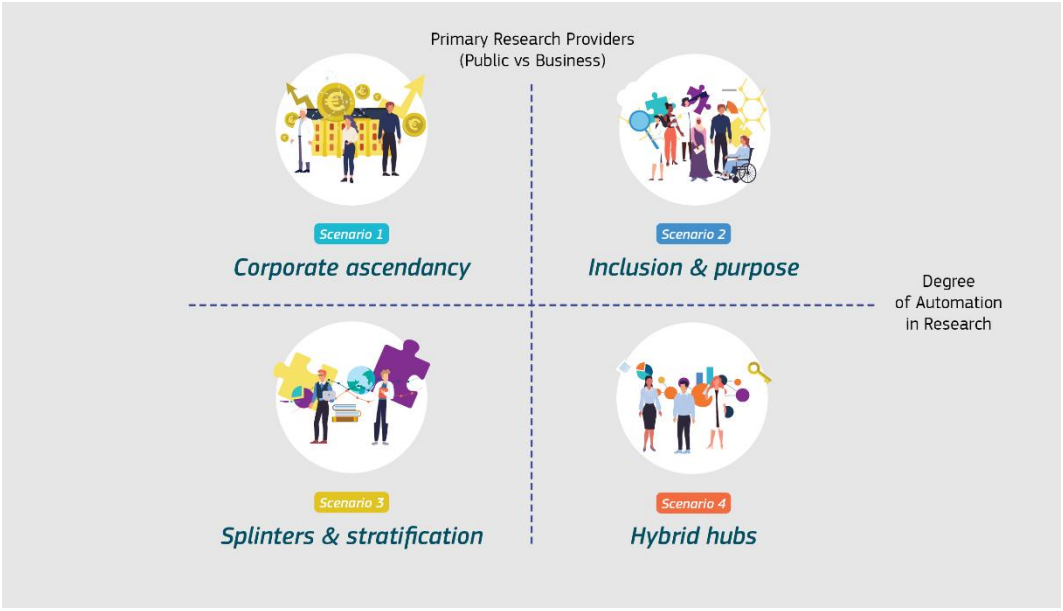
Moving from narrative to impact, the process next focused on mapping the systemic consequences of these futures on the R&I ecosystem. The workshop utilised the Futures Wheel methodology, a structured brainstorming technique that reveals immediate, direct consequences as well as cascading, indirect effects. Participants, working within their assigned scenario groups, placed their future narrative at the centre of the wheel. They then brainstormed the primary implications across four predefined R&I dimensions, followed by the resulting secondary and tertiary implications. This iterative process ensured

a granular understanding of the ripple effects, resulting in a synthesised set of potential challenges and opportunities for the R&I system within each future context.

The final phase centred on stress-testing and refining the proposed interventions through a structured expert consultation. The validation process was conducted on a dedicated online platform, 4CF HalnyX, with features characteristic of the Delphi method. This structure allowed for iterative refinement and testing of strategic recommendations. Firstly, a brainstorming of actions phase was initiated. Experts were presented with the identified challenges and opportunities and asked to propose concrete and feasible strategic actions that would address these findings. This generated a comprehensive pool of potential strategic responses. Secondly, a prioritisation of actions phase was implemented. For each challenge and opportunity, experts were asked to choose the most important action and assess it in terms of required resources and stakeholder engagement. This assessment led to the selection of a refined set of priority strategic actions. Finally, the selected actions underwent windtunnelling (futureproofing). In this phase, experts evaluated how well each priority action would perform and retain its effectiveness when applied across all four distinct future scenarios. The goal was to ensure that the final recommendations were resilient and aligned with predefined desirable future, offering value to the R&I system regardless of which future trajectory materialises. This final step yielded the core set of validated, future-proof strategic recommendations presented in this report.

4. Scenarios 2050

To effectively manage radical uncertainty, this chapter presents four distinct scenarios, which are framed by the two most critical variables: the degree of automation in research and the primary research providers (public vs. business). The identification of key trends and the isolation of critical uncertainties, detailed in the preceding section, confirms that the European R&I system is facing a spectrum of highly divergent possibilities. The project employed the 2x2 matrix method, utilising the two most critical and independent uncertainties: the degree of automation in research and the primary research providers (public vs. business). This chapter presents the four resulting scenarios, which are plausible, challenging narratives depicting fundamentally different futures for the R&I ecosystem up to 2050. These scenarios are not forecasts of what will happen, but rather holistic models designed to move the analysis beyond simple trend extrapolation, enabling a rigorous exploration of what could happen under profoundly different demographic and technological conditions.



4.1. Scenario 1: Corporate ascendancy

This scenario depicts a future where powerful corporations dominate the Research and Innovation (R&I) ecosystem due to weakened public institutions and intense demographic pressures.

Political

The power of national governments to make rules is significantly weakened by privatisation and lobbying, making it difficult to enforce R&I standards or address ethical issues.

Policy decisions are strongly and quietly influenced by corporate profit goals, favouring R&I that serves commercial interests over research that benefits the general public.

Governments face significant challenges in managing the financial costs of an ageing population, further limiting the public funding available for universities and research institutions.

Economic

The economy is dominated by multinational corporations, creating wealth that is not evenly shared and relying on business activity rather than public sector stability.

The research environment is purely market-driven, focusing on short-term profits and commercially viable applications, often making long-term basic research and social sciences less important.

Working in R&I offers significant social prestige and career advancement, but those who fail to meet demanding corporate evaluation systems face clear socio-economic disadvantages.

Social

Public trust in science diminishes as research is increasingly seen as solely driven by profit, leading to scepticism about corporate-led breakthroughs.

A two-level education system develops, where prestigious private institutions attract the best talent, while public universities are underfunded and struggle to teach skills relevant to modern industries.

The competition for global talent intensifies, pressuring the EU to attract and retain skilled workers who are drawn to the

Technological

Corporations adopt an extremely cautious, human-led approach to technology deployment after a major cyberattack, which slows down the widespread adoption of full automation in research.

Major technological advancements are concentrated only in commercially viable areas, particularly age-related solutions, neglecting critical R&I that could benefit the broader public.

Ethical dilemmas surrounding the commercialisation of knowledge increase as

superior conditions offered by large private corporations.	the lack of strict public rules allows innovation to proceed often without considering wider societal consequences.
 **Legal**	 **Environmental**
The legal framework becomes largely permissive, reflecting the diminished power of national governments to regulate in the face of powerful corporate interests. The blurred lines between proprietary interests and the public good create ongoing legal challenges related to knowledge ownership and fair access to crucial innovations.	Environmental damage is made worse by a profit-oriented development approach that gives limited attention and R&I investment to critical areas like biodiversity protection. The belief that technological fixes alone can solve the climate crisis is a point of debate, as current solutions often address only small parts of the problem and fail to tackle the root causes.

To ground this narrative in structural reality, the following overview depicts the state of the R&I ecosystem across its four core dimensions. These points illustrate how the unique conditions of **Corporate ascendancy** manifest within the spheres of education, funding, spatial cohesion, and market dynamics.

The effects of demographic change on tertiary education systems

- Coexistence of prestigious private HEIs with high mobility and disappearing public universities due to declining student numbers.

Increased focus on STEM and profit-oriented research, less on humanities and social sciences.

Growing divergence in dynamics between intra-European and extra-European international student mobility.

Interactions between the R&I ecosystem and related markets

- Strong internalisation of R&I activities within companies and their private HEIs.
- Decline in collaborative projects between traditional academia and industry.

The impact on R&I funding

- Overwhelming dominance of private sector funding for research and innovation.
- Industrial PhD programmes prevailing over traditional public education pathways.

Socio-spatial implications

- Private companies directly recruit international researchers through private channels and scholarships.
- Career paths increasingly tied to the success and global expansion of multinational corporations.

