





STUDY FOR THE DESIGN OF A REGULATORY SANDBOX FOR UA

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EXECUTIVE SUMMARY

This study, promoted by the Xunta de Galicia and the Galician Aeronautical Consortium and conducted by a team of experts in various areas of telecommunications and innovation, presents an exhaustive analysis aimed at evaluating the feasibility and benefits of establishing a regulatory sandbox for drones in Galicia.

The report provides a detailed assessment and concrete proposals on the creation of a regulated test environment for unmanned aerial vehicles (UAS) in Galicia. The proposal seeks to boost technological innovation and competitiveness by creating an environment that facilitates the safe development and experimentation of new technologies in the unmanned aerial systems (UAS) sector. This approach aims to promote innovation and enhance competitiveness in a high-tech sector through a flexible and adaptive regulatory framework.

The study covers a wide range of areas from the review of literature and references on sandboxes in different sectors and countries to specific analyses of challenges and opportunities in the UAV sector. Throughout the document, a detailed analysis of current regulations is provided, the perspectives of companies in the UAS value chain in Spain are evaluated, and possible implementations and effects of a regulatory sandbox are discussed.

CONTEXT AND JUSTIFICATION OF THE STUDY

The initiative to develop a regulatory sandbox arises from the need to adapt the existing legal framework to the pace of technological innovation in the drone sector. Sandboxes used globally in sectors such as finance and health allow companies to test new technologies under real market conditions but

within a regulated and supervised perimeter. This approach not only reduces legal and market risks for innovators but also allows regulators to evaluate and adjust policies based on empirical observations and controlled results. This report argues that a similar approach could significantly boost the UAS industry in the region, attracting investments and fostering the development of new applications and services.

LITERATURE REVIEW AND INTERNATIONAL REFERENCES

The research team conducted an exhaustive literature review to identify practices and lessons learned from sandboxes in other contexts and countries. More than 30 case studies of sandboxes in Europe, Asia, and America were analysed, providing a solid benchmark on success factors and potential risks. Findings reveal that regulated environments not only stimulate innovation but also facilitate better regulatory oversight and reduce legal risks for participants.

ANALYSIS OF THE UAS SECTOR IN SPAIN

The study included a specific assessment of the UAS sector in Spain, focusing on the value chain from manufacturers to service operators and end users. Key challenges were identified, such as current regulatory restrictions that limit the testing of emerging technologies and entry barriers for new companies. Through interviews and focus groups, perspectives were gathered from government entities, academic and research organizations, and companies (including drone manufacturers, service operators, and other value chain agents) who expressed high interest in participating in a sandbox that would allow them to explore new applications without facing full regulatory burdens.

RESEARCH METHODOLOGY

To collect and analyse data, the team used a mixed methodology that included both qualitative and quantitative tools. In-depth interviews were conducted with key stakeholders, including regulators, entrepreneurs, academics, and representatives of civil society, to better understand expectations and concerns regarding the proposed sandbox. Text analysis tools and algorithms were used to process and analyse responses to open-ended questionnaire questions.

STRENGTHS AND WEAKNESSES OF ROZAS AS A SANDBOX HOST

The Rozas area in Lugo stands out as an ideal location for establishing a regulatory sandbox for drones due to its advanced infrastructure, strategic collaborations, favourable geographic location, technological innovation, and high-tech services. However, the lack of air traffic control presents challenges in terms of safety and airspace management that require advanced solutions to mitigate risks and ensure compliance with drone regulations.

RECOMMENDATIONS AND IMPLEMENTATION STRATEGIES

Based on the analyses conducted, the report offers several strategic recommendations for the implementation of a regulatory sandbox in Galicia. These include the importance of establishing clear objectives, transparent eligibility criteria for participants, and rigorous monitoring and evaluation mechanisms. The need for cooperation between the government, industry, and regulatory bodies is also emphasized to ensure that the sandbox not only fosters innovation but also protects public interests and addresses safety concerns.

CONCLUSION

The “Study of Regulatory Sandbox for UAS” offers a viable path to position Galicia as a leader in drone technology innovation by proposing a framework that could serve as a model for other regions in Spain and beyond. With a well-designed and executed approach, the sandbox has the potential to transform regulatory challenges into opportunities for growth and technological development, benefiting the regional economy and enhancing Spain's global competitiveness in emerging technologies.

Implementations of sandboxes already underway and the companies consulted highlight the need for cooperation between the government, industry, and regulatory bodies to ensure that the sandbox not only fosters innovation but also protects public interests and responds to safety concerns.

For the success of the sandbox, it is recommended to establish clear objectives, transparent eligibility criteria for participants, and rigorous monitoring and evaluation mechanisms.

Finally, the importance of adapting the legal framework to the speed of technological innovation is emphasized, and it is suggested that a proactive approach in creating a regulatory sandbox could attract significant investments and foster the development of new applications and services in the UAS sector in Galicia.



1. INTRODUCTION

A regulatory sandbox, also known as a “controlled testing environment” or “experimental environment,” is a flexible and experimental tool that allows innovative companies to test and develop disruptive solutions in a controlled environment. The goal is to promote innovation, consumer protection, and advancement in the respective sector.

In a regulatory sandbox, regulatory authorities establish a specific temporal and geographical framework within which permissions are granted and certain regulations are relaxed to allow innovation and experimentation in a specific sector. This provides companies the opportunity to test their solutions in real-world conditions, in a controlled environment where authorities supervise and evaluate the results and impacts. This allows companies to identify and address potential regulatory, technical, or legal challenges before fully implementing their solutions in the market.

The design and characteristics of a regulatory sandbox can vary depending on the sector and jurisdiction but generally involve defining eligibility criteria, identifying specific exemptions or adaptations of existing regulations, collaboration between participants and authorities, and continuous supervision and evaluation of the tests conducted.

This document presents a study designed for the development of a specific regulatory sandbox for the drone sector in the Galician Community, with the aim of enhancing the competitiveness of this sector at both regional and national levels. The study integrates a comprehensive review of references, studies, and publications on regulatory sandboxes, along with an analysis of specific cases, opinions, and needs of companies in the UAS value chain throughout Spain, gathered through an online questionnaire.



2. REFERENCES ON REGULATORY SANDBOXES IN VARIOUS SECTORS AND COUNTRIES

In the context of constant technological evolution and the imperative need to adapt regulatory frameworks to new challenges, this section provides a summary of references and initiatives on Regulatory Sandboxes and Innovation in various sectors. Through meticulous analysis, both legislative proposals and practical applications in the field of regulatory sandboxes are examined. These experimental tools are designed to foster innovation by allowing companies to test disruptive solutions in controlled and safe conditions. This approach not only facilitates technological advancement but also ensures consumer protection and proper adaptation to current regulatory standards.

The following subsections present different selected references, each focusing on a particular aspect or a specific geographical approach. The summary of the documents allows visualizing, along with the conclusions presented below, how various entities, from the European Parliament to national initiatives, implement these “living labs” to calibrate the effectiveness and safety of innovations in fields as varied as artificial intelligence, urban mobility, and fintech, among others. Through this compendium, it aims to provide a comprehensive view that not only reflects the current state of the implementation of regulatory sandboxes but also highlights key considerations for their future development and optimization.

The analysis of the different studies and publications on regulatory sandboxes reveals a series of common trends and concerns that are crucial for any public administration wishing to design and implement an effective regulatory sandbox. Here are some of the main ideas gathered from the reports and analyses reviewed that can guide entities in creating innovative and adaptable regulatory frameworks:

- **Harmonization and Supervision:** One recurring aspect in the studies is the need to establish harmonized rules, as observed in the Artificial Intelligence Act proposed by the European Parliament, which seeks to unify AI regulations across the EU. The introduction of regulatory sandboxes under supervision allows innovation while ensuring compliance with regulations and consumer protection.
- **Fostering Innovation with Inclusion:** Sandboxes are highlighted for their ability to stimulate innovation within a regulatory framework that is both resilient and future-proof. Emphasis is placed on the importance of inclusion and support for SMEs, which are fundamental for sustainable growth and post-crisis economic recovery.
- **Technological Adaptability:** COTEC's proposal to establish a sandbox system in Spain underlines the importance of adapting to rapid technological changes. This approach not only fosters innovation but also ensures that regulation can keep pace with technological development.
- **Global Impact and Variations:** From a more global perspective, as provided by the World Bank Group, the extensive use of sandboxes in different regions is recognized, highlighting how variations in implementation can result in distinct benefits, especially notable in sectors like fintech.
- **Responsibility and Legality:** Civil liability in testing environments, as discussed in the context of urban mobility, poses significant legal challenges that need to be addressed through legislative adaptation, ensuring that innovation does not outpace safety and legal protection.
- **Criticism and Balance:** Publications like the Vanderbilt Journal offer a critical analysis of sandboxes, highlighting the need for a balance between innovation and protection. It is crucial that sandboxes not only foster innovation but also protect consumer interests and maintain financial stability.

Recommendations for Implementation:

1. **Experimental Clauses:** Should be considered to allow some flexibility within existing legislation.
2. **Interaction with Innovators:** It is vital to understand the specific needs and challenges of the sector.

3. Continuous Evaluation: Sandboxes should be monitored and evaluated regularly to ensure they are meeting their objectives without causing unintended effects.
4. International Collaboration: It is essential to learn from global experiences and avoid duplicating efforts or creating conflicting regulations.
5. Regulatory Entities: Should play a fundamental role in regulatory sandboxes, being an integral part of their structure and operation.

Together, these ideas highlight the importance of regulatory sandboxes as dynamic and adaptable tools for fostering innovation and managing risk in a technologically advanced world. Public administrations should approach their design with a vision that balances the promotion of innovation, consumer protection, and system stability, while remaining open to continuous learning and adaptation.

2.1 STUDIES AND GUIDES FROM PUBLIC ORGANIZATIONS AND GOVERNMENT BODIES

2.1.1 ARTIFICIAL INTELLIGENCE ACT AND REGULATORY SANDBOXES (EUROPEAN PARLIAMENT)

2.1.1.1 MAIN IDEAS

- Proposed act to establish harmonized rules on AI in the EU.
- Introduction of regulatory sandboxes to test innovations under supervision.
- The aim of the act is to foster AI innovation while ensuring consumer safety and compliance with regulatory standards.

2.1.1.2 SUMMARY

The document “Artificial Intelligence Act and Regulatory Sandboxes - European Parliament” provides an in-depth analysis of the proposed legislation to regulate artificial intelligence (AI) in the European Union, with a particular focus on the concept of AI regulatory sandboxes.

2.1.1.3 KEY CONTENTS

2.1.1.3.1 GENERAL DESCRIPTION OF THE AI ACT AND REGULATORY SANDBOXES

The AI Act proposed by the European Commission in April 2021 seeks to establish harmonized rules on AI across the EU. The act introduces the concept of coordinated AI regulatory sandboxes, which are environments that allow companies to test and experiment with innovative AI products and services under regulatory supervision. The aim is to foster AI innovation while ensuring consumer safety and compliance with regulatory standards.

2.1.1.3.2 PURPOSE AND BENEFITS OF REGULATORY SANDBOXES

Regulatory sandboxes serve a dual purpose: fostering business learning through the development and testing of innovations in a real-world environment and supporting regulatory learning to guide companies in their innovation activities. They offer benefits such as better regulatory understanding of innovative products, reduced legal risks for innovators, and the introduction of safer products for consumers. However, there are concerns about potential misuse, regulatory arbitrage, and risks to consumer protection.

2.1.1.3.3 IMPLEMENTATION AND KEY POLICY ISSUES

The AI Act proposes the establishment of national AI sandboxes with a focus on governance, oversight, and ensuring uniform implementation across the EU. Key policy issues discussed include the need to protect the liability of sandbox participants, harmonize sandbox rules to avoid market fragmentation, and concerns over data protection. The document highlights the importance of balancing innovation with public safety and fundamental rights.

2.1.1.3.4 POSITION OF THE EUROPEAN PARLIAMENT

The European Parliament has advocated for regulatory sandbox instruments in several resolutions, emphasizing the need for transparency in the implementation and use of AI sandboxes. The Parliament's draft report calls for broader information exchange among national regulators and the European AI Board and emphasizes the importance of involving relevant stakeholders in sandbox operations.

2.1.1.3.5 RELATED INITIATIVES OF THE COMMISSION AND SME FOCUS

The document also addresses related initiatives of the European Commission, such as the Digital Europe Programme, which supports AI regulatory sandboxes. Special attention is given to the role of small and medium-sized enterprises (SMEs) in these sandboxes, with proposals to prioritize their access and provide regulatory relief.

2.1.1.3.6 GLOBAL CONTEXT AND COMPARATIVE ANALYSIS

The report provides a comparative perspective by analyzing the global adoption of regulatory sandboxes in various sectors such as finance, transportation, and healthcare. It cites examples from countries like Japan, Norway, and the UK, highlighting different approaches to sandbox implementation.

2.1.2 CONCLUSIONS OF THE COUNCIL ON REGULATORY SANDBOXES (EUROPEAN UNION)

2.1.2.1 MAIN IDEAS

- The EU is committed to sustainable growth through efficient regulation.
- Sandboxes as tools to foster innovation, with an emphasis on inclusion and support for SMEs.
- Sandboxes can encourage innovation within a resilient and future-proof regulatory framework.

2.1.2.2 SUMMARY

The document provides a comprehensive overview of the position and recommendations of the European Council regarding the use of regulatory sandboxes as tools to foster innovation within a resilient and future-proof regulatory framework. A brief summary of its key contents is presented below:

2.1.2.2.1 CONTEXT AND BACKGROUND

The document reiterates the EU's commitment to fostering sustainable and inclusive growth through better regulation. It emphasizes the importance of a regulatory framework that is competitive, effective, efficient, and conducive to innovation, especially in the context of recovery from the COVID-19 crisis.

2.1.2.2.2 PRINCIPLES AND PRIORITIES

The Council recalls key principles such as subsidiarity, proportionality, and the precautionary principle. It highlights the importance of considering the “innovation principle” when developing or updating EU policies or regulatory measures, which involves assessing the impact on research and innovation.

2.1.2.2.3 ROLE OF REGULATORY SANDBOXES

The document notes that regulatory sandboxes are increasingly used in various sectors, including finance, health, aviation, transport, and energy, often in conjunction with emerging technologies like artificial intelligence and blockchain. It views these sandboxes as frameworks for testing innovative technologies and approaches in a real-world environment under regulatory supervision.

2.1.2.2.4 INNOVATION AND SUPPORT FOR SMEs

The Council acknowledges European Commission initiatives such as the SME Strategy for a Sustainable and Digital Europe and the development of a pan-European blockchain regulatory sandbox. It underscores the importance of regulatory sandboxes in supporting innovation, particularly for SMEs, startups, and micro-enterprises.

2.1.2.2.5 EXPERIMENTAL CLAUSES AND LEGAL FLEXIBILITY

The document understands experimental clauses as legal provisions that allow authorities to exercise flexibility when testing innovative technologies and services. These clauses are often the legal basis for regulatory sandboxes and are already used in EU legislation and the legal frameworks of many Member States.

2.1.2.2.6 REGULATORY LEARNING AND OPPORTUNITIES

The Council highlights that regulatory sandboxes can provide opportunities to advance regulation through proactive learning, enabling regulators to gain better insights and regulate innovations based on real-world evidence. This is particularly crucial in the face of high uncertainty and disruptive challenges.

2.1.2.2.7 FUTURE GUIDANCE AND RECOMMENDATIONS

The document calls on the Commission to consider the use of experimental clauses in legislation and to create an overview of existing clauses in EU legislation. It also encourages the exchange of information and best practices on regulatory sandboxes among Member States.

2.1.3 SANDBOX SYSTEM FOR SPAIN (COTEC)

2.1.3.1 MAIN IDEAS

- Detailed proposal to establish a sandbox system in Spain.
- Focus on adapting to technological changes and fostering innovation.

2.1.3.2 SUMMARY

The document provides an in-depth exploration of the concept and implementation of regulatory sandboxes in Spain, with an emphasis on promoting innovation and adapting to new technological developments. A summary of each section is presented below.

2.1.3.3 KEY CONTENTS

2.1.3.3.1 INTRODUCTION AND CONTEXT

The document begins with a discussion on the rapid pace of technological change and its implications for the efficiency and effectiveness of the public sector. It emphasizes the need for innovative regulatory tools to adapt to these changes, highlighting the relevance of sandboxes in this context.

2.1.3.3.2 CONCEPT AND UTILITY OF THE SANDBOX

The sandbox is described as a controlled environment where new ideas, products, services, or tools can be tested safely, minimizing legal uncertainties and aiding access to investments. It is considered beneficial for regulators, providers, and users, as it offers a safe environment for experimentation on three levels.

2.1.3.3.3 INTERNATIONAL EXPERIENCES

The document examines sandbox applications in various countries such as the United Kingdom, France, Japan, the Netherlands, and Singapore, and provides different models of sandbox implementation. It highlights how these countries have used sandboxes to create more attractive environments for talent and investment.

2.1.3.3.4 PROPOSAL FOR A SPANISH SANDBOX SYSTEM

A detailed proposal describes how Spain can establish its own sandbox system. This includes legal frameworks, institutional structures, control mechanisms, supervision, governance, and project eligibility criteria. The proposal emphasizes the need for a legal and institutional framework to facilitate multilevel coordination.

2.1.3.3.5 SCOPE AND ELIGIBILITY CRITERIA

The proposed Spanish sandbox model considers types of exemptions, temporal and territorial limitations, and specific criteria for project eligibility, focusing on economic, social, and technical opportunities.

2.1.3.3.6 EVALUATION AND PROJECT DESIGNATION

A proposed evaluation system includes a jury led by the administration, ensuring a rigorous selection and monitoring process. The document also suggests post-experiment communication and control mechanisms, emphasizing transparency and accountability.

2.1.3.3.7 CONCLUSIONS AND REFLECTIONS

The document concludes by emphasizing the importance of adapting the public sector to digital, participatory, and constantly changing environments. It advocates for sandboxes as tools that not only improve legislation but also provide public authorities with new methods to access knowledge and foster socio-economic transformation.

2.1.4 GLOBAL EXPERIENCES WITH REGULATORY SANDBOXES (WORLD BANK GROUP)

2.1.4.1 MAIN IDEAS

- Comprehensive examination of the global use and impact of regulatory sandboxes.
- Highlights variations in implementation and benefits, especially in fintech.

2.1.4.2 SUMMARY

The document “Global Experiences with Regulatory Sandboxes - World Bank Group” provides an in-depth examination of the use and impact of regulatory sandboxes worldwide, focusing particularly on financial technology (fintech). Below is a summary that aims to highlight the document's focus on the global landscape of regulatory sandboxes in the fintech sector, exploring their design, implementation, impact, and the various approaches adopted by different countries.

2.1.4.3 KEY CONTENTS

2.1.4.3.1 OVERVIEW AND PURPOSE OF SANDBOXES

The report describes the rise of regulatory sandboxes as a tool for testing fintech innovations in a controlled environment. It emphasizes the importance of sandboxes in adapting regulatory frameworks to the evolving fintech landscape and highlights their role in fostering innovation and consumer protection.

2.1.4.3.2 GLOBAL IMPLEMENTATION AND VARIATIONS

Another contribution of the analysed report is an extensive review of sandbox implementations in 57 countries, noting variations in objectives, design, and impact. It analyzes the prevalence of sandboxes in emerging markets and developing economies (EMDE) and how different countries tailor their sandbox models to national needs and specific regulatory environments.

2.1.4.3.3 OPERATIONAL AND DESIGN CONSIDERATIONS

The report also examines key aspects of sandbox design, such as the interaction with the legal system, resource requirements, test duration, and thematic approaches. It highlights the resource-intensive nature of sandboxes and the need for a clear definition of objectives and legal frameworks for effective operation.

2.1.4.3.4 IMPACTS AND BENEFITS OF SANDBOXES

The report assesses the impacts of sandboxes, including their influence on policy formulation, regulatory changes, financial inclusion, and support for private sector companies. It acknowledges the challenges in measuring the direct impact of sandboxes but highlights their role in fostering dialogue between regulators and innovators.

2.1.4.3.5 COUNTRY-LEVEL CASE STUDIES

Several country examples illustrate different sandbox approaches, challenges, and successes. These case studies provide insights into how sandboxes are adapted to specific national contexts and regulatory goals, ranging from promoting financial inclusion to fostering innovation in financial technology.

2.1.4.3.6 CHALLENGES AND LIMITATIONS

While recognizing the benefits, the report also discusses the challenges and limitations of regulatory sandboxes, such as resource constraints, potential market distortions, and the need for careful design and management to avoid unintended consequences.

2.1.4.3.7 RECOMMENDATIONS FOR IMPLEMENTATION

The document offers guidance for policymakers considering establishing a sandbox, emphasizing the importance of clear objectives, understanding the local fintech ecosystem, and appropriate legal and regulatory frameworks.

2.1.5 GUIDANCE ON REGULATORY SANDBOXES IN THE EU (EUROPEAN COMMISSION)

2.1.5.1 MAIN IDEAS

- The EU's approach to fostering innovation through regulatory experimentation and the various tools and methods employed to achieve this goal.
- Definition and comparison of different tools: sandboxes, testbeds, and living labs.
- Examples of EU and national initiatives.

2.1.5.2 SUMMARY

The document “Guidance on Regulatory Sandboxes, Testbeds, and Living Labs in the EU” by the European Commission provides a comprehensive overview of various forms of regulatory experimentation. The following sections summarize its content, aiming to capture the essence of the document and focusing on the EU's approach to fostering innovation through regulatory experimentation and the various tools and methods employed to achieve this goal.

2.1.5.3 KEY CONTENTS

2.1.5.3.1 PURPOSE OF THE DOCUMENT

Its purpose is to guide regulators and innovators in their approach to experimentation in the EU, particularly in the context of the New European Innovation Agenda and the REPowerEU Plan.

2.1.5.3.2 REGULATORY SANDBOXES, TESTBEDS, AND LIVING LABS

The document defines and compares these three main tools for experimentation. Regulatory sandboxes allow innovators to test new ideas in a real-world environment under regulatory supervision. Testbeds focus on technology development and scaling, while living labs involve citizen participation in the innovation process.

2.1.5.3 SUPPORTING REGULATORY LEARNING AND LEGAL CERTAINTY

The guidance emphasizes how experimentation supports regulatory learning by addressing the challenges of adapting innovations within legal frameworks and enhancing legal certainty for all stakeholders.

2.1.5.4 EU-LEVEL EXAMPLES

Several EU initiatives supporting innovation and regulatory learning are analyzed, including the AI Act and the Interoperable Europe Act. These initiatives demonstrate the application of regulatory sandboxes in digitalization, financial services, energy, and health.

2.1.5.5 NATIONAL AND NON-EU EXAMPLES

The document provides an overview of national practices and examples outside the European Union, showcasing the global application of these experimentation tools.

2.1.5.6 GENERAL CONCLUSIONS AND THE WAY FORWARD

It concludes with general findings on the role and impact of regulatory sandboxes, testbeds, and living labs, highlighting their benefits in fostering innovation, ensuring regulatory compliance, and contributing to policy development.

2.1.6 HANDBOOK OF REGULATORY SANDBOXES IN GERMANY

2.1.6.1 MAIN IDEAS

- Development and application of regulatory sandboxes in Germany.
- The sandbox as a tool for innovation and regulatory learning.
- Case studies, challenges, and recommendations for effective implementation.

2.1.6.2 SUMMARY

The document “Handbook of Regulatory Sandboxes - Germany” provides detailed information on the development and application of regulatory sandboxes in Germany, as summarized in the following sections. The summary showcases the comprehensive approach of the German government in employing regulatory sandboxes as a tool for innovation and regulatory learning, along with practical guidelines and examples from various sectors.

2.1.6.3 KEY CONTENTS

2.1.6.3.1 CONCEPT AND RELEVANCE OF REGULATORY SANDBOXES

The handbook presents regulatory sandboxes as special environments for testing innovations and regulations. It emphasizes their importance in understanding new technological developments and adapting existing regulations to accommodate these innovations.

2.1.6.3.2 GERMANY'S APPROACH AND STRATEGY

The document describes the German government's strategy for implementing regulatory sandboxes, focusing on promoting innovation, providing legal flexibility, and fostering experimentation across various sectors.

