

## Expanding the Frontiers of Innovation

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With the global landscape characterized by planetary challenges, uncertainty, and rapid change, innovation is increasingly hailed as the solution to today's and tomorrow's issues (de Vasconcelos Gomes et al., 2022; O'Connor & Rice, 2013). To cope with this context, companies are developing dynamic capabilities to foster organizational agility (Teece et al., 2016), integrating diverse disciplines and knowledge domains to accelerate the transition from discovery to innovation (Sharp, 2014). We believe this is necessary—but insufficient—to face the challenges we see in front of us, as these cannot be tackled with the same approaches used at the beginning of the 21<sup>st</sup> century. We should continue experimenting with innovation as a methodology, along with its processes and tools. This should embrace factors such as ecological impact, AI applications, responsible governance, openness, collaboration, customer orientation, and systemic thinking.

Addressing grand challenges requires reaching beyond the status quo to consider infrastructure, capabilities, network, and institutional opportunities across different ecosystems (Ritala, 2024). These challenges, such as climate change, aging societies, food security, and global health issues, demand transformative strategies and collaborative efforts across sectors (Coenen et al., 2015; Voegtlin et al., 2022). Developing new methods, fostering collaboration across disciplines, navigating regulatory challenges, and embracing new perspectives are all crucial for driving meaningful progress. We need to move beyond the present frontiers of innovation to spark new ideas and research at the crossroads of scientific curiosity and societal impact.

The papers in this issue offer novel insights and tools to recraft and extend innovation beyond its traditional domains to focus on complex global challenges, driving innovation frontiers toward transformative and impactful outcomes. In an era where economic growth, societal progress and social equity are focal for policy makers, this issue explores the power of structure and experimentation to surface the complexities of university and industry collaboration.

In the methodological note, “Advancing Design through Science and Research,” Auernhammer (2024) explores the development of Design as a fundamental activity to create and shape the artificial world, vital for innovation and to ensure the survival of all living species. The author challenges the reader on the existence of a Science of Design and distinguishes between three key

concepts: Science for Design, Design Science, and Design Research. Science for Design uses scientific methods to generate insights and theories that directly inform design practices. Design Science, on the other hand, focuses on understanding the relationship between a design's purpose and the means used to achieve it. It emphasizes systematic evaluation of a design's effectiveness in fulfilling its intended function. Design Research takes a broader approach, examining the dynamic relationships within a design situation to consider the social and contextual factors influencing design outcomes. The article advocates for a holistic advancement of Design through Science and Research, where multiple perspectives, measurements, and methodologies are employed to create comprehensive design knowledge.

This issue also encourages us to look beyond traditional frameworks and embrace new dimensions of innovation. Achieving transformative innovation requires that assumptions are challenged to explore seemingly "unthinkable" or "impossible" avenues. To address these challenges, companies should develop innovative approaches that are fitted to their needs. Fresh out of corporate labs, the Progressia method integrates the Technical Readiness Level with a Need/Market Assessment ladder, providing a toolkit to align technological advancements with market demands to accelerate smooth adoption and commercialization (Turetta & Costanzo, 2024). As a method focused on corporate settings, Progressia is explicitly tailored for technological and market maturation. The TRL ladder assesses the technology's maturity, while the Need/Market Assessment ladder evaluates the project's market readiness and alignment with user needs. The article uses two case studies from the agri-food industry to illustrate how Progressia guides projects through concept development and user research, to pilot testing and market launch. The authors conclude that Progressia's dual-ladder approach enables a structured and comprehensive assessment of innovation projects for increased market success.

While embracing unconventional ideas, this issue also acknowledges the importance of structure and rigorous evaluation. The article by Dieing (2024), “Making skills: how courses on digital fabrication enhance 21st-century skills,” examines how micro-courses on digital fabrication can enhance 21st-century skills among students, emphasizing the value of a



structured approach that combines self-study, video tutorials, and face-to-face interaction. The authors argue that traditional classroom training can be supplemented by blended learning, where students construct their own learning strategy. The study focuses on four specific 21st-century skills: acquiring basic skills in digital fabrication, self-efficacy, self-initiative, and learning competence. To achieve this, the researchers designed a blended learning approach consisting of self-study materials, video tutorials, and face-to-face appointments. This design allows students to experiment iteratively by choosing the devices and learning paths best suited to their learning styles and objectives. The study's results, based on student interviews and analysis of project submissions, show that the courses successfully taught both digital fabrication skills and 21st-century skills. The paper concludes that other universities can adopt this approach to enhance their digital fabrication training.