4.1.1. Stories from the future

Persona 1:

The start-up founder

Vera Novak, CEO of SensoHealth

Preparing a pitch inspired by family struggles

The holo-screen in Vera's private office within the OmniCorp Innovation Hub, a sleek glass box loaned to her by the venture fund, glowed an insistent red. Her pitch deck for the Series B funding was due in twenty minutes. Her company, SensoHealth, had developed a sensor system for elderly care that was genuinely revolutionary—a perfect, market-ready solution for the relentless expansion of the "silver economy." In an ageing Europe, with its shrinking care workforce, her technology wasn't just innovative; it was essential. She had started the company with a small team of fellow public university graduates in a cramped, rented workshop, fuelled by lukewarm coffee and a shared belief that they could create something for the public good. The idea had crystallised during a frustrating video call with her father, who was struggling to manage her mother's care in an understaffed public facility two regions away. She had seen the exhaustion in his eyes, a weariness shared by millions.

Funding requires stripping open-source access

The contract waiting on her datapad was the real challenge. The lead venture director from OmniCorp, a man who had never visited a public care facility, was demanding she strip, the open-source interoperability API from the final product. That API, the result of months of collaborative work, was the one remaining lifeline that would allow underfunded public nursing homes—like the one her own mother was in—to integrate her system affordably. It was the soul of her original mission, the very reason she had started this venture.

Weighing personal wealth against public mission

Vera glanced at the projected revenue figures, the numbers shimmering with promises of security and influence. If she signed the proprietary-only contract, OmniCorp guaranteed the kind of resources that would cement her success and personal wealth. She could finally afford the premium private care her mother deserved, moving her out of the struggling public system entirely. If she refused, the funding would collapse, leaving her to fight for scraps. She wasn't just selling a product; she was choosing a side in the socio-economic divide that defined her era. With a single signature, she could secure her own family's comfort by reinforcing the two-tiered system that left so many others behind. The moral pivot was happening now, a choice between the societal need that had inspired her and the personal salvation that commercial viability offered.

Persona 2:

The researcher

Dr. Elias Vance, Senior AI Scientist at BioGene HEI

Aligning research with corporate goals for family

Dr. Vance meticulously reviewed his quarterly performance report for the BioGene Higher Education Institution. The evaluation was, as always, rigorous, a seamless blend of academic review and corporate audit designed to ensure loyalty to the corporation's strategic goals. It was the bedrock of the company's system for capturing and controlling human capital, a constant, low-grade pressure to align his curiosity with the company's bottom line. Here, he had access to unlimited computational power, to labs the failing public system could only dream of. He remembered his last visit to his old university department; the equipment looked ancient, the faculty weary, their conversation circling around budget cuts rather than scientific breakthroughs. He justified his choices as the only way to provide for his family in a world where the public safety net was threadbare.

Perpetuating a system that traps his daughter

Today's report required him to reclassify his latest sequencing breakthrough. The discovery, with profound theoretical implications, was now to become an exclusive proprietary asset for BioGene's new line of anti-aging pharmaceuticals. He felt the familiar, internal friction. He was using his expertise not for public science, but for a commercial interest. This choice was made painfully clear last week when his daughter, a bright teenager, had asked him about applying to public universities. He'd had to gently steer her towards the BioGene HEI prep track, knowing it was her only real path to a secure future. He was perpetuating the very system that had trapped him. The corporate structure forced the best young researchers to either conform or face a marginalised career. Elias signed the reclassification form, the smooth surface of the datapad cool beneath his fingers. It was the price of his position, a silent compromise made not just for himself, but for his daughter's future.

Persona 3:

The R&I official

Anya Petrova, Ministry of research governance

Negotiating as a manager of declining public science

Anya sat in a bare government office, the paint peeling slightly near the window, preparing for a negotiation with representatives from the five tech conglomerates that now ran the continent. Her job was no longer about directing research or fostering innovation, but about managing the decline of public science. The state's R&I budget was a fraction of its former self, gutted by the ever-growing, non-discretionary demands of an ageing population—

pensions and healthcare had long since taken priority. The vibrant posters from past science fairs that once lined the hallway had been taken down, leaving faint rectangles on the walls like ghosts of a more optimistic era. Her own public servant's pension felt less like a guarantee and more like a hopeful fiction.

Begging for data while subsidising state failures

The agenda today was to negotiate for access to a tiny subset of demographic data collected and owned by a private HEI. She needed it to inform a new, minimalist public health initiative for the elderly, but she had to beg for the raw material. She knew the corporations only dominated because the state had retreated, weakened by fiscal pressures. She felt this retreat personally; her ageing father's pension barely covered his rent, and she supplemented his income from her own stagnant salary. She was fighting for public services at work while privately subsidising the state's failure at home. As the negotiation began, the lead corporate liaison listened with a patient smile, his posture relaxed, his power understated but absolute. Anya, stripped of real power, made her case for "public good access," a concept that rang hollow when the funding, the labs, and the research itself were entirely out of their control. She was a custodian of a fading legacy, fighting to save small fragments of public integrity in a system that had already moved on, her arguments met with polite deflections and carefully worded conditions.

4.2. Scenario 2: Inclusion and purpose

This scenario outlines a future defined by a push for social equity, ethical technology, and post-growth economic models, yet strained by social distrust and slow scientific momentum.

Political	Economic
Governments tightly control the digital space to fight false information, a well-intentioned action that risks limiting R&I freedom and creating government-controlled "information bubbles." Rising populist sentiments and a general erosion of trust in institutions directly challenge the credibility and acceptance of public scientific findings and policy recommendations. The EU actively invests in infrastructure and education in less wealthy regions to reduce regional disparities, promoting a more geographically balanced R&I environment.	. The EU prioritises post-growth economic models, shifting R&I investment away from purely expansionist goals towards sustainability and the general well-being of society. The movement of talent from academia to the more agile private sector continues, making it harder for public research institutions to attract younger, innovative researchers. The job market faces strain from an ageing workforce and changing skill needs, making comprehensive lifelong learning models a vital R&I focus area to maintain productivity.
Social	**Technological**
Many older people feel "digital fatigue and scepticism," reducing their willingness to engage with complex information, including scientific research and new technologies. Universities struggle with rigid, outdated structures and an ageing faculty conducting highly specialised research that often fails to address immediate societal needs, limiting their relevance. There is a significant need for participatory research and citizen engagement to rebuild public trust in science and ensure that technological advancements benefit all age and social groups.	Technological development is viewed through a strong ethical lens, leading to robust rules governing AI and emerging technologies, which can sometimes slow down the pace of innovation. AI plays a growing role in improving healthcare efficiency and disease prevention, making biomedical R&I a critical priority for funding to manage the needs of the ageing population. The experience of overstimulation and disillusionment with technology weakens innovativeness by promoting a more cautious and controlled flow of the digital revolution.

 **Legal**	 **Environmental**
The legal system focuses on developing strong ethical and responsibility frameworks for emerging technologies, posing compliance challenges for R&I projects but aiming to ensure fair societal impact. Efforts are made to standardise legal protection for researchers against undue political pressures, which is necessary in a climate of rising populism and institutional distrust.	Climate change acts as a significant, urgent driver for R&I focused on sustainable solutions, though the actual implementation of these solutions is often slow due to a lack of decisive political leadership globally. The post-growth economy and more responsible use of technology in the EU offer a positive path, but the environmental consequences of increased global rearmament remain a huge, unaddressed challenge.

To ground this narrative in structural reality, the following overview depicts the state of the R&I ecosystem across its four core dimensions. These points illustrate how the unique conditions of **Inclusion and purpose** manifest within the spheres of education, funding, spatial cohesion, and market dynamics:

The effects of demographic change on tertiary education systems

- Increased demand for lifelong learning opportunities across all disciplines.
- Notable surge in interest in "futures," "innovation," and "disruptive technologies" among younger generations.
- Growing divergence in dynamics between intra-European and extra-European international student mobility.

Interactions between the R&I ecosystem and related markets

- Healthcare innovation becoming a central focus of R&I due to the ageing population.
- Research topics increasingly driven by alignment with social and market needs.

The impact on R&I funding

- Public funding priorities demonstrably shifting towards areas like ageing and digital health.
- Emergence of novel funding mechanisms (public, peer, crowdfunding) with inherent instability.

