

Scaling Europe's Financial System

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Dear reader,

Europe's capital markets agenda is entering a new phase. The Capital Markets Union (CMU) has long been positioned as a response to fragmentation, aiming to deepen liquidity and broaden access to funding. In March 2025, the European Commission relaunched that ambition under a wider banner: the Savings and Investments Union (SIU), designed to connect household savings directly with productive investment and to bring pensions, market infrastructure and supervision into a single agenda.

This edition of the Journal of Financial Services sits at that turning point. Contributions from academics, market infrastructures, banks, EU institutions and legal experts converge on a shared question: is the SIU another slogan, or a strategy that can actually work?

Europe's starting point remains unresolved. Capital markets are still fragmented along national lines, shaped by differing legal and regulatory frameworks. While the ambition behind CMU, and now the SIU, is widely supported, progress has been uneven. This leaves Europe structurally distinct from the United States, where markets are deeper, more unified and channel a far greater share of household savings into productive investment.

Closing that gap is, at its core, a question of scale: how a patchwork of national markets can become one system large enough to compete. That question runs through this edition, from what it would take to move from fragmentation to scale, to what the SIU would need to look like decades from now to have actually delivered on its ambition.

Scale cannot be built on integration alone. It also depends on supervision that treats the single market as genuinely single, rather than as a set of national regimes operating in parallel. Several contributors now frame this question in terms of sovereignty, from institutional autonomy to Europe's dependence on cloud, compute and capital that it does not control.

Sustainability adds a further layer of complexity. As European capital markets integrate, they are also expected to channel funding towards the green transition. This edition looks at where sustainable-finance and capital-market architectures reinforce each other, and where they still pull in different directions.

These developments form the backdrop to the perspectives brought together in this edition. Decisions on market integration, supervision and sustainable finance will shape Europe's ability to compete and to mobilise capital at the scale its economy needs.

Europe's position is complex. Compared with the United States, the challenge is alignment as much as scale. Compared with more centralised financial systems elsewhere, Europe must balance deeper integration with national autonomy and existing market structures. This complexity may prove to be a strength, but only if it is matched with delivery.

The contributions in this edition reflect that direction. Progress will require coordination across capital markets policy, financial supervision and sustainable finance, alongside space for innovation and experimentation, including through regulatory sandboxes. The SIU is therefore evolving beyond a policy label into a test of whether Europe can turn a long-standing ambition into a working financial system.

For financial institutions, this is no longer a distant ambition but a near-term reality shaping funding strategies, supervisory relationships and cross-border operating models. The task ahead is not simply to integrate markets, but to do so while preserving room for innovation and strengthening resilience.

That balance will define the next phase of European financial services.



Stefan Dierckx, Founder & CEO, Projective Group



Scaling Europe's Financial System

Regulatory sandboxes under scrutiny: five dimensions in need of attention¹

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1. This paper is the result of a panel entitled "Regulatory sandboxes as instruments for rethinking public law: actors, learning, and multi-level governance," which was presented by the authors at the ICON-S Annual Conference in Dublin in June 2026. All of the contributing authors are members of "CybeRights Interuniversity Research Centre", a research centre established within the framework of SPOKE 1 of the Extended Partnership SERICS (Security and Rights in CyberSpace). CybeRights is dedicated to researching, training, and providing technical-legal support on the societal impact of digital technologies, building on and extending the activities originally developed within the SERICS project.

2. The views and opinions expressed are those of the author only and do not reflect or represent any official policy or position of the European Commission.

3. The Ph.D. project funded by the Italian National Cybersecurity Agency, the views expressed are of the author and do not necessarily reflect the Agency's official position.

ABSTRACT

Regulatory sandboxes have become a key instrument in EU digital governance, and substantial academic research has mapped their legal framework and assessed their operational effectiveness. This paper does not revisit that ground. Instead, it identifies a set of structurally important questions that have been inadequately investigated in the existing literature. These questions address the fundamental issue of whether sandboxes can function as legitimate, effective, and democratically accountable instruments of public law. The analysis is structured around five dimensions. The first concerns the co-regulatory shift that sandboxes represent, as well as the associated legitimacy issues and risks of regulatory capture. The second dimension examines the conditions under which sandboxes can facilitate genuine regulatory learning rather than merely bilateral information exchange. The third dimension addresses communication as a critical yet systematically underspecified governance function throughout the sandbox lifecycle. The fourth dimension examines the territorial aspect of sandbox governance, where a significant gap remains between legal possibility and operational readiness. The fifth dimension explores the relationship between sandbox design and the operational protection of fundamental rights. Together, these five dimensions reveal that sandboxes are not merely governance instruments; they also mirror the structural tensions running through EU digital governance. Improving them requires addressing issues that extend well beyond the instrument itself at a time when the current governance choices will indelibly shape how the digital domain is governed and organized.

1. Introduction

Regulatory sandboxes have become one of the most widely discussed instruments in contemporary EU digital governance. A substantial body of scholarship has now been established, laying out their conceptual foundations, mapping their legal architecture across key regulatory frameworks, and beginning to evaluate their practical applications. Rather than retracing this ground, this paper builds on it. It starts from the premise that regulatory sandboxes are structured environments for supervised experimentation, designed to facilitate compliance, enable regulatory learning, and support market access for innovators operating in complex regulatory landscapes.

