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EDITORIAL

Research in action to push the boundaries of scientific research and technological development

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Lying in the space of human curiosity, this issue of CIJ experiments with the boundaries of scientific exploration to foster technological development. To cultivate experimental innovation, it is imperative to translate research into tangible action, explore multifaceted problems, offer support for implementation, and effectuate meaningful changes. For example, *action research* interventions (Guertler, 2024) function similarly to experiments, testing specific hypotheses and research questions, allowing for continuous learning and refinement of research directions in a concrete setting. Similarly, *open innovation* enhances experimental innovation by incorporating external knowledge and expertise, which can lead to more comprehensive and creative solutions. On the other hand, the integration of design thinking provides a structured framework that emphasizes empathy, problem identification, and the co-creation of solutions. This method aligns with experimental innovation by encouraging iterative testing and refinement of concepts through an anthropological engagement with relevant stakeholders.

THE ATTRACT PROJECT

The novelty of this issue is the inauguration of a new Special Section on *Attract Socioeconomic Studies*. The concept of the ATTRACT program revolves around fostering innovation by bridging the gap between fundamental scientific research and market-ready technologies. This European initiative speaks to a wide range of stakeholders, including researchers, entrepreneurs, and industry leaders, to develop innovative technologies with strong commercial potential and societal impact. The etymology of the word "attract" comes from the Latin "attrahere," which means “to draw (objects or persons) to oneself,” it is also a medical term for the body's tendency to absorb fluids and nourishment. This is embodied in the ATTRACT program, which is designed to draw together diverse ideas, talent, and resources to create a dynamic environment where science-based deep technologies are nourished to high levels of market readiness. As part of the European Union's Horizon 2020 framework, ATTRACT is a funding policy experiment designed to support projects that bridge the gap between advanced scientific research and commercial applications, creating a robust ecosystem that encourages innovation across various scientific and technological fields (Pennings et al., 2018). This is an experiment designed to explore whether an innovation ecosystem can support the market exploitation of deep tech on a large scale, allowing scientists to feel supported in their pursuit of technology commercialization alongside fundamental research.

The ATTRACT program changes the world of innovation by providing a scaffolding framework that provides crucial funding, fosters open and collaborative innovation, encourages academic entrepreneurship, and facilitates the early stages of technology commercialization. One of the key levers of the ATTRACT program is its funding mechanism, which provides substantial financial support to selected research, development, and innovation (R&D&I) projects. ATTRACT is divided into two phases. During Phase 1, the funding helps to develop proof-of-concept prototypes to accelerate the commercialization process of novel technologies. Phase 2 builds upon the success of Phase 1 by funding the most promising breakthrough technology concepts. These concepts have strong potential for scientific, industrial, and societal applications. The goal is to de-risk these nascent ideas and make them commercially attractive to private investors. As such, ATTRACT Phase 1 kick-started projects with TRLs from 1 to 4. Phase 2 now aims to strengthen collaborative interactions among the actors, fostering an innovation ecosystem focused on TRLs 4 to 7. These efforts collectively enhance the capacity of European researchers and institutions to develop and commercialize cutting-edge technologies, thereby strengthening the global competitiveness of the European Union in the field of deep-tech innovation.

ATTRACT SOCIO-ECONOMIC STUDIES

All this would be left unnoticed without scholars who help study the critical elements of a platform to systematize serendipity for big science infrastructures: the ATTRACT Socio-Economic Studies (Wareham et al., 2022). During Phase 2, a comprehensive socio-economic study was conducted to assess whether ATTRACT successfully streamlines the upscaling of

breakthrough technology concepts. The Socio-Economic Studies provide critical insights into the economic and social impacts of the ATTRACT program.

The Socio-Economic studies of ATTRACT also explore the broader impacts of these innovations on employment, industry growth, and societal well-being. These studies help guide policy and investment in the science and technology sectors by assessing the developed technologies' economic viability and social utility. In this special section, we asked the scholars of this study to report their research to inform our readers of the main results that ATTRACT has achieved as an innovation experiment. Following, Table 1 reports a summary of the ATTRACT Socioeconomic Studies.

