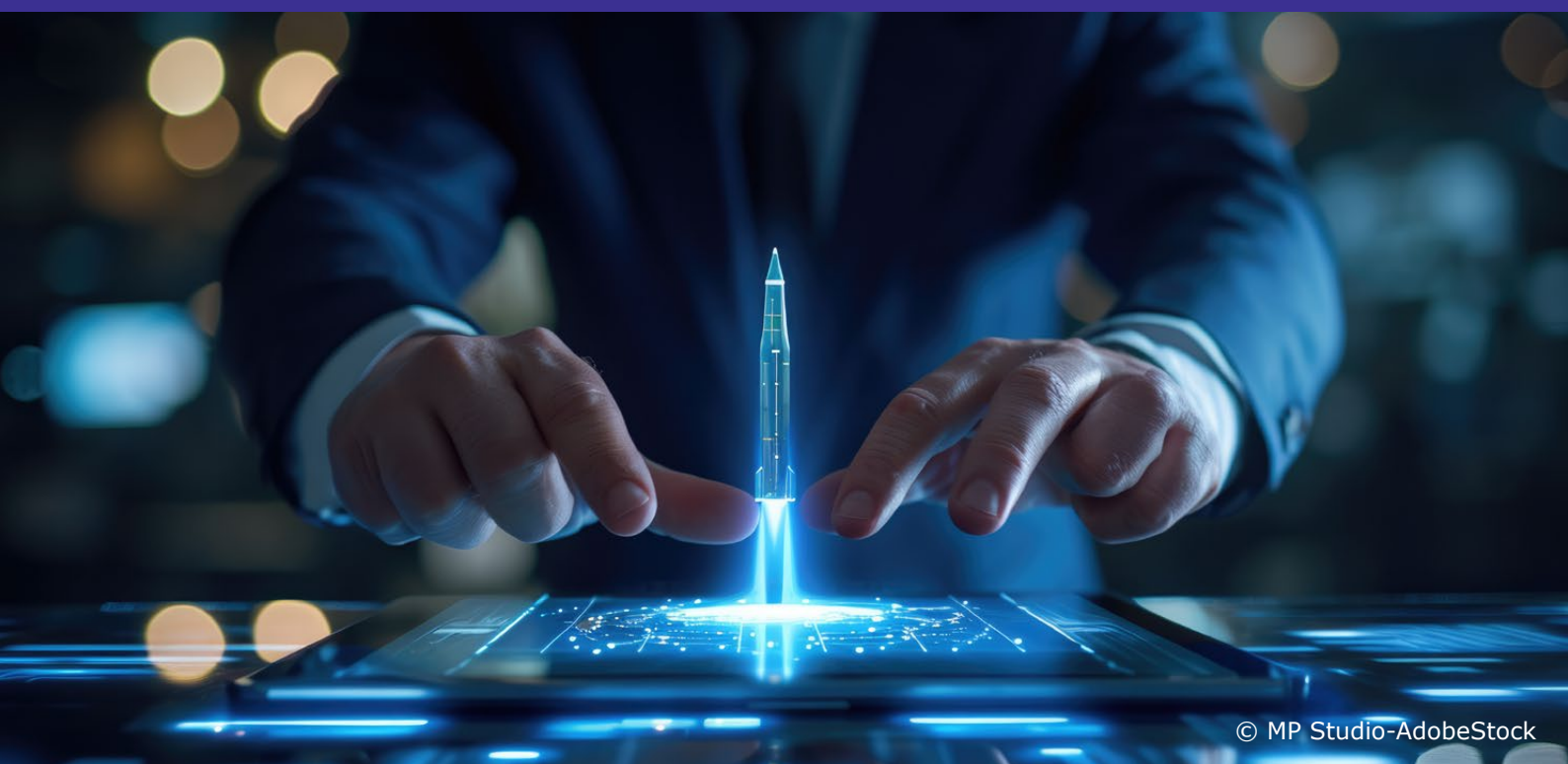




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LIGHTS - Innovation/Entrepreneurship

Enabling Responsible Research and Innovation (RRI) dynamic resilience: Thrive on uncertainty to create sustainable value by keeping pace with innovation

ESCP Impact Paper No.2025-11-EN

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Abstract

This research addresses the crucial challenge of ensuring the resilience of Responsible Research and Innovation (RRI) in today's dynamic and uncertain business environments. We introduce a novel strategic, organizational, and operational model to bolster RRI resilience and its value creation. Developed through a literature review and empirical data collected over five months from 41 senior practitioners, the model utilizes the interplay of external and internal forces to navigate uncertainty and balance stakeholder pressures for effective value management. Furthermore, we explore the potential of integrating AI for analyzing these forces and dynamically monitoring stakeholder interests. We contend that by integrating strategic agility, ambidextrous learning, autonomous organizational structures, and dynamic monitoring, companies can better align RRI with strategic objectives, stakeholder expectations, and macroeconomic trends. This alignment ultimately contributes to RRI resilience and significant innovation impact, leading to economic success.