However, regulatory sandbox literature and governance, despite its sophistication, has not adequately investigated a set of structurally important questions, essential to ensuring that the growing investment results in effective, inclusive, and democratically accountable governance. This contribution, therefore, aims to highlight aspects of the regulatory sandbox phenomenon that require sustained analytical attention, to propose frameworks where they are currently absent, and to begin evaluating tentative responses where the evidence permits.

Five dimensions structure the analysis.

The first of these dimensions concerns the potential “co-regulatory” approach that sandboxes embody, and the questions of legitimacy that it raises. As compliance solutions are (co)developed through structured dialogue between regulators and the entities they regulate, the traditional framework of public law-making is reshaped. The risk of regulatory capture and ethics washing remains insufficiently theorized and unaddressed.

The second dimension considers the conditions under which regulatory sandboxes can facilitate genuine regulatory learning rather than merely bilateral information exchange. Experimental governance literature identifies a demanding set of criteria (transparency of objectives, structured feedback mechanisms, periodic revision, and outward-facing accountability), which most existing regulatory sandbox designs should carefully consider in view of successful regulatory learning.

The third dimension concerns the role of communication as a governance function throughout the sandbox lifecycle. Empirical evidence from national implementations consistently identifies this as a critical determinant of effectiveness, yet the current legal framework leaves it almost entirely unspecified.

The fourth dimension relates to the territorial aspect of sandbox governance. Although Article 57(2) of the AI Act paves the way for local and regional experimentation, there is still a significant gap between legal possibility and operational readiness. Furthermore, the coordination challenges faced by territorial authorities within multilevel governance frameworks remain largely unresolved.

The fifth dimension relates to the relationship between sandbox governance and the protection of fundamental rights. Rather than treating compliance with rights as an ex-ante declaration, sandboxes offer the structural possibility of operationalizing rights through iterative testing under realistic conditions, but only if this function is built into their design from the outset rather than being treated as an incidental by-product.

Together, these five dimensions represent the areas in which the discrepancy between the institutional ambitions of regulatory sandboxes and the adequacy of their current design is most pronounced, and where further investigation is needed.

2. The blurring line between regulator and regulated

As anticipated, the first dimension to be investigated further concerns a transformation that is already underway, but which appears to be insufficiently theorized: the emergence of regulatory sandboxes as spaces of (co)regulatory (co)production, in which the classical boundary between those who make rules and those who follow them is being quietly but consequentially rearranged.

This dimension addresses the conceptual and constitutional question of whether the relationship between law and technology is changing the way public norms are produced. One of the defining features of contemporary digital governance is the emergence of the concept of “co-regulation”: governance models in which the distinction between rule-maker and rule-taker is negotiable and increasingly blurred [Bagni (2026), Longo et al. (2025)]. In this context, regulatory sandboxes are one of the most institutionalized expressions of this phenomenon; however, it seems that the related risks are not sufficiently taken into consideration.

To understand the importance of this issue, it is helpful to provide some context. The EU’s “Digital Decade Policy Programme 2030” has exposed a structural paradox: the more comprehensive the regulatory framework, the greater the risk that its compliance burden will undermine the very innovation it seeks to govern [Baldwin et al. (2010), Weimer and Marin (2016)]. The 2024 Draghi Report addressed this tension directly by placing innovation at the center of the EU’s Strategic Agenda, while also warning that regulatory complexity could erode European competitiveness [EC (2024a, b)]. Finally, the 2025 Digital Omnibus Package has since elevated this concern to the top of the political agenda by explicitly pushing for simplification and burden reduction [EC (2025)]. As a consequence, the conclusion that innovation must be regulated but that the regulatory process itself must also innovate is now widely shared [Hofmann et al. (2022)].

This shift is the result of a structural transformation. The progressive transition from directives to regulations has significantly reduced the flexibility traditionally enjoyed by Member States through transposition. Consequently, the European Commission has become the primary regulatory interlocutor for technology providers worldwide, taking on new responsibilities in supervision, coordination, and enforcement. As the system can no longer deliver flexibility through national legislative design, this must now be achieved through structured dialogue with industry. In this evolving landscape, the European Commission is taking on an increasingly operational “listening” regulatory role, relying on regulatory dialogue, systematic evidence gathering, and structured cooperation with industry to reduce information asymmetries and enhance the effectiveness of enforcement [Bagni (2026), Longo et al. (2025)].

It is precisely in this context that regulatory sandboxes have attracted increasing enthusiasm. The Draghi Report described them as “a catalyst for innovation in Europe’s digital economy”. The Digital Omnibus Package has indicated the potential for the creation of an EU-level sandbox for general-purpose AI systems. From August 2027, national AI regulatory sandboxes will be mandatory across all Member States. Sandboxes are, therefore, becoming a permanent feature of EU regulatory architecture and a new model of law-making. In this emerging model, rules no longer flow exclusively from the top down; rather, they emerge through progressive, dialogic interaction between

regulators and the entities they oversee [Ranchordas (2021), Ruschemeier (2025)].

