

Catalysing Action and Transdisciplinary Pathways towards Sustainable Transitions

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1 Prelude – Special Issue Motivation

The year 2023 marked the 300th anniversary of the birth of Adam Smith, the Scottish economist whose work has impacted how we think about economic principles and the dynamics implied in politics, business, and society. Known for his seminal work “The Wealth of Nations” published in 1776, Smith argued for an economic system with little unnecessary government interference. A model built on the division of labor, guided by an ‘invisible hand’, is part of the argument for free markets directed through price mechanisms and the moral conscience of self-interested people to achieve outcomes that benefit society (Stevens, 2023). Smith’s intention to articulate a liberal economic model that prioritized contributing positively to society’s welfare¹ however, stands in contrast to 20th-century business doctrine, which asserted that ‘their sole social responsibility was to generate as much profit as possible for their stockholders’ (Friedman, 1962, p. 133).

As we move forward further into the 21st century, discussions about capitalism as an ideology (cf. Chiapello and Fairclough, 2013), shareholder capitalism (Mayer, 2018), pro-ecological degrowth (cf. Kallis et al, 2018), the growing corporate social responsibility (CSR) of organizations (cf. Jamali and Mirshak, 2007), and the many social, environmental, and sustainability challenges faced unequally by communities around the world – are becoming more prominent. Over the past two decades, there has been a gradual but significant shift in many parts of society and business towards social justice and equitable futures. This change has been driven by decades of activism, social movements, and a series of corporate scandals, regulatory failures, and financial crises that have caused people to question the way businesses operate (Jourdan, 2023). As a result, there are increasingly vocal calls from communities, politicians, activist investors, and others for companies to re-prioritize their goals to be more ethical and sustainable, rather than focusing solely on maximizing shareholder value (Macey, 2022). Corporations are now expected to consider the interests of stakeholders, communities, and ecologies in addition to their own, leading to a shift in their business mentality (Macey, 2022; Treacy, 2022; Villela, et al., 2021; Weiss, 2021).

An example of this shift is evidenced in the activities of the World Economic Forum, an international non-governmental organization and think tank generally considered to be a pro-capitalist platform for business, with close links to governments in Global Minority countries and their allies. At its 2019 meeting, the Founder and Executive Chairman Klaus Schwab asked the audience: “What kind of capitalism is needed to sustain economic systems for future generations?”

1. How ‘society’ was understood excluded many peoples, nations, and worlds then subject to colonization and resource extraction by countries such as Britain.

With this intervention, prompting the 'Davos Manifesto' (Schwab, 2019), a firm's principal responsibilities toward its wider stakeholders recognizing it as not just a profit-seeking entity, but also a social organism, were declared in this forum. Building on important innovative and critical thinking practices around the world, the manifesto claimed that organizations must establish a comprehensive and binding social contract. It emphasized the importance of adopting a fresh approach to measure 'shared value creation', including environmental, social, and governance (ESG) factors.

Indeed, this approach is necessary to achieve the United Nations' 2030 'Sustainable Development Goals' (SDGs) – which, while their utility and effectiveness, and steps towards them remain contested (see Hickel, 2022) – it presents a global framework agreed by governments around the world committed to in 2015, which aim to address poverty, inequality, environmental degradation, and other global challenges (cf. Moyer and Hedden, 2020). Achieving these goals requires transformative changes and innovative approaches across sectors, nations, and disciplines.

This shift in focus by the WEF, alongside many related developments, indicates a growing movement is underway that puts into question the global zeitgeist on capitalism (Raworth, 2017; Grear & Bollier, 2020; Alexander & Gleeson, 2022). Furthermore, in the face of the real and existential threat of climate breakdown, scholars argue that the ESG movement demonstrates a consensus that governments have failed to act, and thus lack credibility as a likely source of solutions to broad social problems (Macey, 2022, p. 258).