Keywords: Responsible Research and Innovation (RRI), radical uncertainty, sustainable value, innovation impact, dynamic resilience

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Enabling Responsible Research and Innovation (RRI)
dynamic resilience: Thrive on uncertainty to create sustainable
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Dynamic resilience in Responsible Research and Innovation:
thriving on uncertainty to drive sustainable innovation impact

In today's volatile business landscape, the ability of organizations to sustain Responsible Research and Innovation (RRI) is paramount for achieving sustainable value through impactful innovation. RRI activities, aimed at aligning innovation with eco-societal needs for value creation, face unprecedented challenges from market uncertainties, stakeholder pressures, and regulatory demands. To maintain a competitive innovation-based advantage, businesses must cultivate RRI resilience, i.e. the capacity to leverage both external and internal disruptions as opportunities for seamless value creation.

RRI Resilience, in this context, is not just about static endurance for conservation but about dynamic adaptability to pivot, foresight, and the ability to create value despite limitations. It is not about reducing uncertainty or about scenario planning, which has become useless in today's radical uncertainty, but to think forward, acknowledge such uncertainty and thrive on it, seizing emerging opportunities. The central question is the following: how can dynamic resilience of Responsible Research & Innovation be enacted and which adequate strategic and organizational system will make it thrive on uncertainty?

We posit that RRI acts as an influential mediator of businesses re-embedding (REF) into the societal sphere: considering the change from the paradigm of a supposedly autonomous economic sphere in which business is independent from the outer ecosystem and stakeholders to the paradigm of "re-embedding", where the purpose of businesses is no longer solely to make profit, but to make profit by providing value to their stakeholders. Therefore, RRI aims to drive the alignment of businesses strategy with societal needs and generate profit for businesses, which is tantamount to creating value for society and its stakeholders.

The stakes are significant. RRI represents a critical intersection of ethical considerations, societal impacts, and stakeholder alignment, increasingly vital for sustained competitive advantage and corporate responsibility. However, given the growing difficulty for businesses to balance these demands amidst fluctuating external and internal pressures, ensuring RRI resilience is a critical challenge.

To address this challenge, we propose a practical model for building RRI resilience to navigate uncertainty, manage stakeholder expectations, and achieve innovation impact. Drawing on literature review and empirical research with practitioners of RRI in a multinational cosmetic company, we derived insights from ambidextrous and organizational learning, effectuation and external enablers to offer a framework with actionable solutions to ensure RRI generates sustained societal value and enhances competitiveness and value creation for society.

Beyond scenario planning: enacting RRI dynamic resilience in radical uncertainty to keep momentum and responsiveness

Business leaders face conflicting priorities in their pursuit of RRI. They must adapt to rapid market shifts and technological advancements while simultaneously addressing societal expectations for ethical and sustainable innovation. To effectively handle Responsible Research & Innovation projects, flexibility is necessary to navigate these dual pressures; in its absence, the risk is misalignment with strategic goals or stakeholder expectations. As Mike Tyson famously said, "Everyone has a plan until they get punched in the face," underscoring the need for adaptability rather than rigid planning.

Resilience in RRI goes beyond mere survival. It encompasses proactive adaptation, strategic foresight, and effective stakeholder engagement to maintain alignment between societal expectations and economic objectives of value creation. However, traditional approaches often fall short in addressing the complexities of dynamic environments and in sustaining value-creating growth over time.

As such, classic scenario planning is outdated since by essence the nature of the uncertainties cannot be anticipated nor fathomed – think of Black Swans such as COVID. Although AI can help to evaluate potential impacts on RRI activities, i.e. consequences, it remains limited since we cannot imagine all the alternative futures scenarios and it would be too costly to process. In this context, companies often adopt a wait-and-see approach, and freezing in priority RRI. But prolonged waiting can lead to lost momentum, reduced innovation up to hysteresis, a detrimental consequence of decision paralysis. Conversely, acting prematurely can result in costly mistakes requiring backtracking.