Title	Abstract	Aim	Expected Impact
NEXT	Uses experimental methods to evaluate and improve science commercialization initiatives.	To increase the success of science commercialization initiatives through experimental approaches.	Provide actionable insights for innovators, policymakers, and technology transfer actors, to enhance commercialization efforts.
ATTRACT-EMDOI	Investigate factors contributing to the success of breakthrough technologies in commercialization.	To analyze entrepreneurial mindsets, diversity in research teams, and open innovation practices.	Enhance the commercialization of breakthrough technologies by understanding individual and team factors better.
ABC4E	Aims to improve open innovation in ERI science-driven projects through behavioral training.	To develop scientists' psychological flexibility and empower knowledge exchange in open innovation processes.	Boost collaboration between scientists and researchers from industry and other disciplines.
CASEIA	Compares socio-economic impact at the project level within particle accelerator case studies.	To understand how ATTRACT support has led to broad-spectrum socio-economic impact.	Strengthen innovation ecosystems and commercial applications of innovation.
COMPUTE IMPACT	Focuses on the impact of data/computational technologies produced by ERI-IE in the life science industry.	To understand how industrial partners benefit from bioinformatics research infrastructures.	Contribute to a better understanding of Research Infrastructures' impacts on industrial counterparts.
ExSACT	Explores the effect of state administration on financing research and intellectual property rights.	To develop procedures for efficient and long-term cooperation of companies with research organizations.	Improve the Intellectual Property and R&D collaboration approach, especially concerning state aid.
NEXTGEN-TECH-ED	Focuses on the didactical design of science and tech entrepreneurship education.	To contribute to knowledge circulation in innovation ecosystems through Science-based Entrepreneurship Education.	Develop a systematic understanding of the contribution of this type of education to the innovation ecosystem.
CORE	Explores European Research Infrastructure innovation ecosystems from a systems perspective.	Investigates how social connections and knowledge dissemination fuel effective collaboration, laying the groundwork for transformative innovation.	Contribute insights into effectively identifying connections for technological and science-based innovation opportunities.

These projects collectively cover a broad spectrum of activities, from improving commercialization, fostering open innovation, or measuring the larger socio-economic impacts of science and technology research. Each project contributes uniquely to the overarching goal of increasing the benefits of deep-tech investments for Europe's economy. The studies also offer recommendations for the next generation of ATTRACT. These include integrating ATTRACT into broader initiatives, infusing design research mindsets, and enabling ongoing feedback loops in R&D&I projects. By augmenting traditional impact metrics, ATTRACT Socioeconomic Studies help realize the full socioeconomic potential of European Research Infrastructure Innovation Ecosystems like ATTRACT.

In this issue, we present the results of two projects, ATTRACT-EMDOI and NEXTGEN-TECH-ED, that share a common interest in the commercialization and societal application of scientific research. The ATTRACT-EMDOI project investigates how entrepreneurial mindsets, diversity in research teams, and open innovation processes contribute to the commercial success of breakthrough technologies. It aims to push R&D&I projects over the "valley of death" towards targeted market applications. The NEXTGEN-TECH-ED project focuses on the didactical design of science and tech entrepreneurship education. It explores how training, specifically designed for science-based entrepreneurship, can contribute to knowledge circulation in innovation ecosystems, benefiting students, researchers, and practitioners. Both projects recognize the importance of entrepreneurship education. The projects aim to optimize the conditions for scientists and their home organizations to address societal problems through commercialization and education.

The study by Feenstra et al. (2024) "Are Open Innovation and Entrepreneurial Intentions complements or substitutes for the successful commercialization of academic Breakthrough Technologies?" examines the interplay between entrepreneurial intentions and open innovation in the context of academic entrepreneurship. It provides insights into how open innovation activities can complement or substitute entrepreneurial intentions in the academic setting. Specifically, the authors find that inbound and coupled open innovation activities can compensate for lower entrepreneurial intentions among scientists, suggesting that collaborative efforts can enhance the experimental innovation process.

The paper by Fisher et al. (2024) "Entrepreneurial Self-Efficacy of Scientists: A qualitative study on ATTRACT Phase 2 R&D&I Ventures" contributes to the literature on entrepreneurial self-efficacy (ESE), focusing on the characteristics of scientists. The authors describe how and why the successful commercialization of scientific innovations often requires that science-based entrepreneurs have dual self-efficacy, that is, professional identities that reflect both scientific norms and commercialization goals. This research enriches the understanding of how educational, institutional factors and individual differences influence the development of entrepreneurial competencies in scientific domains. It extends the body of knowledge on ESE by exploring unique antecedents relevant to scientists, aspects typically ignored in the broader ESE literature, and underscores the importance of human attributes to bridge the gap between scientific research and market applications.

