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EDITORIAL

Living on the Edge: Limits and Frontiers as the Engine of Innovation

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There's a romantic misunderstanding that often accompanies public talks about innovation: the idea that real innovators "break constraints," "think without limits," and treat boundaries as obstacles to be demolished. Yet anyone who actually works on the new knows this: limits are not merely barriers; they are interfaces. They mark the zones where different logics collide—exploration and exploitation, imagination and feasibility, science and markets—and where novelty becomes possible precisely because it is forced to negotiate across a frontier. Limits are also maps, thresholds, and ways of orienting ourselves. And most of all, they're where almost everything happens.

We often imagine innovation happening at the center—in the heart of the lab, in the middle of the boardroom, or the core of the university. But the research suggests otherwise. Innovation is an act of the edge. It happens on the frontier, as a practice of living at the edge. In organizations, that edge is not poetic—it is structural. Classic work on bureaucracy has already framed formal control as a systematic constraint on creativity, especially where compliance, predictability, and productivity take precedence over experimentation (Thompson, 1965). Contemporary organization design research pushes the point further: there is no single "best" structure for innovation, but rather an efficient frontier of designs that deliver different mixes of exploration and exploitation (Csaszar, 2013). In other words, innovation is not the absence of structure; it is the continual search for a structure that stays on the productive boundary—enough order to coordinate, enough slack to discover.

Innovation, more than a sprint forward, is a life on the frontier. It sits on the thin line between order and chaos; between the language that makes something feasible and the language that makes it imaginable; between the laboratory that controls and the real world that disrupts. And it's precisely when we move "to the edge" that the most interesting paradoxes show up: sometimes you need more structure to be free; sometimes you need more distance from reality in order to return to it with a better idea.

In the sociology of science, the concept of the "frontier" has long served as a defining metaphor. If it is viewed through the lens of Thomas Gieryn's concept of "boundary-work" (Gieryn, 1983), where science struggles to demarcate itself from non-science, the frontier is never merely a line on a map. It is a zone of high tension, high risk, and high potential. It is the liminal space where the known bleeds into the unknown, and where order fights with entropy.

The papers collected in this issue of the *CERN IdeaSquare Journal of Experimental Innovation* do not merely describe innovation; they map its geography. They do not describe a safe, linear process; they describe a tension between opposing forces. Collectively, they suggest that innovation is an act of "boundary spanning"—a persistent effort to navigate the cognitive, structural, and institutional frontiers that separate scientific inquiry from societal impact.

First, we visit the Cognitive Frontier. Here, language is the mapmaker. In classical innovation literature (e.g. March, 1991), organizations face a trade-off between *exploration* (pushing the frontier of new possibilities) and *exploitation* (refining what is known). Several articles in this issue investigate the cognitive mechanisms that allow us to cross this frontier.

This is the central tension in the Ramasubramiam et al. (2025) study. The authors use "Construal Level Theory" demonstrating that language itself acts as a mechanism of travel. They find that abstract, metaphorical language encourages students to engage in "high-level construal," effectively transporting them across the psychological distance to the frontier of divergent thinking. Conversely, technical jargon acts as a gravity well, anchoring thinkers to "low-level construal" and the immediate limitations of feasibility. Therefore, the words we choose determine how far we can travel. Technical jargon acts like gravity, keeping our feet on the ground of "feasibility," while abstract metaphors— e.g. calling sensors "little trampolines"— release us to cross into the unknown territory of creativity.

Similarly, Mahjoobi and coauthors (2025) in their Expert Consultation study reveal that bringing a guide (an expert) to this frontier too early can be a trap. While expertise is often viewed as the ultimate resource, this study reveals that experts can function as "anchors," creating cognitive fixation, preventing teams from seeing what lies beyond the horizon, thus making it

harder to cross the cognitive frontier into new territory. When teams encounter experts too early at the frontier of ideation, they risk retreating into "functional fixedness," unable to imagine applications beyond the expert's existing map. Thus, crossing the cognitive frontier requires a delicate balance: enough abstraction to dream, but enough technical grounding to build.