Therefore, the solution is not about predicting the future but about preparing for it. As David Niles, CEO of Council Advisors, said "it's not about getting the forecast right — it's about having a series of plays ready, so when the unexpected happens, you're not frozen." What is crucial is to identify when to adjust course and to build on "techne" of adjustments and impact mitigations. Multinational companies in particular have trouble maintaining their RRI, considering the growing ecological transition and a deteriorated business climate, which paradoxically highlights the paramount importance of RRI and more generally of innovations in a context of existential crisis. While stakeholder pressure and regulatory frameworks prioritize sustainable transition, of which RRI is a cornerstone, budgetary and fiscal pressures, including reduced public research funding at national and supranational (European) levels, raise concerns about the impact on innovation and competitiveness.

Towards a “re-embedding” paradigm: RRI as key driver to align the purposes of businesses and stakeholders

Responsible Research and Innovation (RRI) is a *modus operandi* encompassed in a paradigm aimed at aligning research and innovation processes with societal values and needs. It involves various stakeholders to ensure that research outcomes are ethically acceptable, sustainable, and socially desirable.¹ RRI addresses industry's need to innovate

¹ Phil. Reve Von Schomberg, member of European Commission RRI DG, RWTH Aachen University in 2012: "Responsible Research and Innovation is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability, and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)."

while maintaining public trust by generating social value in addition to economic returns. RRI aims to shape, maintain, develop, coordinate and align existing and novel research and innovation-related processes, actors and responsibilities to ensure desirable and acceptable research outcomes.

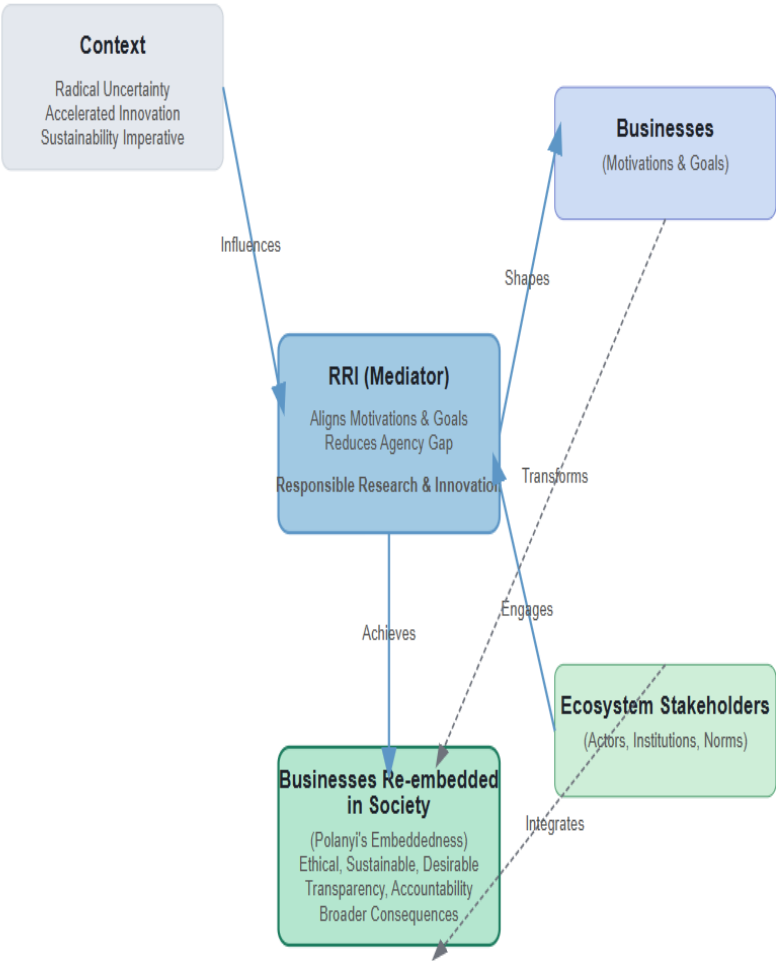
We retain from the multiple definitions of RRI, notably the ones of European agencies and the Observatory of Responsible Innovation, that it is a technical and scientific innovation, transversal, open, and collaborative, and implying a radical change in mindset.