2 Why the need for Innovation Paradigms?

Despite the rapid growth of ESG investment funds in recent years, the United Nations' Sustainable Development Report (United Nations, 2022) brought to light the mounting challenges resulting from the COVID-19 pandemic, the war in Ukraine, and climate change– a “crisis multiplier” effect, which may well put the 2030 Agenda in jeopardy (UN, 2022, p.2). According to The World Economic Forum's latest Global Risk Report (WEF, 2024), environmental risks now rank as the highest category, which is why new approaches to sustainable and more equitable futures are so urgently needed. Such is the existential threat to humanity, and the ecologies humans rely on, that the transformation of societies depends upon actively stewarding change, which scholars have proffered, requires entirely new approaches to designing systems that are more collaborative, inclusive of different forms of knowledge, founded on the concept of care; they must also be capable of working with complexity, values, and diverse human and non-human interests to be effective and supportive of societal transformations (Puig de la Bellacasa, 2011; Fazey, et al., 2020). Here, theories of transitions have been developed pointing to the complex, multi-perspectival processes of change across society (Schot & Geels, 2008; Simeone, 2023; Geels, 2010; Hebink et al, 2022).

Indeed, there has been a persistent challenge for the scientific community to convince leaders in government and business to adopt potentially expensive policy changes and curb economic growth (Barnard, et al., 2021). To tackle this challenge, all stakeholders involved in the innovation ecosystem must recognize the emergence of a new paradigm that involves cross-functional and societal stakeholders (cf. Quadruple Helix Model of Innovation). By doing so, research with sustainable innovation solutions might be better aligned, which ultimately leads to a positive public impact.

To navigate today's complex, contradictory, and chaotic world, it's been suggested that key stakeholders need to apply imagination and creativity to explore alternative ways of thinking and acting that may differ from the norm to move beyond “business as usual”. This approach can

help unleash the diversity of human cultures and help us cope with the challenges of living in "postnormal times" (Funtowicz & Ravetz, 1993; Sardar, 2010, 2015, 2021).

To this end, science, government, industry, and civil society rely on critical interactions, exploring direct and indirect social, political, environmental, and economic influences, and building on well-formulated assumptions that inform strategic, tactical, and practical innovation decisions. Additionally, the volatility, uncertainty, complexity, and ambiguity (VUCA) of the contextual environment calls for new capabilities to help anticipate and analyze possible new situations that have emerged or may arise in the future (Buehring & Bishop, 2020; Bühning, et al., 2023).

Fundamentally, the planet's ecological systems are in a steep state of decline, such that no strategic planner in any type of enterprise worldwide, can afford to dismiss it. Innovation strategies are urgently needed on topics such as carbon emissions, pollution, waste, water, human rights, species and habitat diversity, and ethics (Hysa, et al., 2020). In business, these concerns intersect with energy, raw materials, material durability, logistics, supply chains, workforce, consumer behavior, regulation, finance, plus ESG as part of financial reporting.

Derived from our research, and what motivated the call for papers for this special issue, are a set of considerations that provide a provisional framework to underpin and articulate innovation paradigms for Earth Systems Governance. In what follows we map out, and visualize (see Figure 1) these considerations, drawing on previously published academic contributions in several fields including studies of innovation, transitions management, and design, while acknowledging that any such synthesis will benefit from broader discussions across related academic fields. We then introduce the papers and letters in this special issue, exposing how the evidence and analysis they provide contribute toward catalyzing actions and transdisciplinary pathways toward sustainable transitions.

3 Earth Systems Governance – Key Considerations

The first consideration for a viable innovation paradigm for Earth Systems Governance requires acknowledging **planetary boundaries**. Earth Systems Governance involves responsibly and equitably managing the Earth's interconnected systems, including the climate, biodiversity, land and water within the boundaries that ensure the stability and resilience of the planet. According to recent studies, however, we are exceeding several of these boundaries, which poses risks to human well-being and the functioning of ecosystems (Rockström, et al., 2024). Therefore, an innovation paradigm shift is needed to develop and implement transformative solutions that can help us stay within these boundaries. Decision-making must consider the overall boundary conditions and interactions of systems and between actors, the models currently in use to provide the best data support possible, and what influence the human factor plays in analyzing the data and the consequent innovations based on it (Bühning & de Mozota, 2023; Dunlop, Kanninen & Aaltonen, 2015; Kranabítl, et al. 2021).