Socio-spatial implications

- Migration patterns significantly influencing research agendas, with a focus on urban concentration and health equity.
- Discernible push towards decentralisation of research activities across Europe.
- Greater emphasis on addressing regional disparities through innovation and research.

4.2.1. Stories from the future

Persona 1:

The start-up founder

Javier Cruz, Founder of LocalLoop Diagnostics

Seeking grant funding for a precarious start-up

Javier stood before the Regional Health Council, the fluorescent lights of the community hall humming overhead. This meeting was the final hurdle for the social mandate grant that kept his company afloat. His micro-diagnostic technology was decentralised, built on principles of societal well-being rather than relentless growth. His mission alignment frequently put him in conflict with the pursuit of market stability. He survived on a fragile mosaic of purpose-driven funding—public grants and peer crowdfunding—which made his existence precarious. His motivation was deeply personal; he'd watched his own grandfather, a proud, intelligent man, become increasingly isolated and fall victim to a sophisticated disinformation scam that had cost him his savings. That experience had ignited Javier's passion for creating technology that empowers, rather than exploits, the vulnerable.

Facing community distrust in AI technology

A council member, an older woman with sharp, sceptical eyes who represented the digitally fatigued, challenged him directly. "We appreciate the intention, Mr. Cruz, but we simply do not trust your AI. We have seen too many promises. We are tired of being experimental subjects for technology we don't understand, especially when all our institutions seem to be failing us."

Pivoting to an ethical defence to build trust

The sentiment, a mix of weariness and defiance, hung in the air. This pervasive digital scepticism threatened his entire financial stability. Javier had to pivot his defence away from the technology's effectiveness and toward its ethical framework. He spoke not of algorithms, but of his grandfather, of the community co-design sessions he had held, of the transparent data policies they had written together. He had to painstakingly prove that his work served the common good because he had seen, firsthand, the cost of technology without trust. He knew that his success today depended less on his code and more on his ability to build a fragile bridge of trust with a generation that had every reason to be wary.

Persona 2:

The researcher

Professor Lena Kovač, Head of Digital Ethics, Public University

Facing distrust from elderly research participants

Professor Kovač facilitated a participatory research session, the air in the room thick with a mixture of stale coffee and palpable tension. Her job was to rebuild public trust by designing ethical AI frameworks for healthcare. Her central challenge involved overcoming the populist distrust and digital fatigue of the elderly citizens sitting around her table. They were not abstract subjects; they were individuals with names and histories of being let down by systems that promised progress. She needed their input to validate her governance model, but they openly questioned her motives. "Another expert to tell us what's good for us," one man muttered, just loud enough to be heard. "Then you'll take our stories and sell them to some company."

A political attack creates intergenerational conflict

Suddenly, her device buzzed with a silent, urgent vibration. It was a message from her younger sister, a single mother struggling with precarious gig work, containing a link to a social media post. A junior minister, part of the younger generation of leaders, had just publicly criticised Lena’s work, suggesting her funding should be redirected from "appeasing reluctant seniors" to more "dynamic, high-impact youth projects" like job retraining programmes. Her sister’s message was blunt: "Is he right? Is my future being sacrificed for theirs?" The tweet put her work squarely in the political crosshairs, framing it as an intergenerational conflict that was now playing out in her own family. Lena now had to navigate this political friction in real-time while trying to maintain the trust of the people in front of her. She faced the formidable task of defending her vital social science work—meant to ensure that technology benefited all age groups—against the political challenge of resource allocation, knowing that if she failed, she would be failing both the elders in the room and the generation of her own sister.

Persona 3:

The R&I official

Marc Dubois, EU R&I policy coordinator

Grappling with the productivity paradox

Marc was in a high-stakes meeting, the holographic draft of the new ethical AI framework hovering over the table. He privately grappled with the post-growth productivity paradox. He championed societal well-being and democratic science, yet the shrinking workforce and the fiscal pressure from an ageing population demanded constant productivity gains just to keep the lights on. The ghosts of unfunded pensions haunted every policy decision. He and his partner had been discussing having children for years, but kept putting it off, worried about the economic uncertainty and the heavy tax burden required to support the older generation. The need for productivity augmentation was not just a policy problem; it was the reason his own family's future felt so uncertain.

Choosing between public trust and urgent innovation

The draft proposed strict new transparency requirements for algorithms used in the workplace—a necessity for public trust. A colleague from the economic directorate, a pragmatist, immediately pushed back, her voice sharp with urgency. "These regulations are too slow! We need fast, automated systems to compensate for the labour deficit now. The ethical tightrope is one thing, but we can't afford to stifle the innovation required to maintain our social contract." Marc faced a fundamental decision: where to draw the line between public trust and the critical need for innovation. He realised his job was fundamentally about intergenerational fairness: ensuring the technological solutions he implemented today didn't create new burdens for tomorrow's children—children he himself hoped to have. Every clause he debated felt like a choice between the world they wanted and the world they could afford.

4.3. Scenario 3: Splinters & stratification

This scenario is defined by global fracture and technological isolation, where R&I becomes corporate-driven and focused on national technological catch-up within walled-off digital domains.

Political	Economic
Governments direct R&I mainly by asking for solutions through AI prompt tenders (public bids for AI-driven projects), making the ability to write effective requests a crucial strategic skill in policymaking. Governments tightly control their segments of the "Splinternet," directly influencing the information available and, consequently, imprinting local biases onto domestically developed AI research agents. Closed borders require strict controls on migration, which limits the flow of diverse talent and new ideas essential for keeping the EUF's R&I system dynamic and globally competitive.	. The R&I economy is led by the private sector, which favours short-term, practical projects, pushing long-term basic research and social sciences into a less important role. The economic isolation of the major power blocs leads to unstable boom-and-bust cycles within bloc boundaries, creating financial uncertainty for R&I dependent on local economies. The high cost of advanced technological infrastructure requires shared funding models between governments and corporations, complicating who is accountable for public and private investment.
Social	**Technological**
The power to define initial AI research questions and put the results into practice resides mainly with corporations and governments, largely sidelining public and academic influence over R&I direction. Concerns increase regarding the potential use of human data and populations in the pursuit of AI breakthroughs, raising serious ethical and data governance issues for researchers.	The world is fractured into distinct digital networks (the "Splinternet"), severely hindering the seamless global flow of information and restricting international R&I collaboration and data sharing. A fragmented ecosystem of AI research agents emerges, whose capabilities and biases are deeply shaped by local data and rules, potentially leading to varied and incompatible research outcomes across blocs.

The immense costs of security against R&I espionage force the EUF to spend resources on defence rather than collaborative research, potentially leading to duplicated efforts and stifled diversity of thought.	The high resource (water/energy) demands of AI mean its use is carefully prioritised for only the most critical tasks, limiting its potential use in less commercially urgent research areas.
 **Legal**	 **Environmental**
International trade is heavily restricted by strong protectionist measures, and intellectual property (IP) rights are fiercely guarded within bloc boundaries, greatly complicating any cross-bloc R&I ventures. Data and AI ownership become a complex legal issue, often subject to shared rules between the private and public sectors within the EUF, posing risks to research independence	The significant water and energy consumption of advanced AI systems necessitates a pragmatic approach, limiting their application to the most critical and impactful tasks. Isolationist policies encourage greater circularity and self-reliance on resources within the EUF's economy, but the narrow, high-focus application of AI may neglect broader, non-critical environmental R&I needs.

To ground this narrative in structural reality, the following overview depicts the state of the R&I ecosystem across its four core dimensions. These points illustrate how the unique conditions of **Splinters & stratification** manifest within the spheres of education, funding, spatial cohesion, and market dynamics.

The effects of demographic change on tertiary education systems

- Tertiary education increasingly becomes a choice for personal growth and societal contribution, less tied to direct job requirements.
- Learning formats become more adaptable and individualised.
- Formal academic qualifications decrease in importance compared to practical skills.

Interactions between the R&I ecosystem and related markets

- Technological advancements in R&I are primarily geared towards the needs of the elderly.

