

REGULATORY SANDBOXES IN ARTIFICIAL INTELLIGENCE

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Abstract

Regulatory experimentation tools are used to test new economic, institutional and technological approaches, and legal provisions, outside of existing regulatory structures. This report focuses on regulatory sandboxes, where authorities engage firms to test innovative products or services that challenge existing legal frameworks. Participating firms obtain a waiver from specific legal provisions or compliance processes to innovate. This report presents lessons learnt from fintech regulatory sandboxes and their positive impacts, such as fostering venture capital investment in fintech start-ups. It covers challenges and risks involved in implementing regulatory sandboxes and their testing processes. This report presents policy considerations for AI regulatory sandboxes, including institutional interdisciplinary co-operation and the need to build up AI expertise within regulatory authorities. Findings underline the need for regulatory interoperability and the role that trade policy can play. Finally, it discusses the need for comprehensive criteria to determine sandbox eligibility and assess trials, and the potential impact of sandboxes on innovation and competition.

Abrégé

Les outils d'expérimentation réglementaire permettent de tester de nouvelles approches économiques, institutionnelles et technologiques, ainsi que de nouvelles dispositions légales, indépendamment des structures réglementaires existantes. Ce rapport se concentre sur les « bacs à sable réglementaires », où les autorités collaborent avec des entreprises pour tester des produits et des services innovants qui remettent en question les cadres juridiques déjà existants. Les entreprises participantes à ce processus bénéficient d'une exemption de certaines dispositions légales ou de procédures de conformité, ce qui leur permet de stimuler l'innovation. Ce rapport présente les leçons tirées des « bacs à sable réglementaires » fintech et leurs retombées positives, notamment en termes de stimulation des investissements en capital-risque au sein des startups fintech. Il aborde les défis et les risques liés à l'implémentation de « bacs à sable réglementaires » et des méthodes employées pour leur évaluation. Ce rapport présente des considérations politiques pour les « bacs à sable réglementaires » de l'IA comme l'importance de la coopération interdisciplinaire au niveau institutionnel et la nécessité d'accroître l'expertise en IA au sein des autorités de réglementation. Les résultats soulignent le besoin d'interopérabilité réglementaire et le rôle que la politique commerciale peut jouer pour l'établir. Enfin, il met en avant le besoin de critères complets pour déterminer l'éligibilité au « bac à sable » et pour évaluer les essais, ainsi que de l'impact potentiel des « bacs à sable » sur l'innovation et la concurrence.

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Executive summary

The 2019 OECD Artificial Intelligence (AI) Principles recommend that governments “consider using experimentation to provide a controlled environment in which AI systems can be tested and scaled up.” Experimentation allows regulators to test new economic, institutional and technological approaches, and legal provisions outside of prevailing regulatory structures. Experimental and “hybrid” regulatory approaches include innovation hubs, regulatory sandboxes, standardisation, and co-regulation involving regulators and markets. The growing number and variety of regulatory experimentation approaches tailored to emerging technologies calls for a consolidated taxonomy of instruments and concepts.

This report focuses on regulatory sandboxes, which are promising for areas with fast innovation cycles, such as AI and financial technology (fintech). Sandboxes create spaces where authorities engage firms to test innovative products or services that challenge existing legal frameworks. Participating firms obtain a waiver from specific legal provisions or compliance processes to allow them to innovate. Approaches to regulatory sandboxes vary but share common characteristics: they are temporary, with a testing process usually limited to six months; they bring together regulators and firms; they waive existing legal provisions and provide tailored legal support for a specific project, often based on trial-and-error; and the technical and market information and data they collect helps regulatory authorities assess whether specific legal frameworks are fit-for-purpose or need to be adapted.

There are about one hundred sandbox initiatives around the world to date, including fintech and privacy sandboxes. The UK Financial Conduct Authority (FCA) pioneered the first fintech regulatory sandbox in 2015, and many countries followed suit. The Monetary Authority of Singapore’s FinTech regulatory sandbox facilitates live experimentation on AI products and services. The UK Information Commissioner’s Office is testing the impact of broader AI-related products and services, particularly on privacy frameworks. The European Commission’s (EC) 2021 AI Act to regulate AI-related products and services includes a regulatory sandbox aimed at providing appropriate flexibility while protecting consumers and fundamental rights.

Lessons from fintech show that the benefits of regulatory sandboxes include facilitating firm-financing and market-entry and increasing speed-to-market by reducing administrative and transaction costs. For regulators, testing in sandboxes informs policy-making and regulatory processes. Regulatory sandboxes provide a dynamic, evidence-based approach to regulation and regulatory interpretation. Indeed, a common outcome of sandboxes is that regulators issue amendments or guidance on how to interpret legal frameworks. On the other hand, challenges with fintech regulatory sandboxes to date include a lack of harmonised and standardised eligibility criteria and testing processes. Sandboxes require careful design and testing; inadequate specifications can harm competition, consumers, and public or personal data. Moreover, sandboxes are currently viewed as small-scale testing frameworks with limited cohorts, but as companies realise the competitive advantage of entering a sandbox, there could be pressure to expand them. Regulators might also choose to increase participation, to gather more data to inform policy, which would require automating some sandbox processes using governance- and regulatory-technology (govtech and regtech) tools. Finally, because diverging standards can lead some sandboxes to be more lenient, which promotes arbitrage and forum shopping, international cross-sandbox compatibility and collaboration across jurisdictions would be valuable.

In addition, AI regulatory sandboxes point to specific challenges and solutions:

1. **Multi-disciplinary and multi-stakeholder co-operation** – AI products and services are complex and often affect several areas, so that several regulatory authorities must be involved in their testing. There must be co-operation between firms, competition authorities, intellectual-property offices, national standardisation bodies, and data protection authorities, among others.
2. **AI expertise within regulatory bodies** – Regulatory authorities need AI technical expertise to make decisions about access to sandboxes and to develop testing frameworks. Regulatory authorities can develop new, or adapt and strengthen existing capacity-building programmes to enhance competencies related to AI and digital transformation in public bodies.
3. **International regulatory interoperability and a possible role for trade policy** – Stronger international co-operation and coordination is needed for regulatory experimentation mechanisms, including regulatory sandboxes. AI sandboxes and other regulatory experimentation approaches in emerging technologies could be likened to "technical regulations" in the future via "equivalence agreements" within technical barriers to trade (TBT) trade agreements.
4. **Comprehensive sandbox eligibility and testing criteria** – International co-operation on interoperable experimentation frameworks, including testing parameters for AI, could benefit innovation and decrease regulatory fragmentation.
5. **Impact on innovation and competition** – Considering the impacts on innovation and competition is key. Regulatory sandboxes could affect consumers, fundamental rights, innovation, and competition, which should be assessed as early as possible.
6. **Interactions with other pro-innovation mechanisms** – Sandboxes as regulatory-experimentation tools should be assessed in combination with other regulatory and institutional mechanisms rather than in isolation. There are strong links between AI regulation and AI standards, especially for risk-based AI regulation that relies on standards. AI sandboxes test the fitness of AI regulations or services against existing AI standards. However, AI standards and AI regulatory sandboxes are at an early stage of development and need to inform each other.

Résumé

Les Principes sur l'intelligence artificielle (IA) de l'OCDE 2019 recommandent aux gouvernements « d'envisager le recours à l'expérimentation, afin de fournir un environnement contrôlé dans lequel les systèmes d'IA peuvent être testés et mis à l'échelle ». L'expérimentation permet aux régulateurs de tester de nouvelles approches économiques, institutionnelles et technologiques, ainsi que des dispositions juridiques en dehors des structures réglementaires déjà existantes. Les approches réglementaires expérimentales et « hybrides » comprennent les centres d'innovation, les « bacs à sable réglementaires », la normalisation et la co-régulation impliquant les régulateurs et les marchés. L'augmentation du nombre et de la diversité des approches réglementaires expérimentales adaptées aux technologies émergentes appelle à l'élaboration d'une taxonomie structurée et unifiée des outils et des concepts associés.

Ce rapport se concentre sur les « bacs à sable réglementaires », qui sont prometteurs pour les domaines ayant des cycles d'innovation rapides, tels que l'IA et les technologies financières (fintech). Les « bacs à sable réglementaires » permettent aux autorités de collaborer avec des entreprises pour tester des produits et des services innovants, sans être limités par les cadres juridiques déjà existants. Les entreprises participantes à cette expérimentation bénéficient d'une exemption de certaines dispositions légales ou de procédures de conformité, ce qui leur permet de stimuler l'innovation. Les approches des « bacs à sable réglementaires » varient mais présentent des caractéristiques communes : ils sont temporaires, avec un processus de test généralement limité à six mois ; ils réunissent des régulateurs et des entreprises ; ils renoncent aux dispositions juridiques existantes et fournissent un soutien juridique sur mesure pour un projet spécifique, souvent basé sur des essais et des erreurs ; et les informations et données techniques et commerciales qu'ils recueillent aident les autorités réglementaires à évaluer si des cadres juridiques spécifiques sont appropriés à leur objectif ou doivent être adaptés.