The second consideration is **tipping points and irreversible changes**: According to the Inter-governmental Panel on Climate Change (IPCC), many Earth systems have tipping points, thresholds beyond which they can undergo rapid and irreversible changes. Examples include the melting of polar ice caps, coral reef degradation, and the collapse of ecosystems (cf. Ritchie, et al., 2021). Consequently, urgent new approaches to innovation are required to prevent or mitigate these tipping points and avoid catastrophic consequences.

A third factor is **time sensitivity**. Addressing global challenges requires acting swiftly, as delays in acting can exacerbate the problems and make solutions more difficult or costly to implement (cf. Guterres, 2023 – UN Security Council). The urgency, therefore, of an innovation paradigm

shift stems from the need to accelerate the development of sustainable technologies, practices, policies, and governance to effectively address Earth Systems Governance challenges.

A fourth consideration is **interconnectedness and complexity**. Earth systems are highly complex and interconnected, with feedback loops and non-linear dynamics (cf. Fan, et al., 2021; Aaltonen 2016) across ecologies and communities that can be conceived of as 'pluriversal' (Mignolo, 2018; Escobar, 2018). This complexity poses challenges for traditional approaches to governance and calls for innovative solutions that can account for the interdependencies and interactions between different systems in an epoch known as the 'Anthropocene'. For example, studies of transition design and design for sustainability (cf. Irwin et al., 2015; Ceschin & Gaziulusoy, 2020) propose approaches, frameworks, and methodologies to advance just societal transitions. Consequently, an innovation paradigm shift can help us develop holistic and integrated approaches to address these complexities.

A fifth aspect of the innovation paradigm is **equity and justice**. Earth Systems Governance must address the social and economic inequities that exist within and between countries (cf. Anderies, et al., 2023). Consequently, an innovation paradigm shift can help promote inclusive and equitable development, ensuring that the benefits of innovation are accessible to all and leaving no one behind. For example, development strategies and practices are based on direct and indirect social, political, environmental, and economic influences, and the assumptions made to inform strategic, tactical, and practical innovation decisions (cf. Vollenbrock, 2002) while also being mindful of questions of ethics and equity.

Recognizing these factors points to a sixth consideration, **resilience and adaptation**. Earth Systems Governance should prioritize building resilience and adaptive capacity to cope with the impacts of climate change, environmental disruptions, and other shocks (cf. Hallegatte, et al., 2020). Consequently, innovative solutions can help communities, businesses, and governments adapt to changing circumstances and build resilience in the face of uncertain futures.

A further (seventh) consideration is **policy innovation**. Complex global sustainability challenges cannot be solved by new technology and novel business practices alone; they require policy innovation to ensure alignment and coherence between industry, science, civil society, and policy actors to communicate shared perspectives of a future committed to public goals (Barile et. al. 2018; Berners-Lee, 2021; Buehring & Borja de Mozota, 2021, Bühning et al., 2023; Dhiman and Marques 2016; Fazey. et al., 2020; Vollenbrock, 2002; Wamsler & Brink, 2018). In this context, innovative forms and processes for governance are required including innovative methods of policy development, citizen participation, and social experimentation to enable transitions to sustainable design and innovations (Fischer & Clausen, 2016; Li et al., 2021; Durose & Lowndes, 2021; Kimbell, et al., 2023).

These seven considerations (Figure 1) map out some of the factors we see as associated with shifting innovation paradigms to achieve Earth Systems Governance:

Each of them requires shifts in practices and, potentially, new forms of institutions to respond to associated governance of challenges and dilemmas. In this context, and with an undeniable sense of urgency to bring into being innovation paradigms in the face of achieving equitable Earth Systems Governance, we organized this special issue into four emerging themes that demonstrate some of the scholarly contributions responding to this challenge, and which establish:

- The need for recognition of the **critical leverage points** in the form of technology evolutions, emerging new technologies, changing market demands, responsive regulation, and shifts in the collective consciousness.

