SAFE SKIES.
**SUSTAINABLE
FUTURE.**

ICAO ESAF/WACAF Regional Office UAS/RPAS Workshop

Nairobi, Kenya
June, 2025

Global UAS Regulatory Implementation Challenges

Objectives

➢Understand the Importance of a Regulatory Framework;

➢Understand the Challenges of Implementing a Reg. Fmwk;

➢Considerations for Regulatory Implementation.

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IMPORTANT CONCEPTS
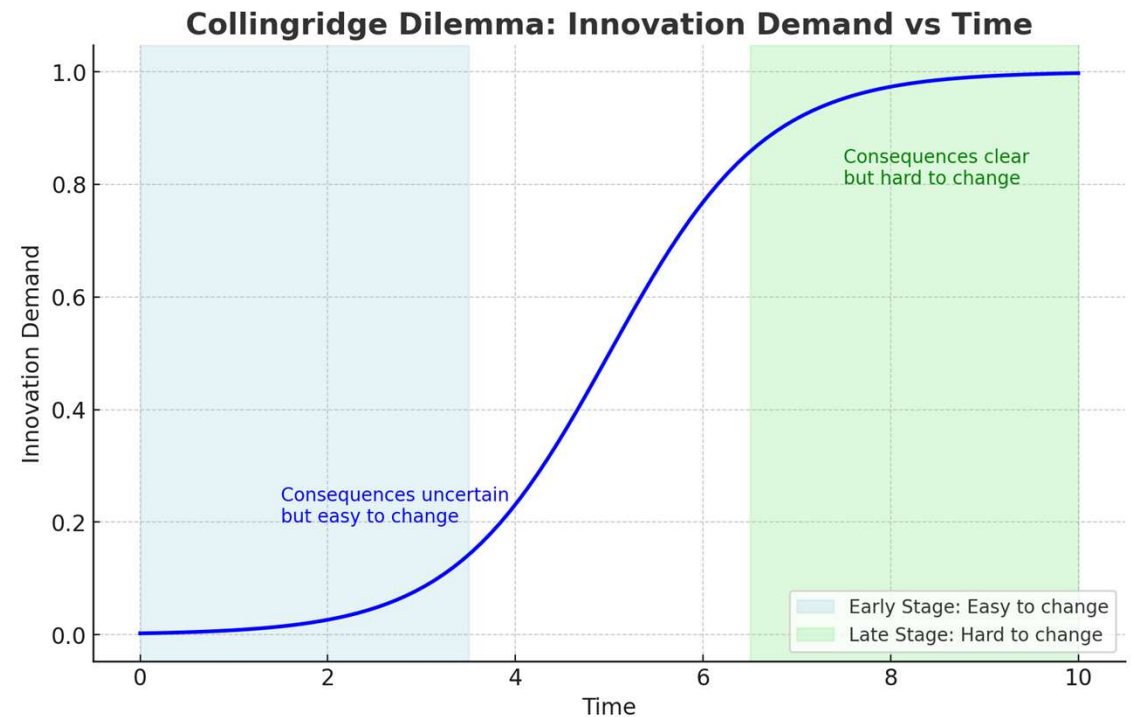
SAFETY IS PARAMOUNT!

SAFETY LEVEL IS NOT NEGOTIABLE!

How to Regulate an Innovation?

🛸 **Innovation includes commercial applications of new technology, new material, or new methods and processes(1).**

🛸 **Innovation also includes the invention of new technologies and disruptive business models(1).**

Collingridge Dilemma: Innovation Demand vs Time

Consequences clear but hard to change

Consequences uncertain but easy to change

Innovation Demand

Time

Early Stage: Easy to change
Late Stage: Hard to change

(1) Cirera, Xavier; Maloney, William F.. 2017. The Innovation Paradox: Developing-Country Capabilities and the Unrealized Promise of Technological Catch-Up. © World Bank. http://hdl.handle.net/10986/28341.

How to Regulate Innovation?

🚁 **The pace, scope and complexity of innovation pose far-reaching and interrelated regulatory challenges for governments(2).**

🚁 **These challenges can be grouped around four broad categories: the "pacing problem"; designing "fit-for-purpose" regulatory frameworks; regulatory enforcement challenges, and institutional and transboundary challenges. (2)**

(2) OECD, Recommendation of the Council for Agile Regulatory Governance to Harness Innovation, OECD/LEGAL/0464.
https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0464

How to Regulate Innovation?