On closer inspection, regulatory sandboxes reveal themselves to be part of something larger. They are not just a technical governance instrument; rather, they are the most vivid institutional expression of a deeper transformation in the relationship between public law and private technological power. From this perspective, two fundamental questions emerge as two sides of the same coin.

The first issue is the transformation of the law-making process itself. As mentioned previously, sandboxes are becoming laboratories for law-making, providing spaces in which regulators and innovators can collaborate to design regulatory solutions that, once validated, can inform future legislation and administrative practice [Ahern (2025), [Longo et al. (2025)]. This shift towards anticipatory, co-produced governance, rather than ex-post sanctioning, is largely a necessary response to the information asymmetry that regulators face in fields such as artificial intelligence (AI). The issue is, therefore, not whether this dynamic is underway, but how far it can legitimately go. A first question is: can public law absorb this degree of private participation without losing its character as a general, democratically grounded expression of public interest [Dizon (2012)]?

A second question reveals the “darker” side of the same coin: if sandboxes are becoming sites of quasi-normative co-production, who shapes what happens inside them and to what end? One under-examined trend is the growing number of experts from major technology companies serving on the advisory bodies of regulators and standard-setting groups that will eventually govern those same companies. This is an inevitable feature of highly complex regulation, where the knowledge required for effective governance is concentrated within the entities being governed. However, there is a risk of “regulatory capture”: regulators may not only be influenced by industry but also begin to think like it. This involves adopting its conceptual frameworks, risk tolerances, and definitions [Dal Bó (2006), Vinci (2024), Zarra (2025)]. In this context, the sandbox tool risks further institutionalizing this dynamic by providing a legally approved space in which the distinction between regulator and regulated becomes increasingly blurred, and in the worst cases is even inverted.

This concern is exacerbated by the risk of “ethics washing”, whereby participation in the sandbox is

used primarily for reputational benefit or to obtain a regulatory shortcut, without any genuine commitment to compliance [Francis (2025), Schultz et al. (2025), Zarra (2025)]. Well-resourced actors can exploit sandboxes to influence regulatory expectations before rules are finalized, thereby transforming tools intended for SMEs and start-ups into instruments of disproportionate influence [Bagni and Lazzeretti (2026)]. The institutional response to these risks cannot merely be to slow down or reverse the co-regulatory shift represented by sandboxes. Structured dialogue is a functional necessity, not a political choice. The question, therefore, is not whether to engage, but how to do so without surrendering the independence, neutrality, and democratic accountability required by public law.

In this context, the most fundamental safeguard is structural rather than procedural. Participation in regulatory sandboxes for businesses is voluntary, and they are only effective if they attract the intended participants, such as SMEs and start-ups. However, if the sandboxes are procedurally complex or resource-intensive, or if the outcomes are uncertain and with no clear added value, these actors will simply not participate. The consequence is not merely underuse, but institutional substitution: the space vacated by SMEs and start-ups will be filled by large, well-resourced companies whose primary motivation could be privileged access to the structured regulatory dialogue that sandboxes provide, rather than compliance learning. In that scenario, an instrument designed to reduce competitive asymmetry could become a mechanism for perpetuating it. This is why properly designed sandboxes - ones that are accessible, proportionate, and genuinely useful to those who need them most - are not just a matter of good administration; they are a prerequisite for the instrument to fulfil its intended purpose as a public tool in the service of the public interest, rather than becoming a private arena for the most powerful actors.

3. Regulatory learning and its practical constraints

The second dimension relates to the conditions under which sandboxes can facilitate genuine regulatory learning, and the structural reasons why these conditions are challenging to fulfil in practice.

Regulatory sandboxes can be structured to produce better regulatory judgment under conditions of uncertainty. The strongest legal account of that claim comes from experimentalist-governance scholarship. In that tradition, decentralized discretion is justified only where local actors must report performance, participate in comparative review, and feed lessons back into periodic revision of goals, metrics, and procedures [Sabel and Simon (2011), Sabel and Zeitlin (2008)]. From that perspective, a regulatory sandbox is not valuable merely because it suspends or relaxes rules, its value depends on whether it converts bounded experimentation into disciplined regulatory learning.

Literature does not treat learning as an automatic by-product of experimentation [Seferi (2026)]. Instead, it argues that sandbox learning must be designed through transparent objectives, credible evaluation, structured information flows, and review mechanisms that can convert case-level experience into more general regulatory guidance [Ahern (2025), Chen and Taihagh (2025), Philipsen et al. (2021), Ranchordas (2021)]. The same literature also shows why those conditions are hard to satisfy in practice: close regulator-firm relations may slide toward capture, evidence generated in small pilots may have weak generalizability, and fragmented jurisdictions may fail to consolidate knowledge beyond isolated cases [Ahern (2021), Brown and Piroška (2022), Johnson (2023), Ringe and Ruof (2020)].