À ce jour, il existe une centaine d'initiatives de « bacs à sable » dans le monde, y compris des « bacs à sable » pour la fintech et la protection de la vie privée. La Financial Conduct Authority (FCA) du Royaume-Uni a été à l'origine du premier « bac à sable réglementaire » pour les fintechs en 2015, et de nombreux pays lui ont emboîté le pas. Le bac à sable réglementaire FinTech de l'Autorité monétaire de Singapour facilite l'expérimentation en direct des produits et services d'IA. L'Information Commissioner's Office du Royaume-Uni teste l'impact de produits et services plus larges liés à l'IA, en particulier sur les cadres de protection de la vie privée. L'UE AI Act de 2021 de la Commission Européenne (CE) visant à réglementer les produits et services liés à l'IA comprend un « bac à sable réglementaire » visant à fournir une flexibilité appropriée tout en protégeant les consommateurs et les droits fondamentaux.

Les leçons tirées de la fintech montrent que les « bacs à sable réglementaires » ont pour avantage de faciliter le financement des entreprises, l'entrée sur le marché et permettent d'accélérer la mise sur le marché en réduisant les coûts administratifs et les coûts de transaction. Pour les régulateurs, les essais dans les « bacs à sable » éclairent l'élaboration des politiques publiques et des processus réglementaires. Les « bacs à sable réglementaires » offrent une approche dynamique et factuelle de la réglementation et de son interprétation. En effet, un résultat courant des « bacs à sable » est que les régulateurs publient des amendements ou des directives sur la manière d'interpréter les cadres juridiques. D'autre part, les défis posés par les « bacs à sable réglementaires » fintech à ce jour incluent manque de critères clairs

d'éligibilité et de processus de test harmonisés et standardisés. Les « bacs à sable » nécessitent une conception et des tests minutieux ; des spécifications inadéquates peuvent nuire à la concurrence, aux consommateurs et aux données publiques ou personnelles. En outre, les « bacs à sable » sont actuellement considérés comme des cadres d'essai à petite échelle avec des cohortes limitées, mais à mesure que les entreprises réalisent l'avantage concurrentiel de participer à un « bac à sable », il pourrait y avoir une pression pour les développer. Les régulateurs pourraient également choisir d'accroître la participation, afin de recueillir davantage de données pour éclairer les politiques publiques, ce qui nécessiterait d'automatiser certains processus de « bac à sable » à l'aide d'outils de gouvernance et de technologie réglementaire (govtech et regtech). Enfin, parce que des normes divergentes peuvent conduire certains « bacs à sable » à être plus indulgents – ce qui favorise l'arbitrage et le « forum shopping » –, la compatibilité internationale entre les « bacs à sable » et la collaboration entre les juridictions seraient précieuses.

En outre, les « bacs à sable réglementaires » en matière d'IA mettent en évidence des défis et des solutions spécifiques :

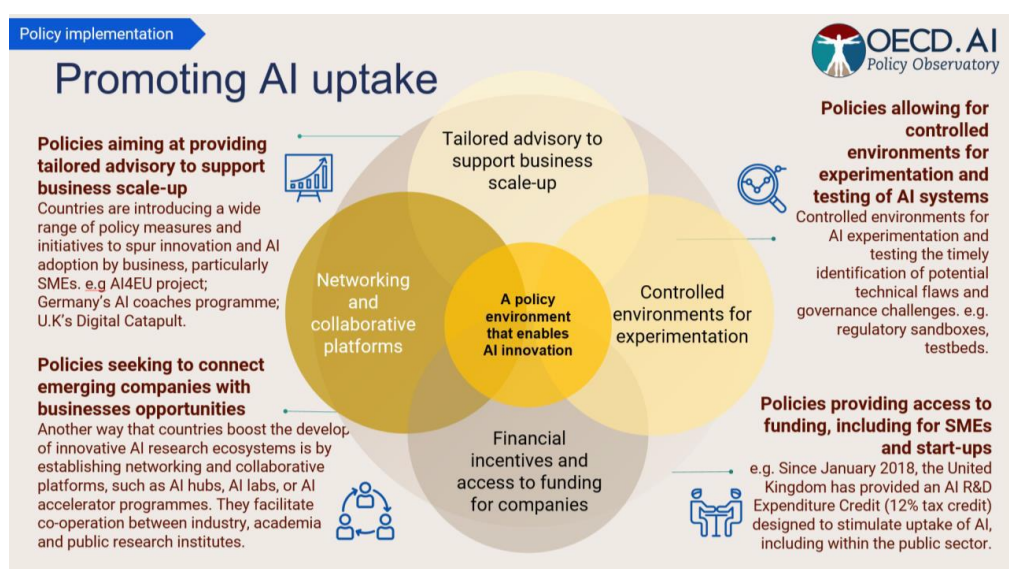
1. **Coopération multidisciplinaire et multipartite** – Les produits et services d'IA sont complexes et touchent souvent plusieurs domaines, de sorte que plusieurs autorités réglementaires doivent être impliquées dans leur test. Les entreprises, les autorités de la concurrence, les offices de propriété intellectuelle, les organismes nationaux de standardisation et les autorités chargées de la protection des données, entre autres, doivent coopérer.
2. **Expertise en IA au sein des autorités de régulation** – Les autorités de régulation ont besoin d'une expertise technique en matière d'IA pour prendre des décisions concernant l'accès aux « bacs à sable » et pour élaborer des cadres de test. Les autorités de régulation peuvent élaborer de nouveaux programmes de renforcement des capacités, ou adapter et renforcer ceux qui existent déjà, afin d'améliorer les compétences liées à l'IA et à la transformation numérique au sein des organismes publics.
3. **Interopérabilité réglementaire internationale et rôle éventuel de la politique commerciale** – Une coopération et une coordination internationales plus fortes sont nécessaires pour les mécanismes d'expérimentation réglementaire, y compris les « bacs à sable réglementaires ». Les « bacs à sable » pour l'IA et d'autres approches d'expérimentation réglementaire dans les technologies émergentes pourraient être assimilés à l'avenir à des réglementations techniques par le biais d'accords d'équivalence dans le cadre des accords commerciaux sur les obstacles techniques au commerce (OTC).
4. **Critères d'éligibilité et de test pour les « bacs à sable »** – La coopération internationale sur les cadres d'expérimentation interopérables, y compris les paramètres d'essai pour l'IA, pourrait favoriser l'innovation et réduire la fragmentation réglementaire.
5. **Impact sur l'innovation et la concurrence** – Il est essentiel de tenir compte des impacts sur l'innovation et la concurrence. Les « bacs à sable réglementaires » pourraient avoir une incidence sur les consommateurs, les droits fondamentaux, l'innovation et la concurrence, ce qui devrait être évalué le plus tôt possible.
6. **Interactions avec d'autres mécanismes pro-innovation** – Les « bacs à sable » en tant qu'outils d'expérimentation réglementaire devraient être évalués en combinaison avec d'autres mécanismes réglementaires et institutionnels plutôt qu'isolément. Il existe des liens étroits entre la réglementation et les normes en matière d'IA, en particulier pour la réglementation de l'IA fondée sur les risques. Les « bacs à sable » de l'IA testent l'adéquation des réglementations ou des services d'IA par rapport aux normes d'IA existantes. Toutefois, les normes d'IA et les « bacs à sable réglementaires » en matière d'IA n'en sont qu'à un stade précoce de développement et doivent s'enrichir mutuellement.

1 Frameworks for regulatory experimentation

Experimental policy approaches to promote trustworthy artificial intelligence (AI) include controlled environments such as regulatory sandboxes and standardisation (OECD, 2021a^[1]). Regulatory experimentation is sensitive and reactive, in that regulators and market players engage and interact directly. Benefits include avoiding possible regulator-market gaps that sometimes accompany hard law. At the same time, regulatory experimentation impacts market and innovation dynamics. This section introduces regulatory experimentation and regulatory sandboxes from theoretical and policy perspectives and establishes a typology of sandboxes.

The transverse nature of AI means that several legal regimes might apply, from sector-specific laws (e.g. in finance or healthcare), to product liability, contract, tax, intellectual property, and personal data protection laws, among others. For example, the relationship of AI liability regulation to trustworthiness, transparency, and explainability is an area of complex debate. A balance is needed so that regulatory policies and AI innovation do not act at cross-purposes (Ranchordás, 2021a^[2]). Sandboxes could contribute to understanding the issues and associated trade-offs. Linking different types of AI regulatory experimentation and sandbox policies clearly and articulating the role of each vis-à-vis the others can promote uptake of trustworthy AI (Figure 1).

Figure 1. Promoting uptake of AI



Source: (OECD, 2021a)

An enabling policy environment for AI

OECD AI Principle 2.3 recommends that governments "consider using experimentation to provide a controlled environment in which AI systems can be tested and scaled up as appropriate" (Box 1). This recommendation focuses on the institutional, regulatory, and legal framework that enables AI innovation. Considering the fast pace of AI developments, it is a challenge to set up a policy environment with enough flexibility to keep up with and promote innovation yet remain safe and provide legal certainty. OECD AI Principle 2.3 addresses this by identifying means to improve the adaptability, reactivity, versatility, and enforcement of policy instruments to accelerate the transition from development to deployment and commercialisation where relevant.

This principle highlights the role of experimentation to provide controlled and transparent environments where AI systems can be tested and in which AI-based business models that could promote solutions to global challenges can flourish. Policy experiments can operate in "start-up mode" whereby experiments are deployed, evaluated and modified, then scaled up or down or abandoned, depending on the outcomes. Finally, this principle acknowledges the importance of oversight and assessment mechanisms to complement policy frameworks and experimentation.