2.1.6.3.3 DESIGN AND IMPLEMENTATION ASPECTS

Detailed guidance is provided on the preparation, planning, and implementation of regulatory sandboxes. This includes discussions on legal considerations, design aspects, and practical steps to establish these frameworks.

2.1.6.3.4 EXPERIMENTAL CLAUSES AND REGULATORY ADAPTATION

The handbook delves into the use of experimental clauses as legal tools to create flexible regulatory environments for testing new technologies and business models.

2.1.6.3.5 CASE STUDIES AND PRACTICAL EXAMPLES

Several case studies are presented to illustrate how regulatory sandboxes have been applied in different sectors within Germany. These examples highlight the diverse applications and benefits of regulatory sandboxes.

2.1.6.3.6 CHALLENGES AND RECOMMENDATIONS

The document acknowledges the challenges in implementing regulatory sandboxes, such as ensuring legal compliance and balancing innovation with public safety. It offers recommendations for designing and managing these environments effectively.

2.1.6.3.7 FUTURE PERSPECTIVES AND GOALS

The handbook concludes with a perspective on the future role of regulatory sandboxes in fostering a culture of innovation and experimentation in Germany, aligning with broader goals of economic and digital transformation.

2.1.7 CIVIL LIABILITY IN CONTROLLED TESTING SPACES FOR URBAN MOBILITY (YOLANDA BUSTOS MORENO)

2.1.7.1 MAIN IDEAS

- Explores civil liability in regulatory sandboxes, specifically in the context of urban mobility.
- Highlights the importance of adapting legislation to technological advancement.
- Emphasizes the need to balance innovation with safety and legal protection for all involved parties.

2.1.7.2 SUMMARY

The document “Civil Liability in Controlled Testing Spaces for Urban Mobility” by Yolanda Bustos Moreno focuses on the legal aspects of civil liability in controlled testing spaces or regulatory sandboxes, specifically within the context of urban air mobility (UAM) and the forthcoming Sustainable Mobility Law in Spain. The summary presented below reflects the document's focus on the legal complexities of implementing regulatory testing environments in

urban mobility, particularly in the UAM field, and the proposed approaches for managing civil liability in these contexts.

2.1.7.3 KEY CONTENTS

2.1.7.3.1 CONTEXT AND IMPORTANCE OF MOBILITY

The document begins by discussing the evolution of transport and logistics automation, emphasizing the need to develop new legal frameworks to address these changes. It highlights the concept of mobility as a public service and the responsibilities of public authorities in regulating and safeguarding it.

2.1.7.3.2 URBAN AIR MOBILITY AND U-SPACE

It delves into urban air mobility (UAM), explaining its integration into smart mobility strategies. The U-Space framework, a system for managing drone traffic in urban areas, is introduced as a key element in the development of UAM.

2.1.7.3.3 REGULATORY SANDBOXES IN URBAN MOBILITY

The document explores the concept of regulatory sandboxes in the context of urban mobility, examining their role in testing new technologies and transport services within controlled environments.

2.1.7.3.4 CIVIL LIABILITY IN REGULATORY TESTING ENVIRONMENTS

A major focus is on the challenges of defining and managing civil liability within these experimental spaces. It analyzes how the forthcoming Sustainable Mobility Law could address these issues, ensuring safety and legal certainty for participants and third parties.

2.1.7.3.5 CASE STUDIES AND INTERNATIONAL PERSPECTIVES

The document includes references to international examples of regulatory testing environments in urban mobility, particularly in the context of UAM. These case studies provide insights into how different countries are addressing the legal and practical aspects of these innovative spaces.

2.1.7.3.6 CONCLUSION AND RECOMMENDATIONS

The document concludes with reflections on the need for legal frameworks that adapt to technological advances in urban mobility. It emphasizes the importance of balancing innovation with safety and legal protection for all involved parties.

2.1.8 ANALYSIS OF REGULATORY SANDBOXES FOR BUSINESS EUROPE

2.1.8.1 MAIN IDEAS

- Focus on how sandboxes improve conditions for innovative businesses in Europe.
- Recommendations for the European Commission, with examples and case studies.

2.1.8.2 SUMMARY

The document “Regulatory Sandboxes - Analytical Paper for Business Europe” by Winnovation Consulting provides an in-depth analysis of the concept and application of regulatory sandboxes in Europe. Here is a summary that aims to capture the document's exploration of regulatory testing environments as tools to foster innovation, address regulatory challenges, and enhance Europe's competitiveness in various market areas.

2.1.8.3 KEY CONTENTS

2.1.8.3.1 PURPOSE AND OBJECTIVE OF THE DOCUMENT

The document aims to demonstrate how regulatory testing environments can improve the framework conditions for innovative companies in Europe, enhancing competitiveness in markets such as the data-driven economy, e-health, and low-carbon products. It emphasizes that regulatory sandboxes provide faster access to innovations while addressing urgent social issues without compromising European values such as consumer protection and privacy.

2.1.8.3.2 CHALLENGES FACING EUROPE

European businesses and societies face fundamental transformation challenges due to factors such as new digital technologies, artificial intelligence, decarbonization, an aging population, and global health issues. The document underscores the need for Europe to increase its capacity to develop and market innovations quickly, suggesting that regulatory testing environments can help overcome market access barriers while ensuring consumer health and protection.

2.1.8.3.3 ROLE AND IMPACT OF REGULATORY TESTING ENVIRONMENTS

Regulatory testing environments facilitate open and transparent interaction between innovators and regulatory authorities. They provide a practical approach to understanding the complex and novel implications of digital business models and data usage, offering an alternative to speculation-based regulation.

2.1.8.3.4 RECOMMENDATIONS FOR THE EUROPEAN COMMISSION

The document suggests that the European Commission should support regulatory testing environments through actions such as the use of experimental clauses across all EU legislation. This approach would provide innovative companies with the opportunity to test new models in real-world environments and assist in the proper implementation of these controlled environments at the EU level.

2.1.8.3.5 TYPES OF REGULATORY TESTING ENVIRONMENTS

Two main types of regulatory testing environments are identified. The first type, established by the European Commission, would ensure uniform treatment of companies across Europe and foster mutual learning among regulators from member states. The second type, deployed at the national level, could be promoted through exemptions in regulations and directives.

2.1.8.3.6 CASE STUDIES AND EXAMPLES

The document presents examples and case studies demonstrating how regulatory testing environments could be implemented in various fields, such as

renewable energy communities (REC), to enable SMEs and municipalities to become energy self-sufficient and promote decentralized energy structures.

2.1.9 REGULATORY SANDBOXES AND INNOVATION IN FINTECH (EUROPEAN PARLIAMENT)

2.1.9.1 MAIN IDEAS

- Analyzes the role of sandboxes and innovation hubs in the FinTech landscape.
- Highlights challenges, global regulatory cooperation, and the EU strategy.
- Emphasizes the need for dynamic and responsive regulatory frameworks to foster innovation while ensuring consumer protection and financial stability.

2.1.9.2 SUMMARY

This document provides a comprehensive analysis of the evolving FinTech landscape, focusing on regulatory testing environments and innovation hubs. It examines the impact of technological innovations in finance, highlighting the challenges and opportunities for regulatory frameworks. Overall, the document provides an in-depth analysis of the implications of FinTech for regulatory practices, emphasizing the need for dynamic and responsive regulatory frameworks to foster innovation while ensuring consumer protection and financial stability.

2.1.9.3 KEY CONTENTS

2.1.9.3.1 OVERVIEW OF FINTECH INNOVATIONS

The rapid pace of technological advancements in finance, such as blockchain, artificial intelligence, and big data, is reshaping the financial sector. This transformation brings opportunities for innovation and challenges for existing regulatory frameworks.

2.1.9.3.2 ROLE OF REGULATORY TESTING ENVIRONMENTS

Regulatory testing environments are experimental frameworks that allow FinTech companies to test new products and services in a controlled environment under regulatory supervision. They are crucial for understanding the practical implications of new technologies and for adapting regulatory measures accordingly.

2.1.9.3.3 FUNCTION OF INNOVATION HUBS

Innovation hubs provide guidance and support to FinTech companies, helping them navigate the regulatory landscape. They act as platforms for dialogue between regulators and innovators, fostering a better understanding of technological advancements and their potential regulatory implications.

2.1.9.3.4 CHALLENGES AND RISKS

The document discusses potential risks associated with FinTech innovations, such as consumer protection issues, data privacy concerns, and risks to financial stability. It emphasizes the need for a balanced regulatory approach that safeguards public interest while fostering innovation.

2.1.9.3.5 GLOBAL REGULATORY COOPERATION

Recognizing the global nature of FinTech, the document advocates for international regulatory cooperation. This cooperation is necessary to address challenges that transcend national borders, such as regulatory arbitrage and ensuring a level playing field.

2.1.9.3.6 EU APPROACH TO FINTECH REGULATION

The European Union's approach to regulating FinTech is characterized by efforts to harmonize regulations among member states, promote innovation, and maintain financial stability. The document outlines EU initiatives, including the development of a digital finance strategy and the establishment of the European Forum for Innovation Facilitators (EFIF).

2.1.9.3.7 RECOMMENDATIONS AND FUTURE DIRECTIONS

The document concludes with recommendations for the further development of regulatory testing environments and innovation hubs. It highlights the importance of continuous evaluation, sharing of best practices, and adapting to technological changes.

2.1.10 LIMITS OF REGULATORY SANDBOXES (VANDERBILT JOURNAL)

2.1.10.1 MAIN IDEAS

- A critical analysis of sandboxes in financial regulation, with an emphasis on fintech.
- Highlights challenges and potential risks, advocating for a balance between innovation, consumer protection, and financial stability.

2.1.10.2 SUMMARY

The document “Sandbox Boundaries - Vanderbilt Journal” provides an in-depth analysis of regulatory sandboxes, primarily in the context of financial regulation and the emerging fintech industry. Overall, “Sandbox Boundaries” offers a comprehensive and critical examination of the role and impact of regulatory sandboxes in financial regulation, underscoring the need for a balanced approach that safeguards important regulatory objectives while fostering innovation.

2.1.10.3 KEY CONTENTS

2.1.10.3.1 REGULATORY SANDBOXES IN THE UNITED STATES AND ABROAD

The development of regulatory sandboxes in the U.S. and other countries is analyzed, highlighting their role in fostering fintech innovation by providing a controlled environment for testing new financial services and technologies.

2.1.10.3.2 CHALLENGES AND RISKS

The text emphasizes the potential risks and challenges posed by regulatory testing environments. These include concerns about consumer protection, financial system stability, and the possibility that regulatory sandboxes could facilitate regulatory arbitrage and a “race to the bottom” in regulatory standards.

2.1.10.3.3 GLOBAL REGULATORY COOPERATION AND GFIN

The document presents an analysis of the role of the Global Financial Innovation Network (GFIN) in fostering international cooperation among regulatory bodies. GFIN aims to share experiences, collaborate on joint projects, and facilitate cross-border testing of new technologies.

2.1.10.3.4 COMPETING REGULATORY OBJECTIVES

The document examines the tension between different regulatory objectives, such as consumer protection, financial stability, market efficiency, and the promotion of innovation and competition. It argues that regulatory policy often needs to balance these objectives, which can sometimes be in conflict.

2.1.10.3.5 IMPACT OF REGULATORY TESTING ENVIRONMENTS ON FINANCIAL REGULATION

The impact of regulatory testing environments on the broader financial regulatory landscape is also critically assessed, particularly regarding consumer protection and financial stability. It suggests that the push for innovation and efficiency might sometimes undermine important regulatory objectives.

2.1.10.3.6 INFORMATION SHARING AND COLLECTIVE ACTION PROBLEMS

The document delves into the challenges of information sharing among regulators operating sandboxes, highlighting collective action problems and the difficulty of sharing confidential business information across jurisdictions.

2.1.10.3.7 CONCLUSION AND RECOMMENDATIONS

The document concludes by expressing concerns about the current trajectory of the sandbox regulatory model. It suggests that, in many cases, the emphasis on promoting innovation might come at the expense of consumer protection and financial stability.

2.1.11 THE ROLE OF SANDBOXES IN THE DIGITAL ERA (OECD)

2.1.11.1 MAIN IDEAS

- Definition, purpose, and common characteristics of regulatory sandboxes.
- Global examples, benefits and challenges, with alternative suggestions for structured experimentation.
- Positive conclusion on the role of regulatory testing environments in promoting innovation and flexibility in the digital era.

2.1.11.2 SUMMARY

The document “The Role of Sandboxes in Promoting Flexibility and Innovation in the Digital Era” by the OECD provides an extensive analysis of the function and impact of regulatory sandboxes across various sectors. It offers a comprehensive view of the role of regulatory testing environments in promoting innovation and flexibility in the digital era, along with their benefits, challenges, and the need for careful evaluation and potentially alternative approaches in certain contexts.

2.1.11.3 KEY CONTENTS

2.1.11.3.1 DEFINITION AND PURPOSE OF REGULATORY TESTING ENVIRONMENTS

Regulatory testing environments are frameworks that provide limited regulatory exemptions or flexibilities for companies, allowing them to test new business models with reduced regulatory requirements. They are often organized by regulatory authorities on a case-by-case basis and have emerged across various sectors, including finance, health, transport, legal services, aviation, and energy.

2.1.11.3.2 CHARACTERISTICS OF REGULATORY TESTING ENVIRONMENTS

The document describes common characteristics of regulatory testing environments, such as the requirement for genuine innovation, identifiable social or consumer benefits, and the need and readiness for sandbox testing. It also highlights the defined temporal, sectoral, or geographic limits of these sandboxes.

2.1.11.3.3 GLOBAL EXAMPLES

The document provides numerous examples of regulatory testing environments in different countries and sectors, including financial services, transport, and health. These examples illustrate the global application and diversity of sandbox approaches.

2.1.11.3.4 BENEFITS OF REGULATORY TESTING ENVIRONMENTS

Sandboxes support competitive innovation, facilitate the market entry of innovative products, and reduce time to market. They help secure funding for innovative companies and improve communication between regulators and market participants. For regulators, these sandboxes provide insights into emerging technologies and business models.

2.1.11.3.5 CHALLENGES AND RISKS

The document acknowledges potential challenges, including the unpredictable nature of early-stage innovations, the resource-intensive nature of sandbox programs, and their limited scalability. It also notes that regulatory testing environments may not address innovations spanning multiple sectoral divisions and may not be the most effective tool in all situations.

2.1.11.3.6 CROSS-SECTORAL EXAMPLES

The document discusses innovative projects from France and Germany that span multiple sectors, highlighting how sandboxes can support diverse innovations, including environmental protection and waste management.

2.1.11.3.7 EFFICIENCY AND ALTERNATIVE APPROACHES

The document raises questions about the effectiveness of regulatory testing environments due to their relative novelty and limited evaluations across countries and sectors. It suggests that other forms of structured experimentation, such as class exemptions and innovation hubs, might be more effective in some circumstances.

2.2 EXAMPLES OF OPERATIONAL SANDBOXES

2.2.1 SANDBOX FOR UAV INTEGRATION INTO AIRSPACE (UK)

The UK Civil Aviation Authority (CAA) is advancing the integration of Unmanned Aerial Systems (UAS) into UK airspace through the implementation of a regulatory sandbox focused on Beyond Visual Line of Sight (BVLOS) operations. This involves collaborations with industry stakeholders and structured testing environments¹.

- **Introduction of the Regulatory Sandbox:** The CAA has launched a regulatory sandbox specifically designed to facilitate and enhance the safe integration of Remotely Piloted Aircraft Systems (RPAS) operating beyond the visual line of sight (BVLOS) in UK airspace.
- **Development of Airspace Policy:** This initiative is part of a broader strategy to develop an airspace policy that uses Temporarily Reserved Airspace (TRA) to ensure safe and controlled UAS operations.
- **Collaboration with Industry:** The CAA is inviting participation from individual organizations or consortia that are developing UAS capabilities. The goal is to test Integrated Operations Concepts (ConOps) to aid in policy development and improve understanding of UAS flights alongside other airspace users.
- **Application Process and Stages:** The application process to participate in the sandbox is divided into three stages, with specific deadlines for each phase. This phased approach allows for organized and staged testing and integration.
- **Eligibility and Test Setup:** Only participants accepted into the sandbox will have the opportunity to establish a test TRA. This controlled setup ensures that the CAA can effectively manage and oversee the testing to

¹ <https://www.caa.co.uk/our-work/innovation/beyond-visual-line-of-sight-airspace-sandbox-trial/>

validate the technical and operational frameworks necessary for safe UAS integration.

- **Supporting Documentation:** Participants and stakeholders can refer to CAP 2616, a publication that provides comprehensive details on the sandbox's objectives, application process, and how the tests align with the CAA's airspace modernization strategy.
- **Innovation Hub and Challenges:** The CAA's Innovation Hub supports various challenges and initiatives, such as the Advanced Air Mobility Challenge, Artificial Intelligence applications, the Future Flight Challenge, and the Hydrogen Challenge, aimed at pushing the boundaries of aviation technology and regulation.
- **Feedback and Engagement:** The CAA encourages feedback on its services through a brief survey and maintains an active role in providing updates and guidance on innovations through its website.
- **News Updates and Developments:** Recent news updates include strengthening aviation safety through bilateral agreements, highlighting the aerospace industry's importance in Wales, and proposing changes to airline charges at Heathrow Airport in response to appeals by the Competition and Markets Authority (CMA).

2.2.2 UAV SANDBOX AND FREQUENCY BAND USAGE (TAIWAN)

The EECi (Eastern Economic Corridor of Innovation) is an entity designed as a hub in Thailand to promote innovation and investment in key industries, transforming research into business opportunities. Located in the Wanchan Valley, Rayong, EECi is intended to be a significant site for innovation in Thailand under the direction of NSTDA and in partnership with Thailand's national energy company, PTT.

Introduction of the Regulatory Sandbox: The EECi regulatory sandbox is designed to facilitate industrial innovation by providing a controlled environment where unmanned aerial vehicles (UAVs) can be tested and developed, enhancing cooperation between innovators and regulatory bodies to accelerate research and development (R&D) and commercialization processes².

Supporting Organizations: This initiative is supported by key regulatory bodies, including the Civil Aviation Authority of Thailand (CAAT) and the National Broadcasting and Telecommunications Commission (NBTC).

² <https://www.eeci.or.th/en/service/regulatory-sandbox-for-research-innovation-and-testing-of-unmanned-aerial-vehicle-uav-and-authorization-to-use-frequency-band-for-uav-related-activities/>

Facilitating R&D Processes: The sandbox facilitates smoother and faster R&D processes by acting as a bridge between innovators and regulators, ensuring that safety and regulatory standards are met without unnecessary delays.

Facilities within the Sandbox:

- UTM (UAS Traffic Management Platform) to manage UAV traffic.
- Provision for temporary take-off and landing of aerial vehicles in a defined area smaller than 18m x 600m.
- Access to advanced telecommunications infrastructure, including 5G network coverage, to support UAV operations requiring high-speed data transmission.
- A Drone Academy project to foster education and training in UAV technology and operations.

Role in Commercialization: The regulatory sandbox not only helps in testing technology but also plays a crucial role in the eventual commercialization of UAV technology by reducing development times and fostering industrial collaborations.

2.2.3 U-WELCOME: TESTING AND MATURING U-SPACE SOLUTIONS

While not explicitly defined as such, the U-ELCOME³ demonstrations and initiative could be considered a regulatory sandbox from the perspective that they provide a controlled environment in which to develop, test, and refine U-space services before these services are fully integrated and deployed on a wider scale. This approach allows stakeholders, including regulatory bodies like EASA and technology providers, to observe and assess the impact and functionality of these services in various operational environments without large-scale deployment. The experimental nature of the project helps identify and resolve potential issues in a limited environment, a key feature of regulatory testing environments, which aim to foster innovation while managing risks and adapting regulatory frameworks accordingly.

Key Features of the Initiative:

- The U-ELCOME project promotes the implementation of U-space services in Europe, focusing on the widespread adoption of U1 and U2 services through tests in Spain, Italy, and France.

³ <https://www.eurocontrol.int/project/u-elcome>

- Involves 51 European partners and builds on previous projects, utilizing real U-space systems from various European organizations.
- Funded by the European Climate, Infrastructure, and Environment Executive Agency, it is part of the Digital Sky Demonstrators promoting smart and sustainable transport.
- Drones are seen as essential for Europe's green and digital economic future, supporting everything from daily transport to global supply chain management.
- U-space services are crucial for safe and efficient drone operations and are being tested in 15 European locations.
- The project tests U-space U1 and U2 services, including core services like drone identification and advanced services supporting beyond visual line-of-sight operations.
- The demonstrations aim to integrate these U-space services with existing air traffic management systems, improving operations for various missions, including medical and goods deliveries.
- U-ELCOM also helps shape regulatory standards for U-space services, in collaboration with EASA and other international bodies.

2.2.4 AI SANDBOX SPAIN

Spain recently approved regulations for its first regulatory sandbox linked to the EU Artificial Intelligence Act. This sandbox allows companies to test AI-driven products and services.

Regulatory Sandbox Introduction: According to the Ministry of Economy, Commerce, and Industry's website⁴, the rapid development and implementation of high-risk artificial intelligence (AI) systems pose significant regulatory challenges. There is a need for effective mechanisms to ensure that these technologies are safe, comply with regulations, and benefit society.

Collaboration with the European Commission: To address this, Spain, in collaboration with the European Commission, launched its first controlled testing environment or sandbox in 2023 under the proposal of the European Artificial Intelligence Regulation. This initiative, aimed at testing the applicability of regulatory requirements for high-risk AI systems, provides a model for Europe with the following key points:

⁴ <https://portal.mineco.gob.es/es-es/comunicacion/Paginas/entorno-controlado-de-pruebas-sandbox-del-Reglamento-Europeo-de-Inteligencia-Artificial.aspx>

- **Establishment of a Controlled Environment:** The sandbox allows collaborative testing between AI providers and users, aiming to develop a guide of best practices.

This includes the selection and admission of companies and clients to test AI systems.

An Advisory Committee of Experts will guide the process.

- **Integration into a Broader Strategy:** This initiative is part of Spain's broader digital transformation strategy, aligning with the Spain Digital Agenda 2026 and the National Artificial Intelligence Strategy.

Supporting the goals of the European Recovery Plan.

- **Regulatory Preparation and Compliance:** The initiative aims to prepare the ecosystem for the imminent European AI Regulation.

Creating guidelines and best practices, particularly helping SMEs and startups.

Pre-registration Process: On October 3, 2023⁵ ⁶, the pre-registration process opened for the participation of entities and experts in the Artificial Intelligence testing environment , . This first Artificial Intelligence testing environment aims to define possible ways to implement applicable requirements for AI systems, including:

- Safety components of regulated products (e.g., medical devices, machinery) subject to third-party assessment under relevant sectoral legislation.
- Certain (autonomous) AI systems in the following areas:
 1. Biometric identification and categorization of natural persons.
 2. Management and operation of critical infrastructure.
 3. Education and vocational training.
 4. Employment and worker management, access to self-employment.
 5. Access to and enjoyment of essential private services and public services and benefits.
 6. Law enforcement.
 7. Migration, asylum, and border control management.
 8. Administration of justice and democratic processes.

⁵ <https://portal.mineco.gob.es/es-es/comunicacion/Paginas/apertura-prerregistro-entorno-de-pruebas-IA-sandbox.aspx>

⁶ https://portal.mineco.gob.es/gl-es/comunicacion/Paxinas/231002_sandbox_ia.aspx

Importance of the Initiative: The sandbox initiative is crucial for defining viable paths for implementing the upcoming European AI Regulation. It will facilitate knowledge transfer, improve compliance, foster innovation, and ensure the development of reliable AI systems. The outcomes will likely influence EU guidelines and contribute to standardization processes, ultimately enhancing the reliability and safety of AI applications across Europe. The initiative also represents a significant step during Spain's presidency of the Council of the European Union, marking it as a pioneer in AI regulation and digital transformation.