The study from Arteagoitia and Fuller (2024), "Using experimentation to boost university-industry collaboration," examines the potential of using experimentation, specifically randomized controlled trials (RCTs), to improve university-industry collaboration. Experimentation in innovation is a generally underutilized but valuable approach to studying the impact of innovation activities to provide robust evidence on the effectiveness of different interventions. This study is part of the ATTRACT Socio-Economic Studies (Vignoli & Wareham, 2024; Wareham et al., 2022) where the ATTRACT NEXT project, led by the Innovation Growth Lab, developed two essential resources: a Handbook on Experiments in University-Industry Collaborations and a University-Industry Impact Accelerator. The handbook provides a framework for identifying key experimentation challenges and provides testable interventions. The Accelerator program supports the design and piloting of these interventions, focusing on areas such as researcher motivation, capacity-building, and relationship development. The authors conclude that purposeful experimentation can lead to more effective university-industry collaborations, supported by evidence-based policymaking and program implementation.

Global challenges require a change of mindset while evaluating the role of policy in innovation. State aid regulations—on property rights specifically—can complicate collaboration between research infrastructures and other organs of industry investment (Fric et al., 2024). The paper by Fric and colleagues (2024), "State Aid in Academia-Industry Cooperation: An Overview of the Existing Conditions and Challenges Through the ExSACT Project," investigates the existing conditions and challenges of state aid regulations within academia-industry collaborations, focusing on the ATTRACT European Research Infrastructures' Innovation Ecosystem (ERI-IE). The authors highlight that while state aid is crucial for fostering these collaborations, the existing regulations are often

complex and hinder the smooth transfer of knowledge and technology. Through surveys and interviews, the ExSACT project, which is part of the ATTRACT Socio-Economic Studies, aimed to understand how state aid rules impact various aspects such as research funding, infrastructure usage, and intellectual property rights (IPR) management. The findings suggest a limited awareness and understanding of state aid regulations among stakeholders, leading to sub-optimal benefits from these collaborations. The authors propose simplifying these regulations, improving their understanding among stakeholders, and providing better support mechanisms to navigate the complexities of state aid. This, they argue, will lead to a more efficient and effective technology transfer process between science, academia and industry.

The papers collectively emphasize the importance of structured approaches to innovation and collaboration, highlighting the need for methods to manage uncertainty, align technological development with market needs, and facilitate effective knowledge transfer between academia and industry. With a departure from traditional approaches, the collection of articles provides concrete examples of how experimentation, structured frameworks, and a willingness to embrace new dimensions of thinking can pave the way for a more sustainable and innovative future. With a critical examination of the complexities of academia-industry collaborations, the challenges of state aid regulations, and the limitations of existing paradigms like Design Thinking, this issue contributes to a richer understanding of the innovation landscape and the urgent need for bold, experimental approaches in tackling global challenges.

The urgency of extending current innovation practices might emerge more clearly while looking at the coffee grounds at the bottom of your empty cup. When practicing this Arabic tradition, which arrived in Europe in the late 17th century, pay attention to the shapes inside the cup to gain insight into your future, and observe the sediment that settles onto the saucer to understand your current situation. While doing this ceremony, do not forget to read our coffee paper, "Are your dimensions transformative?" emphasizing the cruciality of new dimensions for transformative innovation. It uses historical examples like the double-entry bookkeeping and Einstein's theory of relativity to demonstrate that breakthroughs often come from exploring and understanding new perspectives and dimensions. The reading suggests that while design thinking is a valuable approach, additional techniques that reach beyond the traditional feasibility, viability, and desirability attributes are needed. It encourages a shift in thinking towards new dimensions to unlock truly transformative solutions.

This issue provides valuable insights for researchers, practitioners, and policymakers, presenting novel frameworks and methodologies to enhance our ability to innovate effectively and bridge the gap between academic research and industrial application. It offers a

starting point for a broader conversation about the future of innovation. As we navigate an increasingly complex and interconnected world, it is more important than ever to foster collaboration, challenge assumptions, and embrace new dimensions of thinking. More importantly, it is only by working together that we can push the boundaries of creativity and drive societal innovation in a way that benefits all.

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