Core principles of RRI

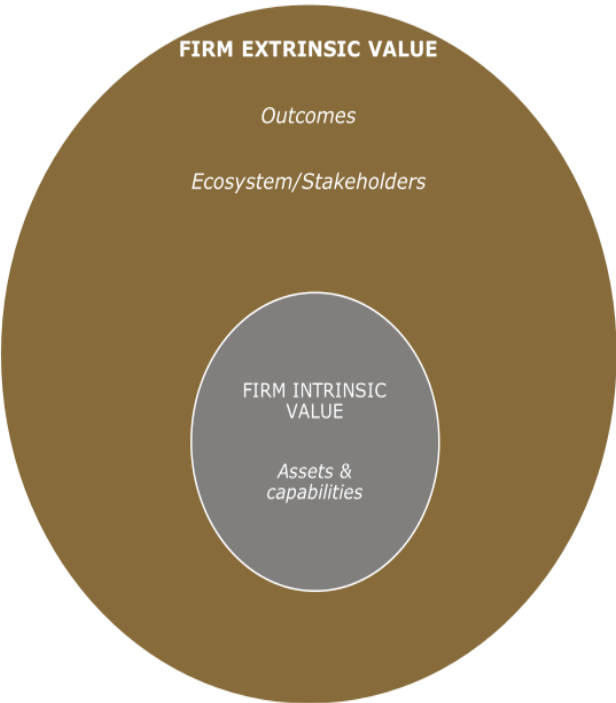
- A culture of testing to be responsible in the face of market rejection risks - Effectuation;
- An approach giving significant importance to democratic deliberation so that innovation is debated and becomes a consensus that empowers the collective - Reflexivity;
- A logic of knowledge sharing, which proposes a culture of resource sharing - Openness.

From these core principles, we can surmise that in such a context of radical uncertainty, accelerated pace of innovation and sustainability imperative, RRI acts as a mediator to align motivations and goals of businesses (reducing agency gap) and its ecosystem stakeholders. The idea is to re-embed businesses into society, referring to Karl Polanyi's concept of embeddedness, reinforcing the understanding that RRI does not occur in a vacuum. Instead, it is deeply entwined with social, economic, and political contexts. Recognizing that RRI activities are embedded in broader societal systems requires understanding and engaging with the multiple actors, institutions, and norms that shape the innovation landscape. This means taking into account ethical considerations, cultural values, and societal expectations when planning and implementing RRI projects. The concept of embeddedness emphasizes the interconnectedness of RRI initiatives with the broader community, highlighting the necessity for transparency, accountability, and open dialogue with stakeholders to ensure the ethical acceptability, sustainability, and societal desirability of innovation. This also points to the need for companies to consider the broader consequences and side effects of R&I efforts.

The Embedding Paradigm: RRI mediates the firm re-embedding into society



Global value



A triadic framework to enable active RRI resilience

Building upon the presented theoretical foundations of Responsible Research and Innovation (RRI), our research is based on the four key dimensions identified by Stilgoe, Owen, and Macnaghten (2013): anticipation, reflexivity, inclusion, and responsiveness. These dimensions provide an essential framework for understanding and implementing RRI. Furthermore, the "Responsible Research and Innovation Maturity Model" by Stahl et al. (2017) offers a perspective on the evolution and achievement of RRI within organizations. Finally, Dr. Anne Snick's methodological proposal for accelerating the transition towards responsible R&I systems oriented towards the commons complements this framework, emphasizing the importance of sustainability and innovation with social impact.

This points to the relevance of ambidexterity methods and principles, considering that organizational and learning ambidexterity facilitates knowledge access and supporting innovation, and exhibits a crucial interdependence with digital capabilities (learning) in contemporary innovation ecosystems. The cultivation of ambidexterity in RRI enables the effective leveraging of both internal and external knowledge domains. Concurrently, the enhancement of digital capabilities is a specific driver in RRI to proactively identify and capitalize on emerging market opportunities in a context in which timely innovation is critical. Prioritizing and promoting robust knowledge-sharing practices constitutes an essential element in the fortification of overall innovation capacity, as pointed out by the Integration, Reflexivity and Responsiveness dimensions of the Stilgoe et al. framework.

Prior research suggests that pre-pandemic organizational ambidexterity functioned as a stabilizing mechanism, enabling firms to effectively deploy and manage diverse resources within dynamically competitive and disruptive environments, particularly through ambidextrous learning fostering knowledge absorption and application for enhanced performance outcomes. The heightened awareness of adaptive necessities within uncertain environments has driven companies to increasingly adopt digital tools and applications to optimize business processes and ensure operational continuity, as explored in the recent work "Exploring the Connections: Ambidexterity, Digital Capabilities, Resilience, and Behavioral Innovation" (Veiga et al., 2024), particularly relevant since RRI has to keep pace with innovations and sustainability pressures.