Box 1. OECD AI Principle 2.3: Shaping an enabling policy environment for AI

"Governments should promote a policy environment that supports an agile transition from the research and development stage to the deployment and operation stage for trustworthy AI systems. To this effect, they should consider using experimentation to provide a controlled environment in which AI systems can be tested, and scaled-up, as appropriate."

Governments should review and adapt, as appropriate, their policy and regulatory frameworks and assessment mechanisms as they apply to AI systems to encourage innovation and competition for trustworthy AI."

Source: (OECD, 2019)

Regulatory experimentation and regulatory innovation

Innovation can be viewed as a "regulatory moving target" (Ranchordás, 2021a_[2]). Ever-faster innovation cycles in information and communication technologies (ICT), and related industries such as AI and other immersive technologies force policy makers to design regulatory approaches that rely on experimentation to inform their decisions.

Regulatory experimentation is a process that accumulates evidence on the costs and benefits of regulation (Greenstone, 2009_[3]). Experimental approaches to regulation have existed for centuries (Ranchordás, 2021a_[2]). They test legal provisions using frameworks outside of prevailing regulatory structures, allowing regulators to experiment with new economic, institutional, and technological methods. Regulatory experimentation occurs either by derogation, where legal provisions are waived to perform the experiment, or by devolution, where national governments or supranational organisations empower local government to establish regulations to carry out the experiment, thus promoting "local policy laboratories" (Ranchordás, 2021a_[2]).

Experimental approaches to regulation enable innovation through the design and implementation of new solutions. Innovation of regulatory functions is often characterised as "anticipatory regulation", as opposed to "adaptive regulation" (Armstrong and Rae, 2017_[4]; Ranchordás, 2021a_[2]). Regulatory innovation encompasses new ways of identifying problems to solve and specifying goals to achieve, changes in data

management, and improvement in the design and implementation of techniques that change behaviour, including but not limited to enforcement across instruments or methods (Black, Lodge and Thatcher, 2005^[5]).

New types of flexible and innovation-friendly regulatory frameworks that use experimentation have emerged in recent years. Mechanisms to encourage regulatory innovation are being adopted worldwide, either as new instruments or derived from existing practices focused on experimentation. Among these, regulatory sandboxes (explained below) complement other tools, including:

- government-promoted innovation testbeds for public infrastructure, such as automated-vehicle and smart-traffic infrastructure in Austria, Finland, Germany, and Sweden (OECD, 2019^[6])
- innovation hubs and testing experimentation facilities (European Parliament, 2021^[7])
- national regulatory guidelines and handbooks for local and regional administrations, such as the European Better Regulation Policy Toolbox 2021 (European Commission, 2021a^[8]) and Germany's Handbook for Regulatory Sandboxes (BMW, 2019^[9])

Focus on regulatory sandboxes

A regulatory sandbox is a limited form of regulatory waiver or flexibility for firms, enabling them to test new business models with reduced requirements. It often includes mechanisms to ensure overarching objectives such as consumer protection. Regulatory sandboxes are typically organised and administered on a case-by-case basis by the relevant authorities (Attrey, 2020^[10]). Their main characteristics are that they are: (1) temporary; (2) use a trial-and-error approach; and (3) involve collaboration and iteration between stakeholders.

Regulatory sandboxes require thorough design and testing with robust methodological and assessment frameworks, evaluating feasibility, demand, potential outcomes, and collateral effects. Inadequate specifications can harm competition, consumers, data protection, and regulation (Black, Lodge and Thatcher, 2005^[5]; Ranchordás, 2021a^[2]). Sandboxes represent a hybrid, flexible paradigm focused “on innovation as the driving principle of regulatory action” (Muñoz Ferrandis, 2021^[11]).

By using an evidence-based approach, regulatory sandboxes adapt existing rules to specific innovative challenges by allowing temporary derogations, additional guidance, or regulatory comfort (EIPA, 2021^[12]) (Council of the European Union, 2020^[13]). Compared to top-down experimental set-ups and regulations, sandboxes take a further step by fostering collaboration and time-restricted iteration between regulators and the market (Almeida Shimizu, 2020^[14]; Ranchordás, 2021a^[2]). Similar initiatives started to emerge in 2012, officially launched in 2015 by the United Kingdom Financial Conducts Authority (Attrey, Leshner and Lomax, 2020^[15]; UK FCA, 2015^[16]). Sandboxes are particularly relevant to highly regulated industries such as financial services, transport, energy, and health (OECD, 2019^[6]) (Annex B).

Table 1. Common eligibility criteria in EU fintech regulatory sandboxes

Criteria	Description
Genuine innovation	The financial-technology (fintech) product or service is truly innovative and/or significantly different from those currently available
Benefits to consumers and the financial system	The fintech product or service has the potential to provide a better outcome for investors and consumers, for financial stability, or for market integrity
Background research	The provider has sought to understand the regulatory framework before approaching the innovation facilitator (sandbox)
Project maturity/test readiness	The project has reached a sufficiently mature stage considering the resources invested and the development stage of the product or service
Need for support/testing	The fintech product or service has a genuine need for support, i.e. the innovation doesn't easily fit the existing regulatory framework and cannot be handled through the usual supervisory channels
Risk mitigation	The provider has ensured that potential risks arising from the proposed product or service are assessed and mitigated, including to consumers and the market
Commitment to investor protection and compliance	A commitment by the applicant entity to investor protection and a culture of compliance
Serves domestic market	The provider intends to offer the proposed product or service to the domestic market

Source: (Parenti, 2020)

Sandboxes involve an application phase, a preparation phase, a testing phase, and an exit and evaluation phase (ESMA, EBA, EIOPA, 2018^[17]). Each sandbox hosts a limited number of stakeholders (often referred to as cohorts), selected based on criteria such as innovativeness (Table 1), who benefit from customised and iterative collaboration with the relevant institution (Allen, 2019^[18]).

Sandboxes can help public institutions with regulatory discovery such as evaluating the suitability of a legal framework (BMW, 2019^[9]) or informing a decision on whether or how much to amend provisions. The regulatory, economic, and technical assessments can inform decisions about whether to adapt legal frameworks or revisit their interpretation, and can save agencies considerable time, especially if they find that the existing legal structure can handle new technologies with relative ease (Muñoz Ferrandis, 2021^[11]).

Companies entering a sandbox benefit from a waiver or other exemption (such as a license exemption) from specific regulatory provisions, reducing the time and capital required to enter the market. In addition, regulatory sandboxes can foster investment in companies participating in testbeds (Attrey, Leshner and Lomax, 2020^[15]; Goo and Heo, 2020^[19]); (Table 2).

Table 2. Benefits of regulatory sandboxes

To regulators	To firms	To consumers
• Inform long-term policy making through learning and experimentation • Signal commitment to innovation and learning • Promote communication and engagement with market participants • Update regulations that might prohibit beneficial innovation	• Reduce time to market by streamlining the authorisation process • Reduce regulatory uncertainty, such as that new technologies and business models will be prohibited • Gather feedback on regulatory requirements and risks • Improve access to capital • Remove market-entry barriers for companies (especially SMEs and start-ups) by democratising the knowledge about legal frameworks around certain innovative products	• Promote introduction of new and potentially safer products • Increase access to financial products and services

Source: Adapted from (Parenti, 2020)

2 Lessons from regulatory sandboxes in fintech

Disruptive technologies and accelerating innovation in the financial industry have challenged traditional markets, institutions, and incumbents. Regulators must strike a balance between protecting consumers and leveraging the opportunities this innovation creates for financial inclusion and economic growth (Zetsche et al., 2017^[20]). Governments around the world take different regulatory approaches to financial technology (fintech), ranging from “wait and see”, to laws and reforms, and innovation facilitators (World Bank, 2020^[21]), with sandboxes included in the latter.

Fintech regulators have used sandboxes since the UK FCA announced the first official fintech regulatory sandbox in 2015. In the years since, policy makers, academia, and industry have highlighted benefits and challenges regarding the implementation of these mechanisms for regulatory innovation.

Positive impacts

Fostering fintech venture capital investment

Fintech regulatory sandboxes foster investment in the market (Attrey, Leshner and Lomax, 2020^[15]; Goo and Heo, 2020^[19]), such as by increasing venture capital invested in fintech start-ups. Reduced regulatory uncertainty and market testing enable innovative firms’ access to financing. For example, 40% of firms that completed the UK FCA inaugural sandbox program subsequently received funding (UK FCA, 2017^[22]). Put differently, after companies’ successful testing in the regulatory sandbox, fintech investment was 6.6 times higher (Goo and Heo, 2020^[19]).

Facilitating market entry

With regulatory sandboxes, companies do not view regulation as a barrier to innovation (Deloitte, 2018^[23]). Sandboxes thus facilitate market entry and reduce administration and transaction costs. Since its launch in 2015, the UK FCA sandbox has supported more than 700 firms and increased their average speed to market by 40% compared with the regulator’s standard authorisation time (Truby et al., 2021^[24]).

Improving communication between regulators and firms

Sandboxes improve communication and learning channels between regulators and industry. Innovators inform regulators’ policy-making and regulation process (Attrey, Leshner and Lomax, 2020^[15]; BIAC, 2020^[25]; Buckley et al., 2020^[26]). The Dutch Authority for Financial Markets (AFM) and Dutch Central Bank (DNB) found that their three-year-old innovation hub and regulatory sandbox initiatives play “an important role in responding to innovation in the financial sector” because of the knowledge exchange between regulators and market operators (AFM & DNB, 2019^[27]; Almeida Shimizu, 2020^[14]).