So far, we've discussed "internal" limits (structures, minds, team dynamics). But innovation is also played out on an external and very hard boundary: the structural one between producing knowledge and creating value in the world. This is the chasm between science and society, between the laboratory and the marketplace. Sociological theories of science (e.g. Star & Griesemer, 1989) describe "boundary objects" as tools that allow different communities (e.g., scientists and business people) to collaborate across their frontiers without losing their own identity. The development of the Research Infrastructure Business Model Canvas (RI-BMC) (Ecchia et al., 2025) exemplifies the design of a new boundary object. It serves as a map that enables scientists, funders, and policymakers to meet at the intersection of their respective worlds. As the authors note, standard commercial logic fails to capture the value of public science. By translating "customers" into "stakeholders" and "revenue" into "finance and opportunities," the RI-BMC creates a shared map that allows scientists, policymakers, and funders to meet at the frontier of public value creation. Similarly, the Flores-Tuxpan et al. (2025) paper describes Technology Transfer Offices (TTOs) as "bridges" or mediators that must span the "valley of death" between the academic frontier and the commercial market. These offices operate in a harsh frontier environment, lacking the stable "institutional roads" found in more developed ecosystems, forcing them to function as pioneers reconciling the disparate languages of science and business.

And here the opening theme returns: innovating often means rewriting the boundary, not denying it. If the second frontier is structural, the third is institutional. How do we stop our organizations from collapsing under their own weight? Organizational ecology suggests that institutions have growth limits (e.g. Hannan & Freeman, 1977). If they become too complex, they suffer from entropy and collapse. The "Star that ate itself" coffee paper (Anonymous, 2025) literally applies the astrophysical "Chandrasekhar Limit" to organizations, a tipping point where bureaucracy overwhelms purpose. It argues that once an organization crosses a specific density of bureaucracy (the "Organizational Event Horizon"), innovation can no longer escape. To survive, the organization must radiate energy outward - trust, purpose, and clarity - pushing against its own collapsing frontier.

Finally, this issue addresses the methods used to study these phenomena. Innovation research constantly navigates the trade-off between Internal Validity (the control of the lab) and Ecological Validity (the chaos of the real world). The methodological note on laboratory experiments (Guerci, 2025) visualizes this not as a binary choice but as a continuum—a line segment stretching from the isolation of the lab to the complexity of the field. Researchers must consciously choose where to stand on this frontier to claim causal understanding.

Complementing this development is the publication of a dataset on student interactions with Generative AI (Sairanen et al., 2025), collected at IdeaSquare. This dataset records real-time engagement with emerging technologies, providing scholars with insights into how the next generation of innovators employs AI as a collaborative partner in problem-solving. With this publication, we inaugurate a new special section of the CERN IdeaSquare Journal of Experimental Innovation dedicated to publishing datasets.

To read these papers is to understand that the innovator is, by definition, a boundary dweller. Taken together, this constellation of ideas tells a simple, uncelebrated truth: innovation doesn't sit comfortably in the center. It lives on the edge. And on the edge you survive by oscillating.

- Too much structure and you collapse: your "event horizon" swallows ideas.
- Too much abstraction and you build nothing; too much technique and you imagine nothing.
- Too many experts too early and you stop exploring; too late and you build impossible castles.
- Too much academia and you stay in papers; too much market and you lose what makes research unique.

So the point isn't "overcoming limits." It's learning to inhabit them. To innovate requires the cognitive agility to use abstract language to escape the gravity of the known, the structural discipline to avoid collapsing into bureaucracy, and the social skill to build bridges across disciplinary divides. The papers in this issue serve as field guides to balance on the line between the abstract and the concrete, the chaotic and the bureaucratic, the scientific and the commercial.

Maybe the right editorial on innovation today should stop celebrating only rupture and start celebrating the harder art: maintaining the edge. Don't stay safe in the center. Come out to the edge, this is where you find us.

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