2.2.5 FINANCIAL SANDBOX BY THE TREASURY (SPAIN)

The Spanish Treasury's Sandbox⁷, supported by the “Legal regime for access and participation in the controlled testing environment” published in the Official State Gazette (BOE) in November 2020⁸, provides a structured and controlled environment for testing technological innovations in the financial sector, facilitating the integration of new technologies under regulatory supervision, thereby promoting a safe and efficient digital transformation of the financial system.

Overview of the Financial Sandbox:

The system acts as a controlled testing ground for new technological innovations in the financial sector. It operates with a cohort system with semi-annual application periods in March and September.

Each cohort cycle is structured into five distinct phases: application submission, preliminary evaluation, negotiation of testing protocols, testing period, and final reporting and exit.

Applicants have 30 business days to submit their projects through the Treasury's electronic headquarters once the application period opens.

Following submission, a preliminary evaluation is conducted, with authorities taking up to two months if necessary to complete their assessments.

Successful projects enter a negotiation phase to agree on testing protocols.

The duration of the testing phase is established in the agreed protocol, followed by an evaluation phase where results are analyzed and reported by both promoters and the supervisory authority.

⁷ <https://www.tesoro.es/sandbox/solicitudes-para-el-espacio-controlado-de-pruebas>

⁸ <https://www.boe.es/boe/dias/2020/11/14/pdfs/BOE-A-2020-14205.pdf>

Eligibility Criteria:

Open to individuals and legal entities providing a technologically innovative project capable of improving the financial system.

Projects must offer advancements in areas such as regulatory compliance, user benefits, operational efficiency, and supervisory mechanisms.

2.2.6 URBAN ENVIRONMENT SANDBOX (ALCOY)

Alcoy is leading innovation through its Sandbox initiative, using a unique urban testing environment to advance technological and environmental solutions with collaborative projects involving universities and local businesses.

The initiative includes three main projects^{9 10}:

- **Emergency Beacon Project by Erum:** Replaces traditional traffic emergency triangles with advanced beacons to improve road safety.
- **Valencia Water Project:** Focuses on digitizing water and air quality monitoring at the Eduardo Latorre sports complex using LoRaWan network technology, enabling real-time environmental health monitoring and legionella prevention.
- **CO2Pure Project by Primlab Global:** Utilizes a natural mineral, antiviral, and antibacterial paint in a meeting room at the Àgora Alcoy space to improve air quality by absorbing and dissolving CO2.

Additionally, more proposals have been made and are ongoing; such as the one in March 2024 by the LegalCripto project¹¹, led by Dr. Carmen Pastor Sempere, to include two revolutionary Proofs of Concept (PoC) within the regulatory framework. These tests focus on:

1. **Tokenization of Commercial Bonds (Local Digital Euro):** This test aims to explore the application of Blockchain technology to create digital representations of commercial bonds, which could revolutionize trade and facilitate local financing.

⁹ <https://www.elnostreciutat.com/es/alcoy-es-un-campo-de-pruebas-para-las-empresas-innovadoras/>

¹⁰ <https://pagina66.com/art/129576/alcoy-cuenta-con-tres-proyectos-en-su-sandbox>

¹¹ <https://www.baeslegalcripto.eu/legalcripto/legalcripto-en-el-sandbox-urbano-de-alcoy/>

2. **Traditional Finance (TradFi):** This project aims to use tokenization to transform traditional finance, enabling new forms of financial interaction that are more inclusive and equitable.

These projects emphasize public-private partnerships, offering a real-scale testing ground for innovative solutions. The Sandbox is part of a broader strategy to drive innovative public procurement under Alcoy's urban agenda, with financial support from Ivace+i and the European Regional Development Fund^{12,13}.

2.2.7 FINANCIAL SANDBOX BY THE FCA (UK)

The Financial Conduct Authority (FCA) of the UK is recognized for creating the first regulatory sandbox worldwide. This project, initiated in 2016, focused on the financial sector and new technologies, becoming a model to follow internationally¹⁴. Fintech firms worldwide could apply to grow and comply with financial regulations under the FCA's supervision. The goal was to foster competition and provide consumers with more and better financial options. Introduction of the Regulatory Sandbox: This regulatory sandbox is an initiative designed to allow companies to test innovative products, services, and business models in a real market environment but controlled.

Various companies from different sectors have participated in the Sandbox to date, including banks like Lloyds Bank, fintech startups like Noggin HQ, and other companies innovating in financial services like Little Steps Financing and Notabene, Inc., among others.

Eligibility Criteria: To be eligible to participate in the Regulatory Sandbox, companies must demonstrate that they meet five eligibility criteria:

- **Scope:** The innovation must be aimed at the UK market and fall within the FCA's regulatory scope.
- **Genuine Innovation:** The product or service must represent a significant novelty or a considerable change from existing offerings.
- **Consumer Benefit:** The proposal must offer clear benefits for consumers.
- **Readiness:** The company must clearly understand how its model aligns with FCA rules.

¹² <https://pagina66.com/art/129576/alcoy-cuenta-con-tres-proyectos-en-su-sandbox>

¹³ <https://www.baeslegalcripto.eu/legalcripto/legalcripto-en-el-sandbox-urbano-de-alcoy/>

¹⁴ <https://www.fca.org.uk/firms/innovation/regulatory-sandbox>

- **Need for Support:** It must be demonstrated that the project requires sandbox support for development.

The results of the Sandbox are measured according to specific objectives set by participating companies, such as reducing costs for consumers, and are evaluated in small-scale tests over a limited period. The FCA provides a dedicated case manager to support the development and implementation of the test, and the benefits and impact on consumers are monitored during and after the trial period.

2.2.8 FINANCIAL SANDBOX BY MAS (SINGAPORE)

In Singapore, the Monetary Authority of Singapore launched a regulatory sandbox for the fintech sector, demonstrating a proactive approach to regulating new financial technologies and promoting innovation in this field¹⁵. The first edition of Singapore's Regulatory Sandbox was launched in November 2016¹⁶ and remains an open and constantly evolving initiative. Since its inception, the program has introduced updates and extensions, such as Sandbox Express in August 2019 and Sandbox Plus in November 2021, to better cater to the changing needs of the fintech sector and facilitate faster and more efficient access for innovative companies¹⁷.

Participation and Support: Various companies have participated in the MAS Regulatory Sandbox, including startups and established fintech firms. For example, BondEvalue tested its fractional bond exchange platform, allowing investors to buy bonds in smaller denominations using distributed ledger technology.

Eligibility Criteria: To participate, companies must meet specific criteria, including genuine innovation, potential consumer improvement, and readiness for market launch. Interested companies must submit their applications via the email provided by MAS and may receive grants and support during the application and testing process.

Outcome Measurement and Impact: The results are measured based on the objectives of each project. MAS works closely with participants to evaluate the innovation and its impact, ensuring that the benefits for consumers and the market are clear and significant. Additionally, transparency is pro-

¹⁵ <https://www.mas.gov.sg/development/fintech/sandbox>

¹⁶ <https://fintechnews.sg/6993/fintech/mas-issues-regulatory-sandbox-guidelines-fintech-experiments/>

¹⁷ <https://www.withersworldwide.com/en-gb/insight/read/fintech-today-a-look-at-fintech-regulatory-environment-and-what-you-need-to-know>

vided regarding approved applications and the details of the experimentation process.

Global Influence: This flexible and supportive approach has made the Singapore Regulatory Sandbox a model worldwide, inspiring similar initiatives in other countries and significantly contributing to Singapore's leadership in the Fintech sector.



3. THE SPECIFIC CASE OF UAVS

This section presents the key concepts related to UAVs and their regulation, including definitions, classifications of UAVs, and relevant regulatory challenges and considerations.

Unmanned Aerial Vehicles (UAVs), commonly known as drones, represent a rapidly evolving technology with a wide range of civil and military applications. Below are key concepts related to UAVs and their regulation:

3.1 DEFINITIONS

- **UAV (Unmanned Aerial Vehicle):** An aircraft remotely or autonomously piloted, with no onboard crew.
- **RPAS (Remotely Piloted Aircraft Systems):** Systems that include not only the UAV but also the ground control system and the communication link.
- **UAS (Unmanned Aircraft Systems):** A broader term that includes the UAV, the controller, and the communication system between them.

3.2 CLASSIFICATIONS OF UAVS

The European Union Aviation Safety Agency (EASA) and the Spanish Aviation Safety Agency (AESA) classify Unmanned Aircraft Systems (UAS) primarily based on the risk associated with their operations.

These categories reflect the risk-based approach adopted by EASA and AESA, where regulations are tailored to the risk level of UAS operations. This

approach seeks to balance safety with the promotion of innovation in the field of UAS.

The classification is structured around three main categories:

1. “Open” Category

Characteristics:

- Low-risk operations.
- No prior authorization or contact with aviation authorities is required to operate.
- Limited to UAS weighing less than 25 kg.

Subcategories:

- A1: Flight over people.
- A2: Flight close to people.
- A3: Flight away from people.

2. “Specific” Category

Characteristics:

- Includes operations with a higher risk level than the open category.
- Requires an Operational Risk Assessment known as SORA (Specific Operational Risk Assessment).
- May require aviation authorities' authorization before flying.
- Operations can be more varied and may include flights in urban areas, long-distance flights, or operations beyond the visual line of sight (BVLOS).

3. “Certified” Category

Characteristics:

- For high-risk operations or those involving passenger transport, hazardous cargo transport, or flights over densely populated urban areas.
- Requires specific certifications, including an airworthiness certificate, operator certificate, and personnel licenses.
- Similar to the requirements for manned aircraft.

Additionally, from a less regulatory perspective, UAVs can also be classified based on size, capability, range, and purpose:

1. By Size and Weight:
 - Micro and Mini UAVs: Small and lightweight, usually used for recreational purposes or short-range surveillance.
 - Tactical and Medium UAVs: Larger and capable of carrying heavier payloads and conducting longer missions.
 - Large UAVs: Used for long-duration, high-altitude missions, often with military applications.

2. By Use:
 - Commercial: For aerial photography, infrastructure inspection, agriculture, etc.
 - Recreational: For personal or entertainment use.
 - Scientific: For research and environmental data collection.
 - Military and Security: For reconnaissance, surveillance, and tactical operations.

3.3 REGULATORY CHALLENGES AND CONSIDERATIONS

The regulation of UAVs is a dynamic and evolving field, requiring a balance between fostering innovation and ensuring safety, privacy, and compliance with the law. Regulatory authorities worldwide continue to work on developing appropriate regulatory frameworks to address these challenges.

- **Air Safety:** Ensuring the safe coexistence of UAVs with manned aircraft and the safety of people on the ground.
- **Privacy and Data Protection:** Addressing concerns about data collection and use by UAVs, especially in urban areas.
- **Airspace Integration:** Developing Unmanned Aircraft System Traffic Management (UTM) systems that allow for the safe integration of UAVs into the airspace.
- **Liability and Insurance:** Establishing liability frameworks in case of accidents or damages caused by UAVs.
- **Regulations and Standards:** Defining clear regulations for UAV operation, certification, and registration.

- **Cross-border Issues:** Coordinating regulations at an international level, especially for UAVs operating across multiple jurisdictions.
- **Security and Protection against Malicious Use:** Implementing measures to prevent the use of UAVs for illicit or terrorist purposes.

3.3.1 AIR SAFETY AND AIRSPACE MANAGEMENT

- **Collision Prevention:** Development of detect-and-avoid systems to prevent collisions with other aircraft and obstacles.
- **UAS Traffic Management (UTM):** Establishment of UTM systems to safely integrate UAS into the airspace, managing UAV traffic and coordinating with manned air traffic.
- **Beyond Visual Line of Sight (BVLOS) Operations:** Regulation of BVLOS operations, which present additional safety and control challenges.

3.3.2 PRIVACY, DATA PROTECTION, AND SURVEILLANCE

- **Privacy Protection:** Addressing concerns over data collection and surveillance by UAVs, especially in residential and public areas.
- **Data Collection Regulation:** Establishing guidelines on what data can be collected and how it should be handled and stored.
- **Use of Cameras and Sensors:** Controlling the use of recording equipment and sensors to ensure privacy laws are not violated.

3.3.3 CERTIFICATION AND TECHNICAL STANDARDS

- **Airworthiness Certification:** Establishing criteria for UAS certification to ensure they meet safety and design standards.
- **Standards for Equipment and Components:** Developing standards for critical safety components, such as communication and control systems.

3.3.4 LEGAL ASPECTS AND LIABILITY

- **Regulation of Commercial and Recreational Use:** Differentiating between the commercial and recreational use of UAS and establishing appropriate regulations for each.

- **Liability for Damages:** Defining legal liability in case of accidents or damages caused by UAVs, including insurance and compensation

3.3.5 INTERNATIONAL AND CROSS-BORDER CONSIDERATIONS

- **Regulation Harmonization:** Seeking harmonization of UAS regulations at an international level to facilitate cross-border operations.
- **International Cooperation:** Promoting cooperation between countries to share best practices and standards in UAS regulation.

3.3.6 TECHNICAL AND INNOVATION CHALLENGES

- **Technological Advancements:** Keeping up with the rapid evolution of UAS technology and adapting regulations accordingly.
- **Research and Development:** Promoting research in safety, efficiency, and noise reduction technologies for UAS.

3.3.7 ENVIRONMENTAL AND SUSTAINABILITY ASPECTS

- **Environmental Impact:** Considering the environmental impact of UAS, including noise pollution and battery and waste management.
- **Sustainable Use:** Promoting sustainable practices in the design and operation of UAS.

3.3.8 SECURITY AND PROTECTION

- **Measures against Malicious Use:** Implementing measures to prevent the use of UAS for illegal or terrorist activities.
- **Cybersecurity:** Ensuring protection against cyber threats to UAS control and communication systems.

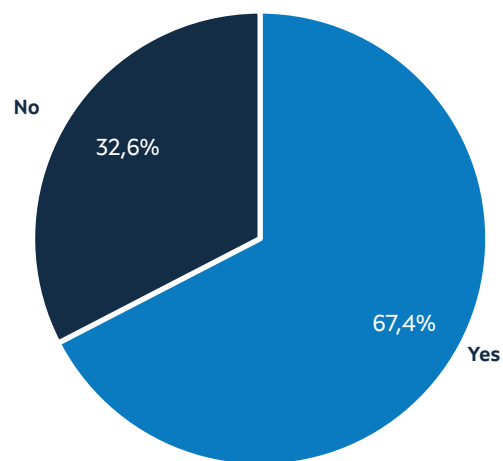
These considerations underscore the need for a robust and dynamic regulatory framework that can adapt to rapid technological changes while ensuring safety, privacy, and sustainability in the growing field of UAS.



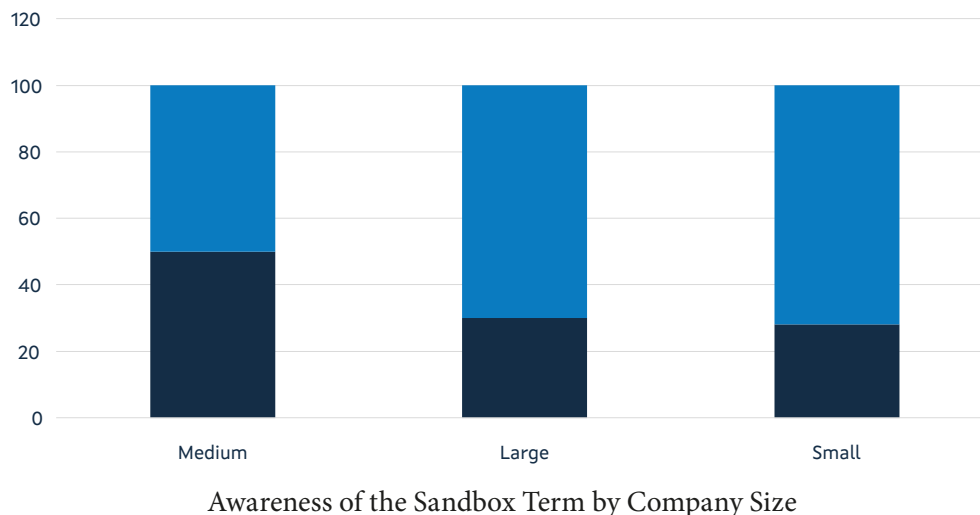
4. THE PERSPECTIVE OF UAS VALUE CHAIN COMPANIES IN SPAIN

4.1 RELATIONSHIP OF COMPANIES WITH REGULATORY SANDBOXES

4.1.1 AWARENESS OF THE TERM “REGULATORY SANDBOX”



Awareness of the Term “Regulatory Sandbox”



4.1.2 WHAT COMPANIES UNDERSTAND BY A SANDBOX

Companies have various perceptions of what constitutes a regulatory sandbox, but there is a common understanding that it is a specific environment or zone designed for realistic trials and experimental testing. This environment allows for the testing and development of new products, technologies, or services more quickly and flexibly than in routine operations, thanks to an adaptive and often temporary regulatory framework.



Image. Key Concepts in Companies' Perception of Sandboxes

Companies recognize regulatory sandboxes as crucial tools for navigating and shaping regulatory challenges in the development of UAS and other emerging technologies. There is a common perception that these spaces offer the necessary flexibility to innovate without the full constraints of standard regulations and are seen as key facilitators for accelerated innovation and technological adoption.

4.1.2.1 DETAILED ANALYSIS OF KEY TERMS

1. Realistic Trials and Experimental Testing

These terms highlight a clear trend towards the practical application of theory in conditions that mimic real-life situations within a safe, regulated environment. Companies view sandboxes as spaces where they can validate their technological developments with a higher level of risk but without compromising overall safety.

2. Controlled Environment

The repetition of the word “environment” underscores the importance of a defined and limited space where these trials are conducted. “Controlled” emphasizes the supervision and risk management within these spaces.

3. Level

“Level” may refer to the depth or degree of the regulatory challenges being tested or to the level of product maturity (TRLs 7 to 8) that is desired before broader implementation.

4. Concept

This reflects the theoretical understanding of what a regulatory sandbox is. Some companies have a “basic understanding,” while others possess “high” or “adequate” knowledge, indicating a degree of familiarity with both the theory and practice of sandboxes.

5. Development and Testing

These terms are closely linked to the process of moving innovations from concept to marketable reality. “Development” suggests an ongoing, progres-

sive approach, while “testing” denotes specific actions within the sandbox to validate progress.

6. Zone

“Zone” carries a geographical and practical connotation, implying a physically or virtually defined space for conducting sandbox activities.

4.1.1.2.2 SPECIFIC EXAMPLES AND APPLICATIONS OF KEY TERMS

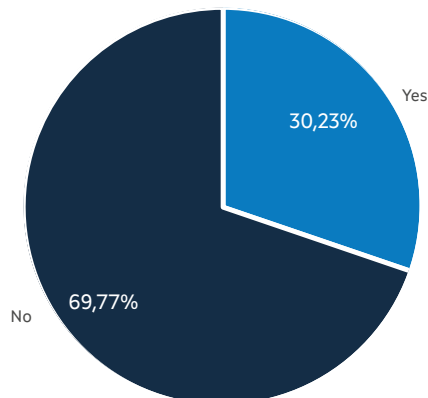
- “Realistic trial environment to certify TRLs 7 to 8” illustrates how sandboxes are viewed as a critical step towards product certification in advanced stages of development.
- “Controlled zones where proof-of-concept tests for equipment or software are conducted” demonstrates the practical use of these spaces to test and refine technologies before applying them in unregulated environments

4.1.1.2.3 COMMENTS ON VARIATIONS IN PERCEPTION OF PRACTICAL APPLICATION AND INTEGRATION INTO THE BROADER REGULATORY STRUCTURE

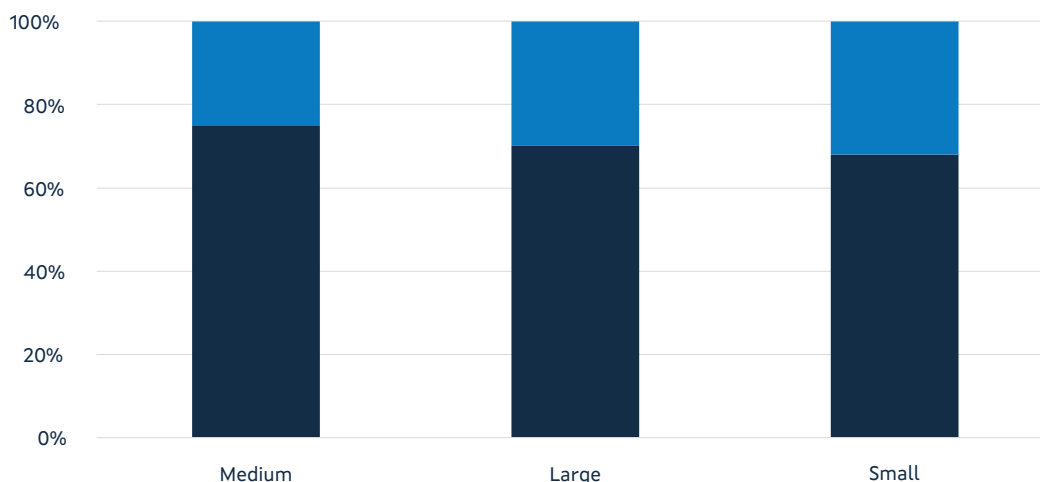
While most companies share a similar vision of regulatory sandboxes as spaces for testing in a more permissive and controlled environment, some responses offer slightly different perspectives or add additional layers of understanding to the concept:

1. **Regulatory and Legal Development Out of Sync with Sandboxes:** One company mentions a Spanish bill that contemplates regulatory sandboxes but notes that at the European level, EASA does not recognize this concept, highlighting a disconnect between national and European regulations.
2. **Frustration and Project Cancellation:** One company expressed frustration at being unable to find an effective alternative to regulatory obstacles, resulting in the cancellation of a project. This perspective underscores the practical difficulties some companies face when trying to operate within current regulatory frameworks, even within a sandbox.
3. **Knowledge Level Evaluation:** Some companies rated their knowledge of sandboxes with terms like “basic,” “high,” “adequate,” or “low,” introducing a subjective dimension to their understanding of the concept. This suggests that while the term “regulatory sandbox” is known, the depth of understanding varies among respondents.

4.1.3 PERCENTAGE OF PARTICIPATION IN REGULATORY SANDBOXES



Percentage of Participation in Regulatory Sandboxes



Participation in Sandboxes by Company Size

4.1.4 HOW COMPANIES HAVE PARTICIPATED IN SANDBOXES

Surveyed companies exhibit a variety of approaches and levels of participation in regulatory sandboxes, ranging from active involvement in trials and developments to cautious evaluation of feasibility and associated risks. The reasons for these different approaches include adaptability to changing regulations, the opportunity to conduct tests without compromising safety, and limitations imposed by current regulations that may restrict innovation.

Algunas empresas destacan por su cautela o decisión de no participar, citaSome companies stand out for their caution or decision not to participate,

citing concerns about legal coverage and feasibility. This contrasts with others actively leveraging sandboxes to explore and expand their technological capabilities in regulated and safe environments.

Key Methods of Participation Include:

- **Demonstrations in Controlled Environments:** Several participants mentioned conducting tests and demonstrations in controlled environments designed to mitigate risks to people, particularly in UAS operations.
- **Regulatory Advice and Development:** Some companies have collaborated in defining sandboxes with public authorities, providing technical and regulatory advice, particularly in temporarily segregated and reserved areas.
- **Experimental Testing and Trials:** Conducting experimental flights and trials with UAVs in centers like ATLAS and government-run incubators, where experimental testing of embedded technologies is allowed.

Additionally, some responses indicate a careful exploration of the feasibility of participating in sandboxes, with some companies deciding not to participate due to a lack of adequate legal coverage or the feasibility of their projects within existing regulatory frameworks

It is noteworthy that while many companies are actively involved and see benefits in sandboxes, some have opted not to participate or have ruled out their feasibility after careful consideration. This suggests a diversity of perceptions and strategies within the sector regarding regulated innovation and the associated risks.



Image. Key Terms Used by Companies to Describe Their Experience

Detailed Analysis of Key Terms

1. Regulatory Reasons

- Context of Use: Several companies mentioned “regulatory reasons” as a determining factor both for participating and for abstaining from regulatory sandboxes. For example, one company decided not to participate due to the “lack of legal coverage in the regulation,” highlighting how regulatory limitations can influence business decision-making.
- Specific Example: “Tests were able to be conducted that, outside the sandbox, for regulatory or risk reasons, could not have been performed.”