Adapting regulatory processes

Sandboxes allow quicker development of more practical regulation. For instance, one of the projects in the fifth UK FCA fintech sandbox cohort led to regulatory amendments that allow portable, electronic identity (eID) in the financial services industry. This resulted in updates to anti-money laundering regulations that allow financial institutions to use customers' eID (Almeida Shimizu, 2020^[14]).

Informing regulation

The evidence-based, dynamic approaches to regulation offered by sandboxes can inform rulemaking and regulatory adaptation (BMW, 2019^[9]). A common result from sandboxes is that regulators issue guidance on how to interpret existing legal frameworks rather than amending laws, absent substantial need (Almeida Shimizu, 2020^[14]; BIAC, 2020^[25]). Cases include:

- UK FCA Policy Statement PS19/22 Guidance on Cryptoassets
- Hong Kong Monetary Authority 2020 feedback from thematic reviews of Anti-Money Laundering and Counter-Financing of Terrorism control measures for remote customer onboarding initiatives
- Canadian Securities Administrators and Investment Industry Regulatory Organisation of Canada Joint 2019 Consultation Paper 21-402: Proposed Framework for Crypto-Asset Trading Platforms

Nurturing internationally harmonised sandbox frameworks

Despite variation in regulatory and industrial policies between countries, an overview of sector-specific sandboxes (e.g. fintech) identifies their enactment of similar safeguards (Attrey, Leshner and Lomax, 2020^[15]). There are also commonalities in entry requirements for regulatory sandboxes (ESMA, EBA, EIOPA, 2018^[17]; Parenti, 2020^[28]) namely: genuine innovation or innovative character (from both technical and business angles); the innovation aims to benefit and protect the public interest; and readiness for the product or service to be tested (Table 1). Jurisdictions implementing these requirements include Austria, Brazil, Denmark, Greece, India, Latvia, Lithuania, Malta, the Netherlands, Norway, Singapore, Spain, Korea, the United Kingdom, and the US State of Wyoming.

Challenges

Inefficient and risky implementation of regulatory sandboxes

The rapidly growing use of regulatory sandboxes in fintech calls for careful assessment. By late 2020, there were 73 sandboxes in 57 jurisdictions worldwide (World Bank, 2020^[21]). However, inefficient and risky implementation of regulatory sandboxes can lead to unanticipated impacts on competition, consumers, and regulation; (Almeida Shimizu, 2020^[14]; Parenti, 2020^[28]; Quan, 2019^[29]). A 2019 report found that a quarter of regulators launched sandbox initiatives without first evaluating feasibility, demand, potential outcomes, or collateral effects (UNSGSA, 2019^[30]). Regulators reported that they were “unprepared for the level of effort and resources required to process sandbox applications and develop testing plans” (UNSGSA, 2019^[30]). Moreover, a report by Business at OECD estimated the cost for regulators of operating a sandbox at USD 1 million (BIAC, 2020^[25]).

Inefficient sandbox testing processes

There are concerns about a lack of robust evaluation methods to assess whether firms meet eligibility criteria and for testing (EIPA, 2021^[12]; Parenti, 2020^[28]; Ranchordás, 2021a^[2]). In particular, the

“innovativeness” criterion might be assessed in a subjective manner by regulators, while the “novelty” requirement for patentability is assessed by relevant patent offices following quasi-standard procedures and harmonised international legislation (e.g., the European Patent Convention and Patent Cooperation Treaty). Furthermore, innovativeness assessment in sandboxes does not yet have standards and is often carried out through desk research by the authority in charge of the sandbox (Almeida Shimizu, 2020^[14]; ESMA, EBA, EIOPA, 2018^[17]). Inefficient eligibility and testing frameworks, and a lack of technical expertise among public servants could make sandboxes less efficient.

Future scalability

Sandboxes are conceived and designed as small-scale testing frameworks with limited cohorts of participants. However, as companies realise the competitive benefit of entering a sandbox, there could be market pressure to enlarge sandbox size and scope. In addition, regulators might want to increase participation to gather more data to inform policy and legislation. The limited number of yearly participants in the UK FCA sandbox can be viewed against the background of 56,000 licensed financial-market participants in the UK in 2022 that could be interested in participating. Broader participation would require automating some of the sandbox processes with more use of regulatory and governance technology tools (European Banking Authority, 2017^[31]; Truby et al., 2021^[24]).

Regulatory fragmentation

Diverging policies and international competition to attract fintech investment and talent could cause some sandboxes to be more lenient and lead to forum-shopping or regulatory arbitrage, in which firms look for sandboxes with the most favourable conditions (Allen, 2020^[32]; Parenti, 2020^[28]). A harmonised, international legal framework enabling cross-sandbox compatibility would thus be desirable (Allen, 2019^[18]; Brummer and Yadav, 2019^[33]; Knight and Mitchell, 2020^[34]). Currently, there is neither harmonisation nor international good-practice guidance regarding liability regimes applied to – or waived by – regulatory sandboxes (Truby et al., 2021^[24]). In addition, sandboxes might be misused and lead to regulators lowering safeguards and requirements to attract innovators.

Regulatory sandboxes operate in specific jurisdictions. However, the international reach of fintech companies calls for frameworks that allow cross-sandbox compatibility (Zetsche et al., 2017^[20]). In 2019, 20% of fintech firms in the Latin American and Caribbean region operated in more than one jurisdiction (UNSGSA, 2019^[30]). The European Commission is driving efforts towards a pan-European renewable technology sandbox that would benefit innovation in the digital single market. The Pacific Islands Regional Initiative launched a sandbox in 2020 to promote fintech development and regulation across several central banks (World Bank, 2020^[21]).

At a global scale, the Global Financial Innovation Network (GFIN) has been trying since 2019 to build a regulatory sandbox of more than 50 financial institutions around the world (Global Financial Innovation Network, 2020^[35]). However, compatibility between legal regimes is a challenge and, to date, only two companies – B+S Bankssysteme and Bedrock AI – were able to join the GFIN sandbox (Global Financial Innovation Network, 2022^[36]; OECD, 2021b^[37]). Provisions for international co-operation with equivalent, compatible foreign sandbox regimes exist in Spain,¹ and in the US states of Arizona² and Wyoming.³ Memoranda of understanding on fintech between countries could embed cross-sandbox provisions and help sandbox compatibility (Herrera and Vadillo, 2018^[38]; Jenik and Lauer, 2017^[39]; Parenti, 2020^[28]).

¹ Financial System’s Digital Transformation Act, Act 7/2020, Article 22(3)

² Regulatory Sandbox Program, HB 2434, provision 41-5611(f)

³ Financial Technology Sandbox, HB 0057, provision 40-28-106(g)

3

Policy considerations for AI regulatory sandboxes and experimentation

This section analyses regulatory approaches for) and identifies challenges that require stronger international co-operation, interoperability, or harmonisation. While regulatory sandboxes are developed on a case-by-case basis depending on national policy and industrial needs, good practices can be identified.

Multi-disciplinary and multi-stakeholder co-operation

As is the case in fintech, institutional co-operation is a success factor for regulatory sandboxes in AI (Almeida Shimizu, 2020^[14]; Quan, 2019^[29]). Given the technical, social, and economic specificities of AI-related products and services, coordination of regulatory responses among national agencies is critical (Brunner and Yadav, 2019^[33]; Government of the United Kingdom, 2021^[40]).

Collaborative institutional approaches can develop interdisciplinary eligibility and assessment frameworks for sandboxes (Ranchordás, 2021a^[2]; 2021b^[41]). Co-operation across authorities and taskforces should be sought even when an AI regulatory sandbox falls under the supervision of one authority – typically the data-protection authority (Attrey, Leshner and Lomax, 2020^[15]). Several countries facilitate such co-operation. Spain's Network of Excellence in AI exchanges interdisciplinary knowledge generated by universities and administrations. Its EU AI Act sandbox involves various government institutions such as the Data Protection Agency and the Agency of Medicines and Medical Devices. The UK's Digital Regulation Cooperation Forum and Regulators Pioneer Fund advisory service pilot bring together competition, communication/media, financial, and data protection authorities, all of which are actors in AI policy. Korea's sandbox has inter-ministerial involvement, and a variety of sectors in Germany use flexible, generic sandbox frameworks (BMW, 2019^[9]). In Brazil, the Securities and Exchange Commission and the Central Bank set up an internal committee that interacts with universities, researchers, associations, and sector representatives to assess sandbox applications (Almeida Shimizu, 2020^[14]).

Coordination with market actors is important too. Authorities in charge of regulatory experimentation engage with bodies such as trade institutions or innovation accelerators (UK FCA, 2014^[42]). Governments are also calling on experts and designating oversight bodies for AI and regional infrastructure. A European Artificial Intelligence Board will provide technical and scientific support to stakeholders in the EU's AI regulatory sandbox (European Parliament, 2021^[7]; OECD, 2021b^[37]). Both the proposed EU AI Act and the European Parliament call for the creation of co-operation frameworks among authorities (European Parliament, 2021^[7]). The Monetary Authority of Singapore (MAS) convened a consortium of financial institutions and technology partners to create guidelines and tools to implement its principles of promoting fairness, ethics, accountability, and transparency (FEAT) in AI (OECD, 2021a^[1]). Other industry-led initiatives that foster AI regulatory experimentation to inform policy include Open Loop's experimentation policy program and BigScience's open and decentralised experimental framework to develop and study

open, natural-language-processing (NLP) machine-learning (ML) models, and transparency-based AI governance processes and tools.