Companies fund immediate research; the government procures longer-term projects.

The impact on R&I funding

- Funding for R&I infrastructure is shared between companies or with the government.

Systems are developed to identify individuals capable of creating effective AI research prompts.

Socio-spatial implications

- Closed borders lead to potential duplication of research efforts.
- Limited immigration, potentially favouring younger, able-bodied individuals.

4.3.1. Stories from the future

Persona 1:

The start-up founder

Kazimierz Marek, Head of Secure AI Systems, EUF

Innovation crippled by market isolation

Kazimierz was hunched over his terminal, the low hum of the secure server room a constant companion. He was meticulously crafting the AI prompt for the government's latest technological tender. His business, focused on secure AI solutions, existed entirely within the fragmented, closed market of the EUF Splinternet, a reality dictated by past geopolitical shocks and severe migration controls. The pace of his innovation was crippled by this isolation. He felt less like a founder and more like a high-tech artisan, working with a limited palette of tools in a walled garden, while rumours of vast, untended jungles of data and talent existed just beyond his reach. This isolation was profoundly personal; his fiancée, a brilliant materials scientist from a non-EUF bloc, was stuck in a years-long visa process, the severe migration controls preventing them from living together. Her expertise was exactly what his hardware team needed, but she was locked out, a daily reminder of their enforced separation.

High costs and security threats in a closed market

He was paying exorbitant fees to licence a specific dataset—the only one approved for use within the EUF. Closed borders prevented him from accessing global talent and data, increasing the cost and risk of duplicating research already done elsewhere. Simultaneously, a frantic message flashed on his secondary screen from his security chief: a sophisticated phishing attempt, with the digital signature of a competing bloc, was targeting their tender submission. Kazimierz had to pull two of his best AI specialists from R&D to work on security defence, a painful reallocation of resources that set their primary project back by a week. His success depended not on global market scaling, but on his ability to win competitive, government-steered tenders while navigating the structural inefficiencies of a closed, high-risk market and the constant, draining threat of espionage, a fight he felt both in his lab and in his empty home.

Persona 2:

The researcher

Dr. Sabine Reuter, Corporate Data Scientist, PharmaCorp

Discovering a data bias with personal consequences

Dr. Reuter stared at a diagnostic output from her proprietary AI agent. The AI, tasked with accelerating drug discovery for an age-related condition, showed an uncanny, statistically undeniable bias favouring one specific genetic marker predominant in the EUF's ageing, native-born population. Sabine knew exactly why: the AI's learning capabilities were deeply imprinted by the limited, controlled data sets harvested exclusively from the closed EUF Splinternet. Her core ethical conflict was the scientific compromise forced by geopolitical isolation. The issue had become terrifyingly personal last month when her cousin, whose ancestry traced to a region outside the primary data pool, received a confusing preliminary diagnosis for a neurological condition from a similar AI system. The doctors were struggling to interpret the results, a direct consequence of the biased data she knew was baked into the system.

Validating a biased AI that may cause harm

The corporate and governmental mandate was clear: rapid, short-term solutions for the immediate demographic problem. She lacked the support of marginalised social sciences or ethical oversight, leaving her in an ethical vacuum to manage the consequences of her biased AI systems. Sabine's task today was to "validate" the AI's findings for the next corporate pipeline stage, fully aware that she was contributing to a technologically powerful, yet ethically and scientifically confined, system that could one day provide ineffective solutions, or even misdiagnoses, to anyone outside the narrow data parameters—potentially even her own family members. She was trapped in the Biased AI Cage, where the cost of isolation undermined the objectivity of science itself.

Persona 3:

The R&I official

Nikolai Volkov, EUF strategic planning official

Managing the paradox of needing talent while enforcing closed borders

Nikolai chaired a crisis meeting on resource allocation, the faces of his department heads looking grim on the secure holo-conference screen. He was constantly navigating the tension between steering national R&D through AI prompt tenders—his main lever of control—and enforcing the severe migration controls necessary for political stability. The ageing population demanded immediate technological compensation for labour shortages, but the closed borders denied him the influx of young, skilled talent he desperately needed. It was a self-inflicted wound he was forced to manage every day, a paradox at the heart of their national strategy. He felt it keenly when he spoke to his son, a bright university student whose entire graduating class was facing a predictable, albeit secure, future within the EUF's national tech sector, with no option to seek experience or contribute innovation beyond the bloc's digital and physical walls. Their talent was desperately needed, but their professional world was rigidly defined.

Trading a public service for a high-priority AI project

The conflict today was about the high resource demands of advanced AI. A major state task, crucial for maintaining their technological parity with other blocs, required immediate expansion of computational clusters, demanding an immense, immediate surge of energy and water. Nikolai had to divert those resources, which meant indefinitely pausing a public transport automation project that would have served his own ageing parents in a remote region. They had been looking forward to the service, a small promise of mobility in their declining years, and he knew they would be disappointed. He was constantly balancing the urgency of a technological catch-up against the socio-economic fallout of resource scarcity and restricted borders. His policy action was not about growth; it was about control. He was trading public services that would help his own family for highly focused, efficient technological power, all to manage the stability of a demographically imbalanced, isolated bloc.

4.4. Scenario 4: Hybrid hubs

This scenario describes a resilient and strategically autonomous EU R&I system, characterised by collaboration, regional specialisation, and a focus on both digital and environmental transformation.

Political

A strong and united EU strategically invests in its own independent digital infrastructures, prioritising technological self-sufficiency and positioning R&I to achieve global strategic autonomy.

R&I funding is closely aligned with EU political priorities (digital, environmental, and security goals), ensuring research contributes to EU strategy but potentially limiting science driven purely by curiosity.

The EU manages the dual challenge of strengthening cooperation while remaining open to strategic partners, necessitating continuous monitoring of research security risks in external collaborations.

Economic

The economy regionalises with shortened supply chains and a greater emphasis on local production, making the transfer of knowledge and technology a key element of regional economic development strategies.

Intensified cooperation between academia and industry creates a high demand for highly qualified graduates with interdisciplinary skills, pushing R&I to focus on industry-relevant solutions.

Investments in regional R&I infrastructure and specialised centres aim to achieve a more balanced development of innovation across Europe, helping to reduce historical regional disparities.

Social

The R&I workforce is boosted by attracting a new talent pool from younger, ambitious societies in Central-Eastern Europe, which helps counter ageing trends in the West but requires continuous effort for effective integration between regions.

Virtual mobility becomes common, making up for limits in physical travel and enabling

Technological

Technological progress gains momentum through a strong synergy between human creativity and AI, making the ethical implications of algorithms on the job market and personal privacy a continuous R&I focus.

The development of Europe's own independent digital infrastructure (cloud, AI systems) reduces reliance on external

collaborative R&I across different countries and regions.

The role of scientists as critical thinkers and experts is deemed irreplaceable, with universities actively educating graduates to counter the sophisticated dissemination of false information and maintain public trust.

providers, securing data and ensuring EU values guide technological R&I.

A key feature is a dispersed but strongly interconnected network of specialised research centres, moving the focus of R&I away from traditional large metropolitan areas.

Legal

Legal systems are constantly adapting to the development of AI, requiring new rules to manage the use of personal data and protect individual rights in a society where algorithms are everywhere.

The evolution of European University Alliances into complex cooperation networks necessitates new legal and administrative frameworks to manage cross-border research security and intellectual property sharing.

Environmental

R&I is strongly driven by ambitious climate policies and a widespread adoption of clean technologies, aiming to make Europe much more resilient to climate change impacts.

The growing importance of the circular economy is a focus for R&I, although making it fully operational is challenged in regions that still heavily depend on fossil fuels.

Energy costs remain high due to the energy use of the developing digital infrastructure (AI and data centres), creating a continuous R&I challenge to make these systems more sustainable.

To ground this narrative in structural reality, the following overview depicts the state of the R&I ecosystem across its four core dimensions. These points illustrate how the unique conditions of **Hybrid Hubs** manifest within the spheres of education, funding, spatial cohesion, and market dynamics.