Building on the integration of these previous works establishing a conceptual basis for exploration of the dynamic resilience of RRI in uncertain business environments, we propose a framework integrating three core components—strategic agility, learning & organizational ambidexterity, and dynamic monitoring—to enable active RRI resilience:

1. Strategic Agility

Strategic agility emphasizes the capacity to pivot quickly in response to external changes without losing sight of long-term goals. Businesses can foster agility by embracing iterative planning cycles and cross-functional collaboration. For RRI, this means continuously re-evaluating societal needs and technological advancements, ensuring alignment with ethical standards and innovation objectives.

2. Learning & Organizational Ambidexterity

Ambidexterity refers to an organization's ability to simultaneously exploit current strengths and explore new opportunities. By fostering dual structures—one focusing on incremental improvements and the other on breakthrough innovations—companies can integrate RRI

more effectively into their operations. This duality enables a balance between efficiency and creativity, essential for resilient innovation.

3. Dynamic Monitoring

RRI success depends on the ability to dynamically assess both exogenous (external) and endogenous (internal) forces. AI-driven tools can enhance this capability by providing real-time analysis of stakeholder sentiment, regulatory changes, and market trends. By leveraging AI, organizations can proactively adapt their RRI initiatives to align with evolving expectations and mitigate risks.

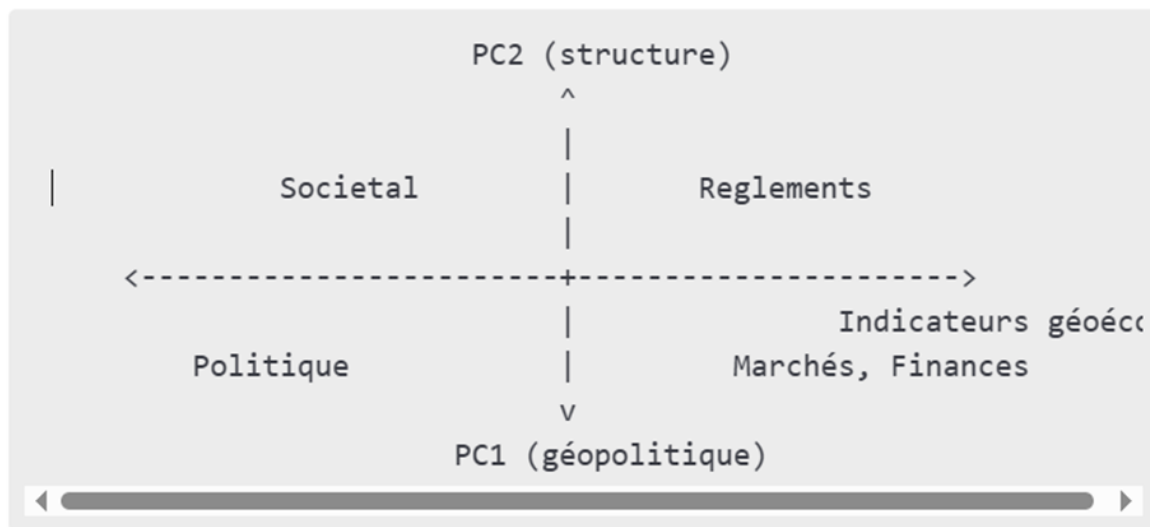
A proposed triadic model to enact RRI resilience based on empirical investigation

Based on literature review and secondary data, we pre-identified main core dimensions structuring the value-creation system for RRI resilience and subsequently conducted semi-structured interviews with RRI practitioners of a multinational cosmetic company and RRI consultants. The following table presents a synthetic overview of the structure of our data after coding according to the Gioia method. This table represents the value dimensions constituting the value-creation system for RRI resilience that we propose and its related decision-supporting grid. Next, we ran a questionnaire and obtained 41 full answers, the results of which we cross-referenced with the results from the interviews to retain the most significant value dimensions at 3 levels of granularity. Finally, we carried out the analysis of the questionnaire results using principal component analysis. We present the key findings of these mixed methods.

The respondents suggest that their company RRI management as it is presently is weak to make up with the new nature of disruptions; they acknowledge that effective RRI management towards resilience necessitates reactivity, adaptability, enhanced data utilization, and proactive risk management. Oft-cited concerns are: over-steering and the need for standardized risk management tools and clear communication as well as improved coordination, talent management, and strengthened governance. They point to internal pressures (management, divisions, digital transformation), including budget volatility, and external pressures (events, market, competition, regulations, geopolitics, technological innovation, environment). While it is essential for RRI to retain skilled and rare human resources so that they can pace with innovation rhythm (researchers & practitioners), the turnover is high and is worsened by budget volatility.