2. Experimental Testing

- Context of Use: The term “experimental testing” is fundamental to understanding the nature of the activities carried out within sandboxes. Companies operating in government-run incubators in Navarra and the ATLAS center have conducted experimental tests to evaluate new technologies and UAS applications.
- Specific Example: “Carrying out experimental flights and tests with UAVs.”

3. Risk

- Context of Use: “Risk” is a constant concern in responses, particularly related to operational safety and legal protection. Sandboxes allow companies to mitigate these risks by providing a controlled environment for testing.
- Specific Example: “Specific demonstrations in controlled environments to avoid risks to people during UAS operations.”

4. Could

- Context of Use: “Could” appears in contexts reflecting the capabilities or limitations companies face regarding their participation in sandboxes. It is often related to the opportunities or constraints experienced by the companies.
- Specific Example: “We have considered participating, but the opportunity has not yet arisen.”

5. Scope

- Context of Use: “Scope” refers to the specific sectors or contexts in which sandboxes apply. For example, it mentions development and implementation in the field of air navigation as a focus area.
- Specific Example: “Related to development and implementation in the field of air navigation.”

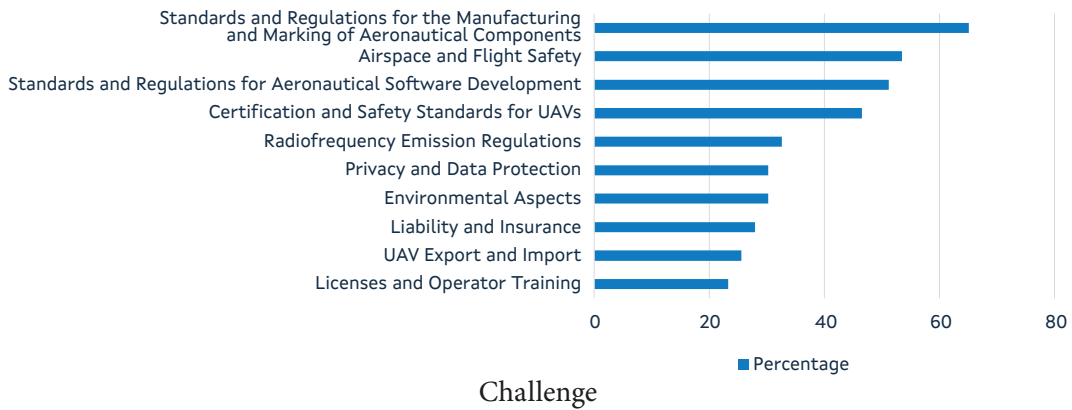
Unique or Noteworthy Responses

Viability and Legal Coverage: One company mentioned ruling out the feasibility of participating in sandboxes due to legal limitations, highlighting the challenges some organizations face when trying to fit their operations into current regulatory frameworks.

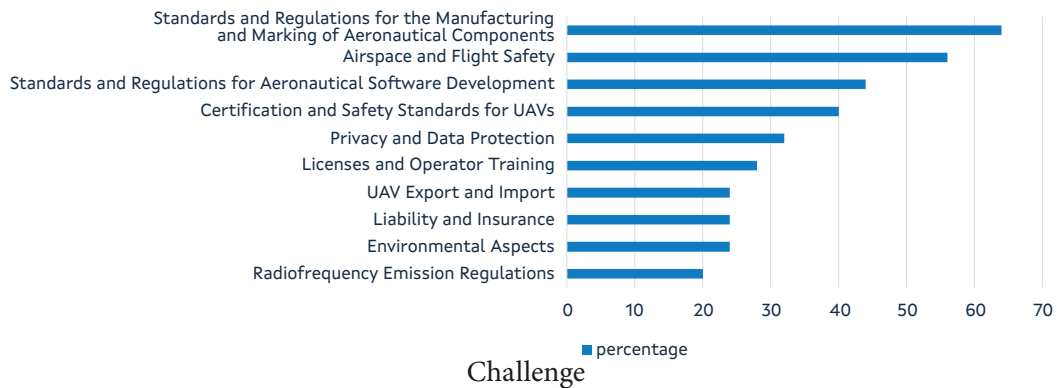
Creation of Proprietary Testing Environments: A technology center stands out for its unique approach by creating testing environments in urban and suburban settings with additional safety measures, an innovative alternative to the traditional sandbox concept.

4.2 ANALYSIS OF REGULATORY CHALLENGES

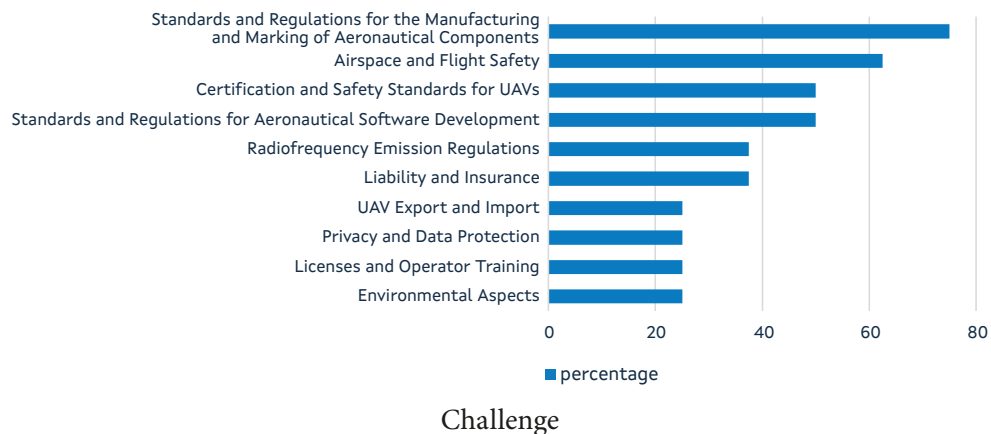
4.2.1 CHALLENGES MOST AFFECTING COMPANIES



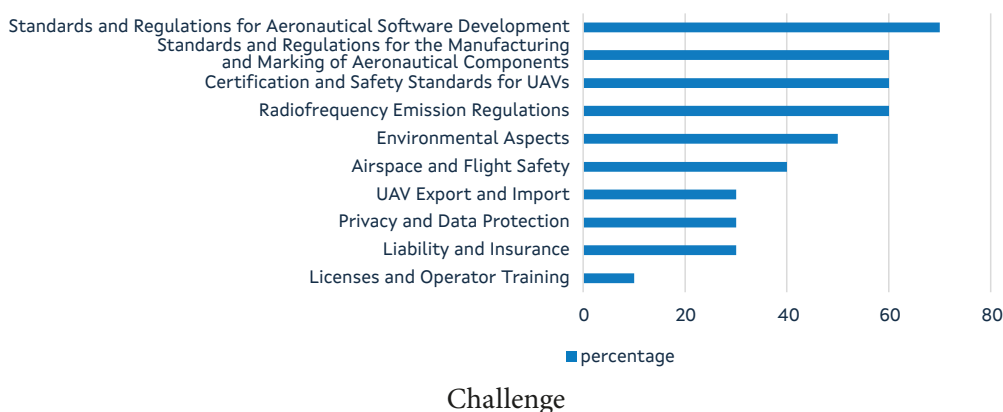
4.2.1.1 CHALLENGES MOST AFFECTING SMALL COMPANIES



4.2.1.2 CHALLENGES MOST AFFECTING MEDIUM COMPANIES



4.2.1.3 CHALLENGES MOST AFFECTING LARGE COMPANIES



4.2.2 PARTICULAR CHALLENGES FACED BY COMPANIES

Responses to the questionnaire suggest that all companies face a series of fairly common regulatory challenges, with particular emphasis on certification and aviation regulations. Standards like DO-178C and regulations from EASA and AESA are frequently mentioned, indicating their importance and the impact they have on business operations. From the content and tone of the texts, it can be concluded that companies are navigating a complex regulatory landscape, with certification and aviation safety regulations representing key challenges. Technical standards, aviation authority regulations, and specific certifications guide product development and daily operations. The need for continuous adaptation and compliance with evolving legislation presents constant challenges for these companies in the aviation sector.



Imagen. . Key Terms When Defining Regulatory Challenges

Detailed Analysis of Key Terms

EASA/AESA: These terms indicate that European and national regulatory entities are central to defining regulatory challenges. References to these authorities highlight their influence in creating a compliance environment that companies must navigate.

Regulation/Delegated Regulation: The mention of “regulations” and “delegated regulations” signals the complexity of the legal framework affecting companies. Challenges stem not only from general rules but also from specific provisions impacting particular aspects of operations.

Development: This term refers to the challenges in creating new products or technologies. Many responses indicate that development is restricted or shaped by certification requirements and safety standards.

Operations: The term reflects how regulations impact the daily and strategic execution of business activities. From airspace management to the certification of new aircraft types, operations are heavily influenced by existing regulations.

Royal Decree/SAIL III: References to specific legislation and programs suggest a series of levels of compliance and authorizations that companies must obtain and maintain. SAIL III, for example, refers to specific levels within the regulations detailing different degrees of safety and certification.

Unique or Noteworthy Responses:

- **Development and Implementation of Critical Systems:** Some companies mention the challenge of developing software and systems that must comply with very specific technical standards, like DO-178C, which are beyond their current capabilities.
- **Collaboration in Manufacturing:** Collaboration in the manufacturing of critical components, as mentioned by some companies, shows how these businesses also rely on material certifications to meet regulations.
- **Capability for BVLOS Flight Testing:** This is a specific capability some companies need to develop to meet regulatory requirements, and it is a particularly challenging hurdle to overcome.
- **Changes in Regulations:** The reference to the development of standards and AMCs (Acceptable Means of Compliance) by European and national entities shows how regulatory changes themselves are a challenge, as companies must continuously stay informed and adapt to new regulations.

4.2.3 GLOBAL IMPACTS OF ALL REGULATORY CHALLENGES

Responses from companies to the question about the impacts of regulatory challenges reveal common concerns regarding uncertainty and restrictions that affect their operations and development strategies. Key terms such as “Development,” “Operations,” “Affects,” “Delays,” “Market,” “Costs,” “Products,” and “Delay” reflect a trend toward perceiving regulatory challenges as obstacles that influence time-to-market, increase costs, and complicate the launch of new products.



Image. Key Terms Describing the Impact of Regulatory Challenges

For example, delays in certification or the implementation of new regulations appear to be a common issue, leading to a general delay in operations, which in turn causes products to take longer to reach the market. This can result in increased production and development costs, directly impacting the competitiveness of companies in the market.

Additionally, the influence of regulatory challenges on the ability to innovate and develop new products is highlighted. The need to comply with specific standards, such as DO-178C for software development, not only adds layers of complexity to the development process but also represents a significant barrier due to the required investment, both in time and financial resources.

Overall, **companies express a clear need for clarity and support in managing regulations to plan and execute their operations efficiently.** Adapting to regulatory changes while managing financial impacts and maintaining the pace of innovation is a central challenge for the sector.

4.2.4 HOW CHALLENGES ARE GENERALLY ADDRESSED

Companies are tackling the regulatory challenges they face in various ways, with a particular focus on development and adaptation to regulations. Some opt to consolidate existing products at the functional level before moving toward certification, while others seek direct collaboration with regulatory entities to facilitate the process and expedite adaptation to regulations.

The “case-by-case” strategy shows that there is recognition of the need to tailor responses to specific challenges each company faces. Conducting tests in controlled environments is another common tactic, allowing companies to ensure that their products can comply with regulations before reaching the market.

Many companies emphasize the importance of staying up-to-date with current regulations and participating in their development to anticipate future changes and ensure compliance and competitiveness.

For companies in the product development phase, the plan seems to include participating in R&D projects and using internal laboratories to keep drones grounded during tests. This underscores the importance of a proactive approach to potential future corrections or adjustments that may be necessary.



Image. Key Terms Used When Addressing Regulatory Challenge

The extracted terms also point to a trend toward certification and regulated flight, with companies looking to adapt to and anticipate regulatory changes. Innovation appears to be a priority, with companies seeking investors or public funds to support development and innovation

Detailed Analysis of Key Terms

1. Regulations and Legislation

Context of Use: These terms are central, as most companies discuss their direct relationship with current regulations and how these influence their operations and development strategies. Adapting to regulations and anticipating future ones are mentioned as critical to operational and strategic success.

Specific Examples:

- “Working together with the relevant authorities.”
- “Developing systems in line with regulations and participating in standardization and regulatory groups.”

2. Development

Context of Use: Reflects innovation activities in response to or in anticipation of regulatory needs. It includes the development of technologies, products, and services that meet legal and market expectations.

Specific Examples:

- “The first phase is to consolidate the existing product at a functional level. From there, the technological risk of developing a certified product is manageable.”

3. Case by Case

Context of Use: Some companies adopt a regulatory management approach tailored specifically to each project or challenge, suggesting a flexible and adaptive strategy.

Specific Examples:

- “Specific agreements with manufacturers and support plans for their integration into the aerospace sector.”

4. Testing

Context of Use: Testing is fundamental to demonstrating compliance with regulations and validating product performance and safety. Conducting tests in controlled environments or internal laboratories is frequently mentioned.

Specific Examples:

- “In our particular case, tests are conducted in internal laboratories where drones are kept grounded.”

5. Plan

Context of Use: Reflects strategic planning in response to regulations, including preparation for future regulatory changes and risk management.

Specific Examples:

- “Own safety plans and collaboration with customers and air safety agencies.”

6. Existing Product and Certified

Context of Use: The concern about keeping existing products up to date and in compliance with new regulations, and the process for obtaining necessary certifications.

Specific Examples:

- “We aim to achieve a SAIL II and military-type certification.”

7. Flight

Context of Use: Refers specifically to flight operations and how these are adjusted or adapted to current regulation.

Specific Examples:

- “Conducting flight tests outside of Spain.”

In summary, the responses suggest that companies are engaged in a continuous and dynamic process of adjusting to regulatory challenges, using a **combination of product consolidation, controlled testing, dialogue with regulators, and preparation for certification as key strategies.**

4.3 COMPANY WILLINGNESS TO PARTICIPATE IN A REGULATORY SANDBOX

Innovation in the business world often navigates uncertain waters, especially regarding compliance with existing regulations. In this context, regulatory sandboxes emerge as experimental spaces that offer fertile ground for companies to test new ideas and products in a controlled environment, without the constraints of conventional rules. However, **a company's decision to enter these domains is not taken lightly. It is deeply influenced by a series of factors that go beyond the mere scope and operational characteristics of the sandbox.**

A company's willingness to participate in a regulatory sandbox balances both opportunities and concerns. On the one hand, the direct relevance of

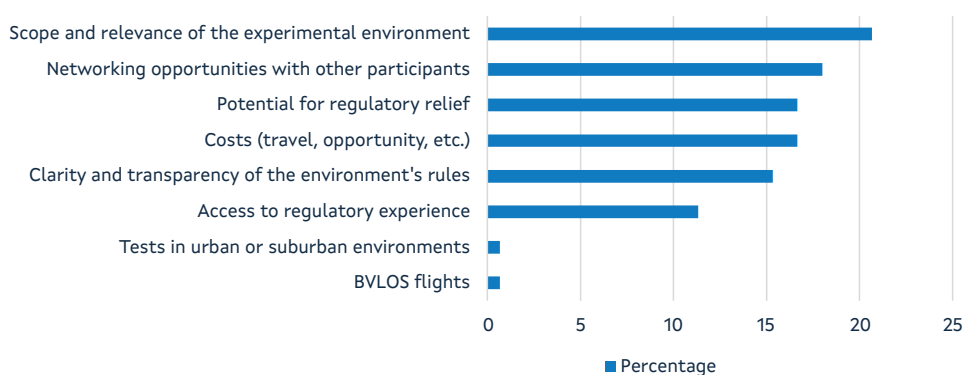
the experimental environment to the development and implementation of their innovative projects is considered. On the other hand, the **perception of risk** is evaluated, where **factors such as legal uncertainty, potential exposure to failures, or the novelty of the proposal may cause hesitation**. Additionally, a set of operational and strategic concerns, such as **associated costs, collaboration opportunities, and the clarity of the regulatory framework**, can tip the scale toward caution or enthusiasm.

This complex mosaic of expectations and apprehensions shapes the landscape in which companies decide whether or not to venture into the sandbox waters. Therefore, understanding both the attractions and reservations that companies associate with these environments is not only crucial for gauging their willingness to participate but also for designing sandboxes that maximize value for all stakeholders and minimize entry barriers. The future of the regulatory sandbox depends largely on how well these dynamics can be aligned and how concerns can be addressed to foster a truly innovative and collaborative spirit.

4.3.1 PARTICIPATION FACTORS

This section presents the conclusions of the analysis of company responses when asked about the factors they consider important for participating in a regulatory sandbox.

Based on this analysis, it can be concluded that participating companies primarily value a sandbox that provides a framework relevant and applicable to their needs, with strong networking opportunities, clear regulatory and economic benefits, and a comprehensible and transparent regulatory framework. More technical or industry-specific factors seem to have less influence on the decision to participate in these environments.



Factors for Participation in a Regulatory Sandbox

- **Priority in Scope and Relevance:** The most valued factor, at 20.67%, is the “Scope and Relevance of the Experimental Environment.” This indicates that for companies, it is crucial that the sandbox offers a testing ground that is meaningful and relevant to their operations and innovation aspirations. They seek to ensure that the experimental environment is representative of real-world situations and offers concrete opportunities to validate their ideas and products.
- **Networking:** “Networking Opportunities with Other Participants” weighs considerably, at 18.00%. Companies find it valuable to establish connections and collaborations with other actors within the sandbox, which can open doors to new business opportunities, cross-learning, and potential strategic partnerships.
- **Regulatory and Economic Benefits:** The factors of “Potential for Regulatory Relief” and “Costs (travel, opportunity, etc.)” each account for 16.67%. This suggests that companies are seeking a balance between regulatory benefits, such as reduced regulatory burdens, and economic efficiency, including the direct and indirect costs associated with participating in the sandbox.
- **Clear Rules and Transparency:** 15.33% of companies emphasize “Clarity and Transparency of the Sandbox Rules.” A clear understanding of the operational framework within the sandbox is essential for companies, as they seek to avoid surprises and ensure that they can operate within the established parameters without incurring unforeseen risks.
- **Access to Regulatory Expertise:** “Access to Regulatory Expertise” is also an important factor, with 11.33%. This reflects the desire of companies to learn directly from regulators and gain knowledge that they can apply in developing their businesses.
- **Lesser Considered Factors:** The least considered factors, at only 0.67% each, are “Testing in Urban or Suburban Environments” and “BVLOS Flights (Beyond Visual Line of Sight).” This may be because these areas are very specific and perhaps only applicable to certain industries, or companies believe they are already adequately covered in the current testing framework. However, the small percentage is mainly due to these factors being indicated by companies when presented with the “other” option, and only a small number of companies opted to fill them in.

4.3.2 PERCEIVED RISKS AND CONCERNS REGARDING PARTICIPATION

Companies were asked two questions that may sound quite similar (risks and concerns), but were interpreted (as intended) differently, as can be seen from the focus of the responses received:

- **Perceived Risks:** The responses relate more to uncertainties and potential negative consequences that could arise from participating in the sandbox, such as exposure to unanticipated legal or technical failures, or the possibility that participation may not yield the expected results due to unforeseen restrictions.
- **Perceived Problems:** The companies' answers focused more on concrete operational challenges and practical obstacles, such as the difficulty of obtaining necessary resources, managing interoperability with existing standards, or the need for specific infrastructure that may not be sufficiently developed within the sandbox.

In any case, it is important to highlight that both risks and concerns repeatedly feature two key concepts:

1. **Concerns about Regulation and Compliance:** In both questions, companies express concern about how current regulations and regulatory changes might affect their participation in sandboxes. They fear that regulatory uncertainty could negatively impact their operations and the validity of their tests and developments within the sandbox.
2. **Associated Costs:** Both in risks and concerns, costs are mentioned as a significant factor. This includes the cost of adapting to new regulations, the potential cost of implementing technologies, and the investment required for compliance and certifications necessary to participate in the sandbox.

4.3.2.1 PERCEIVED RISKS

Companies have identified several risks associated with participating in a regulatory sandbox. The most prominent risks include the possibility of regulatory ambiguity, exposure to security failures during testing, and potential loss of intellectual property. Additionally, there is concern about whether the results obtained in controlled environments are applicable to real market situations.

In general, companies exhibit a cautious attitude towards participating in regulatory sandboxes, with a strong focus on protecting against regulatory, security, and economic risks.



Image. Key Concepts in Companies' Perception of Risks

Analysis of Key Terms and Their Relation to Responses

1. **Ambiguous Regulation:** Many companies expressed concern about “ambiguous regulation” that may not provide the certainty needed for long-term planning and execution.
2. **Security:** The term “security” is frequently mentioned, reflecting fears about system integrity during tests in environments that are not fully proven or controlled.
3. **Intellectual Property:** “Intellectual property” is another significant risk, with companies concerned about sharing sensitive information that could be exposed to competitors.
4. **Unexpected Costs:** “Unexpected costs” arise as a concern due to the possible need for rapid adaptations to new regulations or failures during testing.

Specific Examples of Term Usage in Responses

- One company mentioned: “The risk of unclear regulation could leave us vulnerable to future legislative changes.”
- Another highlighted: “Participation could expose us to security risks that we are not willing to accept without additional guarantees.”

Notable Discrepancies

- A unique response came from a company that sees the sandbox primarily as an opportunity rather than a risk, emphasizing the possibility of “leading sector innovation” despite the risks mentioned.

This analysis reflects a generally cautious attitude toward participating in regulatory sandboxes, with a strong focus on protecting against regulatory, security, and economic risks.

4.3.2.2 CONCERNS REGARDING PARTICIPATION

The concerns expressed by companies about participating in regulatory sandboxes are diverse but typically focus on security, intellectual property protection, regulatory uncertainty, and associated costs. These concerns reflect a significant degree of caution regarding the operational and financial risks involved in experimenting within a regulated but still evolving environment.



Image. Key Terms for Defining Concerns about Participation

Analysis of Key Terms

Security and Intellectual Property: As mentioned earlier, these terms highlight concerns about operational integrity and the risk of sharing sensitive information.

Regulatory Uncertainty: This underscores the difficulty of adapting to evolving regulations, affecting strategic and operational planning.

Costs: Many companies emphasize the economic impact of participating in sandboxes. They are concerned about the costs of adapting to new requirements, investing in technology and resources to meet experimental regulations, and high operational costs due to the need to comply with more rigorous testing standards

Examples of Term Usage in Context

“The term “**costs**” appears in contexts like the need to invest in additional security and compliance systems to adapt to sandbox regulations, which increases operational and development costs.

One company specifically mentions the costs related to obtaining permits and conducting tests that meet the sandbox standards, which involves significant investment before a product can reach the market..

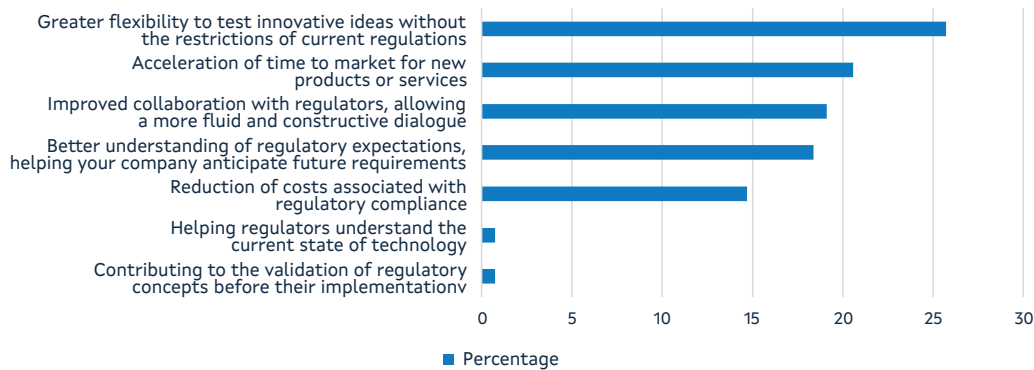
Additional Observations

Given the financial impact, it is clear why costs are a significant concern for companies. This also reinforces the need for a clear and stable regulatory framework that can minimize unexpected costs and allow for more effective financial planning.