The effects of demographic change on tertiary education systems

- Mergers and consolidations of higher education institutions aim to optimise resources and increase efficiency.

Academic institutions are specialising their research offerings, focusing on narrower areas.

Interactions between the R&I ecosystem and related markets

- There is a growing demand in the labour market for graduates with interdisciplinary skills.
- The transfer of knowledge and technology is becoming a key element of regional economic development.

The impact on R&I funding

- Competition for financial resources stimulates interdisciplinary collaboration between research units.
- Investments in regional R&I infrastructure strengthen local innovation and competitiveness.

Socio-spatial implications

- The network of research centres is becoming more dispersed beyond traditional metropolitan areas.
- The dispersion of research infrastructure contributes to a more balanced development of innovation across Europe.

4.4.1. Stories from the future

Persona 1:

The start-up founder

Elena Stoica, Founder of GreenGrid Tech

Balancing collaboration with a local mandate

Elena simultaneously managed three video conferences from her regional hub office in Cluj-Napoca. Her startup focused on green digital technology, aligned with the EU's strategic goal of digital independence and ecological transformation. She was constantly balancing maximising synergistic collaboration across the distributed network with adhering to her company's local mandate for regional production. She had founded her company in her home region specifically to counteract the brain drain that had seen most of her childhood friends, including her own sister, leave for the West a decade ago. Her commitment to local production was a commitment to building a future where people like her sister could one day come home.

Mediating a conflict to protect regional goals

On one screen, a renowned Professor Novák from an established Western HEI, a titan in his field, was clashing with Dr. Popescu, a talented young researcher from her own emerging Central-Eastern European (CEE) partner institution, over the production methodology. Elena needed Novák's deep-seated expertise and Popescu's innovative, young talent pool—the interregional partnership was crucial for counteracting internal brain drain and achieving collective gain. Yet, the Western partner was pushing for a centralised production model that violated Elena's commitment to building a local, regionalised supply chain. Elena had to mediate the conflict, gently reminding the professor of the strategic value of dispersed manufacturing in a fragile world, while encouraging her young compatriot to integrate the proven quality controls from the West. Her daily success hinged on her ability to integrate dispersed expertise and balance scaling the business (synergy) with the political imperative of local mandates.

Persona 2:

The researcher

Dr. Stefan Lind, Specialist in Human-AI Synergy, Regional Centre

Efficient virtual collaboration comes at a personal cost

Dr. Lind sat in his specialised regional centre in Odense, running a complex human-AI simulation for port logistics optimisation. His progress was driven by seamless virtual collaboration with researchers hundreds of kilometres away in Hamburg and Rotterdam, a core feature of the EU's dispersed excellence strategy. The intense specialisation, forced by resource optimisation and declining student numbers, ensured excellent funding and deep expertise, but it had also shaped his personal life. His partner was a leading neuroscientist at another specialised hub in Finland. They had built a life together across the EU's sovereign cloud, raising their young daughter through a patchwork of high-presence video calls and carefully scheduled monthly visits. The efficiency of virtual life came at a constant, personal cost.

Hyper-specialisation hinders broader discovery

Today, he faced a critical data inconsistency error reported by his AI co-researcher, an anomaly it couldn't resolve, flagging a potential flaw in their underlying assumptions. He needed to physically consult a foundational academic paper on fluid dynamics from a public library, but it had since been digitised and restricted to internal university archives. The virtual system, designed for efficiency, had inadvertently cut him off from the kind of serendipitous, cross-disciplinary discovery that once fostered broader critical thinking. He felt a pang of frustration, the same feeling he got when a video call with his daughter would lag at a crucial moment. While the system valued his ability to verify data and mitigate disinformation, the specialisation pressure meant his knowledge was intensely focused, creating a constant tension between the hyper-efficiency of virtual mobility and the intellectual and personal constraints of a life lived through a screen.

Persona 3:

The R&I official

Inès Moreau, EU policy coordinator for regional R&I

Reviewing hub proposals to manage demographic shifts

Inès reviewed the final three proposals for the next major R&I infrastructure hub investment, the future of a billion-euro initiative resting on her recommendation. Her mission was to use R&I funding as a powerful tool for demographic crisis management and achieving EU strategic autonomy. She constantly sought to maintain the investment balance: strategically dispersing infrastructure and facilitating internal talent flow while mitigating existing regional disparities. Her own family's history was a quiet testament to these forces; her parents had left a struggling region in southern Europe for a prosperous one in the North decades ago, a move that had given her opportunities but had left them disconnected from their roots, with only annual visits possible.

The demographic crisis becomes a personal reality

As she deliberated, a notification chimed on her husband’s datapad, which he had left on the kitchen counter that morning. It was an official notice, impersonal and unavoidable: he had been selected for the mandatory three-month rotation in a geriatric care facility, slated to begin in six weeks, in a struggling rural area. The message landed with a quiet thud in her meticulously organised life. Her husband, a data architect working on complex EU-wide systems, would soon be on the front lines, assisting with basic care, living the very reality of the demographic crisis she spent her days strategising about. She immediately began to calculate the logistical and emotional fallout: managing their home, their shared responsibilities, and the strain of his absence. The policy was designed as an impartial civic duty, a great equaliser, and now its fairness was no longer an abstract concept but a deeply personal, disruptive reality.

Facing a politically fraught choice between regional proposals

Now, as she looked at Proposal A, which offered the largest immediate economic return in an already prosperous Western hub, she felt a profound unease that went beyond mere strategy. It was the safe, predictable choice, reinforcing the path her own parents had taken, but it risked a further concentration of innovation capacity, potentially worsening the very care shortages and regional isolation that would soon define her husband's life for three months. Proposal B, a joint venture from Estonia and Latvia, suggested a location in a demographically struggling region with high youth outmigration, a risky but highly strategic move for regional cohesion. It represented the kind of opportunity that might have allowed her parents to stay, and offered a lifeline to regions desperately needing investment and care infrastructure. The choice was politically fraught, representing the constant tension between achieving collective EU gain and addressing localised economic and demographic imbalances. Inès had to select the proposal that would most effectively strengthen the resilient, distributed European R&I fabric, actively promoting talent circulation and mitigating internal brain drain—a decision now imbued with the weight of her husband’s impending service.

5. Challenges, opportunities & answers

The true strategic value of future narratives lies in analysing their practical consequences; the following section translates the four scenarios into a concrete set of potential challenges, opportunities and answers across four key dimensions of the R&I system. The four scenarios—ranging from states of extreme corporate dominance to public sector resilience—provide a comprehensive framework for understanding the potential systemic shifts facing the European R&I system. However, the true strategic value of this foresight work lies not in describing these futures, but in analysing their practical, on-the-ground consequences. To bridge this gap between narrative and strategy, an Implications Workshop was conducted, utilising the futures wheel methodology to systematically map the ripple effects of each scenario. The following section consolidates the findings of this exercise, translating each narrative into a concrete set of potential challenges (risks and vulnerabilities) and opportunities (strategic advantages) across key dimensions of the R&I system, providing the necessary foundation for the subsequent future-proof policy recommendations.

5.1. Dimension 1: The effects of demographic change on tertiary education systems

5.1.1. Challenges for the R&I system

The Decline of the traditional public university model

Core problem: The traditional public higher education system in Europe is in decline, threatened by a combination of internal rigidity and external pressures.

Primary driver: Demographic ageing strains public finances, leading to reduced state funding for universities and a "talent drain" as top researchers move to the better-paying private sector.

Key consequences: The national research agenda risks being skewed towards short-term, private interests, starving the public R&I system of the foundational knowledge and diverse talent it needs for long-term innovation.

A narrowing of the R&I talent pipeline

Core problem: The European R&I talent pipeline is narrowing as education shifts towards market-driven, task-specific skills at the expense of deep, holistic scientific training.

Primary driver: A market demand for job-specific skills devalues traditional long-term degrees (like PhDs) in favour of short-term certifications and industrial training models.