🛸 **"Pacing Problem" > gap between the rapid development of emerging technologies and the much slower pace at which regulatory frameworks evolve;**

🛸 **"Fit-For-Purpose" > regulatory instruments to match specific policy targets.**

🛸 **Regulatory enforcement challenges (For instance - difficulties in apportioning and attributing responsibility for damages caused);**

🛸 **Transboundary Challenges: innovations can span multiple regulatory regimes.**

(2) OECD, Recommendation of the Council for Agile Regulatory Governance to Harness Innovation, OECD/LEGAL/0464.
https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0464

How to Regulate Innovation?

Key implications of innovation on markets and societies (3)

- Competition
- New market failures
- Data privacy and security challenges
- Reduction in transaction costs
- Development of decentralised exchanges
- Development of networks
- Shift towards services
- Growing powers to consumers
- Socio-ethical challenges

(3) OECD/KDI (2021), Case Studies on the Regulatory Challenges Raised by Innovation and the Regulatory Responses, OECD Publishing, Paris, https://www.oecd.org/content/dam/oecd/en/publications/reports/2021/12/case-studies-on-the-regulatory-challenges-raised-by-innovation-and-the-regulatory-responses_82fcd441/8fa190b5-en.pdf

How to Regulate Innovation?

Regulate & Forget

⬇

Adapt & Learn Approaches

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How to Regulate Innovation?

Market Growth and Economic (Expectations)

North America: In 2025, the revenue in the Drones market in North America amounts to approximately US$1.5bn. It is projected to experience an annual growth rate of 0.19% (CAGR 2025-2029).
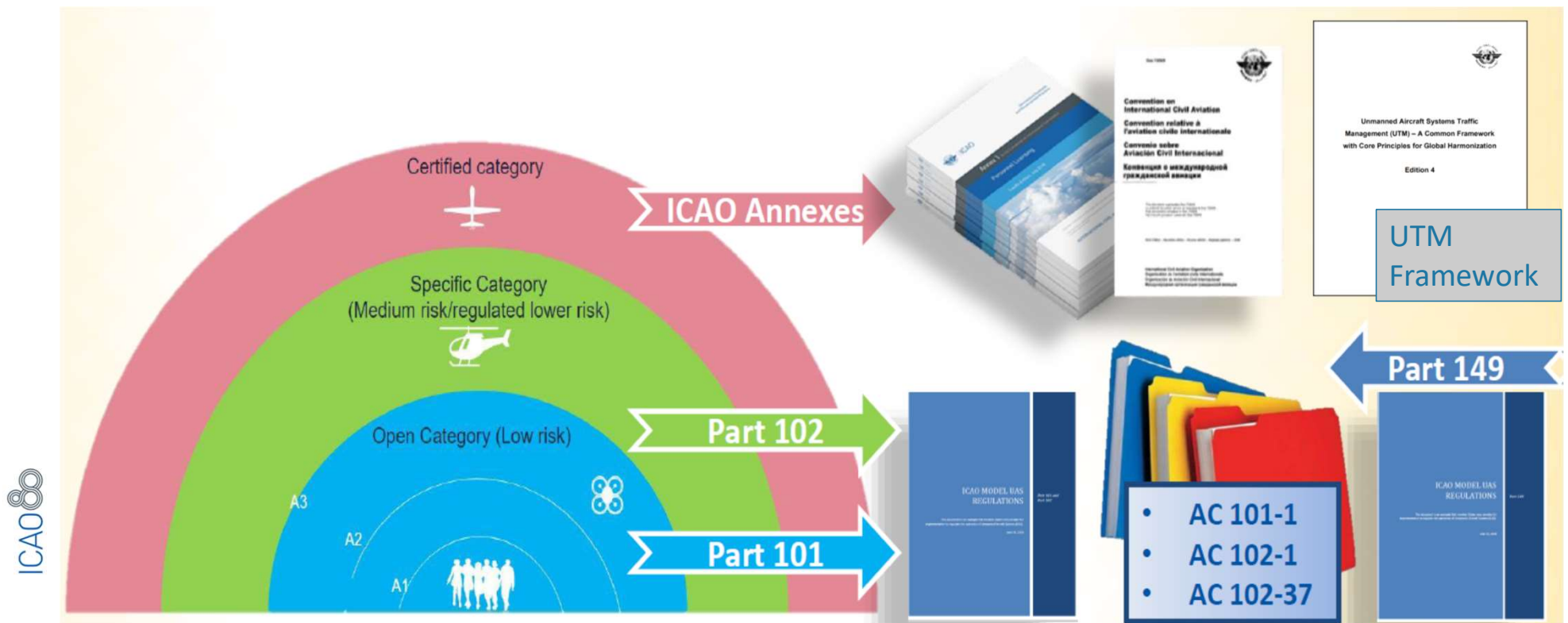
Central America: The drone market is projected to grow at a compound annual growth rate (CAGR) of 5.53% from 2025 to 2029, reaching an estimated market volume of $12.8 million by 2029.