4.4 PERCEIVED NEEDS AND BENEFITS

4.4.1 HOW COULD COMPANIES BENEFIT?

This section analyses the responses from companies when asked about the benefits they perceive from participating in a regulatory sandbox. Several key conclusions can be drawn regarding how companies view the value of these experimental environments within the regulatory framework.



Perceived Benefits by Companies in a Potential Regulatory Sandbox

Priority on Flexibility and Innovation: The most valued benefit, with 25.74% of responses, is “Greater flexibility to test innovative ideas without the constraints of current regulations.” This underscores the importance that companies place on having a space where they can explore new ideas and business models without being limited by existing regulations, which is crucial for fostering innovation and adaptability in rapidly changing markets.

Reduced Time to Market for New Products: The second most highlighted benefit, with 20.59%, is “Accelerating time to market for new products or services.” Companies highly value the ability to move quickly, which is essential in a competitive and technologically advanced business environment.

Collaboration and Regulatory Understanding: With 19.12% and 18.38%, respectively, the benefits of “Improved collaboration with regulators” and “Better understanding of regulatory expectations” show a trend towards seeking a more constructive and transparent relationship with regulatory bodies. These benefits reflect companies' desire to work more closely with regulators to better understand and anticipate regulatory requirements, facilitating greater compliance and possibly reducing barriers to market entry for new products and services.

Economic Impact of Compliance: “Reducing the costs associated with regulatory compliance,” at 14.71%, suggests that companies also see a regulatory sandbox as a way to lessen the financial burden of compliance, which can be particularly significant for startups and emerging companies facing resource constraints.

Interaction and Concept Validation: The less frequently mentioned benefits, each with only 0.74%, were “Helping regulators understand the current

state of technology” and “Contributing to the validation of regulatory concepts before their implementation.” This could indicate that these areas are seen as less critical or perhaps more specific and technical, relevant mainly to certain sectors or types of companies.



Image. Key Terms for Defining Perceived Benefits in a Sandbox

In conclusion, the data reveals that **companies highly value regulatory sandboxes primarily for their ability to facilitate innovation and efficiency in product launches**, as well as for improving interaction with regulatory bodies, which **can ultimately translate into tangible economic benefits**.

4.4.2 PROJECTS WHERE A REGULATORY SANDBOX COULD BE APPLIED

Companies responded to the question of how they would apply a regulatory sandbox mainly with approaches centered on project development that are still in the testing phase or require validation under specific regulations. The general context indicates strong interest in using these environments to advance technologies and innovative solutions that would otherwise be limited by current regulations



Image. Projects Where a Regulatory Sandbox Could Be Applied

Detailed Analysis of Responses and Relation to Key Terms

- 1. Development of Innovative Projects:** Many companies mention that they would use a regulatory sandbox to “develop” and “test” innovative projects in their early stages, where existing regulations could limit critical experimentation. For instance, a company might be interested in exploring emerging UAV (Unmanned Aerial Vehicle) technologies that require BVLOS (Beyond Visual Line of Sight) operations, which are currently restricted outside of sandbox environments.
- 2. Technology Validation:** Terms such as “experimental testing” and “certification” indicate that companies seek to validate technologies that are not yet fully regulated. An example could be the testing of detection and avoidance systems in drones, where a sandbox would provide the safe, controlled environment needed for such tests without the restrictions of normal airspace.
- 3. Specific Project Applications:** Some companies highlighted specific projects where they would apply a sandbox. These range from the development of new autonomous vehicle platforms to the implementation of advanced air traffic management systems. One example is a company aiming to develop eVTOLs (electric vertical takeoff and landing vehicles) and needing space to test these devices in real urban conditions.

Unique or Particularly Relevant Responses

One company mentions using a sandbox to explore cybersecurity regulations in critical infrastructures, an area that may diverge from the more common use of sandboxes for physical or hardware testing.

Another interesting response comes from a company that sees the sandbox not just as a place for technological testing, but as a catalyst for regulatory change, suggesting that the results obtained could help shape future laws and standards in the aerospace sector.

4.4.3 : PREVENTIVE MEASURES THE SANDBOX MANAGER SHOULD TAKE

Companies seem to be very aware of the need to establish clear and robust preventive measures in regulatory sandboxes to mitigate the identified risks. Some of the most mentioned measures include implementing rigorous security protocols, constantly evaluating and updating procedures, incorporating advanced technological safeguards, and maintaining close cooperation with regulatory entities to ensure proper oversight.



Image. Preventive Measures Against Perceived Risks by Companies

Analysis of Key Terms and Their Context

The key terms extracted from the responses, such as “security protocols,” “evaluation,” “technological safeguards,” and “cooperation with regulatory entities,” reflect a proactive approach to risk management within sandboxes. For example:

Security Protocols: Several companies emphasize the importance of having well-defined and rigorous protocols to ensure that all operations within the sandbox meet the highest safety standards.

Evaluation: The need for periodic evaluations to review and improve existing procedures is frequently mentioned, allowing for quick adaptation to emerging risks.

Technological Safeguards: Some responses highlight the use of advanced technology as a critical preventive measure, suggesting a trend toward the digitalization and automation of safety.

Cooperation with Regulatory Entities: Collaboration with regulators is seen as key to ensuring that preventive measures are aligned with legal and technical expectations and to facilitating a rapid and effective response to any incidents.

Unique or Significantly Different Responses

One particularly unique response comes from a **company suggesting the creation of an “ethics committee” within the sandbox to oversee all activities and ensure they remain within established ethical and legal boundaries.** This proposal differs from the more technical and operational focus observed in most other responses and highlights the importance of considering the ethical aspects of testing and technological development.

4.4.4 RESOURCES NEEDED

Companies highlight a variety of resources they consider essential to maximize the benefits of participating in a regulatory sandbox. The most frequently mentioned resources include **access to advanced data and technologies, specialized technical and legal support, and adequate infrastructure for testing and development.** Close collaboration with regulators and access to temporary regulatory adjustments are also seen as crucial for experimenting with innovations under a controlled yet flexible framework.

Analysis of Key Terms and Their Relation to Responses

Data: Several companies emphasize the need for extensive, high-quality data to validate their products and technologies within the sandbox. This includes real-time operational data and historical data, which can help calibrate and improve systems.



Image. Relevant Concepts Through Which Companies Express Their Needs

Technical and Legal Support: Specialized support is critical to navigate the regulatory and technical challenges during the testing of new products or services.

Infrastructure: References to appropriate infrastructure suggest that companies value an environment where they can conduct tests safely and effectively, including laboratories, dedicated testing spaces, and access to simulation technologies.

Unique or Significantly Different Responses

There don't seem to be responses that differ significantly from the general consensus, indicating a relatively uniform view of what companies expect and need from a regulatory sandbox. However, some responses are more specific regarding the types of regulatory or technical support, perhaps reflecting differences in industrial sectors or the strategic goals of each company.

4.5 FUTURE PERSPECTIVES AND EXPECTATIONS

4.5.1 FUTURE PERSPECTIVE OF SANDBOXES

The companies surveyed view a **promising future** for regulatory sandboxes, considering them essential for fostering innovation and adapting to new technologies in a controlled and secure environment. They recognize that these spaces allow

for experimentation with fewer regulatory restrictions, which could accelerate the implementation of new solutions and products in the market. Overall, **the sandboxes are seen as valuable tools** for advancing technological innovation within a controlled framework, preparing the ground for more adaptive and open future regulations.

Relationship of Key Terms with Responses

1. **Innovation:** Several responses emphasize that sandboxes are platforms for innovation, allowing companies to test emerging technologies without the usual restrictions.
2. **Regulation and Legislation:** It is frequently mentioned that these environments facilitate a better understanding and adaptation to future regulations, acting as precursors to legislative changes.
3. **Growth and Development:** Some responses highlight that sandboxes contribute to economic and technological development, providing a means to validate products and services before commercial launch.
4. **Standardized Environments:** A concept often repeated explicitly or implicitly is the idea of standardized sandbox environments, suggesting that there is a common model or format being followed. This could be both a strength and a weakness: on the one hand, a “standardized environment” could facilitate implementation and predictability for participating companies; on the other hand, it could limit the necessary flexibility to adapt to very specific needs or innovations.

Specific Examples

- One company mentions how sandboxes have allowed them to test drones for urban deliveries, an area that would be difficult to explore without a flexible regulatory framework.
- Another company cites the use of sandboxes to test artificial intelligence software in real-world environments without compromising safety or regulatory compliance.

Significant Discrepancies

Although most companies view sandboxes positively, some responses express concerns about potential security and privacy risks that could arise in a less regulated environment. These concerns highlight the **need for a ba-**

lance between freedom to innovate and guarantees of security and ethical compliance.

Some responses also use terms like “refractory attitudes” or similar expressions to indicate **resistance or skepticism** toward adopting regulatory sandboxes. This skepticism seems to stem from concerns about effectiveness, risks, or the perception that sandboxes might not adequately address certain regulatory or technological challenges based on stakeholders' attitudes or positions.

4.5.2 POSSIBLE REAL INFLUENCE ON REGULATION

The responses suggest that regulatory sandboxes are perceived as **effective tools for influencing future regulation**, primarily due to their ability to provide a controlled environment for experimentation and testing of new technologies, though there remains some level of **caution regarding their reach and real effectiveness**. Most companies believe that these environments **allow regulators and innovators to work together more effectively** and consider this collaboration key to maximizing the sandbox's impact on regulation.

Despite the general consensus on the benefits of sandboxes, some responses reflect a more cautious view, indicating that while sandboxes are useful for demonstrating technological capabilities, they may not be sufficient to drive significant or rapid regulatory changes due to the slow and complex nature of regulatory processes.



Image. Most used terms to describe the possible influence on regulation

Key Terms and Contextual Analysis

- **Regulatory Bodies and Aeronautical:** These terms highlight the specific interaction between technology companies in the aeronautical sector and regulators. Sandboxes serve as a bridge where operational needs and aeronautical regulations can converge.
- **Influence and Regulation:** These terms are crucial as they encapsulate the hope that sandboxes won't just be technical trials but will actively inform and transform existing regulations. The ability to "influence" is seen as a direct benefit of participating in these programs.
- **Regulator and Doubt:** While "regulator" reflects the entity that companies seek to influence through sandboxes, "doubt" may indicate uncertainty about the effectiveness of sandboxes in driving real and swift regulatory change, suggesting that skepticism still exists regarding how quickly learnings from sandboxes can be integrated into broader policies.

4.5.3 REGULATIONS POTENTIALLY MOST BENEFITED

Most responses emphasize that regulatory sandboxes could significantly benefit areas related to drone operations, especially in complex or advanced scenarios such as **beyond visual line of sight (BVLOS) flights**, **autonomous operations**, and in populated or highly congested airspace. Additionally, remote pilot operations and the testing of new technologies in a controlled environment are mentioned.

Some responses mention that specific regulations, such as those related to the radio frequency spectrum and extremely high safety requirements, might be difficult to address in a sandbox.

An additional notable aspect in some responses is **skepticism or a lack of specific knowledge** about how sandboxes could benefit certain areas. This highlights the need for greater education and outreach about the potential benefits of sandboxes within the business and regulatory community.



Image. Terms used to describe most benefite regulations

Analysis of Terms and Specific Examples

BVLOS Flights (Beyond Visual Line of Sight): This term appears repeatedly as one of the key areas that could significantly benefit from sandboxes. Testing in sandboxes would allow validation of the safety and efficiency of UAVs operating beyond the pilot's line of sight, a critical step for their integration into general airspace.

Air Traffic Management and Advanced Air Mobility: Terms like “Air Traffic” and “Advanced Air Management” indicate that sandboxes are seen as crucial for experimenting with traffic management systems that could safely integrate UAVs with conventional air traffic.

Communications and GNSS Signals: The importance of testing communications and integrating GNSS (Global Navigation Satellite System) signals in sandboxes is also highlighted. Sandboxes provide an ideal environment to test how interference (jamming and spoofing) in GNSS signals can affect flight operations and how to mitigate these risks.

Air Mobility: This term, along with “Aerial,” reinforces the view that sandboxes could help accelerate the adoption of new forms of air mobility, including eVTOLs (electric vertical takeoff and landing vehicles) and other autonomous aircraft.

In this particular case, besides the general analysis, and given the potential interest in the nuances of some responses, it is worth presenting specific responses in each of the regulatory areas most highlighted by companies, specifically:

BVLOS Flights and airspace integration

- “Flights beyond visual line of sight”
- “BVLOS.”
- “Everything related to BVLOS flights and remote pilots”
- “Everything related to remote command”
- “Automated flights. Flights beyond the line of sight”
- “All advanced operations (BVLOS, populated environments, transportation of people...)”
- “BVLOS operations”
- “BVLOS and integration with manned airspace and airports”
- “Flights in conditions currently unauthorized or only allowed under very specific conditions (BVLOS, swarms, >25kg MTOW, etc.)”

Positioning and communications

- “Recreation of jamming and spoofing environments for GNSS signals.”
- “Positioning and communications”
- “In communications and in obstacle detection systems”
- “Radio spectrum, new control/communications algorithms (need to declare a high level of Safety)”
- “Use of RF bands currently unauthorized”

USpace

- “U-Space services.”
- “All that allows faster access to airspace for UAVs in urban/suburban environments.”

UTM

- “Air Traffic Management, Advanced Air Mobility, including autonomous operations.”
- “Certification of Systems and Service Providers for Unmanned Air Traffic Management, Ground Infrastructure, and Communications.”

Certification of aircraft and systems

- “Creation of new means of compliance for operational authorization and certification of aircraft or services”
- “There is a regulatory gap for certified category UAS”
- “Demonstration of redundancy in critical systems such as aircraft propulsion and control”
- “The area of developing critical software, considering both safety and cybersecurity”

Specific applications

- “Application of phytosanitary products”

4.5.4 TECHNOLOGIES MOST AFFECTED

The companies mention various technologies that could be positively impacted by the implementation of a regulatory sandbox. They highlight the acceleration of technological development, especially in areas such as automation, safety, communications, and navigation. It is expected that a regulatory testing environment would provide opportunities to experiment with emerging technologies and safely validate innovative concepts.

Technologies
Formal Flight
Related Technologies
Already Mentioned
Development
Previous Answers
Communications

Image. Relevant terms used to describe the technologies potentially most affected

Main Technologies Mentioned

1. **Communications:** The importance of secure and reliable communication technologies is highlighted, especially in environments where interaction between multiple systems and platforms is required.
2. **Automation and Autonomous Flight:** The automation of flight and fully autonomous flight are mentioned as areas that could significantly benefit from a regulatory sandbox, facilitating the development of advanced operations and the integration of drones into the airspace.
3. **Safety and Mitigations:** There is an emphasis on the need for technologies related to safety and risk mitigation, including obstacle detection and avoidance systems, as well as safety procedures for drone operations.
4. **Navigation and Positioning:** Technologies related to navigation and positioning, such as GNSS (Global Navigation Satellite System), are mentioned as areas that could benefit from a regulatory testing environment to improve the precision and reliability of these systems.
5. **Development and Testing:** The importance of having secure and regulated testing environments for the development and validation of new technologies related to drones and unmanned systems is highlighted.

References to Previous Responses

As observed in the word cloud of relevant terms presented in the next paragraph, many companies refer back to previous responses by mentioning “As previously mentioned” or “Previous answers,” indicating that they consider certain aspects have already been addressed (when discussing the projects they would apply, the regulations affected, etc.).

Correlation with Extracted Key Terms

The technologies mentioned by the companies, such as communications, flight automation, and safety, are aligned with the extracted key terms like “Communications,” “Flight,” “Automation,” and “Safety.” There is a direct correlation between the key terms and the technological areas mentioned in the responses, suggesting that these areas are considered highly relevant in the context of a regulatory sandbox.

5. STRENGTHS AND WEAKNESSES OF ROZAS AS A BASE FOR A REGULATORY SANDBOX

5.1 STRENGTHS OF THE ROZAS ENVIRONMENT

The Rozas aerodrome in Lugo stands out as an ideal location for drone testing and trials due to a combination of infrastructural, geographical, and institutional support factors, forming a solid foundation on which to establish a regulatory Sandbox to support companies in the UAS value chain. Specifically, the following aspects stand out:

1. **Infrastructure and Equipment:** It boasts advanced facilities, including a control center, communication, and meteorological systems, as well as comprehensive support, facilitating the development of advanced aerospace technologies and enabling high-tech testing.
2. **Strategic Collaborations and Institutional Support:** The collaboration between the Government of Galicia, the Ministry of Science, and the National Institute of Aerospace Technology (INTA) strengthens Rozas' development as an aerospace hub, attracting significant investments and facilitating research and development projects with international companies like Airbus.
3. **Geographic Location and Airspace Features:** Located in a region with low population density and away from commercial air routes, Rozas provides a less saturated and safer airspace for drone operations. Additionally, its proximity to the sea is advantageous for tests requiring simulations over water or in coastal weather conditions.
4. **Technological Innovation and Pioneering Projects:** Rozas has been the setting for pioneering tests, such as the first pilotless aerotaxi flights

in Spain, demonstrating its capacity to host innovative projects in the aerospace sector.

5. **Integrated High-Tech Services:** The most advanced control tower in Spain, located at Rozas, completes the CIAR, providing a state-of-the-art testing and certification environment for unmanned aircraft, making it a reference point in Europe.

These combined elements make Rozas aerodrome an ideal place for advanced research, development, and testing in unmanned aeronautics, ensuring continuous advancement in technological and operational innovations.

Given the importance of the following systems and qualified resources available at Rozas, they will be described in more detail in the following sections:

- a) The Rozas Airborne Research Center (CIAR)
- b) Deployments and systems resulting from the Civil UAVs Initiative (CUI)
- c) The infrastructure, means, and personnel of Avincis

5.1.1 THE ROZAS AIRBORNE RESEARCH CENTER (CIAR)

The research center is a joint initiative of INTA, the Xunta de Galicia through the Galician Innovation Agency (GAIN), the Galician Institute for Economic Promotion (IGAPE), and the Ministry of Science, Innovation, and Universities (MICIU). The project is 80% co-financed by the European Regional Development Fund (ERDF) and Spain's Multi-Regional Operational Program (POPE), with the remaining 20% financed by GAIN and IGAPE.

CIAR^{18,19}, is an experimental center affiliated with the National Institute of Aerospace Technology (INTA), benefiting from INTA's 82 years of experience in aerospace research and the availability of experts with recognized expertise in their fields if necessary.

It is a pioneering test center integrating both Airborne Research Platforms (PAI) and new developments with remotely piloted systems (UAS). It offers innovative and multidisciplinary facilities for safe and efficient flight tests, including runways, hangars, laboratories, communication systems, and more. With its comprehensive infrastructure, resources, and highly qualified personnel, CIAR provides integral facilities and services for aerospace research and testing, ensuring safety, innovation, and efficient operations.

¹⁸ https://www.civiluavsinitiative.com/wp-content/uploads/2021/07/CIAR_WEB.pdf

¹⁹ <https://www.inta.es/CIAR/es/>

5.1.1.1 FACILITIES

The center offers a privileged location with the following facilities:

- **Two runways:** one paved (1200x45m) and one dirt (1000x40m), suitable for various aircraft configurations and wind conditions.
- Hangar (40x40m) equipped with ground support equipment and adjacent **offices** and locker rooms.
- **Electronics laboratory and mechanical workshop** equipped for minor repairs during tests.
- Available aircraft, such as the Stemme motorglider (piloted, based at CIAR) or the ALO unmanned aircraft (based in Torrejón), to test sensor developments and payloads

5.1.1.2 PERSONNEL

The center has a young team of eight people, primarily experienced in testing. Their qualifications are distributed as follows:

- 1 Atmospheric physicist
- Aeronautical mechanics
- 1 Computer engineer
- Aeronautical engineers

5.1.1.3 KEY ELEMENTS

- **Control and Monitoring Center:** The operational core, providing operational safety, instrumentation, and supervision of user operations.
- **Communication Systems:** With communication capabilities with air traffic control and other control centers.
- **On-site Meteorological System:** Provides on-site meteorological instrumentation for flight programming and real-time data visualization.
- **Secondary Radar:** A key tool for aircraft safety during tests.
- **Telemetry Reception:** Automatic tracking system with omnidirectional and directional antennas for data reception.

5.1.1.4 INNOVATIVE SYSTEMS

DronAs. A prototype acquired for tests and certifications in the U-Space environment, consisting of B2B tools and services for U-Space management before and during flights.

CONDOR. A service tool that reduces the time needed for test preparation, saving costs and allowing non-technical profiles to operate complex equipment.

PIMAD. A meteorological information and decision-making tool, helping predict atmospheric phenomena that could hinder flight tests.

5.1.1.5 EUROPEAN AERONAUTICAL TEST CENTERS NETWORK

CIAR is part of the International Consortium of Aeronautical Test Sites (ICATS²⁰), a global organization of aeronautical test centers, including prominent European members. Its main mission is to develop centers of international expertise in the development, applications, and operations of unmanned aerial systems (UAS/RPAS). ICATS focuses on supporting and guiding the industry in UAS/RPAS development, operation, and certification according to the regulations established by each country's regulatory bodies. ICATS also seeks to standardize cross-border training, licensing, airspace management, and relevant regulations. The organization works to facilitate collaboration between private sector, academic, and public sector partners, as well as experts worldwide, to create new business opportunities in UAS/RPAS operations. It also supports research and development activities, job creation, investment promotion, advanced technology development, and the expansion of existing services.

In Europe, the International Consortium of Aeronautical Test Sites (ICATS) includes several notable centers specializing in UAS/RPAS research and development. Some of the key European aeronautical test centers that are members of this network are:

1. **Centre d'Essais Aéronautiques de Toulouse (CESA)**, Bordeaux, France. This center is a test area for civil UAS managed by Bordeaux's Technowest and supported by French regional and national entities.
2. **National Aeronautical Centre (NAC)**, Wales, UK. This center is notable for its restricted airspace specifically designed for unmanned aerial system operations, both military and civil, with specialized facilities to support the aerospace industry.

²⁰ <https://www.roboticstomorrow.com/news/2014/03/03/oklahoma-co-founds-an-international-consortium-to-help-develop-uas-sector/23187>

3. **Unmanned Aerial Systems Centre of Excellence**, Quebec, Canada. Although outside Europe, this center closely collaborates with European centers and focuses on developing expertise and innovative services in UAS design, operations, and applications.

These centers form part of ICATS to develop international expertise focused on UAS/RPAS development, applications, and operations. Additionally, they seek to support and guide the industry in UAS/RPAS development, operations, and certification, following the regulations of each country. They also focus on cross-border training standardization, airspace management, and regulations.

This consortium promotes collaboration between private sector, academic, and public partners worldwide, creating business opportunities in UAS/RPAS operations and supporting research and development activities.

Participation in networks like these allows CIAR to access a wide range of test and development facilities and collaborate in transnational research programs, which is vital to maintaining competitiveness and innovation in the European aerospace sector. Additionally, these networks are often supported or financed by European Union initiatives, providing additional resources for research and technological development.

5.1.2 SYSTEMS AND PROJECTS DEPLOYED AS PART OF THE CUI

To date, the Xunta de Galicia has awarded a total of 12 contracts under the Civil UAVs Initiative (CUI), resulting in 13 currently ongoing projects. These represent significant opportunities to participate in innovative and strategic aerospace and public service projects in Galicia, generating resources and capabilities that could be made available for a future regulatory sandbox once the needs and suitability of the available resources are assessed.

Examples include two tenders explicitly focused on generating infrastructure and solutions for sector users: the tender for the development of 5G systems and cybersecurity for the Centro de Investigación Aerotransportada de Rozas (CIAR) and the tender for developing innovative solutions in U-Space simulation research and experimental development.

The first, tendered in December 2022, sought to acquire systems and tools related to 5G technology and cybersecurity for CIAR to enhance its airborne research capabilities and ensure operational security by strengthening its cybersecurity measures.