Key consequences: A critical skills gap emerges, leaving the future R&I workforce without the broad, creative, and critical-thinking foundations required for true scientific breakthroughs, thus threatening Europe’s long-term competitive edge.

5.1.2. Opportunities for the R&I system

Systematising lifelong learning to create agile career pathways

Core opportunity: To build a formal, systematic framework for lifelong learning that continuously upskills and reskills the existing workforce.

Primary driver: A demographically older Europe with a shrinking younger talent pool and longer careers makes it imperative to keep the current workforce productive and at the cutting edge.

Key benefits: This creates a more resilient and innovative research community, enables more agile and diverse career pathways with greater mobility between academia and industry, and fosters a dynamic talent pool that is continuously updated with new skills.

Redefining the university's societal role as a guardian of public interest

Core opportunity: For universities to reinforce their societal value by becoming essential public hubs for fostering critical thinking and scientific literacy.

Primary driver: The growing influence of private-sector R&I and the public's increased vulnerability to disinformation create a critical need for trusted institutions that safeguard the public interest.

Key benefits: This builds a robust "social *licence*" and deep public trust for the entire R&I system, creates a populace capable of resisting misinformation, and ensures that technological advancement remains ethically grounded and aligned with societal well-being.

5.1.3. Recommended strategic actions

Reinvest in deep scientific education and training

Description: Strengthen PhD and postdoctoral programmes to combine academic excellence with interdisciplinary, creative, and critical thinking skills. This action counters the narrowing talent pipeline by ensuring the workforce retains the capacity for complex problem-solving beyond immediate market needs.

<table>
<tr><th>  Responsible stakeholders:</th><th>  Resources needed:</th><th>  Level of urgency:</th></tr>
<tr><td rowspan="2">National governments, universities & research organisations, EU institutions.</td><td>Financial: National/State-level financing, EU-level financing (e.g., Marie Skłodowska-Curie actions).</td><td rowspan="2">Now or within 5 years. (Immediate action is required to prevent a generational skills gap).</td></tr>
<tr><td>Non-financial: Human capital (mentorship capacity), Institutional know-how.</td></tr>
</table>

Establish a European framework for lifelong learning in R&I

Description: Create a coordinated framework enabling modular upskilling and reskilling throughout research careers. This should include novel funding mechanisms, such as a "sabbatical re-training fund" modelled on pension contributions, to support mid-career transitions.

Responsible stakeholders:	Resources needed:	Level of urgency:
National governments, EU institutions, private sector (industrial groups), universities.	**Financial:** Multi-source funding (public-private partnerships), tax incentives for corporate training.	Now or within 5 years.
	Non-financial: Political will to reform labour/education laws, digital infrastructure for micro-credentials.	

Allocation of funding for citizen science

Description: Ring-fence specific funding lines for citizen science and community-based research. This operationalises the university's role as a guardian of public interest by actively involving citizens in data collection and agenda-setting, thereby rebuilding trust in science.

Responsible stakeholders:	Resources needed:	Level of urgency:
EU institutions, national funding agencies, regional authorities, civil society organisations (NGOs).	**Financial:** EU-level financing (Horizon Europe), philanthropic grants.	Medium-term (6–15 years).
	Non-financial: Public support, methodological expertise (know-how) in participatory research.	

5.2. Dimension 2: The impact on R&I funding

5.2.1. Challenges for the R&I system

Funding instability and the neglect of basic research

Core problem: Basic, curiosity-driven research is facing chronic underfunding due to overall funding instability.

Primary driver: Demographic pressures on public finances lead to volatile and limited state funding, forcing a focus on projects with immediate, predictable outcomes over ambitious, long-term science.

Key consequences: The pipeline of foundational ideas that fuels future breakthroughs risks running dry, undermining Europe's ability to innovate and respond to grand societal challenges in the long term.

The fragmentation of funding and loss of strategic cohesion

Core problem: The R&I funding landscape is becoming increasingly fragmented, decentralised, and lacking in strategic direction.

Primary driver: As strained public budgets reduce the state's central role, a patchwork of uncoordinated private funding sources (corporate, venture capital, etc.), each with its own agenda, becomes dominant.

Key consequences: Capital is misallocated towards short-term commercial returns, while areas of critical public interest (like climate research or pandemic preparedness) are systemically underfunded, leading to an inefficient and incoherent national innovation strategy.

5.2.2. Opportunities for the R&I system

Building a legitimate, mission-oriented R&I system

Core opportunity: To focus R&I funding on clear, ambitious, and societally relevant "missions" that mobilise the entire system towards common goals.

Primary driver: The need to address large-scale demographic and societal challenges while rebuilding public trust in institutions.

Key benefits: A mission-oriented approach fosters radical collaboration, enhances the system's effectiveness and legitimacy, and creates a virtuous cycle where public trust, built through participatory processes, secures the long-term mandate and funding for transformative breakthroughs.

Creating a more efficient and dynamic R&I funding ecosystem

Core opportunity: To design a more dynamic funding ecosystem based on a strategic "division of labour" between public and private capital.

Primary driver: The urgent need to maximise the impact of every public euro due to fiscal constraints, while productively harnessing the rise of private-sector R&I investment.

Key benefits: Scarce public funds can be targeted to de-risk high-risk basic research, while private capital focuses on closer-to-market development. This accelerates innovation while ensuring the long-term pipeline of foundational ideas remains secure.

5.2.3. Recommended strategic actions

Mandate a fixed percentage for fundamental research

Description: Enact legislation or binding targets mandating that a fixed percentage of national and EU R&I budgets be dedicated exclusively to fundamental, non-applied research. This creates a "firewall" protecting long-term science from short-term economic fluctuations.

Responsible stakeholders:	Resources needed:	Level of urgency:
National governments (parliaments/ministries of finance), EU institutions (European Commission)	**Financial:** National/state-level financing (budgetary allocation). **Non-financial:** Strong political will, regulatory frameworks (ERA Act).	Now or within 5 years.

Obligation to publish national R&I roadmaps

Description: Include an obligation in the European Research Area (ERA) Act for Member States to publish transparent, multi-annual national R&I roadmaps. This ensures strategic alignment, reduces duplication across borders, and provides predictability for investors.

Responsible stakeholders:	Resources needed:	Level of urgency:
European Commission (DG RTD), national governments.	**Financial:** Administrative funding for foresight and planning. **Non-financial:** Data and information access, coordination expertise.	Now or within 5 years.

Create a European mission lab network

Description: Establish a network of regional "mission labs" where citizens, researchers, and policymakers co-design and test mission-driven innovations. These hubs act as the physical interface for the mission-oriented approach, ensuring local relevance and uptake.

Responsible stakeholders:	Resources needed:	Level of urgency:
Regional & local Authorities, universities, EU institutions, civil society.	**Financial:** Structural funds (ESIF), Horizon Europe funding.	Medium-term (6–15 years).
	Non-financial: Public support, collaborative infrastructure (living labs).	

5.3. Dimension 3: Socio-spatial implications

5.3.1. Challenges for the R&I system

A geographically concentrated and fragile R&I system

Core problem: R&I excellence is increasingly concentrating in a few "superstar" hubs, creating a damaging "brain drain" from other regions and making the overall system fragile.

Primary driver: A self-perpetuating cycle where dynamic hubs attract top talent, which depletes peripheral regions and makes the central hubs even more attractive, further widening the innovation gap.

Key consequences: This leads to a brittle and unbalanced system with under-utilised talent in many regions and intense competition in a few, making Europe vulnerable to localised shocks and unable to leverage its continent-wide potential.

Infrastructure conflicts limiting R&I growth

Core problem: The massive demand for new, energy- and land-intensive digital infrastructure (e.g., data centres) is creating intense competition for physical space and resources.

Primary driver: The demographic imperative to adopt automation and AI to compensate for labour shortages drives an enormous need for this new infrastructure.

Key consequences: This competition for land and energy can directly constrain R&I growth, clash with other essential uses like housing, and create new innovation bottlenecks due to high costs or pragmatic resource rationing.