Caribbean: In 2025, the drone market revenue is estimated at $9.1 million, with an expected annual growth rate of 3.77% through 2029.
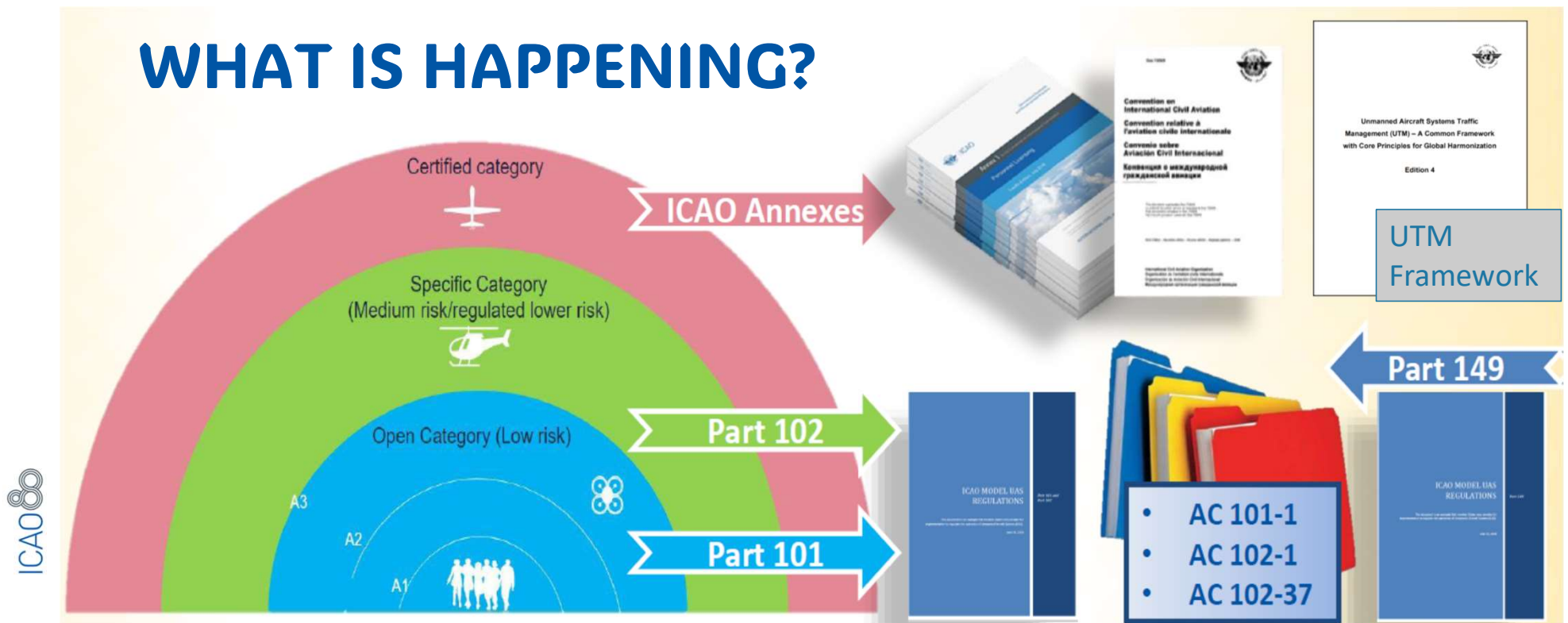
Source: Statista Market Insights

Revenue   Revenue Change

North America: The revenue in the Drones market in 2025 is estimated to be US1.5bn.

Revenue   Revenue Change

Central America: The revenue in the Drones market in 2025 is estimated to be US10.3m.

Revenue   Revenue Change

Caribbean: The revenue in the Drones market in 2025 is estimated to be US$9.1m.