The resources generated through this tender could represent a significant step toward consolidating an advanced regulatory sandbox for UAV operations. On the one hand, 5G integration is critical for UAS research and develop-

ment, enabling improved connectivity, real-time transmission of large data volumes, and minimal latency—crucial aspects for UAV operations. On the other hand, cybersecurity is essential to protect the integrity, confidentiality, and availability of critical information related to these operations. Investment in these areas not only boosts CIAR's research capacity but also ensures its operations meet the highest cybersecurity standards—an indispensable requirement for experimentation and development within a regulatory sandbox environment.

The second, with a budget of €10.9 million, aims to develop a U-Space simulator to enhance Rozas' capabilities as a reference center for UAV development and experimentation. The development of a U-Space simulation environment is a significant step toward the safe and effective integration of UAVs into airspace, advancing not only technological innovation but also fostering innovation in air traffic management and public safety-related services.

The remaining contracts and projects are briefly described below, with an indication of each contract's objectives and execution dates:

1. Contract CPTI - Solutions AMTEGA 1

- Description: Development and demonstration phase of an information processing platform for Galician agricultural plots under the PRIMARE project.
- Project dates: June 2018 - December 2020.

2. Contract CPTI - Solutions AMTEGA 2

- Description: Development and demonstration phase of a georeferenced information management system for agricultural activity control in Galicia under the PRIMARE project.
- Project dates: July 2018 - December 2020.

3. Contract CPTI - Solutions AMTEGA 3

- Description: Development and demonstration phase of an expert system for automated and intelligent control of agricultural activities associated with Common Agricultural Policy (CAP) aid, under the PRIMARE project.
- Project dates: July 2018 - December 2020.

4. Contract CPTI - Solutions Mar 1

- Description: Similar to the previous contract, this project focused on automating oceanographic sampling using unmanned vehicles.
- Project dates: December 2018 - June 2020.

5. Contract CPTI - Solutions Mar 2

- Description: Automation of oceanographic sampling using unmanned vehicles.
- Project dates: December 2018 - June 2020.

6. Contract CPTI - Solutions Tierra 1

- Description: Management of georeferenced data sets obtained by UAVs.
- Project dates: October 2018 - June 2020.

7. Contract CPTI - Solutions Tierra 2

- Description: Acquisition, maintenance, and automation of topographic and cartographic bases using unmanned aerial means.
- Project dates: November 2018 - June 2020.

8. Contract CPTI - Solutions Tierra 3

- Description: Monitoring land occupation dynamics and aiding territorial planning using unmanned aerial vehicles.
- Project dates: November 2018 - June 2020.

9. Contract CPTI - Solutions Tierra 4

- Description: Automation of oceanographic sampling using unmanned vehicles.
- Project dates: December 2018 - June 2020.

10. Contract CPP - I+D Aire

- Description: Joint R&D program for traffic management and safety in shared airspaces.
- Project dates: March 2019 - June 2020.

5.1.3 INFRASTRUCTURE AND RESOURCES OF AVINCIS

Avincis' participation in the Civil UAVs Initiative (CUI) has demonstrated significant capabilities in terms of resources, infrastructure, and specialized personnel involved in UAV development. The creation of the LUMES drone

platform is an example of how projects can be supported in experimental regulatory environments such as sandboxes.

The LUA drones, capable of carrying emergency support payloads and flying beyond the visual line of sight, reflect Avincis' advanced technological and operational infrastructure. This infrastructure is key to conducting tests in regulated environments where flexibility and adaptation to emerging standards are needed—common characteristics of regulatory sandboxes.

Avincis' expertise in UAV operations, supported by approval from the Spanish Aviation Safety Agency (AESA), reinforces its position as a player capable of supporting and executing tests that require a deep understanding of aerospace regulations and safety standards. This extends to the expertise of Avincis' personnel, which includes highly qualified R&D engineers who have developed UAV technology within the CUI framework, focusing on complex emergency missions and urgent transport of medical supplies. This is particularly relevant for projects seeking to explore and push the boundaries of current regulations to advance innovation in emergency air services.

Avincis' commitment to continuous improvement and collaboration with regulatory entities ensures that the company not only complies with existing regulations but also contributes to the development of new regulations in the airspace sector—a key contribution to projects executed within regulatory sandboxes. Avincis' cooperation with initiatives like Business Factory Aero (BFAero) and its involvement in developing onboard electronic systems and validation tests highlight its active role in promoting an innovative and regulated ecosystem for aerospace and UAS in Galicia and beyond.

5.2 WEAKNESSES OF THE ROZAS ENVIRONMENT AS A SANDBOX BASE

Establishing a regulatory sandbox for drones in an area where there is an aerodrome but no air traffic control presents several challenges and risks, mainly related to air safety and airspace management. The following are some of the main problems:

- **Collision Risk:** Without air traffic control, the risk of collision between drones and other aircraft operating at the aerodrome increases. Coordination and air traffic monitoring are essential to avoid incidents, especially in areas where drones and manned aircraft share low-altitude airspace.

- **Airspace Management:** The lack of air traffic control means there is no centralized supervision to handle simultaneous drone and manned aircraft flights. This complicates airspace segregation and the implementation of safe flight procedures for all airspace users.
- **Communications:** In an area without air traffic control, communications between drone operators and aircraft pilots may be limited or non-standardized, potentially leading to misunderstandings and errors in coordinating aerial activities.
- **Emergency Procedures:** In emergency situations, the lack of air traffic control can complicate a quick and effective response. Procedures for handling emergencies in the air and on the ground may not be clearly defined or sufficient to ensure safety.
- **Regulations and Compliance:** Implementing a sandbox in an area without air traffic control may make it difficult to enforce and comply with drone regulations. Without proper supervision, it may be harder to ensure that all operators adhere to established flight regulations and restrictions.
- **Integration of Unmanned Traffic Management (UTM) Systems:** Establishing and operating an effective UTM system, which is essential for managing drone traffic, may be more complicated without the infrastructure and support of air traffic control services.

To mitigate these issues, it would be necessary to develop and implement advanced traffic management solutions for both drones and manned aircraft and to establish clear and effective procedures that can be followed without direct air traffic control supervision. Additionally, ongoing education and training for drone operators and pilots on safe flight practices in these areas would be crucial to minimizing risks and ensuring operational safety.



6. DESIGN OF THE REGULATORY SANDBOX

This section details the components and characteristics of the proposed sandbox, including objectives, focus areas, participation requirements, timelines, and supervision and evaluation mechanisms.

6.1 BEST PRACTICES AND RECOMMENDATIONS

The following is a list of best practices and recommendations for implementing and monitoring a regulatory sandbox in the development value chain of unmanned aerial systems (UAVs). These practices are essential for creating an environment conducive to innovation in the UAV sector, while ensuring safety and regulatory compliance.

6.1.1 ESTABLISHMENT OF CLEAR AND DEFINED OBJECTIVES

1. **Definition of Specific Objectives:** Clear goals should be set for the sandbox, such as promoting innovation in UAV manufacturing or exploring new service applications.
2. **Scope and Limitations:** It should be defined which aspects of the value chain will be covered and the limitations of the sandbox to maintain a clear focus.

6.1.2 COLLABORATION WITH STAKEHOLDERS

- **Industry Participation:** Active involvement of UAV manufacturers, service operators, and other relevant stakeholders is recommended.
- **Dialogue with Regulators:** Open communication should be maintained with aviation authorities and other regulators.

6.1.3 REGULATORY AND LEGAL FRAMEWORK

- **Regulatory Flexibility:** Flexibility within the legal framework should be ensured to allow innovative testing without compromising safety.
- **Consumer and Third-Party Protection:** Measures should be implemented to protect consumers and third parties from potential risks.

6.1.4 INFRASTRUCTURE AND RESOURCES

- **Adequate Infrastructure:** Necessary infrastructure for testing, including designated flight areas, should be provided.
- **Resources and Expertise:** Availability of technical resources and UAV expertise should be ensured.

6.1.5 MONITORING AND EVALUATION

- **Continuous Monitoring:** Mechanisms for continuous monitoring of activities within the sandbox should be established.
- **Evaluation and Feedback:** Periodic evaluation processes should be implemented.

6.1.6 SAFETY AND COMPLIANCE

- **Safety Standards:** Air safety standards and industry norms must be met.
- **Risk Management:** A risk management plan should be developed.

6.1.7 TRANSPARENCY AND COMMUNICATION

- **Public Reports:** A policy of transparency should be maintained.
- **Clear Communication:** Ensure that all participants and stakeholders understand the rules and objectives of the sandbox.

6.1.8 PLANNING FOR SCALABILITY AND TRANSITION

- **Scalability:** Consider how innovations tested can be scaled and applied more widely.
- **Post-Sandbox Transition:** Strategies should be developed for the successful transition of projects.

6.2 TYPES OF AUTHORITIES REQUIRED

Regulatory entities must play a fundamental role in regulatory sandboxes, being an integral part of their structure and functioning. Their presence is crucial to ensure legality and compliance with existing regulations, as well as to ensure that the results and lessons learned in the sandbox directly influence regulatory advancements. Involving regulatory entities from the start promotes close collaboration between the public and private sectors, contributing to the effectiveness and legitimacy of the sandbox as a controlled innovation platform. This active interaction also allows regulations to be proactively adapted as new needs and challenges are identified in the evolving business and technological environment.

For the establishment of a regulatory sandbox to promote innovation in the field of drones, collaboration and participation from several Spanish authorities and government agencies would be required, including:

Spanish Aviation Safety and Security Agency (AESA)

AESA is responsible for regulating and overseeing air safety in Spain. It is crucial to obtain AESA's approval and permits for conducting drone testing and innovation activities to ensure compliance with safety regulations.

Ministry of Transportation, Mobility, and Urban Agenda

Since AESA operates under this ministry, coordination may be required to gain necessary support and facilitate the implementation of specific regulatory measures for the sandbox.

Spanish Data Protection Agency (AEPD)

If innovation activities involve handling personal data, coordination with AEPD is essential to ensure compliance with data protection laws.

Ministry of Science and Innovation

This ministry could be involved, especially if the regulatory sandbox focuses on promoting research and innovation in drones. Collaboration could be key to accessing funding and resources for research and development.

Ministry of Industry, Trade, and Tourism

This ministry may be interested in promoting innovation in the drone sector from an economic and industrial perspective. Collaboration with this entity could facilitate the support and promotion of innovative initiative.

National Institute of Cybersecurity (INCIBE)

If innovation activities include cybersecurity aspects, coordination with INCIBE would be beneficial to ensure secure practices.

Regional or Local Government (Xunta de Galicia)

Depending on the specific location of the sandbox, regional or local authorities may also be involved. Coordination with them is important to gain local support and address any region-specific issues. In Galicia, there is a clear involvement, predisposition, and proactivity from the government towards developing the drone value chain in general and establishing a regulatory sandbox in particular.

6.3 NEED FOR A RESPONSIBLE OPERATOR AND CONVENIENCE OF LUC AUTHORIZATION

After analyzing the regulatory challenges affecting companies and the necessary regulatory entities, there is no doubt about the importance of addressing airspace-related aspects and the need for involvement from the Spanish Aviation Safety and Security Agency (AESA).

In most cases, and especially in the case of AESA, administrative intervention means are associated with an administrative file. Although this is not an absolute rule for all forms of intervention, files are essential for interventions that affect individual rights or require detailed documentation of the process and decisions made by authorities. An administrative file is fundamental because, first, it provides a formal framework for documenting, reviewing,

and deciding on administrative actions, ensuring legality, transparency, and traceability of the administration's actions. Additionally, the existence of an administrative file will enable AESA to allocate its valuable resources to the project to be executed.

If the goal is to have a test environment where not all operators participating must conduct their tests and trials within a separate and specific file, **it will be necessary for the regulatory sandbox to have a responsible UAS operator.** Given current possibilities, it is considered that **the most appropriate approach that would contribute most to a sandbox would be to have an operator holding a Light Unmanned Aircraft Operator Certificate (LUC).**

This is a concept regulated by the European Aviation Safety Agency (EASA) that allows drone operators to obtain greater privileges under the specific operation category. By involving a LUC-certified operator in a regulatory sandbox, organizers could benefit in several ways:

- 1. Demonstration of a high level of competence and safety:** A LUC-certified operator has demonstrated compliance with high standards of safety and operational management, reinforcing the sandbox's regulatory robustness and providing a model for other operators.
- 2. Advanced operational flexibility:** LUC-certified operators can self-assess operations and conduct flights under standardized scenarios without requiring additional authorizations for each specific operation. This allows sandbox organizers to observe how advanced and flexible practices are implemented within a regulated framework.
- 3. Innovation in procedures and technology:** LUC-certified operators can test new technologies and procedures within the sandbox, offering organizers valuable data on how these innovations can be integrated and regulated in European airspace.
- 4. Encouragement for other operators:** Including LUC-certified operators can incentivize other drone operators to meet these standards and apply for their own certifications, promoting a culture of excellence and safety in the sector.
- 5. Collaboration in regulatory development:** LUC-certified operators can work collaboratively with regulators within the sandbox to refine and adapt existing regulations based on real-world operations and experiences.
- 6. Impact on public perception and acceptance of drone technology:** The presence of LUC-certified operators who comply with strict standards can improve public perception of drone safety and usefulness, facilitating greater acceptance and expansion of these technologies.

6.4 SELECTION CRITERIA FOR PARTICIPANTS

Selecting participants for a regulatory sandbox is a crucial process to ensure the success and effectiveness of the program. This section presents criteria that could be used to evaluate and select applicants. By combining these criteria, a more informed and equitable selection of participants can be made for the regulatory sandbox, maximizing the chances of success and generating significant benefits for the drone sector and the broader community.

- ***Relevance and Impact***
 - Evaluate the relevance of the proposal to the sandbox's objectives.
 - Analyze the potential positive impact on the drone sector and society at large.

- ***Technical and Development Capacity***
 - Review the applicants' experience and technical skills in developing drone-related technologies.
 - Assess the ability to implement and execute the proposed project

- ***Innovation and Originality***
 - Consider the originality and level of innovation of the proposal.
 - Value the applicants' ability to bring creative solutions to existing challenges.

- ***Technical and Financial Feasibility***
 - Analyze the technical and financial feasibility of the proposed project.
 - Evaluate the soundness of the execution plan and the applicants' ability to ensure project sustainability.

- ***Past Experience***
 - Review the applicants' past experience in similar projects.

- Consider previous success stories and demonstrated ability to overcome challenges.
- ***Collaboration and Cooperation***
 - Value the applicants' willingness to collaborate with other entities within the sandbox.
 - Seek teams that demonstrate the ability to work together to maximize the program's benefits.
- ***Regulatory Compliance***
 - Ensure applicants are willing to comply with existing regulations and standards, even within the sandbox environment.
 - Evaluate applicants' understanding and commitment to safety and privacy requirements.
- ***Diverse Representation***
 - Seek a diverse representation of participants, including different business profiles (startups, SMEs, large companies) and technological approaches.
 - Encourage the inclusion of actors who can bring varied perspectives to the sandbox.

6.4.1 POTENTIAL FOR SCALABILITY

- Evaluate the potential for the project to scale and have an impact beyond the sandbox.
- Consider how the lessons learned and solutions developed could be applied on a broader scale.

6.4.2 LONG-TERM COMMITMENT

- Evaluate applicants' long-term commitment to the project and the continuous development of the drone sector.

6.5 GENERAL STEPS FOR THE CREATION OF THE SANDBOX

For an autonomous government in Spain to involve a regulatory authority in the development of a sandbox, several steps would need to be followed. These steps are generally applicable to the creation of any regulatory sandbox but may require specific adaptations depending on the regional context and the sector of interest (e.g., fintech, aeronautics, artificial intelligence, etc.).

Basic Outline of Steps to Follow:

1. Identification of Needs and Objectives

- Evaluate the needs of the market or specific sector that is to be regulated.
- Define the objectives of the sandbox, such as promoting innovation, protecting consumers, or facilitating technological development.

2. Regulatory and Legal Analysis

- Study current national and regional legislation to identify possible legal or regulatory barriers.
- Consult legal experts to understand how a sandbox could fit within the existing legal framework.

3. Consultations with Stakeholders

- Conduct consultations with stakeholders, including companies, consumers, technology experts, and representatives from the relevant sector.
- These consultations can help better understand the sector's needs and design a sandbox that addresses these needs.

4. Collaboration with Regulatory Authorities

- Involve the relevant regulatory authority or authorities from the initial stages. In this case, collaboration with airspace regulators like AESA is indispensable.
- Establish continuous dialogue and collaboration to ensure that the sandbox meets regulatory and public policy objectives.

5. Design of the Sandbox Framework

- Develop a framework for the sandbox that outlines how it will function, including eligibility criteria for participants, project durations, and monitoring and evaluation measures.
- Ensure that the sandbox framework aligns with national and regional legislation and policies.

6. Approval and Legislation

- Depending on the scope of the sandbox and existing laws, it may be necessary to develop and approve new legislation or amendments to existing legislation at the regional or even national level.
- This could involve working with the central government or the regional parliament.

7. Implementation and Monitoring

- Once approved, implement the sandbox and begin accepting participants.
- Establish mechanisms to monitor and evaluate progress, ensuring that objectives are met and that the interests of consumers and the general public are protected.

8. Review and Adjustment

- Conduct periodic reviews of the sandbox's operation and adjust policies and practices as necessary, based on results and feedback received.

6.6 MEASURES OF THE SANDBOX'S IMPACT

Measuring the impact of a regulatory sandbox after its first period of operation involves evaluating various aspects, such as technical innovation, economic outcomes, and influence on regulatory aspects. Below are some measurement mechanisms, objectives, descriptions, metrics, references, and approximate thresholds for assessing impact.

It is essential to tailor these measurement mechanisms to the specific goals of the sandbox and the characteristics of the drone sector. Regularly reviewing and adjusting these criteria will provide a more accurate evaluation and help improve future iterations of the sandbox program.

6.6.1 TECHNICAL INNOVATION

Objective

Evaluate the technological progress achieved during the sandbox period.

Description

Measure the development of new technologies, features, and capabilities compared to the initial state.

Metrics

- Number of new technologies or features developed.
- Improvements in operational efficiency of drones.

References

Observe the success of similar implementations in other industries or innovation programs.

Thresholds

- No impact: No new technologies have been developed.
- Low impact: Some improvements have been implemented, but they are not significant.
- Medium impact: Innovative technologies with practical applications have been developed.
- High impact: Innovations have significant potential to transform the drone industry.

6.6.2 ECONOMIC OUTCOMES

Objective

Evaluate the economic impact and viability of the solutions developed.

Description

Measure the return on investment, revenue generation, and economic growth of participating companies.

Metrics

- Revenue generated by new solutions.
- Return on investment for the companies involved.

References

Compare with the economic performance of companies in the same industry outside the sandbox.

Thresholds

- No impact: No identifiable economic improvements.
- Low impact: Marginal increase in revenue and return on investment.
- Medium impact: Substantial economic improvements for participating companies.
- High impact: The developed solutions have had a significant impact on the economy.

6.6.3 INFLUENCE ON REGULATORY ASPECTS

Objective

Evaluate the sandbox's influence on the evolution of regulations related to drones..

Description

Measure the adoption of new regulations inspired or influenced by the sandbox experiences.

Metrics

- Number of regulatory changes implemented.
- Degree of regulatory flexibility achieved.

References

Analyze the successful implementation of regulatory changes in other jurisdictions as a result of similar initiatives.

Thresholds

- No impact: No significant regulatory changes.
- Low impact: Some regulatory changes have been introduced, but they are not substantial.
- Medium impact: Significant regulatory changes allowing greater flexibility.
- High impact: The sandbox has influenced important and positive regulatory changes.

6.6.4 ADOPTION OF THE SANDBOX MODEL

Objective

Evaluate whether other jurisdictions or industries have adopted the sandbox model.

Description

Observe the replicability and adoption of the sandbox model in other locations or industries.

Metrics

- Number of sandbox initiatives adopted in other locations.
- Sectors or industries that have implemented a similar sandbox.

References

Investigate cases where the sandbox model has been successfully adopted in other areas.

Thresholds

- No impact: No evidence of adoption of the sandbox model.
- Low impact: Some jurisdictions or industries have shown interest in the model.
- Medium impact: The sandbox model has been adopted in a significant number of places or industries.
- High impact: The sandbox model has become a standard in multiple locations or sectors.

6.7 STRATEGY TO MAXIMIZE LESSONS LEARNED

Extracting lessons learned from the first edition of the sandbox is crucial to improving all aspects for future editions. Here are some techniques that can be applied to gain valuable lessons.

By combining these techniques, a holistic view of the sandbox experience will be obtained, allowing for continuous improvement and maximizing the benefits of future editions. Constant feedback and adaptation are key to the sustained success of regulatory sandbox programs.

6.7.1 PERFORMANCE EVALUATION

Technique

Conduct comprehensive evaluations of the sandbox's performance in terms of objectives, technical, economic, and regulatory results.

Approach

- Analyze metrics and KPIs to measure success.
- Collect quantitative and qualitative data through surveys, interviews, and report reviews.

6.7.2 FEEDBACK SESSIONS

Technique

Organize feedback sessions with participants, promoters, and external stakeholders.

Approach

- Facilitate structured discussions to gather specific comments.
- Identify what worked well and areas needing improvement..

6.7.3 ANALYSIS OF SUCCESSFUL AND FAILED USE CASES

Technique

Analyze case studies of successful implementations and situations that did not meet expectations.

Approach

- Identify common patterns in successful cases.
- Examine the reasons behind failures and the lessons that can be learned from them.

6.7.4 STRUCTURED SURVEYS

Technique

Design structured surveys to collect specific data on various areas of the sandbox.

Approach

- Include detailed questions about participants' experiences, challenges faced, and suggestions for improvement.

6.7.5 REVISIÓN DE DOCUMENTACIÓN Y INFORMES

Technique

Review sandbox reports, documentation, and records.

Approach

- Analyze technical and financial reports, and any relevant documentation.
- Identify lessons learned related to implementation and outcomes achieved.

6.7.6 INDIVIDUAL AND GROUP INTERVIEWS

Technique

Conduct individual and group interviews with key participants, promoters, and other stakeholders.

Approach

- Obtain detailed perspectives and personal experiences.
- Facilitate open discussions about challenges and opportunities.

6.7.7 COMPARATIVE ANALYSIS WITH OTHER SANDBOXES

Technique

Compare the performance and outcomes of the sandbox with other similar programs at national or international level.

Approach

- Identify best practices adopted in other sandboxes.
- Learn from successful experiences and avoidable mistakes in other contexts.

6.7.8 DEBRIEFING EVENTS AND WORKSHOPS

Technique

Organize debriefing events and workshops with participants to thoroughly analyze the experience.

Approach

- Facilitate interactive sessions to explore lessons learned.
- Encourage active participation and open discussion.

6.7.9 LONG-TERM IMPACT ANALYSIS

Technique

Evaluate the long-term impact of the solutions developed in the market and industry.

Approach

- Observe how sandbox innovations have positively affected the drone sector over time.
- Identify opportunities for scalability and broader applicability.

6.7.10 CREATION OF A LESSONS LEARNED REPORT

Technique

Compile all lessons learned into a structured report.

Approach

- Document each lesson learned clearly and concisely.
- Include specific recommendations for improvements in future editions.

7. CONCLUSIONS AND NEXT STEPS

7.1 COMMON TRENDS AND CONCERNS IN REGULATORY SANDBOXES

The establishment of regulatory sandboxes globally has emerged as a key strategy to promote technological innovation within a resilient and adaptable regulatory framework. The analysis of various studies and publications on regulatory sandboxes has revealed a series of common trends and concerns that are crucial for any public administration looking to design and implement an effective regulatory sandbox. These include:

- The need for Harmonization and Oversight
- Innovation Promotion with Inclusion
- Technological Adaptability
- The pursuit of Global Impact and Attention to Variations
- Responsibility and Legality
- Balancing Innovation and Protection

Studies like the Artificial Intelligence Act proposed by the European Parliament highlight the need to harmonize regulations to ensure uniformity in the implementation of disruptive technologies such as AI across the European Union. These supervised testing environments not only promote innovation but also ensure regulatory compliance and consumer protection.

Inclusion and support for SMEs are crucial aspects of promoting sustainable innovation and economic recovery, as highlighted by sandboxes. Similarly, the proposal to establish sandboxes in Spain by COTEC emphasizes the importance of adapting to rapid technological changes, ensuring that regulation keeps pace with technological progress.