From this perspective, there are several requirements that may support efficient and successful regulatory learning. The first requirement is systematic documentation. Poorly designed experimental regimes produce only a “scientific façade” for discretionary decision-making if objectives, variables, cohorts, duration, and evaluation criteria are not specified in advance [Ranchordas (2021)]. This matters both methodologically and legally. Without clear hypotheses and data-gathering plans, sandbox outcomes have weak internal validity because it is unclear whether observed effects were caused by the regulatory intervention rather than by background conditions. They also have weak external validity if the participating firms are too atypical to support broader inference [Ranchordas (2021)]. Sandbox learning, therefore, depends on design features that make the experiment legible before, during, and after operation.

A similar conclusion has also been reached through the concept of legal resilience rather than experimental validity [Philipsen et al. (2021)]. Because

sandbox arrangements create temporary legal enclaves for a limited set of firms, they put pressure on legality, legal certainty, equality, and public accountability. That pressure can be mitigated only if the sandbox has a clear legal basis, transparent selection procedures, standardized reporting and data collection, defined success criteria, and clear ex-ante indications of what successful participation does and does not entitle a firm to expect [Philipsen et al. (2021)]. Transparency is, therefore, not only a procedural virtue [Rizzuto Ferruzza and Billi (2026)], but also part of the legal justification for differential treatment.

A second requirement is institutionalized feedback. A study of the U.K. Financial Conduct Authority sandbox has shown that frontline interactions can build trust, improve information sharing, and help firms understand how principles-based rules apply in practice [Fahy (2022)]. The same interactions also help regulators learn how new products work and where existing regulatory categories do not fit the technology. Sandbox-like public-health governance is also treated as a dialogic arrangement in which ongoing disclosure and real-world performance data allow the agency to revise authorization conditions over time [Sherkow (2021)].

Yet the same bilateralism that makes sandboxes informative also makes them normatively fragile. Regulatory sandboxes depend heavily on relational trust, but that can blur the line between supervision and collaboration, create uneven treatment between insiders and outsiders, and weaken the credibility of enforcement where regulators are effectively limited to persuasion or expulsion [Johnson (2023)]. Thus, constant regulator-experimenter dialogue can impede public accountability if responsibilities are not sharply demarcated [Philipsen et al. (2021)]. Regulatory sandbox governance can become opaque in ways that allow risk to be selectively framed or “risk-washed”, especially when outsiders cannot see the dialogue through which regulators come to treat a technology as manageable [Brown and Piroška (2022)]. The question is, therefore, not whether dialogue should exist, but how it should be disciplined.

The key implication is that feedback mechanisms should not remain purely bilateral. They need forms that can be observed, challenged, and in some measure generalized [Seferi (2026)]. That supports measures such as structured debriefings at sandbox exit, published summaries of recurring compliance questions, opportunities for external

experts or affected stakeholders to submit observations, and formal review processes in which authorities explain whether identified issues led to guidance changes or no action. Without such outward-facing channels, the sandbox may generate tacit knowledge for the regulator and the participating organization while failing to generate public regulatory learning.

The third requirement is periodic revision of the sandbox design itself. Experimental governance is iterative by structure: the framework, performance metrics, and decision procedures must themselves be open to revision in light of experience [Sabel and Zeitlin (2008)]. Regulatory sandboxes belong within a broader anticipatory-governance culture built around foresight, experimentation, and regulatory learning [Ahern (2025)]. In that model, revising policy direction in response to new evidence is not a sign of failure, it is the point of the exercise. A learning-oriented sandbox should be reassessed not only by reference to participant satisfaction or market-entry speed, but also by asking whether the existing design is producing usable regulatory knowledge.

Thus, there is a need to understand if the regulatory sandbox sufficiently includes cases from which broader learning can be drawn, since a non-representative cohort weakens external validity [Ranchordas (2021)]. Indeed, in order to avoid learning that remains private and fragmented across participating use cases, published outputs from the regulatory sandbox should turn case-level experience into generally accessible guidance [Brown and Piroška (2022), Johnson (2023), Ranchordas (2021)]. The regulatory sandbox should change wider regulatory practice, not merely handle a few firms individually [Ahern (2025), Sherkow (2021)].

4. Communication as a governance function

The third dimension concerns communication within regulatory sandboxes, considered here as a key pillar of effective sandbox governance, despite receiving relatively little attention in legal frameworks and academic literature.

Regulatory sandboxes are built upon sustained and iterative dialogue between regulatory authorities and innovators [Alaassar et al. (2020), Novelli et al. (2025), Ranchordas and Vinci (2024)]. Neverthe-

less, empirical evidence has consistently identified ineffective communication as a significant factor that contributed to compromising the effectiveness and proper operation of regulatory sandboxes established so far.