Challenges

COMMON CONSTRAINTS

Regulatory Hurdles

Varying or unclear national/international drone laws; airspace restrictions

Limited Battery/Range

Drones can't fly far enough or carry large payloads

Data Security/Privacy

Concerns about capturing images of civilians or sensitive areas

Community Acceptance

Fear or misunderstanding of drones among local populations

Weather Dependence

Many drones can't fly safely in high winds, rain, or extreme conditions
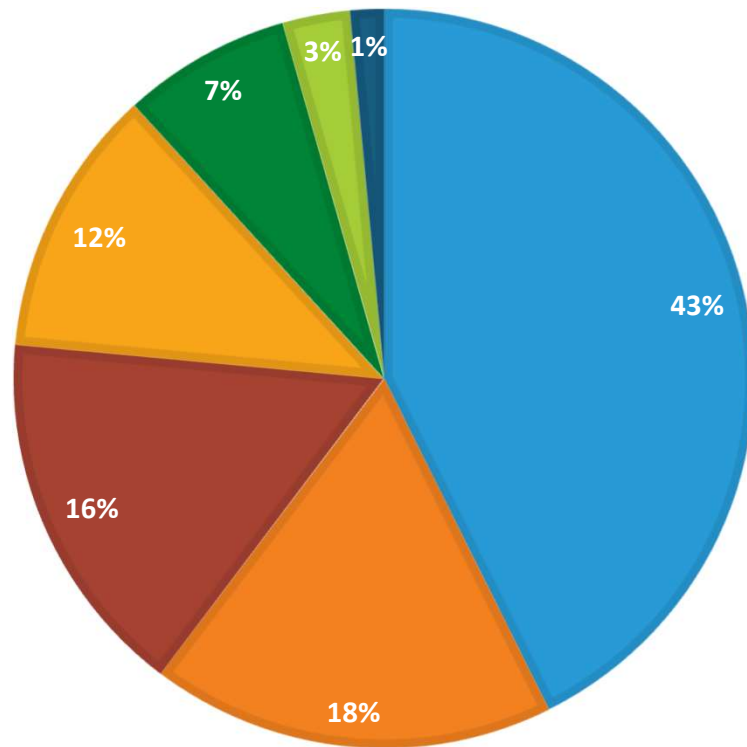
Cost and Logistics

High cost of advanced drones, plus transport and maintenance in remote areas

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* Key constraints commonly mentioned in sources discussing UAS use in humanitarian contexts, identified across academic, NGO, and regulatory literature.

* Stakeholders Interactions

Challenges

Regulatory ■ **Technical** ■ **Institutional** ■ **Implementation** ■ **Awareness** ■ **Environmental** ■ **Enforcement**

43%
18%
16%
12%
7%
3% 1%

* Data Collected in the Workshop on UAS for UN Missions (April, 2025)

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Challenges

Manned vs Unmanned Concepts
HUMAN INTO THE SYSTEM

✈ **Proprioceptive Condition (Pilot`s feeling);**

✈ **Noise, Smell, …;**

✈ **Cockpit Coordination;**

✈ **Visual Conditions (Human Eyes)**

✈ **Spatial Disorientation;**

✈ **Task Load vs Stress Level (Emergency vs Risk of Death);**

✈ **Comm Fail – Pilot On Board (No Comm);**

✈ **…**

SITUATIONAL AWARENESS

Regulatory Perspective

🚁 **No Proprioceptive Condition (Pilot`s feeling);**

🚁 **Limited Visual Cues (Sensors` Dependency);**

🚁 **Cockpit Coordination;**

🚁 **Low Level for Spatial Disorientation;**

🚁 **Task Load vs Stress Level (Emergency vs Risk of Death);**

🚁 **Comm Fail – Pilot Not On Board (Possible Comm);**

🚁 **…**

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Implementation Considerations

Regulatory Approach

PRESCRIPTIVE
- ✓ Prescribes in detail what must be done in order to be compliant;
- ✓ Constrains operations to the technology available and procedures at the time the rule was implemented.

PERFORMANCE BASED
- ✓ Specifies the desired outcome;
- ✓ Specifies the risks or hazards which must be mitigated against;
- ✓ Allows operator to adapt operation to more efficient models.

COMPETENCY BASED
- ✓ Human performance;
- ✓ Knowledge, skills, and attitude;
- ✓ Conditions, performance, standards.

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Implementation Considerations

PRESCRIPTIVE APPROACH

Benefits	Drawbacks
• **Clarity & Simplicity**: Provides clear rules and checklists (e.g., specific altitude limits, equipment standards). • **Ease of Enforcement**: Inspectors and operators know exactly what to comply with. • **Consistency**: Uniform standards reduce ambiguity and disputes. • **Safety Baseline**: Good for new or immature industries — sets minimum acceptable safety levels.	• **Inflexibility:** Hard to adapt quickly to new technologies or unique operations. • **Stifles Innovation**: Operators must comply with rules even if better, safer methods exist. • **One-Size-Fits-All**: May not fit all risk levels — small drones and large BVLOS (Beyond Visual Line of Sight) operations are very different but can be constrained by the same rigid rules.