5.3.2. Opportunities for the R&I system

A geographically balanced R&I ecosystem built on regional strengths

Core opportunity: To build a more distributed and resilient R&I system as a polycentric "network of excellence" based on the unique competencies of different regions (smart specialisation).

Primary driver: The need to counteract over-concentration and brain drain by leveraging the diverse demographic and intellectual assets across the entire continent.

Key benefits: This fosters a more balanced and equitable European Research Area, reverses regional decline by creating new specialised R&I hubs, and builds a more cohesive, integrated system that unleashes the innovative potential of all its communities.

Leveraging R&I to drive cohesion and strategic autonomy

Core opportunity: To use targeted R&I investment as a dual-purpose policy instrument that simultaneously builds Europe's strategic autonomy and reduces internal regional disparities.

Primary driver: The geopolitical need for resource independence and sovereign capabilities, combined with the internal need to address economic and social imbalances exacerbated by brain drain.

Key benefits: This creates a virtuous circle where investing in strategic industries in less prosperous regions builds both sovereign capabilities and vibrant local innovation ecosystems, resulting in a more resilient, equitable, and stronger Europe.

5.3.3. Recommended strategic actions

Create a European network of regional innovation campuses (ENRIC)

Description: Develop a distributed ecosystem where peripheral regions host specialised innovation nodes focused on their unique local strengths (smart specialisation), connected digitally to central hubs.

<table>
<tr><th>  Responsible stakeholders:</th><th>  Resources needed:</th><th>  Level of urgency:</th></tr>
<tr><td rowspan="2">Regional & local authorities, universities, EU institutions (cohesion policy actors).</td><td>Financial: EU cohesion funds, regional/local-level financing.</td><td rowspan="2">Medium-term (6–15 years).</td></tr>
<tr><td>Non-financial: Technological infrastructure, regional know-how.</td></tr>
</table>

Establish a European strategic resilience lab network

Description: Launch cross-regional hubs specifically tasked with testing and scaling technologies critical to Europe's strategic autonomy (e.g., energy independence, defence dual-use), embedding these strategic assets in local economies to ensure security of supply.

Responsible stakeholders:	Resources needed:	Level of urgency:
EU institutions, national governments, defence/strategic industries.	**Financial:** EU-level financing (STEP - Strategic Technologies for Europe Platform), public-private partnerships. **Non-Financial:** Strategic intelligence, political will.	Now or within 5 years.

Innovation mobility guarantee

Description: Launch a "circular talent" programme that guarantees researchers and innovators positions in peripheral regions after periods abroad, or incentivises mobility to these regions, preventing permanent brain drain.

Responsible stakeholders:	Resources needed:	Level of urgency:
EU institutions, national governments, universities.	**Financial:** EU-level financing (mobility grants), national top-ups. **Non-financial:** Regulatory frameworks (portable pensions/benefits).	Medium-term (6–15 years).

5.4. Dimension 4: Interactions between the R&I ecosystem and related markets

5.4.1. Challenges for the R&I system

The dominance of market logic in defining R&I value

Core problem: Market viability and short-term profitability are becoming the primary arbiters of scientific value, marginalising research for the public good.

Primary driver: As the state's influence wanes due to fiscal pressures, powerful corporations emerge as the dominant players, reorienting the R&I system to service their commercial demands.

Key consequences: The pursuit of knowledge is transformed into a transactional process for private wealth creation, devaluing innovations that are not immediately commercialisable and skewing the R&I system away from broad societal progress.

Regulatory lag stifling or enabling harmful innovation

Core problem: Regulatory frameworks are failing to keep pace with the rapid speed of technological change, creating a high-stakes environment of legal uncertainty.

Primary driver: The urgent pressure to deploy new technologies (like AI) to solve demographic challenges can cause governments to favour rapid innovation over cautious, resource-intensive oversight.

Key consequences: This creates a dual threat where legal uncertainty can either stifle beneficial innovation or, more dangerously, enable harmful outcomes like monopolies, unethical data use, and the deployment of technologies that erode public trust.

5.4.2. Opportunities for the R&I system

Pioneering future markets through strategic R&I collaboration

Core opportunity: To pioneer and lead the global markets of the future (e.g., the "silver economy") by designing a high-momentum innovation ecosystem built on intense collaboration between academia and industry.

Primary driver: Profound societal and demographic shifts are creating fertile ground for entirely new industries and services to meet emerging needs.

Key benefits: This synergy accelerates the journey from the laboratory to the market, giving Europe a significant first-mover advantage in shaping standards, dominating high-value markets, and translating its demographic challenges into a competitive edge.

AI-driven R&I as a catalyst for market leadership

Core opportunity: To strategically integrate AI into the research process itself, unlocking a step-change in productivity and dramatically accelerating innovation cycles.

Primary driver: The transformative potential of AI tools to drastically shorten the development time for new materials, medicines, and technologies.

Key benefits: This "speed-to-market" capability allows European industries to out-compete rivals, lowers the high costs of discovery, and creates a new, high-value market for sophisticated AI research tools, providing a direct route to market leadership.

Cultivating a market that values and rewards socially conscious R&I

Core opportunity: To capitalise on shifting consumer and talent values to create a commercial environment that actively rewards purpose-driven, ethical, and socially conscious innovation.

Primary driver: A growing demand from consumers and top R&I talent for companies that demonstrate genuine social responsibility and a focus on well-being, not just profit.

Key benefits: This translates into durable business advantages, as companies aligned with societal values build brand trust, attract the best talent, access new capital, and earn a "social licence to operate," ensuring their long-term resilience and profitability.

5.4.3. Recommended strategic actions

Agile, multi-stakeholder regulatory networks

Description: Move from static, siloed agencies to agile regulatory networks involving innovators, ethicists, and civil society. These networks use foresight to draft "anticipatory regulation" for emerging technologies like AI.

 **Responsible stakeholders:**	 **Resources needed:**	 **Level of urgency:**
Regulatory bodies, industry representatives, civil society, researchers.	**Financial:** National/state-level financing.	Now or within 5 years.
	Non-financial: Foresight expertise, data access, trust/collaboration frameworks.	

Incentives for regional innovation clusters (future markets)

Description: Strengthen incentives for clusters focusing on demographically driven emerging markets (e.g., longevity, circular manufacturing). Use tax credits and matching grants to de-risk private investment in these high-social-impact sectors.

Responsible stakeholders:	Resources needed:	Level of urgency:
National ministries of economy, regional development agencies, private investors/VCs.	**Financial:** Tax incentives, structural funds. **Non-financial:** Market intelligence, cluster management expertise.	Now or within 5 years.

Investment in homegrown AI infrastructure

Description: Invest strategically in sovereign European AI models, datasets, and computing infrastructure that are auditable and aligned with European values. This prevents dependency on non-EU tech giants and ensures data sovereignty.

Responsible stakeholders:	Resources needed:	Level of urgency:
EU institutions, national governments, consortiums of research institutions & tech companies.	**Financial:** Massive public-private investment (Euro HPC style). **Non-financial:** Technological infrastructure (computing power, data centres), technical talent.	Now or within 5 years.