Box 2. Safety and quality certification

Regulatory sandboxes can be seen as ex ante instruments that certify the safety and quality of AI products and services in an efficient manner (European Parliament, 2021^[7]; Scherer, 2016^[43]; Thierer, O'Sullivan and Russell, 2017^[44]). The link between AI regulatory sandboxes and AI certification is clear: testing an AI product in a regulatory sandbox can help an agency decide to certify its quality or safety. Fast-tracks could be established to lighten AI certification administrative processes and make them more effective. These could lead to better-informed decision-making, allowing a certification agency with sandbox testing information to evaluate an AI application's compliance. Fast-track processes are common in formal international standardisation settings (e.g. ISO/IEC JTC1 PAS submitter process) and intellectual-property offices (e.g. WIPO PCT-patent prosecution highway and Singapore's fintech patents fast-track assessment). However, balance is needed between flexible, bottom-up solutions and rigid, top-down controls (Thierer, O'Sullivan and Russell, 2017^[44]). An example is Singapore's Sandbox Express, which speeds approvals for low-risk experiments (MAS, 2019^[45]).

AI expertise within regulatory authorities

Technical expertise at public institutions and in policy-making that deal with emerging technologies is a key consideration (Erdélyi and Goldsmith, 2022^[46]; Government of the United Kingdom, 2021^[40]). The technical complexity of some AI systems is a challenge for authorities and agencies in charge of AI regulatory sandboxes. A lack of expertise in emerging technologies can lead to inefficient decision-making about sandbox access and testing frameworks (Scherer, 2016^[43]). Building technical expertise within AI regulatory sandboxes would maximise the benefits that testing can bring to markets, regulators, and consumers. In contrast, lack of sufficient technical expertise at institutions managing AI regulatory sandboxes can generate misleading conclusions that could negatively impact market competition, such as if a project is rejected because examiners do not understand it, or a project does not pass the testing process when it would be viable to implement under normal market conditions. UNESCO's Digital Transformation and Artificial Intelligence Competency Framework for Civil Servants report underlines the competencies civil servants need to enable the digital transformation of their countries and societies (Broadband Commission, 2022^[47]).

Beyond AI technical expertise, competition experts with experience assessing market dynamics and behaviours, and innovation assessment expertise will also be needed (Chen, 2019^[48]), as competition and innovation are core values for regulatory sandbox frameworks to promote.

International regulatory interoperability and a possible role for trade policy

Many challenges posed by AI transcend borders and countries' regulatory efforts are converging towards global governance frameworks such as the OECD AI principles. Yet different social and political values, geopolitical interests and "first-mover" advantages can cause regulatory fragmentation, and lead to competition to capture the global AI market; (Ala-Pietilä and Smuha, 2021^[49]; Cihon, 2019^[50]). Some have put forward that "the 'race to AI' is also bringing forth a 'race to AI regulation'" (Smuha, 2021^[51]). Regulators might try to design AI regulatory frameworks that attract foreign investment and resources such as talent and researchers. Competition between countries can lead to differing regulatory frameworks that offer

differing liability regimes in AI regulatory sandboxes (Ala-Pietilä and Smuha, 2021^[49]; Truby et al., 2021^[24]). Regulatory fragmentation in AI can increase the cost of international trade by creating competing regional and international standards (OECD, 2022^[52]).

The EC proposed the AI Act to avoid the increased regulatory costs that result from fragmentation (European Commission, 2021b^[53]). The European AI Board is being designed as an overarching institution to coordinate the national implementation of tools like regulatory sandboxes, which are embedded in the Act, and to address concerns about legal uncertainty in coordinating member states' sandboxes with the EC (Ranchordás, 2021a^[2]). Regional and international co-operation on AI can tackle regulatory fragmentation and establish communication platforms for a cohesive approach to AI regulatory advancements (Brummer and Yadav, 2019^[33]).

The innovation and economic interaction from research and development (R&D) agreements between countries, and regional co-operation and trade agreements can also contribute to harmonised, international AI regulatory frameworks (OECD, 2022^[52]; 2021b^[37]). Trade agreements include the Digital Economy Partnership Agreement between Chile, New Zealand and Singapore to promote the safe and responsible use of AI technologies, which also advocates for the implementation of regulatory sandboxes (Datasphere, 2022^[54]; OECD, 2022^[52]; 2021b^[37]; Ministry of Trade and Industry of Singapore, 2021^[55]).⁴ These policy, R&D, and trade agreements can facilitate cross-sandbox interoperability or co-operation frameworks, like for fintech. Multi-lateral trade agreements could facilitate cross-sandbox interoperability, reducing regulatory arbitrage and forum-shopping (Datasphere, 2022^[54]).

Cross-border data flows show how regulatory sandboxes can generate trust among countries and regulators by means of international co-operation (BIAC, 2020^[25]). Privacy-related regulatory sandboxes are natural spaces to experiment with a common approach to managing cross-border data flows (Box 3).

Box 3. Initiatives in ASEAN

The partnership between the Association of Southeast Asian Nations (ASEAN) and the Global System for Mobile Communications Association (GSMA) is a pilot regulatory program enabling stakeholders to test cross-border data flows between ASEAN countries (GSMA Asia Pacific, 2019^[56]). The ASEAN Regulatory Pilot Space can be seen as an escalated regulatory sandbox: i.e. a cross-sandbox international framework. It has an international co-operation infrastructure that serves governments and companies, which must meet specific requirements to be eligible for the testing phase (BIAC, 2020^[25]).

Similarly, the ASEAN Financial Innovation Network's Application Programming Interface Exchange (APIX) initiative is a cross-border sandbox for financial institutions and fintech firms to test common APIs to foster financial inclusion in the region (UNSGSA, 2019^[30]). To date, over 117 financial institutions and more than 1 691 fintech companies are part of the initiative (Synfindo, 2023^[57]).

Regulators and institutions are used to regulatory co-operation (OECD/WTO, 2019^[58]) and regulatory interoperability instruments in international trade agreements. The World Trade Organisation Agreement on Technical Barriers to Trade (TBT Agreement) includes compatibility tools such as "equivalence" or "arrangements for conformity assessment". According to Article 2(7) of the TBT Agreement:

Members shall give positive consideration to accepting as equivalent technical regulations of other Members, even if these differ from their own, provided they are satisfied that these regulations adequately fulfil the objectives of their own regulations.

⁴ Article 9.4 on Data Innovation

Regarding “arrangements for conformity assessment”, Article 6(1) of the same text states that:

Members shall ensure, whenever possible, that results of conformity assessment procedures in other Members are accepted, even when those differ from their own, provided they are satisfied these procedures offer an assurance of conformity with applicable technical regulations or standards equivalent to their own procedure.

However, these mechanisms apply only to “technical regulations”, defined as “documents which lay down product characteristics or their related processes and production methods, including the applicable administrative provisions, with which compliance is mandatory”.

In principle, regulatory sandboxes are not considered technical regulations under the TBT Agreement. This raises the question of whether regulatory sandboxes and other experimentation legislation in emerging technologies could be considered “technical regulations” in the future, with proposed amendments to international legal frameworks to foster interoperability tools for sandboxes and regulatory experimentation in general. As WTO members benefit from the TBT Agreement to reach “equivalence agreements” on TBT-related technical regulations, the same could be proposed for regulatory sandboxes in fields like AI to promote interoperability between regulatory sandboxes.

Mutual Recognition Agreements based on the TBT “arrangements for conformity assessment” – whereby the parties recognise specific results, such as certifications, in specific sectors (Lim, 2021^[59]) – could be explored to enable cross-border interoperability of AI regulatory sandboxes. This is relevant because of the links between regulatory sandboxes and mechanisms such as AI certification or standardisation. Some suggest the need for a cross-border framework for AI regulatory sandboxes, enabling the sharing of best practices, cross-border sandbox frameworks, and common terminology and standards fostering cross-sandbox interoperability. Such a framework could improve regulatory certainty and improve new firms’ access to customers and services abroad. However, challenges include different cultural understandings of risk, and the complexity of varying legal frameworks (Datasphere, 2022^[54]).

Comprehensive sandbox eligibility and testing criteria

Differences in eligibility criteria and their interpretation can be a risk for cross-sandbox compatibility. The definition, interpretation, and analysis of core, common eligibility criteria – such as innovativeness, public interest, and readiness for testing – could be harmonised at the international level to promote cross-sandbox compatibility. While AI-related business models are often inherently international, sandboxes are often limited to a specific jurisdiction. This means AI companies must test products or services in several sandboxes, resulting in different access decisions and testing results.

A parallel can be drawn with the European patent system, whereby applicants can pursue a single European patent instead of filing a patent in each country with potentially different outcomes and chose in which jurisdictions to enforce it. A similar approach for technology-based regulatory sandboxes could be interesting (Box 4).

Box 4. Proposed EU AI Act Sandbox

To avoid regulatory fragmentation across EU member states, the European Commission would aim to set a harmonised, operational approach to AI regulatory sandboxes and, consequently, propose a similar set of entry requirements and testing procedures for member states to implement.