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Implementation Considerations
PERFORMANCE-BASED APPROACH

Benefits	Drawbacks
• **Flexibility:** Encourages operators to innovate and use the best technology to meet safety outcomes. • **Adaptability**: Better suited for rapidly evolving drone tech and new use cases. • **Risk-Based**: Can scale requirements based on operation risk instead of blanket rules. • **Encourages Best Practices**: Operators can demonstrate compliance through advanced safety cases, rather than box-checking	• **Complexity**: Requires operators to develop and prove safety cases, which demands expertise and resources. • **Enforcement Challenges**: Regulators must have skilled staff to assess compliance with broad performance goals. • **Uneven Application**: May favor large companies that can afford robust compliance demonstrations, leaving small operators behind. • **Potential for Loopholes**: Vague standards can lead to exploitation if oversight is weak.

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Implementation Considerations
COMPETENCY-BASED APPROACH

Benefits	Drawbacks
• **Focus on Skills & Outcomes**: Ensures drone pilots/operators can demonstrate required knowledge, skills, and decision-making ability — not just hold a paper license. • **Better Safety Culture**: Encourages continuous training and real-world skill checks, not rote box-ticking. • **Flexibility**: Adapts to varying levels of operation complexity (e.g., hobbyist vs. commercial BVLOS pilot). • **Supports Innovation**: Operators can adopt new tech if they prove staff are competent to handle it safely.	• **Training & Assessment Burden**: Requires robust training organizations and skilled assessors to verify competency. • **Possible Inconsistency**: Different training providers may vary in rigor if oversight is weak. • **Resource Intensive**: Small operators may struggle to maintain competency programs, especially for specialized operations. • **Regulator Oversight**: Authorities need to monitor both training orgs and individual competencies over time.

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Implementation Considerations

OPERATION-CENTRIC

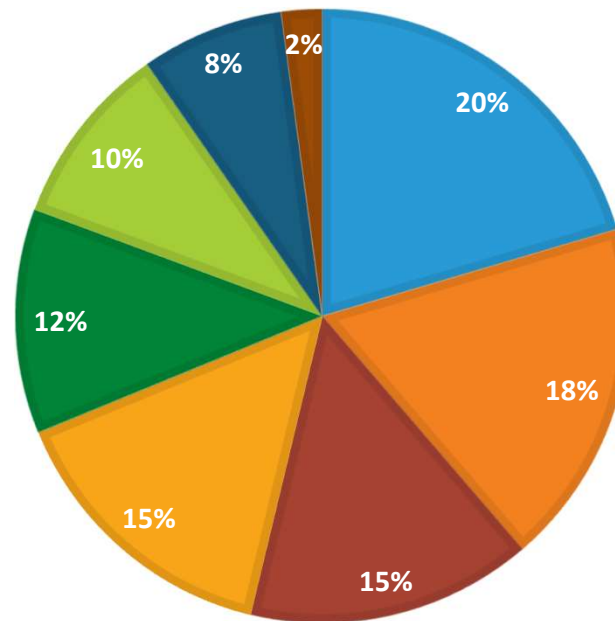*"An evaluative approach focused on the entirety of an activity".*

+

RISK-BASED

"A proactive approach involving safety risk management principles to reduce and control risks to a tolerable level."

Implementation Considerations

SOLUTION TYPE SUMMARY

- ■ Operational Tools & Procedures — 20%
- ■ Coordination & Partnerships — 18%
- ■ Training & Capacity Building — 15%
- ■ Knowledge Sharing & Innovation — 15%
- ■ Regulatory Tools / Frameworks — 12%
- ■ Oversight & Safety Management — 10%
- ■ Awareness & Stakeholder Engagement — 8%
- ■ Strategic Planning — 2%

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Implementation Considerations

Understanding the relation between regulation & innovation.

Assess the market demands & operational needs (contact people).

Assess regulatory relationships & regulatory impact (Sandbox, Enabling Clause,…).

Leverage the use of technology to reach out the users (Digital Platforms).

Promote Regulatory Knowledge (Training, Workshops, Seminars,..).

Seek for International Harmonization.

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*"By **embracing innovation and working together,** we can create a **new era in aviation** that is inclusive of a broad range of users and operations. To achieve this vision, **high levels of global cooperation** should be enabled by strategic planning while remaining adaptable to changes".*

Call to Action AAM 2024

Thank You