Regarding internal project management, they hint that it would require more reactivity and adaptability, with interest in integrating impact assessments, better data utilization, and proactive risk management. The effectiveness of digital collaboration tools is questioned. Suggestions include standardizing risk management tools and practices, potentially with a dedicated manager, and integrating R&D models into the company's overall risk management, with clear communication and a standardized tool, while avoiding excessive bureaucracy.

We then shed light on the primary factors influencing RRI projects through a Principal Component Analysis (PCA)

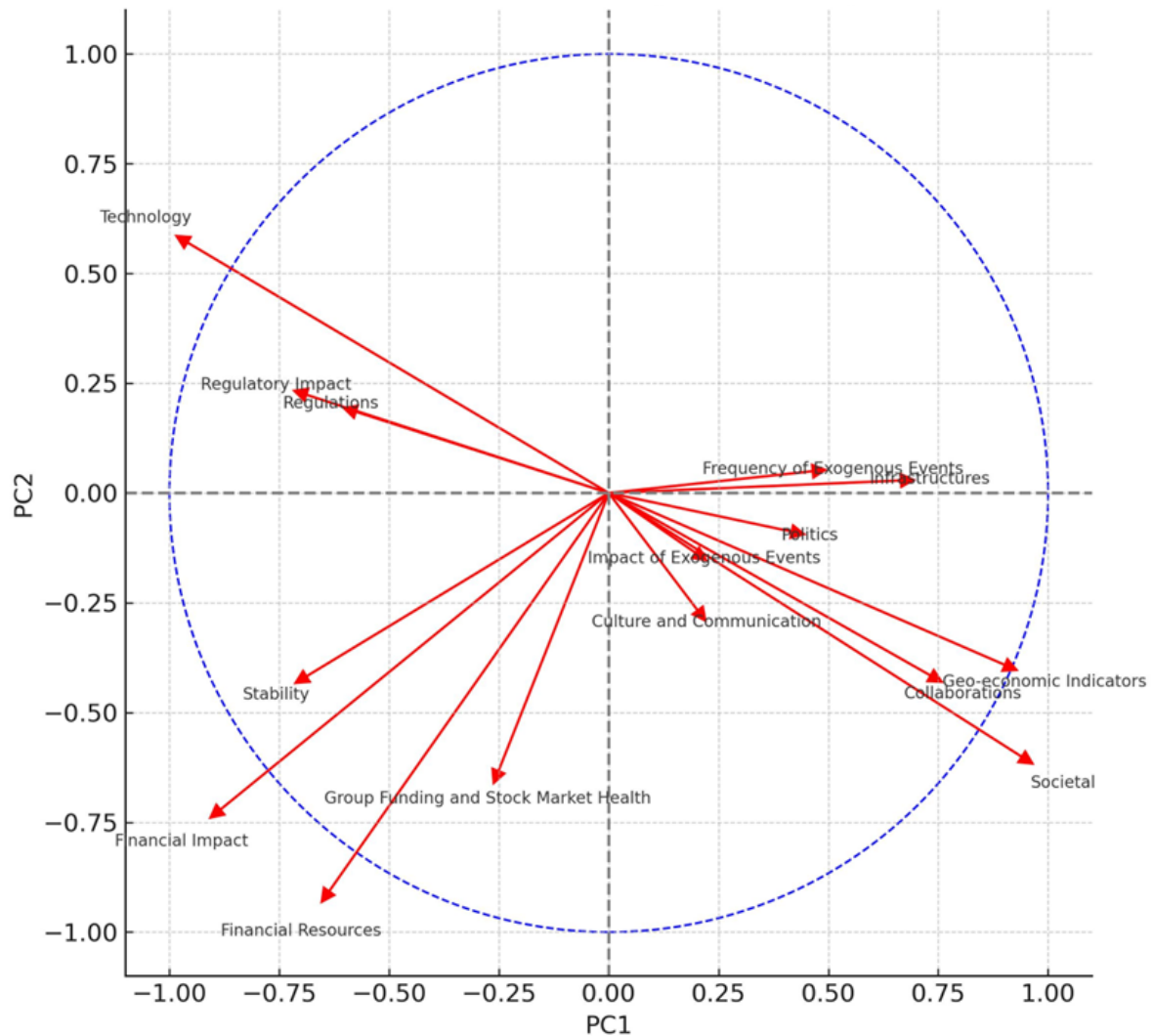


Our PCA reveals that individuals organize around two main trends: sensitivity to the regulatory/societal environment and dependence on economic and geo-political indicators indicating the need to consider both political/geopolitical anchoring and structural constraints (including societal ones) in RRI strategy and monitoring to make it fit for dynamic resilience and keep creating value independently from changing landscapes (both at the internal & external level).