Provisional Framework – Key Considerations

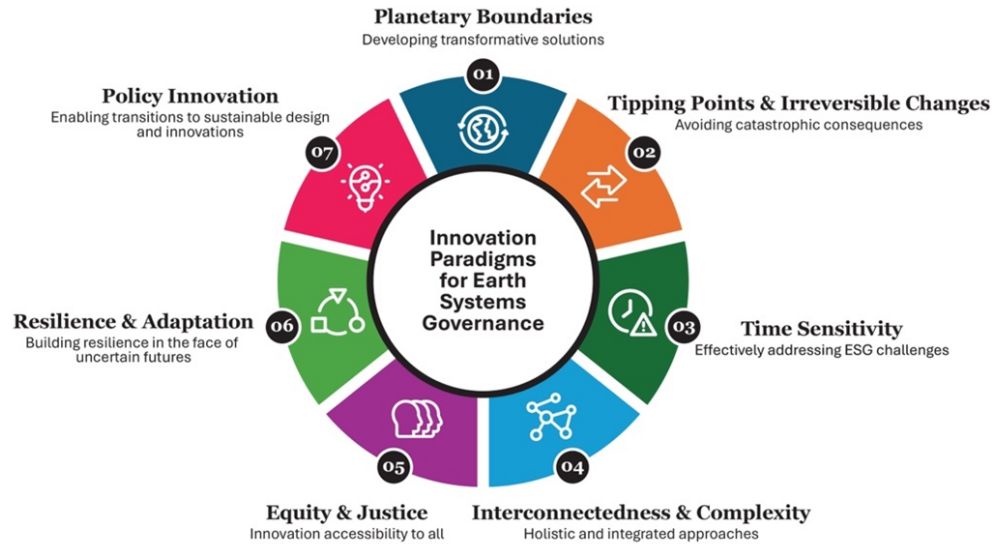


Figure 1. A Provisional Framework for ESG Innovative Paradigms
(Source: Authors) *Illustration: LAM Nga Wing Justina*

- The need for **interdisciplinary and transdisciplinary research** that integrates varied domains of knowledge and insight into the strategic innovation process.
- The need for **distributed collaboration** between governments, businesses, scientists, civil society, and innovators – collectively and continuously learning about the intractable challenges ahead.
- The need for **inclusive and responsible innovations** and outcomes that consider the needs and interests of all relevant stakeholders and population groups, as well as the potential impacts on the environment, society, and future generations.

4 Scholarly and Industry Perspectives – Responses to our Call

The responses received include both research articles and letters from academia and professionals. Contributors to the special issue provide insight and nuance to **identifying and activating critical leverage points**, the first theme across the papers in the special issue. Namely, within research on transition management, the concept of “niches” (Geels, 2010; Geels & Schot, 2010) has consolidated the idea that small-scale innovations in varied locations and types of settings can lead to large-scale transformation. Relatedly, there is growing recognition of the roles and contributors at critical moments or points within a wider ‘system’.

In some areas of the world, national or regional innovation policies play an important part in guiding or shaping transitions. Such activities have symbolic dimensions (providing legitimacy for pathways) and material and financial aspects (providing funds and other resources), as well as

constructing or maintaining infrastructures and processes. Often tied to political agendas, it is rare to find detailed evidence of the business impacts of such innovation investments, including those specifically researching environmental innovation.