From a global perspective, the varied impact of sandboxes in different regions is recognized, with notable benefits already measurable in sectors such as fintech. However, significant challenges arise in terms of civil liability and legislative adaptation to ensure legal security and protection in testing environments.

Publications and past experiences underscore the importance of balancing innovation with consumer protection. It is essential that these testing environments not only drive innovation but also safeguard consumer interests and maintain financial stability in the process.

These are some of the main ideas gathered from the reviewed reports and analyses, which can guide entities in creating innovative and adaptable regulatory frameworks.

7.2 REGULATORY CHALLENGES FOR COMPANIES IN THE DRONE VALUE CHAIN IN SPAIN

Companies in Spain's drone value chain face various regulatory challenges that impact their ability to develop products or services. These challenges include compliance with standards and regulations for the manufacturing and labeling of aeronautical components, airspace management, flight safety, certification, and UAV safety standards, among other aspects. From the companies' perspective, the regulatory aspects that most affect them are, in this order:

- Standards and Regulations for Manufacturing and Labeling Aeronautical Components
- Airspace and Flight Safety
- Standards and Regulations for Aeronautical Software Development
- Certification and Safety Standards for UAVs
- Radio Frequency Emissions Regulations
- Privacy and Data Protection
- Environmental Aspects
- Liability and Insurance
- UAV Export and Import
- Operator Licenses and Training

These regulatory aspects directly affect various specific projects. These projects cover areas such as testing, beyond visual line of sight (BVLOS) flights, aeronautical software development, UAV certification, and aspects

related to privacy, data protection, and the environment, among others. The most frequently mentioned concepts by companies to describe the projects, products, or services impacted by regulations include:

- Testing and Trials in General
- BVLOS
- Line of Sight
- GNSS Receiver
- GNSS Data
- Development of Innovative Systems

Regarding the affected projects, companies agree that these regulatory aspects particularly impact development and operations, causing market delays, increasing costs, and hindering the timely introduction of new products. The most repeated concepts and terms across companies to refer to these impacts are:

- Development
- Operations
- Delays
- Market
- Costs
- Products

7.3 RESOURCES NEEDED TO ADDRESS REGULATORY CHALLENGES

To successfully address the identified regulatory challenges and improve product development, companies agree on the need for a set of resources that could be provided by a regulatory sandbox. These resources include infrastructure for flights and testing, operational facilities, designated spaces, technical and logistical support, among others. In this case, the most frequently mentioned terms and concepts by companies to describe the necessary resources are:

- Testing
- Facilities
- Flights
- Space

- Environments
- Support
- Power

7.4 POTENTIAL BENEFITS OF IMPLEMENTING A REGULATORY SANDBOX

The implementation of a regulatory sandbox could provide concrete benefits for companies, such as the ability to test innovative ideas, improve compliance with current regulations, reduce costs, meet regulatory expectations, and gain flexibility to experiment and innovate.

- Testing Ideas
- Innovative Ideas
- Improvement
- Current Regulations
- Cost Reduction
- Regulatory Expectations
- Flexibility
- Testing
- Innovative

7.5 FACTORS INFLUENCING COMPANIES' PARTICIPATION IN A REGULATORY SANDBOX

Several factors could influence companies' decisions to participate in a regulatory sandbox, including cost considerations, development opportunities, the provided experimental environment, project potential, the clarity of rules and procedures, access to relevant resources, and logistics for travel.

- Costs
- Opportunities
- Adequate Experimental Environment
- Potential
- Scope
- Clarity
- Access
- Relevance
- Travel

7.6 PERCEIVED RISKS AND CONCERNS ABOUT PARTICIPATING IN A REGULATORY SANDBOX

Companies may also have concerns and perceived risks related to participating in a regulatory sandbox, such as the associated time and costs, potential delays in administration, challenges with the regulatory environment, coordination with other stakeholders, the need for flexibility, and potentially high costs.

- Time
- Costs
- Administrative Delays
- Regulatory Environment
- Coordination
- Flexibility
- High Costs

7.7 AREAS WITH THE MOST DEVELOPMENT POTENTIAL

- **Technology and Hardware Testing:** Development, evaluation, and experimentation with new sensor technologies, efficient propulsion systems, and materials for drones.
- **Beyond Visual Line of Sight (BVLOS) Operations:** Enabling drone flights beyond the operator's line of sight for extensive inspections, long-distance deliveries, and other applications.
- **Drone Integration into Airspace:** Development and testing of drone traffic management systems, along with the implementation of anti-collision technologies and advanced detection systems for their safe integration into air traffic.
- **Drone Deliveries:** Facilitating pilot tests for drone delivery services and establishing protocols for route management and safety in package delivery.
- **Specific Drone Applications:** Research, development, and experimentation with specialized drones for applications such as precision agriculture, topographic mapping, environmental monitoring, and emergency and rescue services.

- **Security and Privacy:** Development of technologies to detect and respond to potential security threats, along with ensuring data privacy when handling information collected by drones.
- **Artificial Intelligence and Automation:** Implementation and testing of AI algorithms to improve drone autonomy and decision-making, as well as the development of machine learning systems to enhance their operational efficiency.
- **Interoperability:** Establishment of standards and integration tests for interoperability between different drone manufacturers, allowing drones from various providers to be integrated into the same operational environment.
- **Operator Training and Certification:** Development of specific training programs for drone operators, along with the establishment of agile certification processes for new drone models and technologies.
- **Business Development and Monetization Models:** Experimentation with innovative business models for drone companies and exploration of monetization opportunities, such as subscription-based services, advertising, or data collected by drones.

7.8 STRENGTHS AND WEAKNESSES OF ROZAS AS A SANDBOX SITE

7.8.1 STRENGTHS

- **Infrastructure and Equipment:**
 - The Rozas Airborne Research Center (CIAR)
 - Systems and deployments resulting from the Civil UAVs Initiative (CUI)
 - The Infrastructure, resources, and personnel of Avincis
- Strategic Collaborations and Institutional Support
- Geographical Location and Airspace Characteristics
- Technological Innovation and Pioneer Projects
- Integrated High-Tech Services

7.8.2 WEAKNESSES

For the purpose of establishing a regulatory sandbox, an aerodrome without air traffic control presents several challenges and risks, particularly regarding air safety and airspace management.

- Risk of collision
- Airspace management
- Communications
- Emergency procedures
- Regulations and compliance
- Integration of unmanned traffic management (UTM) systems

7.9 THE NEED FOR A CERTIFIED DRONE OPERATOR WITH LUC CERTIFICATION

It is considered necessary for the regulatory sandbox **to have a responsible UAS operator, specifically an operator holding a Light UAS Operator Certificate (LUC)**. This would bring, among other benefits:

- Demonstration of a high level of competence and safety
- Advanced operational flexibility
- Incentive for other operators
- Collaboration in regulatory development

7.10 BEST PRACTICES AND RECOMMENDATIONS

Throughout this report, a set of best practices and recommendations has been identified and discussed for the implementation and monitoring of a regulatory sandbox in the unmanned aerial systems (UAS) value chain. These are considered fundamental to creating a conducive environment for innovation in the UAV sector while ensuring safety and regulatory compliance:

- Establishment of Clear and Defined **Objectives**: Define specific goals and the scope of the sandbox to guide innovation in UAVs and set clear boundaries.
- Defining **Scope** and **Eligibility**: Deciding which types of companies and innovations qualify for the sandbox can be challenging.
 - The criteria must be strict enough to prevent misuse of the sandbox, but broad enough to foster genuine innovation.
 - Ensuring Fair Competition: It is necessary to ensure that the sandbox does not grant unfair advantages to participants over com-

panies not in the sandbox, requiring careful oversight to avoid market distortions.

- Collaboration with **Stakeholders**:
 - Actively involve the industry and maintain open dialogue with regulators to ensure participation and compliance.
 - Regulatory entities must play a fundamental role in regulatory sandboxes, being an integral part of their structure and operation.
 - Interaction with Innovators: It is essential to understand the specific needs and challenges of the sector.
 - International Collaboration: Essential for learning from global experiences and avoiding duplication of efforts or the creation of conflicting regulations. Coordination with regulatory bodies in other jurisdictions can be complex, especially in the aeronautical world, where the European Aviation Safety Agency (EASA) delegates certain activities to national aviation authorities (AESA in the Spanish case).
- **Regulatory and Legal Framework**: One of the main challenges is maintaining a balance between allowing enough regulatory flexibility for innovators to test new products or services and ensuring adequate consumer protection. Regulatory sandboxes must ensure that participants do not take advantage of a more relaxed regulatory environment to the detriment of consumers or the market's overall stability. In summary:
 - Experimental clauses should be considered to allow some flexibility within the existing legislation.
 - Ensure flexibility within the legal framework and protect consumers and third parties from potential risks.
- **Infrastructure and Resources**: Operating a regulatory sandbox requires significant resources, including expert personnel to oversee and assist participants:
 - It is necessary to provide the required infrastructure and technical resources for UAV testing.
 - Regulators must allocate enough resources without overburdening their existing regulatory responsibilities.
 - There should be dedicated staff specifically for sandbox management or, at the very least, staff with a sufficient time allocation to give the sandbox the necessary management level.
- **Safety and Compliance**: Comply with air safety standards and develop a risk management plan.

- **Data Protection and Privacy:** Ensuring data protection and privacy within the sandbox, especially when dealing with new technologies like artificial intelligence and big data analytics, can be a significant challenge.
- **Monitoring and Evaluation:** Sandboxes must be regularly monitored and evaluated to ensure they meet their objectives and avoid unwanted effects. For this, it is essential to:
 - Design appropriate metrics to measure the success of the sandbox and evaluate the impacts of the innovations tested in the market and on consumers.
 - Establish continuous monitoring mechanisms and periodic evaluation processes.
- **Transparency and Communication:** It is recommended to maintain public reporting and ensure clear communication about the sandbox's rules, objectives, and the monitoring and evaluation results indicated in the previous point.
- **Planning for Scalability and Post-Sandbox Transition:** It is necessary to consider from the sandbox's design phase the scalability of the tested innovations and develop strategies for a successful post-sandbox transition. To achieve this:
 - **Manage legal and regulatory uncertainties regarding the outcomes.** Regulatory sandboxes operate in a space where existing laws may not fully apply, which can create uncertainties. There may be ambiguities about how existing regulations apply within the sandbox and concerns about the legal status of products or services once they leave the sandbox. All these aspects need to be managed within the sandbox's management model.
 - Establish a **clear path** for successful sandbox participants **to scale operations** under the standard regulatory framework.

7.11 GOVERNANCE MODEL

As a fundamental element in designing the regulatory sandbox, an integrated governance model for aerial innovation should be implemented, establishing key roles and responsibilities for various actors involved in developing and implementing regulatory sandboxes in aviation. The description of each actor and their role is as follows:

- **National Aeronautical Authority – Regulator and Supervisor:** This entity is responsible for establishing regulations governing the use of drones and overseeing the tests and operations conducted in the sandbox. Its main role is to ensure safety and compliance with aeronautical regulations.
- **Xunta de Galicia – Driving and Promoting Agent:** The Xunta actively participates in the sandbox as a driving and promoting agent. It provides the resources and means at its disposal to support innovation activities in aviation. It also coordinates the various agents involved in the sandbox, leading participant selection and project monitoring. Its goal is to drive technological development and promote collaboration among different actors to ensure the sandbox’s success in Galicia.
- **Security and Privacy Organizations – Security and Privacy Advisors:** These organizations advise on security and privacy issues related to drone use. Their goal is to ensure that drone operations comply with security and data protection regulations.
- **Companies and Organizations Already Established in the Sandbox Environment – Resource and Expertise Providers:** These agents, capable of providing technical, human, infrastructural, and regulatory knowledge resources to the sandbox, could contribute significantly to the project’s success.
- **Program Manager – Coordinator of Activities and Final Services:** Their participation in sandbox governance would ensure comprehensive and efficient management of all activities and services offered, under the supervision and coordination of all governance members.
- **Technology Companies and Drone Manufacturers – Developers and Innovators:** These companies are the main actors in creating and innovating drone technology. They participate in the sandbox by developing and testing new technologies and systems in both urban and non-urban environments.

7.12 NEXT STEPS

Based on the information gathered in this study and the needs expressed by participating companies and organizations, the following steps should be taken:

1. **Identify Needs and Objectives:** Based on the information already collected in this study and subsequent contacts with the sector, evaluate

market demands and define the sandbox's objectives to foster innovation and protect consumers.

2. **Conduct a Thorough Analysis of the Required Resources and Infrastructure:** To address the sector's identified needs, conduct a detailed mapping of these resources with those available from the agents mentioned in the study and already present in the sandbox's geographic area.
3. **Regulatory and Legal Analysis:** Further examine the existing legislation covering the required tests and trials for value chain agents and consult legal experts to understand potential restrictions and ensure compliance with the legal framework.
4. **Design a General Sandbox and Governance Model:** Conduct consultations with stakeholders and industry experts to understand needs and design a sandbox that meets them, considering not only technical, economic, and regulatory aspects but also financial aspects and possible ways to facilitate resource access in an economically viable way for companies of different financial capacities.
5. **Collaborate with Regulatory Authorities:** Involve the relevant authorities from the start and establish ongoing dialogue to meet regulatory and public policy objectives.
6. **Design the Sandbox Framework:** Based on the initial draft and considering the expressed needs and requirements of regulatory authorities, develop a detailed framework specifying how the sandbox will operate, including participation criteria, project duration, and monitoring metrics.
7. **Approval and Legislation:** Develop and approve new legislation or necessary amendments or exemptions at the local or national level, working with the corresponding authorities for all cases where it is required as a guarantee of legal compliance or as a demand from regulators.
8. **Implementation and Monitoring:** Once approved, implement the sandbox and establish systems to monitor and evaluate to ensure compliance with objectives and protect public interests.
9. **Review and Adjust:** Conduct periodic reviews of the sandbox's operation and adjust policies and practices as needed, based on results and feedback received.



ANNEX I. CHARACTERIZATION OF THE SAMPLE OF COMPANIES AND INSTITUTIOS

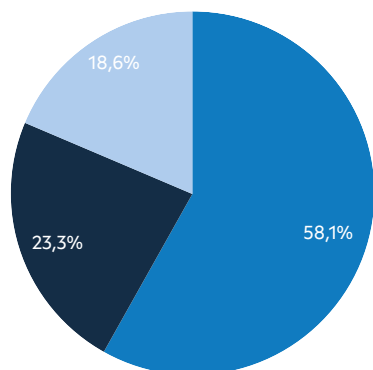
8.1 PARTICIPATING COMPANIES

A total of 203 companies have been contacted in order to join this study. Out of the total number of companies invited to participate, 44 have contributed with their answers and 43 have agreed to make public their collaboration in the study. You can find a full list of these below:

- ACRE SOLUCIONES TOPOGRAFICAS
- ADANTIA
- Abionica Solutions
- Aerial Works S.L.
- Aeromedia UAV S.L.
- Aguia Analítica Avanzada S.L.
- Airbus
- Alpha Unmanned Systems
- Arquimea ADS
- AtlanTTic
- BCN Drone Center
- Beagle Technology
- CANARD DRONES
- CENTUM Research & Technology
- CESGA
- CTAG - Centro Tecnológico De Automoción De Galicia
- Cartogalicia SL
- Centro De Investigación E Tecnoloxía Matemática De Galicia (CITMAga)

- Cielum
- DRONE BY DRONE
- Demsu
- EHang
- ETRA AIR
- Fundacion CETMAR
- GEONUMERICS SL
- GRADIANT
- General Drones S.L.
- IFCAE - Universidad De Vigo
- Ingeniería Insitu SL
- Inster Tecnología Y Comunicaciones
- Instituto Tecnológico De Galicia
- Marine Instruments
- NM3D Ibérica Sistemas De Metrología
- NTT Data Spain SLU
- Orbital Critical Systems
- PROMEGA
- SAFETYTUDE
- SDLE Nexgen
- SOTICOL Robotics Systems
- Soluciones Aeronáuticas De Galicia S.L.
- Telespazio
- Veoline Sistemas Aeronáuticos S.L.

8.2 SIZE OF THE SURVEYED ENTERPRISES



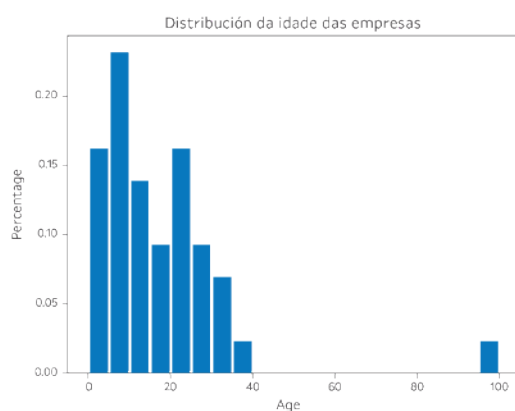
■ Small ■ Large ■ Medium

Percentage of companies by size

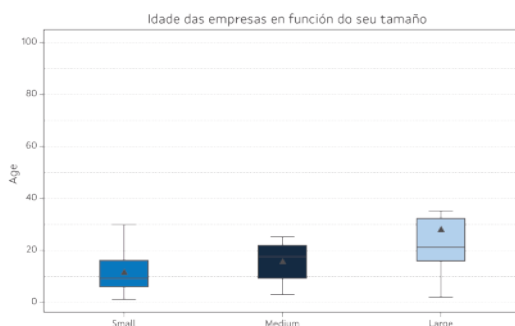
Size	Occurrences	Percentage
Small	25	58.1
Large	10	23.3
Medium	8	18.6

Table 2 Size of the surveyed enterprises

8.3 AGE OF THE SURVEYED ENTERPRISES



Age distribution of enterprises

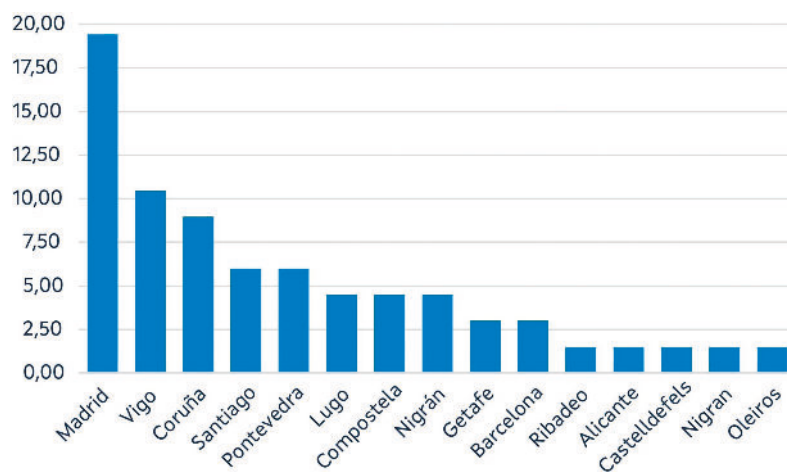


Age of companies by size

Age (From)	Age (To)	Percentage
0.0	5.0	16.0
5.0	10.0	23.0
10.0	15.0	14.0
15.0	20.0	9.0
20.0	25.0	16.0
25.0	30.0	9.0
30.0	35.0	7.0
35.0	40.0	2.0
40.0	45.0	0.0
45.0	50.0	0.0
50.0	55.0	0.0
55.0	60.0	0.0
60.0	65.0	0.0
65.0	70.0	0.0
70.0	75.0	0.0
75.0	80.0	0.0
80.0	85.0	0.0
85.0	90.0	0.0
90.0	95.0	0.0
95.0	100.0	2.0

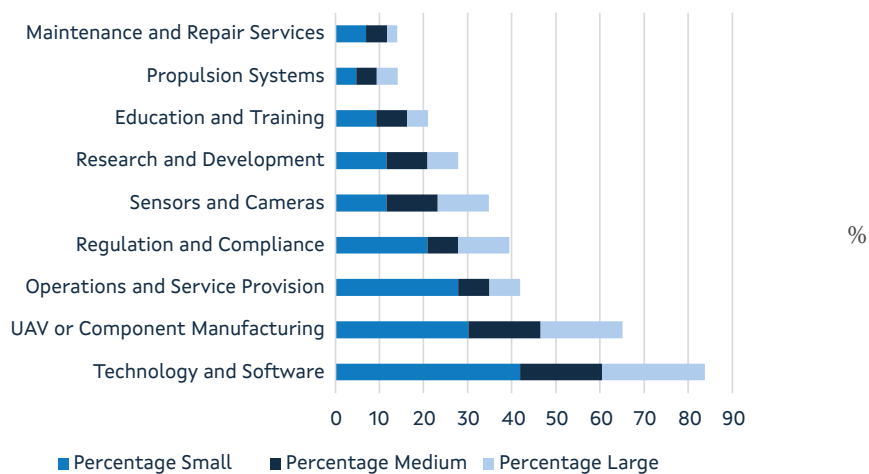
Table 3 Age of the surveyed enterprises

8.4 LOCATION OF THE ENTERPRISES



Location of the surveyed enterprises

8.5 TYPE OF ACTIVITY CARRIED OUT BY THE ENTERPRISES

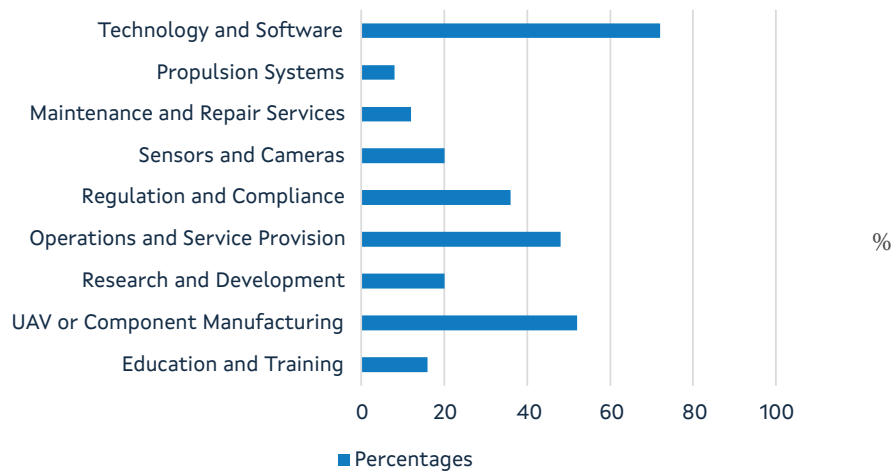


Type of activity carried out by the enterprises

Activity Type	Percentage			
	Percentage	Small	Medium	Large
Technology and Software	83.7	41.9	18.6	23.3
UAV or Component Manufacturing	65.1	30.2	16.3	18.6
Operations and Service Provision	41.9	27.9	7.0	7.0
Regulation and Compliance	39.5	20.9	7.0	11.6
Sensors and Cameras	34.9	11.6	11.6	11.6
Research and Development	27.9	11.6	9.3	7.0
Education and Training	20.9	9.3	7.0	4.7
Propulsion Systems	14.0	4.7	4.7	4.7
Maintenance and Repair Services	14.0	7.0	4.7	2.3

Table 5 Type of activity carried out by the enterprises

8.5.1 TYPE OF ACTIVITY OF SMALL-SIZED ENTERPRISES

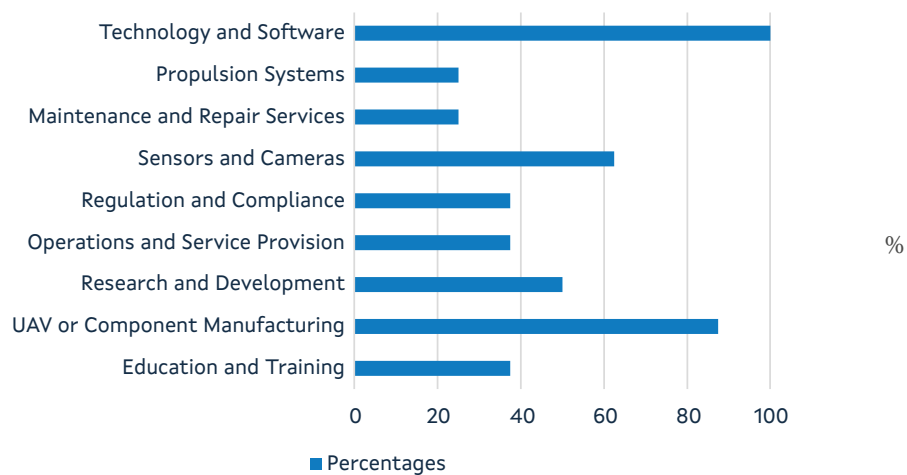


Type of activity of small-sized enterprises

Activity Type	Percentage
Technology and Software	72.0
UAV or Component Manufacturing	52.0
Operations and Service Provision	48.0
Regulation and Compliance	36.0
Sensors and Cameras	20.0
Research and Development	20.0
Education and Training	16.0
Maintenance and Repair Services	12.0
Propulsion Systems	8.0