Factor Axes	
AXIS 1: Strategy and Geopolitical Environment (37%)	
• Geo-economic indicators: 17% • Politics: 12% • Stability, Unforeseen Impact, Talent Access: ~10%	
AXIS 2: Structure, Rules, and Society (19%)	
• Regulations: 23% • Infrastructures: 21% • Societal factors: 18% • Market financing: 10%	

Key Factors	Variance Contribution	Description
Geo-economic Indicators	17%	Key influence on R&I projects
Regulations	23%	Structural factor significantly impacting RRI
Societal Factors	18%	Societal considerations are vital for RRI

Correlation Circle (PC1 vs PC2) ²



Interpreting the correlation circle

Axis 1 (21% of the variance):

- Impact 'Culture and understanding' (16%)
- Impact 'Local infrastructure' (14%)
- Geo-economic indicators (12%)
- Impact 'Politics' (11%)
- Impact 'Stability' (11%)

Axis 2 (16% of the variance):

- Relevance of financial market indicators (22%)
- Impact 'Regulatory' (18%)
- Impact 'Financial' (18%)
- Geo-economic indicators (17%)
- Impact 'Local collaboration' (13%)

² The correlation circle shows the relationship between the variables and the principal axes. Long and well-aligned vectors show a strong contribution.

A new strategic, organizational, and operational model for RRI dynamic resilience

Based on our results, we believe that there is a need to manage the external and internal forces corresponding to the geo-economic, regulations and societal factors and to address the limitations of existing RRI management models with a new holistic system to sustain value creation and innovation impact.

We posit that the creation of a relatively autonomous economic RRI platform forming an overall system known as a value system, which models the dynamics of five collective forces associated with stakeholders (collective forces that can destroy or create value: shareholders, public authorities, clients, partners, organizational competencies) emerges as a relevant solution. This new value system is conceived and represented as a value chain with the three components identified above: strategic agility, learning and organizational ambidexterity, and dynamic monitoring. These three components form a system by interacting with the five forces, like a dynamic game of mega-platforms in a multidimensional spatial plan.

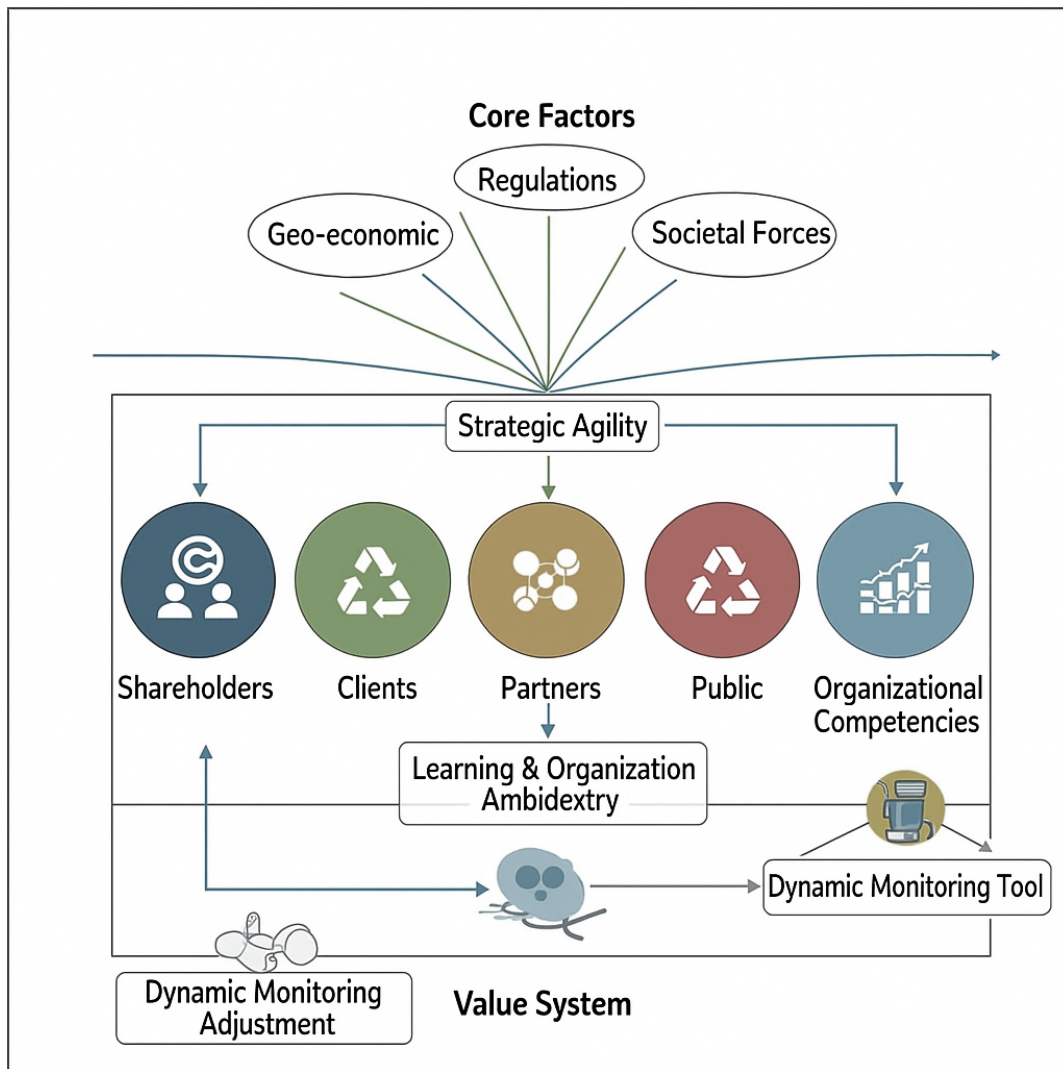
Strategic agility: The strategy for RRI resilience must include a long-term vision and align RRI objectives with sustainable strategic priorities while ensuring their compatibility with market constraints. It orchestrates the alignment of stakeholders by establishing a collaborative framework where the five forces embodied by these five stakeholders converge to support resilience and sustainable innovation. It then adopts, at the strategic level (decision-making), proactive risk management to anticipate potential disruptions and integrate adapted action plans to minimize impacts.