The European Commission's 2025 Survey Report on the use of regulatory sandboxes in EU Member States, drawing on fifty-seven responses from twenty-five Member States, places "open communication" among the key success factors identified by national authorities [Vuorinen et al. (2026)]. Furthermore, national experiences converge on this point: Austria has identified continuous, strategically targeted communication as a critical determinant of trust, collaboration, and transparency, while irregular communication and resource constraints were found to undermine project outcomes [FMA (2020)]; Italian authorities have stressed the need to clarify the scope of sandbox participation through communication [Vuorinen et al. (2026)]; and Italy, Lithuania, Spain, and Sweden all recommended transparent communication strategies to manage participant expectations [Vuorinen et al. (2026)]. Comparable conclusions emerge outside the EU survey: the AI regulatory sandbox piloted by the Canton of Zurich in 2021 integrated a dedicated communication function within its governance structure, highlighting the benefits of this decision [Von Thiessen (2025)], and empirical investigations with regulatory sandbox practitioners identified communication as a strategic variable across the entire experimentation cycle [Bagni (2026)].

Despite this convergence, the role of communication and how to properly manage it within regulatory sandboxes remains under-specified in the relevant legal framework. When considering AI regulatory sandboxes under the AI Act, for example, it provides only a weak normative anchor: Article 58.2(g) requires that procedures be "simple, easily intelligible, and clearly communicated" to facilitate SMEs and startups participation, while Articles 57.9(b) and (d), by identifying best-practice sharing and evidence-based regulatory learning among the objectives of regulatory sandboxes, assign to communication a crucial practical function, but yet without prescribing how communication should be operationalized across the sandbox life cycle. The Draft Implementing Act to the AI Act on AI regulatory sandboxes issued by the European Commission in December 2025 did not address communication explicitly, giving Member States full discretion regarding how engagement schemes are designed.



This gap is deemed problematic for two main interrelated reasons. First, the absence of common guidance generates significant heterogeneity in practice, from comprehensive and specified in advance detailed phase-by-phase commitments such as the Danish model of the AI Regulatory Sandbox established by the Danish Data Protection Agency (Datatilsynet) and the Danish Agency for Digital Government, to a more negotiated, case-by-case logic exemplified by the sandbox model established by the Commission nationale de l'informatique et des libertés (CNIL) in France, jeopardizing in some cases the possibility for prospective participants to have clear expectations on the resources needed and the outcome of the sandboxing process [Novelli et al. (2025)]. Second, after the conclusion of the sandbox process, when results of regulatory sandboxes are not widely or effectively communicated, this can generate a phenomenon of "sandbox lock-in", here conceived as a regulatory sandbox that does not create positive effects of the instrument beyond the single experimentation.

Investigating the communication dimension within regulatory sandboxes thus requires moving beyond a normative reading of the legal framework toward an empirical assessment of communication practices as they unfold across the sandbox life cycle, and trying to build common references on it, together with a strategy for its effective implementation. In this regard, notwithstanding the wide range of means and modalities through which different authorities may implement effective communication, it is helpful to identify common conditions that communication should contribute to creating within regulatory sandboxes, and from these identify for each entity the most suitable means and contents to establish such conditions, based on the features of communication in the different stages of the regulatory experimentation.

Three conditions may be identified: trust, as companies may withhold information if they fear punitive responses or disclosure of commercially sensitive material [Alaassar et al. (2020)]; clarity on the role of the regulatory sandboxes and the foreseen outcomes; and expectation alignment: misunderstandings over reporting burdens, timelines, or the purpose of participation can, in fact, weaken cooperation and reduce the quality of knowledge exchange [Chen and Taeihagh (2025)].

As for the means through which to operationalize such conditions, regulators should assign stable

contact points, as well as explain the sandbox's goals and participation criteria, calibrate interaction frequency to the testing stage, and define participation conditions clearly and in advance [Fahy (2022), Johnson (2023)]. Regarding the features of the communication, during the pre-application and application phases, it is predominantly unilateral, from the competent authority(ies) to the public, focusing on transparency regarding eligibility, procedures, and objectives. Once testing begins, communication becomes dialogical, where the participating companies also have a recognized role in making the sandbox process function effectively, requiring their active and good-faith commitment. Communication means and contents will need to adapt to such different features.

In conclusion, while empirical evidence highlights the need to accord greater attention to the role of communication in regulatory sandboxes, the relevant legal frameworks provide little guidance on how communication should be structured and implemented. In this regard, particularly in the context of AI regulatory sandboxes, the Implementing Act on Regulatory Sandboxes under the AI Act, under adoption, could provide a valuable contribution in highlighting the importance of establishing a sound communication strategy and laying down common principles and core elements with a view to achieving a coherent and harmonized approach to communication across jurisdictions. This should also preserve sufficient flexibility for competent authorities to adopt context-specific approaches tailored to their institutional frameworks and regulatory needs.

5. Local sandboxes between legal possibility and operational readiness

The fourth dimension addresses a structural gap largely overlooked by existing regulation: the position of local and regional authorities within a sandbox governance framework that is formally "polycentric", yet under-specified operationally at the territorial level.

The legal opening for local and regional AI regulatory sandboxes is real, but it is often observed that operational guidance, coordination, and insti-

tutional design remain underdeveloped [Ahern (2021), Longo (2025)].