Article 53(6) of the EU AI Act states:

The modalities and the conditions of the operation of the AI regulatory sandboxes, including the eligibility criteria and the procedure for the application, selection, participation and exiting from the sandbox, and the

rights and obligations of the participants shall be set out in implementing acts.

While Article 58 Act holds that the EU AI Board will “contribute to uniform administrative practices in the Member States, including for the functioning of regulatory sandboxes”.

Like the case of fintech sandboxes, common principles and standards for the development of AI regulatory sandboxes would be beneficial for both governments and industry (Parenti, 2020^[28]).

Impact on innovation and competition

The design of regulatory sandboxes should be assessed carefully before their implementation, considering competition and innovation dimensions. From a competition standpoint, the regulatory authority in charge of a sandbox has a strong influence on markets that could still be in early stages of development, which might affect the “level playing field” between firms (Parenti, 2020^[28]). Company selection, legal waivers or other testing methods, and ex-post market actions can impact competition, and thus require further research (Chen, 2019^[48]; Knight and Mitchell, 2020^[34]; UK FCA, 2014^[42]).

Sandboxes are selective given resource constraints, and participants are selected based on eligibility criteria. Out of 63 applicants to the 2019 UK Information Commissioner's Office (ICO) sandbox, just ten were selected based on clearly determined criteria (UK ICO, 2019^[60]). According to Financial Supervisory Commission of Chinese Taipei, if an application is approved, subsequent applications with similar business models and “implementing existing patented or non-patented technologies in patently different technological and business models will be denied for lacking ‘innovativeness’” (Chen, 2019^[48]). This raises the question of how to determine innovativeness. While patents could be considered an important indicator, they risk conferring exclusivity on a selected technology, which could then become an essential technology due to the sandboxing process and its exclusion of potential competitors. The participation in sandboxes of competition-law and economic experts could be a line of policy research and consider questions of equal treatment of market players. Objective criteria are even more important.⁵ The applicability of liability regimes to sandboxes needs clarification (BIAC, 2020^[25]) as it could impact both innovation and competition. Applying normal market liability regimes to a sandbox could hinder its use, as firms might be reluctant to expose their algorithms and trade secrets without a legal waiver.

Due to the transverse nature of AI applications, sandboxes might be used in different fields such as privacy law, tort law, sectoral safety and quality laws etc. In the case of the EU AI Act, Recital 72 states:

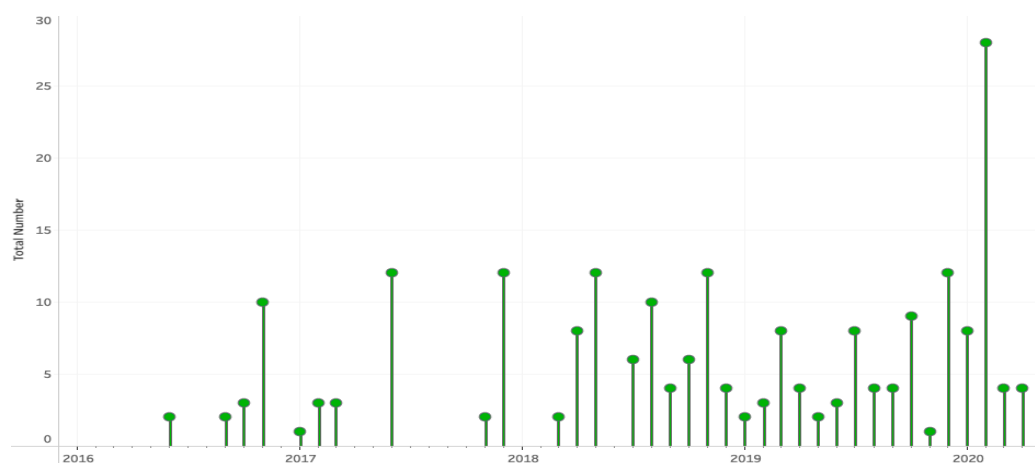
The objectives of the regulatory sandboxes should be to foster AI innovation by establishing a controlled experimentation and testing environment in the development and pre-marketing phase with a view to ensuring compliance of the innovative AI systems with this Regulation and other relevant Union and Member States legislation.

The growing number of sandboxes and related mechanisms helps shape a global regulatory ecosystem that encourages innovation. However, the newness of these mechanisms and lack of standard typologies means every sandbox is different. In particular, time-to-market factors into designing a sandbox, which can be classified as: (1) a pre-market instrument – before an AI application is launched; (2) a regulatory mechanism – operating in parallel with the release of an AI application into the market, allowing stakeholders to commercialise their applications under a restricted framework; or (3) a voluntary ex-post

⁵ Differentiation between market actors does not necessarily violate the legal principle of equal treatment in the EU: according to EU case law, as held in C-127/07 Arcelor Atlantique, by the Advocate General Maduro, differentiations in regulatory experimentation are compatible with the principle of equal treatment as far as experimental laws have a transitory character, and the testing is carried out in accordance with objective criteria.

instrument – once the product is already in the market, to test AI applications and benefit from specific guidelines on regulatory interpretation.

Figure 2. Number of regulatory sandboxes, 2016 to mid-2020



Source: (World Bank, 2020^[21])

Interactions with other pro-innovation mechanisms

AI regulatory sandboxes should be considered one of several tools for regulatory experimentation and innovation, alongside complementary areas: standardisation; innovation hubs; other sandboxes such as fintech and privacy sandboxes; and governance technologies.

AI regulatory sandboxes and AI standardisation

AI standards are simultaneously policy tools and sources of innovation and competition. Standardisation is a focus of AI policies (OECD, 2021b^[37]) on which regulations increasingly for trustworthy AI compliance mechanisms, such as in the proposed EU AI Act (European Commission, 2021b^[53]; European Parliament, 2021^[7]). Policies that increase interoperability between AI standards in regional or international level are being developed through new institutional programs such as StandICT.eu in the EU and the UK AI Standards Hub launched in October 2022, led by the Alan Turing Institute and supported by the British Standards Institution and the National Physical Laboratory.

AI regulation and AI standards are interdependent, especially for risk-based approaches that use standards to implement regulation. This interdependence calls for clear, harmonised frameworks and guidelines for interactions between these governance mechanisms: AI regulatory sandboxes test the readiness of AI-related products or services to be marketed and must assess such readiness in light of existing AI standards. The challenge is that AI standardisation, like AI sandboxes, is at an early stage of development. Therefore, their development will run in parallel. In response, national, regional, and international regulation and standardisation frameworks must be closely coordinated.

Regulatory sandboxes and standardisation processes can feed and complement each other. For instance, data gathered from AI sandboxes on a yearly basis could be used to spot patterns and identify the need for a standard in a specific area. Conversely, ongoing standardisation processes could inform testing in AI regulatory sandboxes. The European Parliament included in its assessment of the AI Act amendments (proposal for amendment of Article 53(1)(a): “The AI regulatory sandbox shall allow and facilitate the involvement of notified bodies, standardisation bodies, and other relevant stakeholders when relevant.”

Standards also enable cross-sandbox compatibility. Two jurisdictions might implement differing AI regulatory sandbox regimes but adopt the same standards for testing safety or risk characteristics of an AI product or service. This could lead to a common framework for testing, and potentially to consistent sandbox outcomes. In contrast, adopting different AI standards could lead to different assessments of AI safety or quality, which could negatively impact trade relations and AI sandbox processes: a company that successfully tested its product in one country might have to go through another process elsewhere.

AI regulatory sandboxes and AI innovation-experimentation hubs

Sandboxes should not be used only to validate hard-law expectations, but also to support open innovation. Regulatory sandboxes should be implemented as complementary tools alongside existing innovation institutions, notably innovation hubs (Bromberg, Godwin and Ramsey, 2017^[61]; Buckley et al., 2020^[26]). Sandboxes and innovation hubs are both “innovation facilitators” and complement each other. For example, the EU Testing and Experimentation Facilities (TEF) provide frameworks to test AI applications using an industrial-process-oriented approach that can be cross-referenced with simultaneous regulatory testing from specific EU AI sandboxes, informing both the authority in charge and the TEF. The proposed EU AI Act explicitly references in Recital 74:

In order to minimise the risks to implementation resulting from lack of knowledge and expertise in the market as well as to facilitate compliance of providers and notified bodies with their obligations under this Regulation, the AI-on-demand platform, the European Digital Innovation Hubs and the Testing and Experimentation Facilities established by the Commission and the Member States at national or EU level should possibly contribute to the implementation of this Regulation. Within their respective mission and fields of competence, they may provide in particular technical and scientific support to providers and notified bodies.

TEFs combine physical and virtual assessment and provide technical support to test AI-based software and hardware technologies (including AI-powered robotics) in real-world environments (European Commission, 2022^[62]). AI sandboxes can complement TEFs by providing a regulatory perspective. According to the European Commission, TEFs provide the technical infrastructure to allow sandboxes to test AI applications (European Commission, 2022^[62]). TEFs’ interactions with sandboxes from administrative and public-law perspectives are yet to be explored.

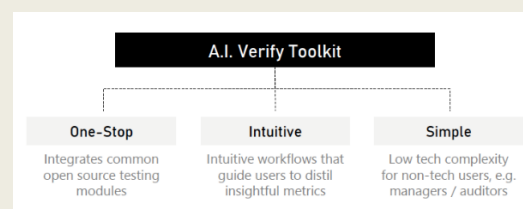
AI regulatory sandboxes and regtech/govtech initiatives

Regulatory technology (regtech) and governance technology (govtech) support “smart” regulation and sandbox scalability, institutional data sharing, and co-operation initiatives (Zetsche et al., 2017^[20]; Omarova, 2020^[63]). Govtech and regtech instruments can automate part of AI sandbox functioning. Integrating data-management and data-science can create common, international policy to measure AI-innovation-related institutional and regulatory frameworks.