Organizational & learning ambidexterity: To strengthen resilience, an ambidextrous organization is proposed, where RRI functions as an autonomous entity within the company. RRI is structured as an organic "spin-off" that would be directly attached to the general management and have its own budget and internal resources, its strategy, and production tools, thus made autonomous within the overall organization of the company.

Dynamic monitoring tool: For each of the dimensions and each of the aspects of our analysis grid, three criteria structuring the management of RRI activities, a decision support and portfolio management tool allowing resource allocation according to the score on these three criteria at the heart of resilient RRI (responsible or sustainable): profitability, acceptability, and controllability (including the possibility of stabilization and adaptation actions) - the sustainability criteria being taken as a baseline and inherent to RRI.

This new integrated value system offers an actionable strategic, organizational, and operational model to transform the management of RRI activities in a competitive and pressure-filled environment. By combining strategy, ambidextrous organization, and dynamic monitoring, it enables companies to ensure the resilience and sustainability of their activities while balancing the interests of the five collective forces and the five stakeholders embodying them. Our comprehensive approach could represent an essential advance in aligning RRI with strategic objectives, stakeholders, and the macro-environment (external forces and trends) and its economic success.

A Triadic Dynamic Resilience Model for Responsible Research and Innovation (RRI)



For professionals and managers, our integrated triadic model offers actionable insights:

- **Embed responsiveness in agile processes:** Encourage the integration of responsive agile methodologies within processes. This ensures that RRI objectives remain adaptable and readily actionable in response to evolving circumstances and unforeseen disruptions.
- **Foster ambidexterity in teams:** Establish distinct yet interconnected organizational units. One unit should focus on optimizing existing RRI processes and maximizing current strengths, while the other should be dedicated to exploring novel avenues for innovation and addressing future challenges. This balanced approach cultivates both efficiency and creativity.
- **Invest in AI capabilities:** Prioritize the adoption and integration of Artificial Intelligence (AI) tools. Leveraging AI will enable organizations to gain deeper, real-time insights into dynamic stakeholder sentiments and emerging external trends, thereby significantly enhancing the quality and responsiveness of decision-making processes related to RRI.

Conclusion

Enhancing the resilience of Responsible Research and Innovation is not a mere ethical imperative but a strategic necessity. By adopting a triadic approach—combining strategic agility, organizational ambidexterity, and dynamic monitoring—organizations can better align their innovation efforts with societal expectations and economic objectives. With AI as a critical enabler, businesses can navigate the complexities of modern markets while ensuring that their innovations drive both value creation and positive societal impact. The path forward is clear: embrace resilience not as a reactive measure but as a proactive strategy to thrive in an ever-changing world

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