Hence, with this Special Section at CIJ, we aim to provide concrete evidence that can inform policymakers about the potential economic, social, and environmental impacts of deep-tech innovations. We also wish to strengthen collaborations between research institutions, industry, and public entities.

METHODOLOGICAL NOTE ON ACTION RESEARCH

We present the third paper of our Methodological notes. We now direct our focus to action research after design science (Romme, 2023) and quasi-experiments (Florio & Castelnovo, 2023). Guertler and Sick (2024), in their paper "Action research: Combining research and problem solving for socio-technical engineering and innovation management research" discuss the application of action research (AR) as an experimental methodology in socio-technical engineering and innovation management. This paper impacts the literature on AR by detailing its use in real-world interventions that combine academic perspectives with practical problem-solving. It contributes to the streams of organizational change, systems engineering, and innovation management by demonstrating how AR can be effectively utilized to address complex socio-technical experiments.

COMPLEMENTARY PERSPECTIVES

The paper by Sierra and Di Stasi (2024) "Multiplicity and diversity: the key for innovation" explores the impact of diversity on innovation within educational teams. By examining how multiplicity and diversity in team composition influence learning innovation, this research adds to discussions in organizational behavior and educational psychology, particularly in the context of interdisciplinary and multicultural team settings.

Ranti, Arumsari, and Lee (2024), in their paper "Exploring student and teacher perspectives on education with technological advancement in Indonesia through Design Thinking in response to COVID-19" investigate the use of Design Thinking to address challenges in technology-driven learning during the COVID-19 pandemic in Indonesia. This paper influences literature on educational technology and instructional design by showcasing how Design Thinking can be

applied to develop practical solutions for online learning challenges. It also touches on the broader implications of technology in education, contributing to ongoing discussions about effective educational practices in crisis situations.

The article by Dajani and Šaranko (2024) highlights the impact of unconscious bias on creativity and idea generation within multidisciplinary teams. Participants were engaged in diverse team activities at a CERN IdeaSquare Summer School, underwent ethnographic research, and completed a survey on biases in the ideation process. The paper's main findings focus on how unconscious bias influences the ideation process in multidisciplinary teams, leading to reduced creativity, reluctance to explore new directions, and criticism of differing ideas. The study underscores the need for proactive measures, such as open communication and managerial coaching, to recognize and address these biases.

These papers leverage the interconnectedness of diverse literature streams to underscore the importance of interdisciplinary approaches in addressing contemporary challenges in innovation, education, and organizational studies. By focusing on these strategies, organizations and researchers can enhance their capacity for experimental innovation, leading to more effective and sustainable solutions in various fields.

This issue ends with an invitation for a coffee at Ideasquare (AA.VV, 2024), the innovation space at CERN, where in the last two years (2021-2023), +24,339 cups of coffee were consumed (CERN & Leveratto, 2023). In fact, the coffee paper's main purpose is to explore the conjecture that "Coffee is a device for turning conversations into transformative innovations" by examining the historical role of coffee consumption in major transformative innovations. Is coffee the secret ingredient in the recipe for transformation? The paper employs a playful and speculative approach to investigate this theme, blending historical anecdotes with a creative examination of coffee's impact on innovation, ultimately leaving open questions for further research. It's part of history that one of the first applications in the World Wide Web, invented at CERN in 1989, was a solution to watch over coffee in Cambridge to allow academics to continue working until fresh coffee was brewed (Xcoffee, the first webcam). So, as we sip on the last drops of our espresso, let's raise our mugs to the humble bean that fueled humongous moments of eureka around the world. We need to celebrate the fact coffee isn't just a beverage, it's a catalyst for the alchemy of ideas. As we ponder the caffeinated mysteries of creativity, let's not forget to refill our cups: The best discussions (and perhaps the next world-changing idea) are just a coffee break away. After all, the next transformative innovation might just be brewing in the bottom of your cup.

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