Box 5. A.I. Verify governance technology tool in Singapore

A.I. Verify is an open-source software tool to assess the trustworthiness of AI systems according to a set of criteria and factors. Developed by Singapore's Infocomm Media Development Authority and Personal Data Protection Commission, this govtech tool is at minimum-viable-product stage. Stakeholders like Google, Microsoft, and Amazon tested it as part of a pilot program. It aims to automate transparency assessment of AI systems, allowing companies to see whether new AI systems comply with relevant international standards and regulations.

Source: Singapore Infocomm Media Development Authority and Personal Data Protection Commission



Intersections between AI regulatory sandboxes and privacy sandboxes

Privacy sandboxes are an important topic, of particular interest to the OECD Working Party on Data Governance and Privacy (DGP) in the context of the review of the OECD Guidelines Governing the Protection of Privacy and Transborder Flows of Personal Data. The intersection between AI sandboxes and privacy sandboxes is significant. The proposed EU AI Act states that AI sandboxes could help address privacy-related matters. Privacy sandboxes focus on: (1) privacy-by-design approaches, assessing risks from new technologies and determining how to mitigate them by building privacy protections (BIAC, 2020^[25]); (2) cross-border data flows that require cross-regulatory and cross-border scenarios (BIAC, 2020^[25]). Due to the cross-sectoral character of AI applications, the same application could involve testing several legal frameworks, meaning a privacy sandbox could ideally consider other regulations in addition to privacy (BIAC, 2020^[25]). At the same time, an AI sandbox might also consider several regulations, including privacy regulations.

Intersections between AI regulatory sandboxes and fintech sandboxes

AI technologies are widely used in fintech applications (OECD, 2021a^[11]), such that existing fintech sandboxes already do or can be expected to soon test AI-related applications. Authorities managing regulatory sandboxes could benefit from coordinated approaches to assessing and testing AI projects to optimise testing and allow several authorities to benefit from one process, e.g. privacy or AI (Box 6).

Box 6. Cross-sandbox testing by Bedrock AI: Using machine learning to identify flags in Canadian corporate disclosure agreements

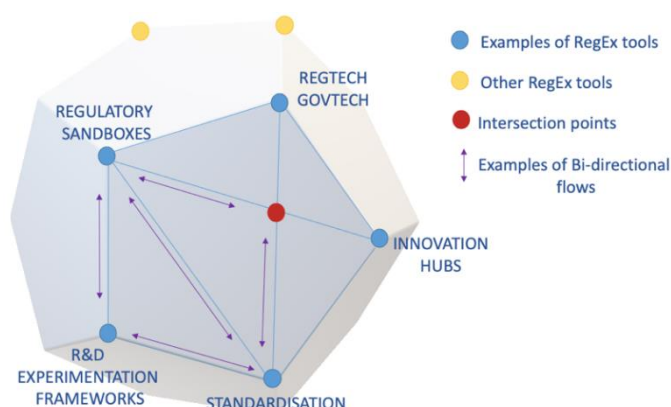
The Global Financial Innovation Network (GFIN) has been pushing for the creation of a “global sandbox” using an international legal compatibility initiative between its members to implement simultaneous testing processes in different institutions. Bedrock AI was one of two companies to enter the GFIN cross-testing initiative. The Alberta Securities Commission, Quebec's Autorité des Marchés financiers, the British Columbia Securities Commission, and the Ontario Securities Commission approved Bedrock AI to test its machine-learning solutions to identify flags in Canadian corporate disclosure agreements.

Source: (Global Financial Innovation Network, 2022^[36])

A holistic and modular approach to regulatory experimentation in AI

Assessing AI regulatory sandboxes and other pro-innovation regulatory tools – sandboxes, standards, TEFs or govtech – as part of a system requires identifying potential interactions among these instruments. Each regulatory experimentation instrument could be thought of as one node interacting with other nodes in an interconnected system (Figure 3).

Figure 3. AI regulatory experimentation landscape and system



Box 7. Case study: EU AI regulatory sandbox pilot program in Spain

Spain launched an AI regulatory sandbox in 2022 as the first pilot program to test the future EU AI Act. Spain's initiative is undertaken with the EC and seeks to onboard other EU members. Uniquely, the Spanish AI sandbox was established to test a regulation that has neither been finalised nor entered into force (the EU AI Act is expected to enter into force in 2025). The goal is to test the proposed regulatory framework with real AI applications to assess how the regulation and application-development respond, to suggest modifications or explanatory guidelines.

Expectations from the EC Spanish AI sandbox pilot program



Importantly, both the Spain and the EC put forward that the pilot AI sandbox will test other regulatory experimentation mechanisms such as AI standards, and Testing and Experimentation Facilities (TEFs). TEFs provide a framework, tools and infrastructure to test innovative AI products, including how they

comply with regulatory requirements. Regulatory sandboxes can also provide valuable insights into standardisation processes. Practical implementation of the proposed EU AI Act's requirements for high-risk AI systems will provide use cases examining how those requirements could be developed. Standards and TEFs could play a crucial role in the testing phase of regulatory sandboxes. On one hand, standards development organisations will be able to test preliminary drafts of AI standards. On the other hand, TEFs can provide the technical backbone for AI sandboxes in certain instances, and the technical infrastructure necessary to test certain AI applications.

According to Spain, future regulatory trends will be to create international clusters of AI sandboxes enabling cross-testing. Until then, a sequential approach could be taken that includes:

7. **A national phase**, during which AI regulatory sandboxes are used at national level to enable regulators to gather data, improve practices, optimise internal testing processes, and issue public guidelines to improve firms' legal certainty.
8. **An international phase**, with mechanisms to encourage participation by public (e.g. competent national authorities) and private actors from different countries, regardless of their origin, or the regulatory frameworks or sectors covered. This could facilitate the creation of international regulatory experimentation initiatives and possible regulatory harmonisation.

Source: presentation by Spain to the OECD Working Party on AI Governance, June 2022

Annex A. Sandbox typology mapping

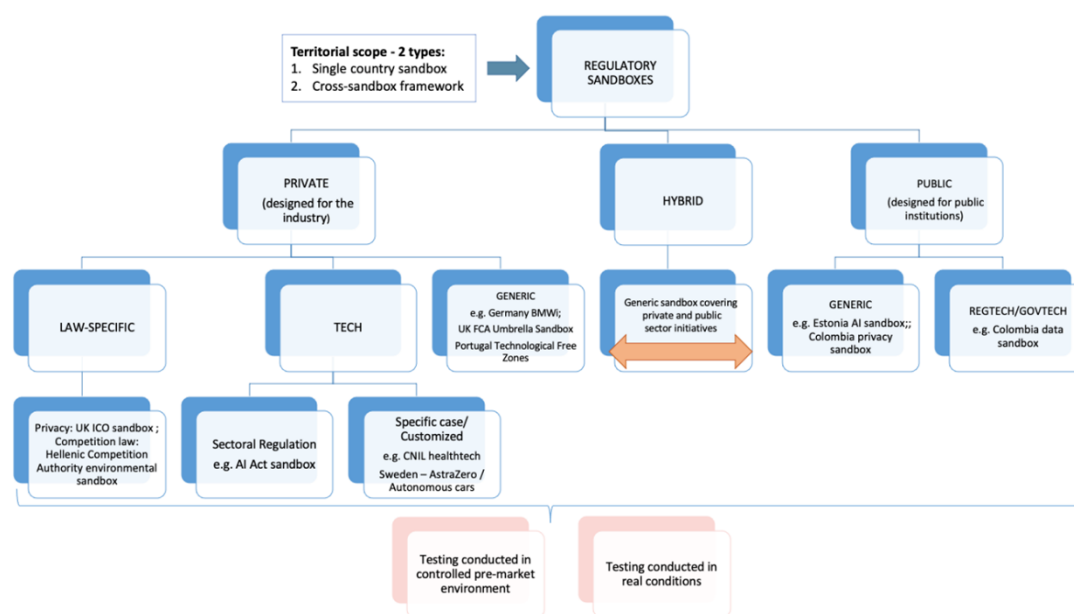
Sphere

- **Private:** Sandboxes designed to test industry's technological applications (i.e. private-sector focus)
- **Public:** Sandbox designed to test public institutions' technological applications in the public procurement context
- **Hybrid:** Sandboxes designed to include and test both private- and public-sector actors' technological applications

Scope

- **Law-specific:** Sandboxes designed to test technological applications' impact on a specific legal framework (present or future) and its response
- **Technology-based:** Sandboxes designed to test the impact of a specific technology in sectoral or several legal frameworks
- **Generic/cross-sectoral:** General sandbox frameworks designed to articulate and fit different types of sandboxes for either public or private stakeholders, and for different technologies and regulations
- **Regtech/govtech:** Sandboxes designed to test technological applications by public institutions for public procurement purposes

Figure A.1. Sandbox typology mapping



Annex B. AI-related sandboxes

European Union

The EU foresees a role for regulatory sandboxes in the development of safe AI technologies (Council of the European Union, 2020^[13]; European Commission, 2021^{c[64]}; European Parliament, 2021^[7]), in line with its innovation principle for EU policy and regulations (Ranchordás, 2021a^[2]). This is articulated in the proposed EU AI Act:

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“The regulatory sandboxes would foster innovation and increase legal certainty for companies and other innovators giving them a quicker access to the market, while minimising the risks for safety and fundamental rights and fostering effective compliance with the legislation through authoritative guidance given by competent authorities (problems 1, 2, 3 and 4). They would also provide regulators with new tools for supervision and hands-on experience to detect early on emerging risks and problems or possible need for adaptations to the applicable legal framework or the harmonised technical standards (problem 3). Evidence from the sandboxes would also help national authorities identify new high-risk AI use cases that would further inform the regular reviews by the Commission of the list of high-risk AI systems to amend it, as appropriate.”