This gap is addressed in the paper by Veiga. The focus of this study was the results of a large business support programme using European structural funds of over €40m provided to organizations in the autonomous province of Andalusia in southern Spain. The aid (between 2011 to 2020) financed projects on the condition that they fostered employment, were of a high technological level, and promoted activities likely to increase the added value of the companies involved. The projects could be in any area of business and did not include a requirement to focus on sustainability. Veiga conducted a microeconomic analysis of the impacts of these investments in 337 companies supported through European funding (compared to a control sample of companies that were not). The article shows positive impacts on business indicators as a result of these innovation projects. Companies that participated in environmental or sustainability-related innovation projects (supported through funding) performed better on four business indicators: revenue, GVA, employment, and profitability. The study therefore shows that regional funding mechanisms can play an important role in stimulating businesses, which have the potential to be more targeted (e.g. intentionally focused on sustainable transitions). The implication is that multi-national funding programmes can indeed play important roles in driving essential innovations required to address challenges associated with climate transitions.

Dependencies on **interdisciplinary and transdisciplinary research** come to light in a paper by Lappas et al., where the authors illuminate the challenges associated with the primary missions of governmental agencies to prepare for urgent responses in times of crises. The authors highlight the diversity of stakeholders involved in needing to respond to, and anticipating crises; having frameworks or mental models of social and environmental phenomena is understood to shape, sometimes negatively, potential responses. To deal effectively with situations such as civil unrest, terrorist attacks, earthquakes, or economic shocks, public officials and businesses must prepare for multiple, diverse, and unexpected events. Being able to generate a wide range of alternative responses is essential. Hence, having access to guidance in the development of alternatives can be a catalyst in decision-making processes when time is short, uncertainty and ambiguity are high, and there are pressures to act. To explore this, the authors created mind map templates using established creativity techniques, to be used in the context of national emergencies. They developed and tested the approach through hypothetical security scenarios relating to national emergencies explored by using the proposed technique with 32 military and civil students from seven different European countries. The resulting mental model serves as a checklist for the swift and effective generation of mitigation plans for future emergencies. It points to the challenge of building on expertise and understanding alongside having an anticipatory capacity to develop responses to sudden shocks and to negotiate uncertainty and complexity.

Systemic approaches acknowledge multiple actors involved across society in efforts to address sustainability challenges. There is growing recognition that advancing equitable and sustainable transitions requires **distributed collaboration** across society, which emerged as the third theme of the special issue. The 'Quadruple Helix' (QH) framing is now well-established in practice-oriented research and policymaking as a means for government, business, academia, and civil society to collaborate, share expertise, and work towards societal innovation. However, the challenge of implementing this QH approach, and crucially, civil society engagement within them, is understudied. In their paper, Paskaleva et al. take on this issue and examine claims made for QH in smart cities research. Through a literature review, the authors found that QH approaches are perceived as helpful for legitimizing engaging citizens in decision-making in smart city development.

Previous studies demonstrate a wide range of ways that citizens are involved in different forms of decision-making. However, the evidence base of the results of this engagement is very limited.

Adding to the discussion on how to achieve sustainable growth through distributed (cross-sector) collaborations is Bühning et al.'s *Letter from Academia*, which argues for new approaches to developing executive leadership capabilities that help transform organizations by creating leadership collectives focused on innovative strategies. Taking the industry perspective, Quint's *Letter from Industry* approaches the topic through the lens of collaborative creativity, echoing the need for a shift in mindsets which can be achieved through the language-, ways of thinking-, and the value of design, by design.

With the world's finite natural resources being consumed at an alarming rate, the current linear "take-make-waste" economic model is unsustainable (Wang & Azam, 2024). In its place, governments are increasingly implementing policies and regulations that encourage the adoption of circular economy principles (Hartley, et al., 2023). Adopting circular economy solutions, Pascussi et al.'s paper draws attention to the importance of cross-functional collaboration and knowledge exchanges among teams. Their contribution is focused on theorizing a knowledge governance concept and micro-foundations approach that requires firms to redesign prevailing innovation processes when implementing circular economy principles.

From the innovation management perspective, the business model is the foundational framework that determines how value is created, delivered, and captured sustainably. However, to ensure the realization of value to all participants involved, Pellikka et al. identified a gap in our understanding of ecosystem business models; their paper introduces a case study business model design within the water industry management sector, which revealed the dynamic nature and life cycles of ecosystems.