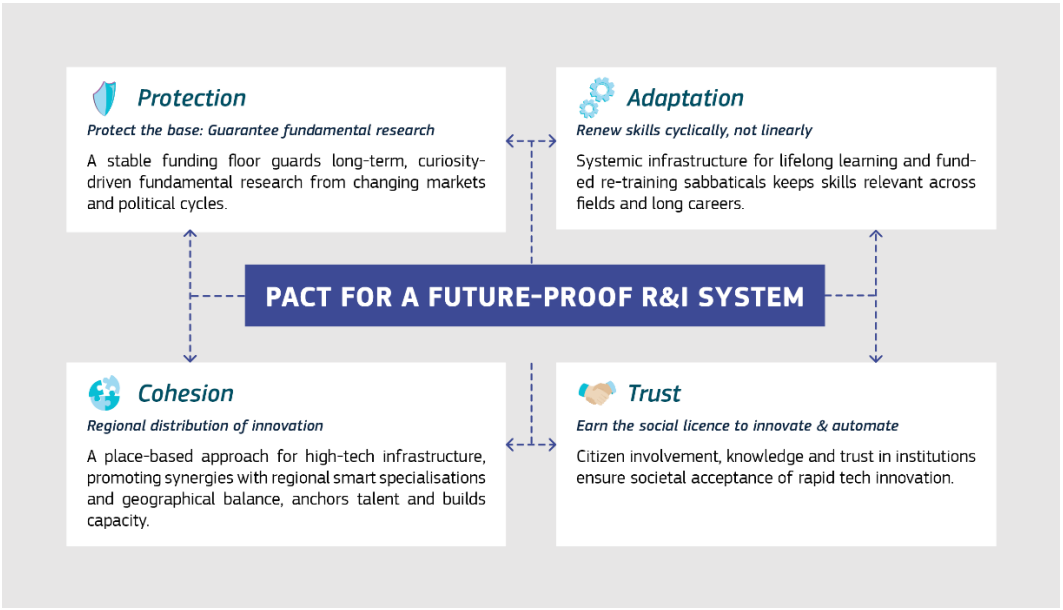
Purpose certification & disclosure framework

Description: Establish a mandatory European framework requiring large R&I organisations and corporations to verify and disclose the social and environmental impact of their innovation portfolios. This creates transparency and allows the market to reward responsible actors.

Responsible stakeholders:	Resources needed:	Level of urgency:
EU institutions (for legislation), independent auditing bodies, industry associations.	**Financial:** Private sector compliance funding. **Non-Financial:** Regulatory frameworks (reporting standards), data transparency.	Medium-term (6–15 years).

6. Recommendations for policymakers

The foresight process concludes that European R&I requires a structural overhaul, identifying four strategic mandates that represent the most robust and cross-cutting priorities for future-proofing the system. The process, encompassing scenario building, implications mapping, and the wind-tunnelling of potential actions, reveals that the accelerating demographic decline and geopolitical uncertainty demand a fundamental restructuring of the system's relationship with society, the market, and the state. This concluding analysis synthesises the core findings, identifying four strategic mandates that emerged as the most robust and cross-cutting priorities for future-proofing the European R&I ecosystem. These mandates represent actions that proved consistently effective across the full spectrum of contrasting scenarios, offering maximum resilience regardless of which future trajectory ultimately materialises.



The protection mandate calls for a legislative ring-fenced mechanism to establish a mandatory funding floor for fundamental research, insulating the "seed corn" of scientific inquiry from volatile budgetary cycles. The analysis reveals that the most critical vulnerability identified in scenarios defined by fiscal contraction or corporate dominance (such as Corporate ascendancy) is the swift erosion of long-term, curiosity-driven science. Expert validation consistently warned that without a legislative defence mechanism, funding will inevitably shift towards short-term, applied projects to plug immediate fiscal gaps caused by ageing populations and budget constraints. This mandate, which calls for national governments to establish a mandatory funding floor for fundamental research, is therefore not merely a financial plea but a structural defence mechanism. By insulating this "seed corn" of scientific inquiry, Europe ensures it retains the capacity to generate the radical, breakthrough ideas necessary to solve currently undefined future

problems, rather than merely optimising solutions for problems that are already understood. Expert feedback highlighted a risk of "directionality creep," where even basic research funding is subtly pushed towards political missions; this mandate aims to structurally sever the link between demographic volatility and the freedom of scientific discovery.

The adaptation mandate requires a paradigm shift from the traditional R&I pipeline to a "cyclical" human capital model, implemented via a European framework for lifelong learning and dedicated sabbatical funds. The traditional "pipeline" model of human capital—educating the young to replace the old—is statistically untenable in a shrinking demographic context. The analysis dictates a paradigm shift to a "cyclical" model, recognising that if careers now span fifty years, the human capital base must be renewed multiple times to prevent mass skills obsolescence. The adaptation mandate calls for a European framework for lifelong learning (LLL) and dedicated sabbatical funds. This framework transforms continuous upskilling from a personal burden into a systemic infrastructure, akin to a pension scheme. By providing dedicated funds and guaranteed access to re-training sabbaticals, the R&I system gains the necessary agility to rapidly pivot researchers from declining or obsolete fields to emerging, strategic ones. Validation cautioned against conflating LLL with traditional academic degrees; the focus must be on agility, micro-credentials, and industrial placements, directly addressing the "skills gap" without relying on unsustainable demographic growth.

The cohesion mandate dictates that Europe must trade short-term efficiency for long-term distributed resilience by distributing high-tech infrastructure like regional innovation campuses to peripheral regions to anchor local talent. Centralised R&I "superstar" hubs, while offering local efficiency, are strategically brittle. In scenarios involving geopolitical uncertainty, supply chain fractures, or fragmented global systems (like Splinters and stratified R&I), concentrating R&I capacity in a few major cities leaves the wider continent vulnerable and exacerbates brain drain. The cohesion mandate dictates that Europe must trade some short-term efficiency for long-term distributed resilience. By deliberately distributing high-tech infrastructure—such as regional innovation campuses and resilience labs—to peripheral regions, the system anchors talent locally. This action converts regional diversity from a liability into a strategic asset for autonomy, turning "left-behind" places into specialised nodes, capable of leading in niche areas like the silver economy or green hydrogen. Experts emphasised that these new structures must not duplicate existing infrastructure but must have a distinct mission focused on regional smart specialisation.

The trust mandate ensures the system earns a "social licence to automate" by creating agile regulatory networks and integrating citizens through ring-fenced citizen science funding, thereby mitigating societal backlash against rapid technological acceleration. Demographic shortages will inevitably force Europe to automate its research and industry faster than many other global players. However, foresight workshops highlighted a high risk of societal backlash (as seen in Inclusion and social purpose) if this rapid technological acceleration is perceived as unethical or purely profit-driven. The trust mandate argues that R&I cannot proceed faster than the public's willingness to accept it. By creating agile regulatory networks that include ethicists and civil society, and by integrating citizens directly into the research process through ring-fenced citizen science funding, the system actively builds a "social licence." This reduces the cost of friction, prevents regulatory deadlock, and ensures that the inevitable deployment of AI and automation serves human needs. To be effective, citizen science must be elevated

from a hobbyist activity to a rigorously funded and integrated component of university and research missions, acting as the necessary bridge between the research community and a potentially sceptical public.

The resilience of the future R&I system relies not on individual policies, but on the synergistic interplay between these four mandates. These four mandates are not silos; they are interconnected and mutually reinforcing. Sovereignty requires cohesion: Europe cannot achieve strategic autonomy if half its regions are drained of talent. adaptation requires trust: a workforce cannot be rapidly reskilled using algorithms they do not trust. And resilience requires a base: none of the applied innovations are possible without the long-term, curiosity-driven ideas protected by the protection mandate. Collectively, these strategic mandates provide a robust and validated roadmap for the European R&I system to convert demographic pressure from a vulnerability into a strategic opportunity.

Ultimately, these recommendations serve as the definitive answer to the structural dilemma posed in the Introduction: how to convert demographic pressure into a catalyst for a future-oriented R&I system. By implementing these mandates, policymakers move beyond adaptation, actively constructing a regenerative model capable of thriving in a new demographic reality. This decisive shift ensures that the demographic turn, rather than marking an era of decline, creates the foundation for a leaner, fairer, and more technologically advanced European Research Area, securing its competitiveness for the decades to come.

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Demographic change is not a distant forecast but a structural reality that demands immediate action. This foresight analysis reveals that inaction risks fracturing Europe’s cohesion and eroding its scientific competitiveness. However, by implementing the protection, adaptation, cohesion, and trust mandates, policymakers can build an R&I system defined by agility, resilience, and future-oriented thinking. These "wind-tunnelled" actions ensure the continuity of ideas through protected funding, the renewal of the workforce through cyclical learning, and the inclusion of all regions and citizens in the innovation process. Europe must now seize this opportunity to pioneer a resilient, distributed, and human-centric model of innovation, setting a global standard for thriving in a world with a critical demographic shift.

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