Table 6 Type of activity of small-sized enterprises

8.5.2 TYPE OF ACTIVITY OF MEDIUM-SIZED ENTERPRISES

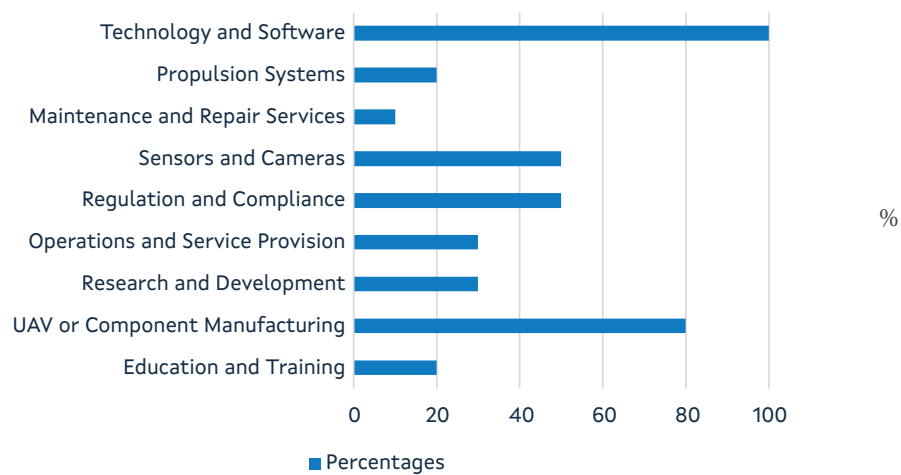


Type of activity of medium-sized enterprises

Tipo de Actividad	Porcentajes
Technology and Software	100.0
UAV or Component Manufacturing	87.5
Operations and Service Provision	62.5
Regulation and Compliance	50.0
Sensors and Cameras	37.5
Research and Development	37.5
Education and Training	37.5
Maintenance and Repair Services	25.0
Propulsion Systems	25.0

Table 7 Type of activity of medium-sized enterprises

8.5.3 TYPE OF ACTIVITY OF LARGE COMPANIES

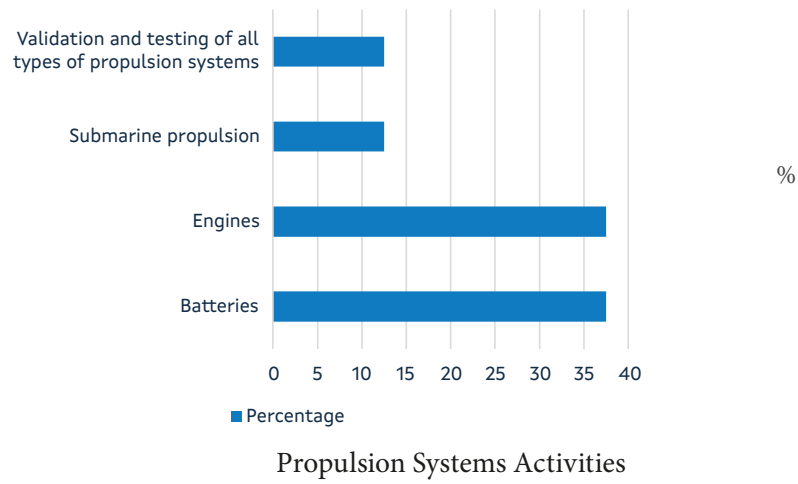


Type of activity of large companies

Activity Type	Percentage
Technology and Software	100.0
UAV or Component Manufacturing	80.0
Operations and Service Provision	50.0
Regulation and Compliance	50.0
Sensors and Cameras	30.0
Research and Development	30.0
Education and Training	20.0
Maintenance and Repair Services	20.0
Propulsion Systems	10.0

Table 8 Type of activity of large companies

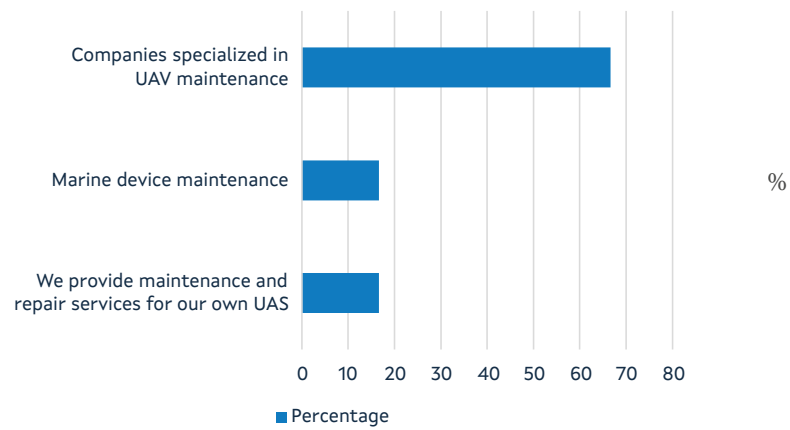
8.5.4 PROPULSION SYSTEMS ACTIVITIES



Activity	Percentage
Engines	37.5
Batteries	37.5
Validation and testing of all types of propulsion systems	12.5
Submarine propulsion	12.5

Table 9 Propulsion Systems Activities

8.5.5 REPAIR AND MAINTENANCE ACTIVITIES

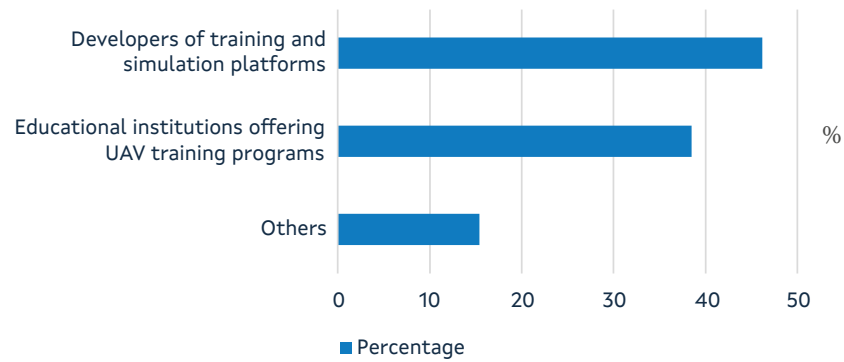


Repair and Maintenance Activities

Activity	Percentage
Companies specialized in UAV maintenance	66.67
Marine device maintenance	16.67
We provide maintenance and repair services for our own UAS	16.67

Table 10 Repair and Maintenance Activities

8.5.6 EDUCATION AND TRAINING ACTIVITIES

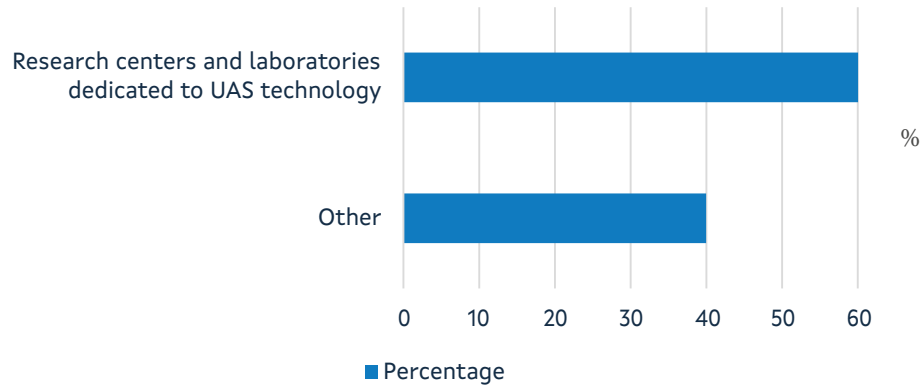


Education and Training Activities

Activity	Percentage
Developers of training and simulation platforms	46.15
Educational institutions offering UAV training programs	38.46
Others	15.38

Table 11 Education and Training Activities

8.5.7 RESEARCH AND DEVELOPMENT ACTIVITIES

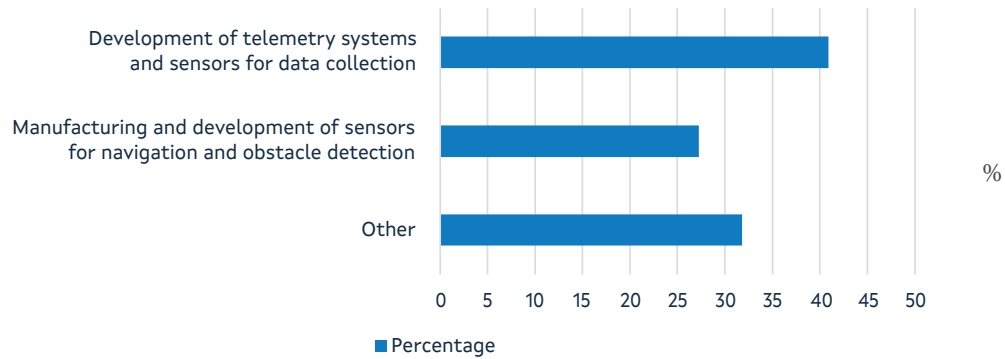


Research and Development Activities

Activity	Percentage
Research centers and laboratories dedicated to UAS technology	60.0
Others	40.0

Table 12 Research and Development Activities

8.5.8 SENSORS AND CAMERAS ACTIVITIES

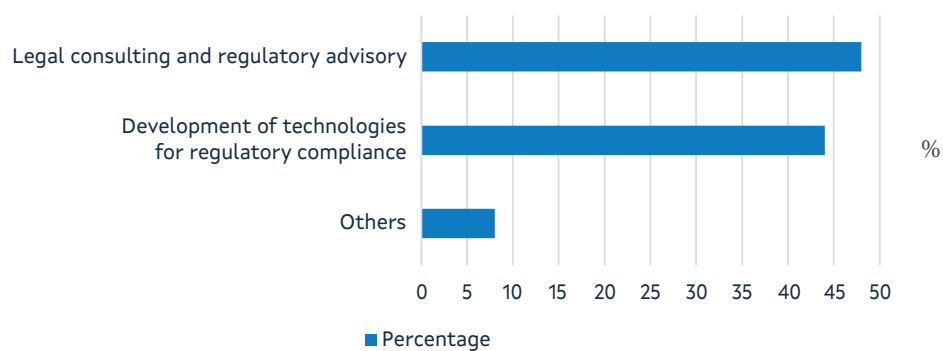


Sensors and Cameras Activities

Activity	Percentage
Development of telemetry systems and sensors for data collection	40.91
Manufacturing and development of sensors for navigation and obstacle detection	27.27
Others	31.81

Table 13 Sensors and Cameras Activities

8.5.9 REGULATORY AND COMPLIANCE ACTIVITIES

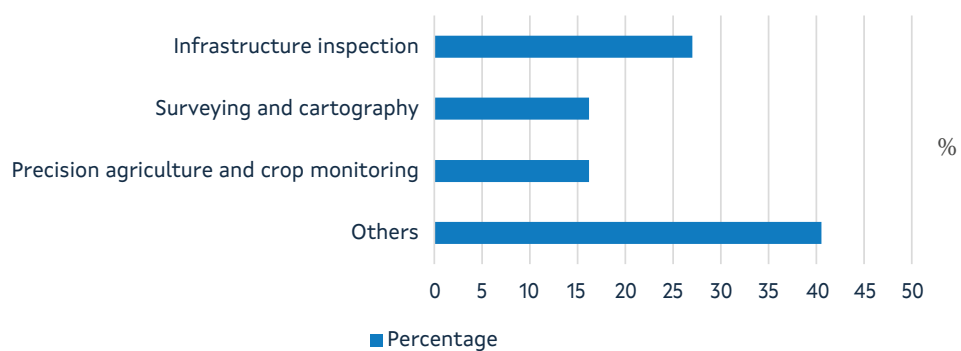


Regulatory and Compliance Activities

Activity	Percentage
Legal consulting and regulatory advisory	48.0
Development of technologies for regulatory compliance	44.0
Others	8.0

Table 14 Regulatory and Compliance Activities

8.5.10 OPERATIONS AND SERVICE ACTIVITIES

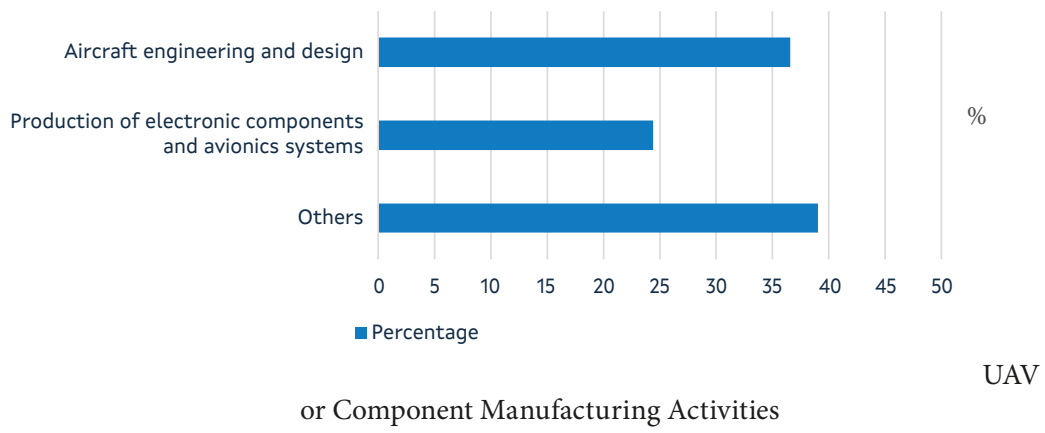


Operations and Service Activities

Activity	Percentage
Infrastructure inspection	27.03
Surveying and cartography	16.22
Precision agriculture and crop monitoring	16.22
Others	40.54

Table 15 Operations and Service Activities

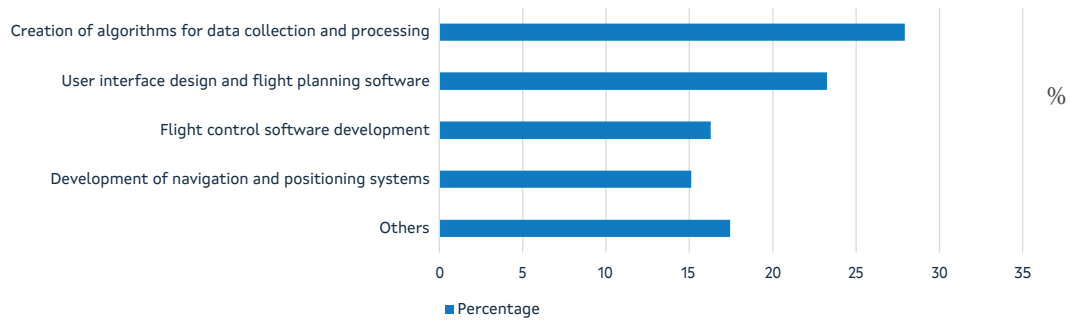
8.5.11 UAV OR COMPONENT MANUFACTURING ACTIVITIES



Activity	Percentage
Aircraft engineering and design	36.59
Production of electronic components and avionics systems	24.39
Others	39.02

Table 16 UAV or Component Manufacturing Activities

8.5.12 TECHNOLOGY AND SOFTWARE ACTIVITIES

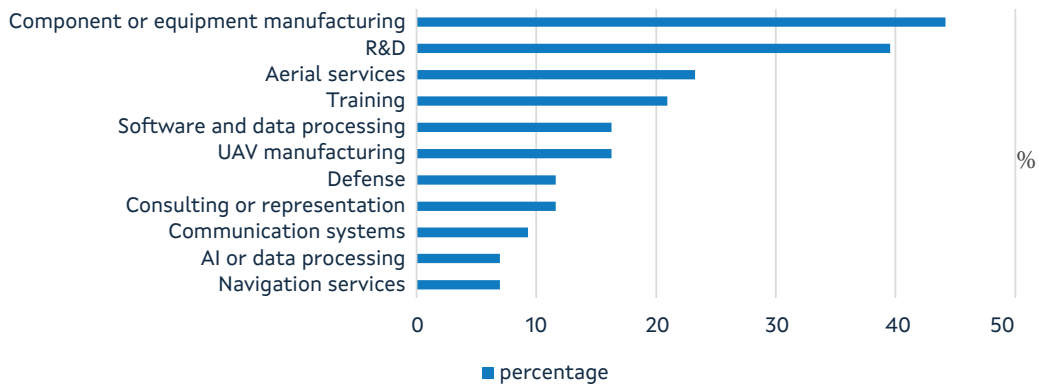


Technology and Software Activities

Activity	Percentage
Creation of algorithms for data collection and processing	27.91
User interface design and flight planning software	23.26
Flight control software development	16.28
Development of navigation and positioning systems	15.12
Others	17.44

Table 17 Technology and Software Activities

8.6 COMPANY BUSINESS UNITS

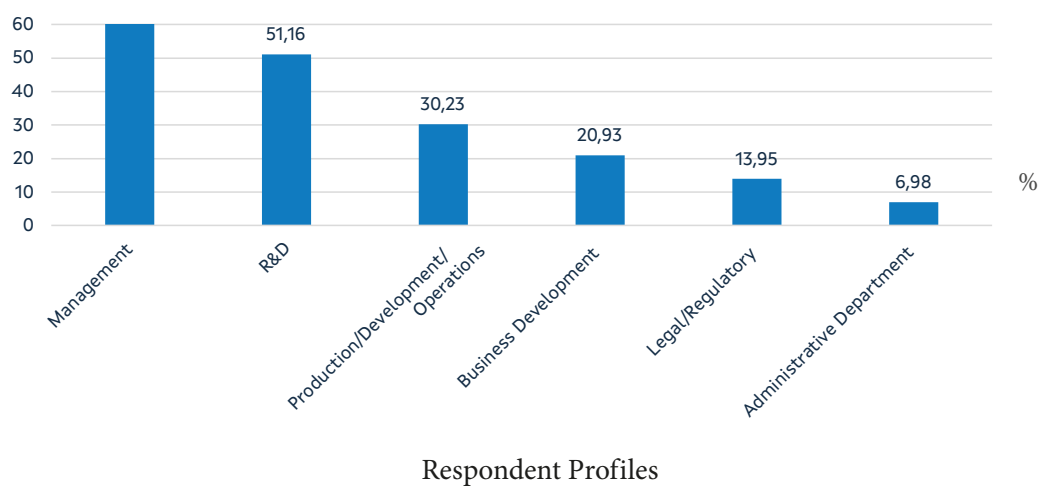


Company Business Units

Business Area	Occurrences	Percentage
Consulting or representation	5	11,63
Training	9	20,93
Engineering	2	4,65
Aerial services	10	23,26
UAV manufacturing	7	16,28
Software and data processing	7	16,28
R&D	17	39,53
Defense	5	11,63
Testing	1	2,33
Commercialization	2	4,65
Component or equipment manufacturing	19	44,19
Navigation services	3	6,98
Communication systems	4	9,30
AI or data processing	3	6,98
Safety or regulations	1	2,33

Table 18 Company Business Units

8.7 RESPONDENT PROFILES



Profiles	Occurrences	Percentages
Management	27	62.79
R&D	22	51.16
Production/Development/Operations	13	30.23
Business Development	9	20.93
Legal/Regulatory	6	13.95
Administrative Department	3	6.98

Table 19 Respondent Profiles



ANNEX II. STUDY METHODOLOGY

8.8 LITERATURE REVIEW

- A thorough review of academic and technical literature related to regulatory sandboxes was conducted.
- Academic databases, specialized journals, research reports, and conferences were used to identify studies, research, and best practices in the field.
- Special attention was paid to recent publications, as the field may be constantly evolving.

8.9 CONSULTATION OF OFFICIAL SOURCES

- Efforts were made, where possible, to access official sources from regulatory bodies, government agencies, and international organizations involved in the implementation of regulatory sandboxes.
- Documents, reports, guides, and press releases were sought to provide information on existing initiatives, requirements, assessments, and results.

8.10 ONLINE RESEARCH

- Online searches were conducted using search engines and online resources to gather up-to-date information about regulatory sandboxes in different jurisdictions.

- Websites of government agencies, think tanks, consultancies, and organizations specializing in regulatory and technological issues were explored.

8.11 CASE STUDIES AND COMPARATIVE ANALYSIS

- Information and publications about relevant regulatory sandboxes implemented in different countries or regions were reviewed.
- The design, structure, requirements, outcomes, and lessons learned from the selected cases were examined.
- The information collected, along with the needs gathered during the interview process described in the following section, was used to identify patterns, trends, and best practices in the implementation of regulatory sandboxes.

8.12 INTERVIEWS AND CONSULTATIONS

8.10.1 QUESTIONNAIRE DEVELOPMENT

A list of specific and standardized questions was designed to gather detailed and consistent information on various aspects of regulatory sandboxes.

8.12.2 PARTICIPANT SELECTION

An exhaustive list of potential companies and professionals interested in the proposed regulatory sandbox, as well as those with experience in regulatory policies and disruptive technologies, was created. The companies were selected from one or more of the following groups: participants in the Civil UAVs Initiative, members of the Galician Aeronautical Consortium, participants in the Business Factory Aero, members of EUROCAE's WG-105, exhibitors at major Spanish drone fairs (UNVEX, DroneExpo,...), companies that had applied to AESA for operational authorizations or STS-02 scenario authorizations, and other prominent companies in the sector.

8.12.3 DATA COLLECTION

The study began with data collection through a comprehensive questionnaire distributed to a wide range of companies. This questionnaire included a series of open-ended questions that allowed respondents to express themselves freely. The responses were collected using Google Forms and stored in a spreadsheet for further analysis.

8.12.4 DATA PREPARATION

The collected data was uploaded into Python using the Pandas library, which facilitated the manipulation and preliminary processing of the data. This step included converting the responses into a format suitable for analysis, cleaning the data where necessary (e.g., removing empty or irrelevant responses).

8.12.5 TEXT ANALYSIS WITH NLP

Various NLP (Natural Language Processing) techniques and tools were used to analyze the text and extract key terms and concepts from the responses. The techniques used include:

- YAKE (Yet Another Keyword Extractor): Used to automatically identify keywords within the text based on word frequency and contextual distribution.
- TF-IDF (Term Frequency – Inverse Document Frequency): This technique helped assess the importance of a term within a set of documents by weighing the term's frequency in a document against its frequency across all documents.
- Spacy: An NLP library that provided tools for tokenization, lemmatization, and named entity recognition, among other capabilities. Each of these methods generated its own set of key terms and concepts, which were compared and analyzed to determine their relevance and frequency.

8.12.6 NORMALIZATION AND VISUALIZATION

To facilitate the interpretation of the results, a normalized score was calculated for each term, based on its relevance and frequency in the responses. This score allowed for visual representation of the data through word clouds,

where the size of each term in the cloud reflected its relative importance. Additionally, a custom color palette was used to improve visualization, enabling an intuitive and straightforward interpretation of the most significant results.

8.12.7 CONCLUSION

The integration of multiple NLP techniques allowed for a deep and detailed understanding of the perspectives expressed by the surveyed companies. This methodology provided not only a qualitative insight into the data but also facilitated the quantification of key concepts and terms, enabling a robust and detailed analysis of the questionnaire responses.

8.13 FOCUS GROUPS

Once the report is finalized, it would be beneficial to organize focus groups with carefully selected participants from various stakeholders (companies, regulators, academics, representatives of civil society, public administration, etc.). The main objective would be to create an appropriate environment for the exchange of ideas and opinions on regulatory sandboxes and to record the discussions for analysis and extraction of meaningful conclusions.