Another paper considers the topic from end-user perspectives and the collaboration across ecosystems. Maintaining a focus on end-user needs and perspectives is a topic closely associated with design, which several papers address. Within product development and innovation practices, design is often seen as an important resource – both as a stage or phase in the innovation process and as a capability. Hecker et al.'s paper provides an analysis of qualitative interviews with people in managerial or research and development (R&D) roles in 12 material innovation companies in textile manufacturing, biotechnology, and packaging industries. The article identifies a set of seven challenges faced by these firms as they try to innovate regenerative materials at the crucial design stage when decisions can lock in particular ways forward. These include the need for better collaboration across the innovation ecosystem, supported by a regulatory framework to incentivize companies to develop regenerative solutions and set standards. The authors turn to Ulwick's (2005) outcome-driven innovation approach, which prioritizes driving innovation from the perspective of the customer's needs.

Tapiola et al.'s paper examines the challenges associated with the management of (national) innovation ecosystems and the role of publicly funded research institutes within them. They draw on their expertise as employees of a public research institute in Finland, with a focus on innovation in the circular bioeconomy. As in many countries, there are complex interactions across business, entrepreneurs, and government including regulators, the public sector, academia, and civil society. Further, the bioeconomy itself can be considered from various perspectives. In their paper, Tapiola et al. integrate perspectives from studies of risk management, new product development, and innovation processes, recognizing that the development of new bio-based products spans all these considerations. In such contexts, the boundary-spanning activities of a public research institute can play important roles in enabling, or hindering, technology transfer from academia to industry and beyond. Through interviews with researchers in the bio-innovation sector in Finland, the authors

developed a framework and tool that they tested in a workshop and used to examine a case. This research found that many examples of bio 'products' emerge as side products of a research project and are therefore disconnected from the understanding of end users and markets. They concluded that for a public research institute to enable innovation, both the companies it works with and researchers must understand the entire value chain and the needs of the various actors involved including 'end users'. The implication is that without such an orientation potentially important innovations will remain as 'inventions' that do not disseminate through society.

A fourth theme in this special issue is **inclusive and responsible innovation**. Here, exploring the boundaries of responsible innovations, Thelen et al.'s paper brings to our attention the application of an outcome-driven innovation method (ODI); in the context of product development and electric mobility space, the approach seeks to inform the design of electric two-wheeler product and service development. The paper concludes that establishing a citizen feedback loop during the product design and innovation stages adds to a responsible approach to innovation.

One sector where such challenges are very visible is energy. The language of 'energy transitions' is widespread in policy and practice, recognizing the complexity of the socio-technical systems and variety of the organizations, infrastructures, and resources associated with the sector. The paper by Önnared brings new perspectives to energy transitions in the European Union by applying the lens of participatory systems thinking. After a year-long process of exploring futures such as 'megatrends', the authors iteratively framed and articulated a set of challenges for contemporary energy systems. Noting the need to shift from profit-centered to purpose-centered economies, the authors argue for a reconfiguration of the energy sector to navigate the complexity and the interrelatedness between different societal actors including policy, business, industry, science, and culture.

5 Conclusion

The articles and letters selected for inclusion in this special issue demonstrate that innovation paradigms required for Earth Systems Governance are a 'work in progress' that is complex, experimental, and where evidence is sometimes scarce. Collaboration and interdisciplinary research across society are understood to be prerequisites for innovation towards Earth Systems Governance, in which frames such as 'Quadruple Helix' are considered to be useful. However, the evidence base is still at an early stage, roles are unclear, and institutional barriers get in the way. Hence, even in contexts specifically associated with innovation such as government-funded programmes for business or in sectors with high levels of R&D, the papers suggest that prevailing innovation paradigms are insufficient to address the urgent challenges associated with climate breakdown and environmental degradation. Though there is progress, the need for a reconfigured, and reconfiguring, innovation paradigm remains urgent.

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