Article 57(2) of the AI Act creates a significant opportunity for local and regional AI regulatory sandboxes, because the Union's sandbox model is explicitly conceived as decentralized, polycentric, and capable of including territorial authorities within a broader multilevel governance framework [Ahern (2021), Longo (2025)]. This matters for municipalities and regions because AI systems increasingly operate through public services, administrative processes, interoperability infrastructures, and citizen-facing digital environments that are territorially governed rather than exclusively national [Cohen et al. (2024, 2025)]. The sandbox is not framed as mere deregulation, but as a controlled environment for supervised development, testing, validation, and regulatory learning before market placement or operational deployment [Ahern (2021), Buocz et al. (2023)].

For territorial authorities, the main opportunity lies in using sandboxes as instruments of contextualized public innovation. As discussed above, the literature associates sandboxes with a range of positive features that are highly relevant where local authorities procure, host, or co-govern AI systems [Bagni (2025), Ranchordas and Vinci (2024)]. Territorial proximity also supports experimentation in areas such as digital public services, mobility, environmental monitoring, and public-sector interoperability, where public authorities need mechanisms that can test systems under real administrative conditions [Cohen et al. (2025), Cohen et al. (2025)].

Building on this, accounts of experimental regulation treat sandboxes not as one-off derogations but as iterative governance devices that generate knowledge feeding back into rule-making and supervisory practice over time [Ruscheimer (2025)]. For territorial authorities, this iterative dimension is decisive: a sandbox that produces no transferable regulatory learning risks becoming a localized exemption rather than a genuine instrument of public innovation. Embedding evaluation criteria, documentation duties, and structured reporting from the outset would let regional experiments inform regional policy as well as the national and EU frameworks within which they must ultimately co-operate [Ruscheimer (2025)].

The current framework, however, leaves major gaps. At EU level, the AI Act does not yet provide a complete operational blueprint for access, valida-

tion, supervision, and exit, and these elements still depend on implementing acts, guidelines, codes of practice, and other soft law measures that EU and national competent authorities have yet to define [Longo (2025), Ranchordas and Vinci (2024)]. More broadly, a unified consensus on the definition, functioning, and specific innovation rationale of sandboxes is still taking shape (considering the coexistence of multiple sandbox definitions), which can sometimes complicate the design process for authorities [Ranchordas and Vinci (2024), Ford and Ashkenazy (2025)]. That uncertainty is especially acute for territorial authorities, because the available materials point to the need for new policy-making mechanisms, stronger monitoring capacities, and better government digital infrastructures before experimental oversight can work credibly in practice [Cohen et al. (2024, 2025), Cohen et al. (2025)].

A second cluster of problems concerns coordination and legality. Sandbox participation does not displace other applicable legal regimes, and AI experimentation remains embedded within data protection, consumer protection, equality, competition, and product-safety frameworks [Ahern (2021)]. This creates a structural coordination problem for regional or local sandboxes: who authorizes participation, who supervises testing, and how regulatory learning inside a territorial sandbox connects to national conformity assessment and EU oversight remain under-specified [Longo et al. (2025)].

Examining early movers at the territorial level is, therefore, crucial to understanding the real-world challenges of designing sandboxes. The Italian region of Tuscany represents a highly instructive case study in this context. As a proactive territorial entity attempting to formalize local experimental frameworks to align with EU digital policies, Tuscany shows how a regional legislature can begin to occupy this space, but also how partial the current settlement remains. Article 25 of Regional Law 57/2024 defines regulatory sandboxes as controlled frameworks under competent-authority supervision and allows the Region, within its competences and in coordination with national authorities, to implement sandboxes for innovative fields including AI and cybersecurity [Regional Law (2024)]. The same law ties experimentation to transparency, ethics, non-discrimination, accountability, accessibility, inclusion, user information, data protection, environmental impacts, and technological lock-in, while also requiring structured experimentation with safeguards and risk evaluation. Yet

Article 25 does not resolve the precise internal allocation of competences, the procedural architecture of regional supervision, or the formal pathway by which a provider participating in a regulatory sandbox established under such a legal framework would obtain recognition within national and EU compliance channels.

The most plausible solutions are interpretive and institutional rather than purely declaratory. A possible reading of Article 57(2) is that territorial sandboxes are legally possible only within a nationally coordinated framework that sets minimum conditions for admission, supervision, reporting, and exit while still permitting local adaptation [Ahern, D. (2021), Longo et al. (2025)]. A second solution consists of shared supervision: territorial authorities could host or co-design experimentation, while national competent authorities and EU coordination bodies preserve consistency on core compliance questions [Ranchordas and Vinci (2024)]. A third solution is stronger public participation throughout the regulatory lifecycle, because participation improves legitimacy, reduces capture risk, and brings out information that formal administrative processes often miss [Cohen et al. (2025)].

In summary, Article 57(2) of the AI Act opens a meaningful path for territorial AI experimentation, but the current landscape shows a wide gap between legal possibility and operational readiness. Local and regional sandboxes appear capable of supporting context-sensitive innovation, public-service experimentation, and regulatory learning, yet they remain vulnerable to fragmentation, weak coordination, and under-specified safeguards unless clearer EU and national guidance emerge. For territorial authorities, the central question is no longer whether local and regional AI sandboxes are imaginable, but under what institutional conditions they can become lawful, coordinated, and trustworthy instruments of public governance.