Stakeholder views: “out of the 408 position papers that were submitted, at least 19 discussed establishing regulatory sandboxes as one potential pathway to better allow for experimentation and innovation under the new regulatory framework. (...) At least 12 Member States supported regulatory sandboxes in their national strategies.” For instance, among stakeholders’ representatives referring to sandboxes in their position statements on the public consultation were Big Data Value Association, BusinessEurope, Developers Alliance, Technology Industries of Finland, and EuroCommerce.

Proposed text: EU AI Act, Recitals 71 and 72 and Articles 53ff

EU AI Act sandboxes will focus not only on privacy-related matters, but on transparency, data quality, accuracy, and security. Thus, there is opportunity in AI regulatory sandboxes for GDPR-related matters and sectoral laws.

Proposed text: Interoperable Europe Act, Article 11 and Article 12

The Interoperable Europe Act sets its own rules regarding the establishment of regulatory sandboxes but contains clauses where the EU AI Act prevails in case of a conflict of rules regarding regulatory sandboxes that involve the use of AI.

UK: FCA and ICO sandboxes

The Financial Conduct Authority (FCA) sandbox focuses on fintech while admitting AI-related solutions applied in the financial sector. Moreover, until 2021, the Bank of England and FCA surveyed around 300

financial institutions to better understand the implementation of machine learning technologies in the financial sector (OECD, 2021b^[37]).

The Information Commissioner's Office (ICO) sandbox includes a focus on AI and privacy-related solutions and aims to help reinterpret privacy principles in the context where new technologies evolve. However, this does not mean that privacy obligations can be broken under the sandbox.

Norway: AI data protection sandbox

In 2020, the Norwegian Data Protection Authority (Datatilsynet) introduced a regulatory sandbox that aims to promote ethical, privacy-friendly, and responsible innovation within AI. Inspired by the UK ICO regulatory sandbox, companies selected for the Norwegian regulatory sandbox will be guided in the development of products that comply with data protection law, are ethical, and respect fundamental rights (Olsen, 2020^[65]). The Norwegian sandbox follows the principles of responsible AI as proposed by the EU High Level Group on Trustworthy AI. The Norwegian AI Sandbox will exempt companies from any enforcement measures during the development phase of the service without providing an overall exemption from the Personal Data Act. This regulatory sandbox received twenty-five applications from multiple public and private organisations and selected four projects for the sandbox that started in March 2021 (Datatilsynet, 2021^[66]).

France: CNIL sandbox pilot project focused on health-tech

The Commission nationale de l'informatique et des libertés (CNIL) launched a first "personal data sandbox" session, in the form of a call for projects in the field of health. Ten projects will benefit from CNIL support in 2021, four of which will receive enhanced support to come up with a solution that respects the privacy of individuals. This regulatory sandbox will not exempt participants from the application of the GDPR, but it will help organisations implement privacy-by-design from the beginning.

Singapore: Monetary Authority of Singapore

The MAS facilitates live testing of AI applications, e.g. the Kristal.AI case (Lin, 2019^[67]) in its fintech regulatory sandbox. Moreover, in 2018, MAS released a set of principles co-created with the financial industry and other relevant stakeholders to promote Fairness, Ethics, Accountability, and Transparency (FEAT) in the use of AI and data analytics in the financial sector. The FEAT principles were released as part of Singapore's National AI Strategy to build a progressive and trusted environment for AI adoption in this sector. They seek to provide a baseline to strengthen internal governance of AI applications and foster the use and management of data in financial institutions.

Korea

The Korean Ministry of Science and ICT; Ministry of Trade, Industry and Energy; and Ministry of SMEs and Start-ups established a sandbox in 2019 that grants a time-limited regulatory waiver to businesses to test innovative products, services, and business models. The sandbox also informs government regulations based on real-life data. The Korean Ministry of Science and ICT launched the 7 AI+X projects in collaboration with other ministries that use Validation Labs to solve problems in the military, security, customs, energy, defence, and industry (OECD, 2021a^[1]). The ICT industry convergence sandbox covering special regulation-free zones, such as smart cities or special R&D scenarios. It could be deemed more than just a sandbox, but rather a public industrial experimentation framework.

Germany

Germany's AI strategy plans to establish AI living labs and testbeds, such as a living lab on the A9 autobahn. These allow testing of technologies in real-life settings (Government of Germany, 2018^[68]). ONE AI member Andreas Hartl (Germany) noted that experimentation can help companies adopt AI and allow the government to identify needed regulatory reforms. Germany facilitates regulatory experimentation by: (1) creating new experimentation clauses as the legal basis for new regulatory sandboxes, with the help of a guide for formulating experimentation clauses (BMW, 2021^[69]); (2) creating a network of regulatory sandboxes with over 700 participants; (3) providing a *Handbook for Regulatory Sandboxes* (BMW, 2019^[9]); and (4) organising a competition ("Innovationspreis Reallabore") for regulatory sandboxes and highlighting innovative practices. Germany's work on regulatory sandboxes is steered by the coordinating office for Regulatory Sandboxes at the Federal Ministry for Economic Affairs and Climate Action. Some regulatory sandboxes were developed in the field of automated driving. A regulatory sandbox operating in Hamburg lasted seven months and offered a testbed for an autonomous delivery robot (OECD, 2021a^[1]).

Estonia

The Ministry of Economic Affairs and Communications established a technological sandbox framework for co-operation between the public and private sectors in IT development. One of the main directions of the Estonian national action plan for the implementation of AI is the testing, commissioning, and making available by the state of base components of standard applications that would speed up the implementation of AI-based solutions. This can happen throughout a wide variety of domains by different stakeholders (Observatory of Public Sector Innovation, 2019^[70]).

Lithuania

Lithuania plans to create a regulatory sandbox that will allow the use and testing of AI systems in the public sector. They also envision data sandboxes that grant access to highly sensitive (personal) data within a restricted digital and/or physical environment to trusted users.

Malta

Malta's Digital Innovation Authority created a regulatory sandbox in 2020 focused on emerging technologies such as AI. The sandbox aims to help companies comply with existing standards.

Colombia

A privacy-by-design sandbox, wherein public entities also participate, e.g. Mayor's Office of Barranquilla.

Global Financial Innovation Network

The Alberta Securities Commission, Quebec's Autorité des marchés financiers, the British Columbia Securities Commission, and the Ontario Securities Commission approved Bedrock AI to test its algorithmic solutions to identify flags in Canadian corporate disclosure agreements.

Annex C. AI regulatory sandbox scenarios

	Scope	Example
AI applications tested in a sectoral regulation sandbox	Focus on several legal regimes at the same time: privacy law, product safety law, sectoral law	The EU AI Act: regional sectoral regulation leading to the national implementation of AI regulatory sandboxes to test AI under different legal frameworks (sectoral law, privacy law, civil liability)
AI applications tested in a law-specific regulation sandbox	The AI application will be tested in a specific legal regime, such as privacy law	UK ICO privacy sandbox
AI applications tested for a specific sectoral niche as a case-by-case tailored scenario	The government, motivated by public infrastructure and public interest (e.g. autonomous vehicles highways) designs a testing framework for a specific AI application, e.g. autonomous cars	Hamburg autonomous vehicles sandbox
AI applications tested for public institutions	Sandbox for AI applications in public administration, aimed at testing the safe, transparent and accountable use of AI by public institutions	Colombia public administration data sandbox
AI applications tested simultaneously in several sandboxes	Two scenarios: 1. Intra-state and inter-institutional 2. Inter-state (cross-border testing of AI applications between countries)	GFIN sandbox testing BedrockAI with different Canadian institutions involved, i.e. intra-state/inter-institutional

These case scenarios might respond to specific techno-economic phenomena spotted by regulators and policy makers in their territories. Some of the case scenarios overlap and complement each other:

- **Case 1:** AI sandbox is embedded in a regional sectoral regulation leading to the national implementation of sandboxes regulations by member states, e.g. the EU AI Act. Accordingly, national AI sandboxes are going to test AI applications under the framework of a sectoral law, but also other types of laws, such as specific product-safety, privacy, or civil liability-related laws, etc.
- **Case 2:** AI applications are tested in a law-specific regulation, e.g. privacy, competition law, or product safety regulation sandbox.
- **Case 3:** AI applications are tested for a specific sector niche, either as case-by-case tailored scenarios or as part of a national umbrella approach to regulatory sandboxes, as Germany is taking with e.g. Hamburg autonomous vehicles.
- **Case 4:** AI applications to be tested for public infrastructure purposes, e.g. Colombia public administration data sandbox.
- **Case 5:** AI applications are tested simultaneously in several sandboxes.

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