6. The question of rights protection in AI governance and cyber resilience

The fifth and final dimension concerns the relationship between sandbox governance and the protection of fundamental rights. This relationship is

structurally significant, yet it is rarely placed at the center of sandbox design.

Regulatory sandboxes are usually defended as tools for innovation support, compliance assistance, and regulatory learning. Yet this framing potentially understates their wider constitutional significance. In digital societies, where public administration, essential services, market participation, and democratic institutions depend on complex technical systems, the quality of oversight applied before broad deployment can have direct implications for the practical exercise of fundamental rights. It, therefore, becomes even more important to understand not simply whether sandboxes facilitate innovation, but whether they can help render rights protection operational in contexts where legal duties must be tested against real or realistic technical environments [Novelli et al. (2025), Buocz et al. (2023), Philipsen et al. (2021)].

This shift in lens holds even more significance when considering that most of the negative consequences of digital regulation do not arise at the level of abstract legal principle. They spill out when systems are used in settings where privacy, transparency, equality, and accountability depend on technical design choices, access to data, human oversight, security architecture, and the practical capacity of regulators to intervene [Yeung and Li (2025), [Chiara (2025)]. A sandbox can, therefore, be understood not only as a market-enabling instrument, but as a site where the gap between formal rights and operational protection can become visible and thus addressed.

The literature on AI governance already provides the clearest basis for this claim. Recent work on the AI Act increasingly presents regulatory sandboxes as structured environments for supervised experimentation rather than as enclaves of relaxed law [Novelli et al. (2025), Ahern (2025)]. On that view, their significance lies in their ability to expose whether a system can meet legal demands in practice: whether bias testing is meaningful, whether explainability claims survive contact with actual users, whether personal data are handled lawfully, and whether human oversight is more than a formal requirement [Buocz et al. (2023), Paul and Am (2025)]. This supports a more precise understanding of operationalization: rights become operational when they are not addressed only through ex-ante declarations of compliance, but through iterative testing of how systems handle

personal data, explainability demands, bias risks, human oversight, and complaint pathways in practice [Buocz et al. (2023), Paul and Am (2025)].

Cases such as the Norwegian Data Protection Authority's AI sandbox illustrate both the promise and the limits of the rights-based lens. The Norwegian example shows that supervised dialogue can help translate broad GDPR norms into more concrete compliance practices around privacy, fairness, and transparency [Paul and Am (2025)]. At the same time, that experience also reveals the fragility of the model: selective participation, weak follow-up, and pressure on limited regulatory resources can blur the line between critical supervision and innovation partnership. The case is valuable not because it proves that sandboxes can solve rights problems, but because it shows how much depends on institutional design and on the regulator's ability to preserve distance while still engaging closely with innovators.

The problem becomes exacerbated when of live or quasi-live testing affects people directly. Studies of facial-recognition experimentation in Europe illustrate how real-world trials can undermine privacy, data protection, equality, and due process when legal basis, consent, testing metrics, and bias evaluation remain under-specified [Yeung and Li (2025)]. These examples, albeit not formally sandbox experiences established under the AI Act, show what happens when experimentation proceeds without a sufficiently robust account of whose rights are at stake, how harms are measured, and when testing must stop. The wider relevance is that rights-sensitive experimentation cannot be judged only by technological novelty or regulatory flexibility; it must also be evaluated by the conditions under which risk exposure is made acceptable.

This understanding strengthens the view that sandbox design should move away from an instrument for regulatory-compliant market entry and align more with evidence-producing institutions, in which the question of rights should become central, and not simply a byproduct of good administration. Thus, variables such as what must be tested, who bears the risk during testing, what kinds of harm trigger intervention, and what public record remains once the experiment ends should inform the foundation of the model [Novelli et al. (2025), Buocz et al. (2023), Philipsen et al. (2021)]. In this respect, the sandbox could effectively reinforce legal accountability beyond merely repackaging discretion.

Cyber resilience introduces a parallel, although increasingly cross-cutting, dimension. The Cyber Resilience Act represents the EU's main legal framework on cyber resilience, introducing mandatory cybersecurity requirements for products with digital elements across their lifecycle. While this Regulation is framed mainly in terms of product security, vulnerability management, software maintenance, and enforcement, those obligations also protect the conditions under which privacy, personal integrity, trust, and effective use of digital services can be sustained. In that sense, cyber resilience functions as an indirect layer for rights protection [Chiara (2025)]. Emerging work on sandbox models for cyber resilience extends this logic by treating experimentation as a way to test monitoring plans, emergency exits, documentation duties, and vulnerability handling across products and systems [Seferi (2025)]. This is a valuable consideration because it places security failures within the same governance problem as AI failures: rights violations often follow from design and deployment conditions that are difficult to assess in the abstract [Bagni, F. (2023, 2025)].

A comparative look at FinTech sandbox experimentation supports the relevance of this theme. The pertinent literature offers practical lessons on entry criteria, exposure limits, consumer safeguards, supervisory guidance, and structured exits [Ringe and Ruof (2020)]. It also supplies the strongest warnings: critics show that sandboxes can produce opacity, unequal access, favoritism, cognitive capture, and risk washing, especially when regulatory involvement creates a misleading appearance of safety or legitimacy [Johnson (2023), Brown and Piroška (2022)]. These concerns identify a core tension in sandbox governance: the same institutional form that promises closer oversight can also weaken scrutiny if participation itself begins to signal trustworthiness.

All these elements, when examined together through the rights-based analytical lens, tend to suggest that regulatory sandboxes deserve attention not only as instruments of innovation policy, but as sites where the practical meaning of rights protection is negotiated under conditions of uncertainty. The key contribution of this perspective is not a claim that sandboxes can inherently protect rights. It is a narrower and potentially more useful assertion: regulatory sandboxes could reveal whether legal protections can be made operational before large-scale deployment, and how easily that ambition can fail when experimentation is opaque,

selective, or weakly supervised [Novelli et al. (2025), Philipsen et al. (2021), Ahern (2025)]. The sandbox debate then becomes part of a broader question in digital governance: how public authorities can test emerging systems without normalizing preventable harm or turning temporary experimentation into a substitute for accountable regulation.

7. Conclusion: The regulatory sandbox as a “mirror” for governance design

The five contributions gathered in this paper converge on a shared diagnosis. Examined carefully, regulatory sandboxes reveal something larger than themselves. The governance challenges they highlight - such as questions of legitimacy in co-produced law-making, the conditions for genuine regulatory learning, the role of communication as a governance function, the fragmentation of territorial oversight, and the discrepancy between declaratory and operational rights protection - are not pathologies unique to a single instrument. Rather, they are symptoms of structural tensions running through EU digital governance, such as persistent information asymmetries between regulators and the regulated, insufficient institutional capacity at the territorial level, the absence of common standards for participatory governance, and an unresolved tension between formal democratic legitimacy and the practical demands of governing highly technical domains in real time. What makes regulatory sandboxes analytically distinctive from other governance instruments is that they make tensions visible in ways that diffuse governance failures rarely do. In this sense, the regulatory sandbox is a “mirror”: improving it requires addressing problems that extend well beyond the instrument itself.

This paper reflects a specific moment in time that is unlikely to be repeated. The EU regulatory sandbox ecosystem is still in the process of formation. The implementing acts that will define, for instance, the operational parameters of national AI regulatory sandboxes under Article 58 of the AI Act are still pending. The potential creation of a sandbox at the EU level for general-purpose AI systems under the Digital Omnibus Package has not yet taken definitive institutional form. Most national competent authorities are designing their sandbox frame-

works for the first time, with limited precedent and significant discretion. In the precise sense of the term, this is a constitutional moment for regulatory sandbox governance: the choices being made now will determine not only how individual sandboxes function, but also the institutional practices, administrative cultures, and legal expectations that will be difficult to revise once consolidated.

This is why the five dimensions explored in this paper are not just peripheral refinements; they are preconditions. A sandbox that fails to address the questions of legitimacy raised by regulatory co-production risks becoming a legally sanctioned arena for asymmetric influence, rather than a genuine instrument of adaptive public law. Similarly, a sandbox that does not facilitate regulatory learning through transparent objectives, outward-facing feedback mechanisms, and periodic revision will generate tacit bilateral knowledge rather than public regulatory intelligence. If the communication function of a sandbox is left unspecified, it will undermine the essential objectives the regulatory sandboxes are designed to support. A sandbox lacking adequate territorial coordination will fragment along jurisdictional lines, producing isolated experiments rather than transferable regulatory knowledge. A sandbox that treats fundamental rights as an ex-ante declaration rather than a design constraint will also fail to close the gap between formal compliance and operational protection at the critical moment before large-scale deployment.

The regulatory sandbox is an institutional mechanism designed to strengthen the cooperation between regulators and those they regulate, in a way that serves the public interest while maintaining the independence and democratic accountability required by public law. Whether this bet pays off depends on the design of the governance structure. Empirical evidence shows that well-designed sandboxes generate genuine value, including bidirectional regulatory learning, reduced compliance costs for SMEs and startups, the early detection of emerging regulatory needs and meaningful engagement between public authorities and innovative actors. In contrast, poorly designed sandboxes produce the opposite outcomes: selective access for well-resourced actors, reputational signals that substitute for genuine compliance, regulatory expectations shaped by the most powerful participants before rules are formally consolidated, and learning that remains private rather than being made publicly available. The difference between

these two outcomes is not a matter of good intentions, it is a matter of institutional design. Specifically, the five dimensions that this paper has identified as an urgent and under-investigated research agenda.

This contribution does not claim to have resolved the questions it raises. Rather, it aims to identify the areas in which these questions must be urgently pursued while there is still time to act on the answers. Whether this identification will be valuable ultimately depends on whether the institutions currently designing regulatory sandbox frameworks engage with these dimensions as operational imperatives rather than academic observations. The regulatory sandbox has become too significant a governance instrument, and the present juncture is too pivotal for governance choices to be made by default.



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