



International Civil Aviation Organization

## WORKING PAPER

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### ASSEMBLY — 41ST SESSION

#### TECHNICAL COMMISSION

#### Agenda Item 31: Aviation Safety and Air Navigation Standardization

#### PERFORMANCE-BASED REGULATION FOR EMERGING TECHNOLOGY

(Presented by New Zealand)

##### EXECUTIVE SUMMARY

This paper discusses the development and application of performance-based regulations in response to rapidly evolving technological innovations in the aviation sector. It considers how a performance-based approach to rule development can favour innovation and flexibility while remaining effective and safe. It proposes that ICAO should focus its efforts on developing robust and agreed performance-based standards from which States can approach the management of emerging technology.

**Action:** The Assembly is invited to:

- recognize that the rapid pace of technological development in the emerging aviation technology area will continue to challenge prescriptive regulatory frameworks, and that greater use of performance-based regulation will be needed to effectively manage safety risk while accommodating innovation;
- note that the implementation of performance-based regulatory frameworks requires a number of critical elements to be considered, including the technical competence of the regulator, the competence of the sector to apply performance-based regulation, education, and guidance material;
- encourage ICAO to consider how performance-based requirements can be effectively incorporated into Standards and Recommended Practices related to innovative and emerging technologies; and
- encourage ICAO to focus on the development of principles that reflect the concept of technological experimentation when developing standards to assist States to manage risks related to innovation in this field.

<i>Strategic Objectives:</i>	This working paper relates to the Security and Facilitation, and Safety Strategic Objectives.
<i>Financial implications:</i>	None
<i>References:</i>	None

## **1. INTRODUCTION**

1.1 Emerging aviation technologies span a broad range of systems and capabilities. Examples include new types of low emission propulsion systems, new systems for traffic management, emerging weather forecasting demands and solutions, radically new training systems, digitally driven ecosystems, and novel flying platforms.

1.2 Traditionally, regulation of aircraft design, equipment and systems has been largely prescriptive and based on well-proven technical standards. While prescription supports standardisation, it can also create barriers to the adoption of new technology – particularly where standards do not keep up to date with the application of new technologies.

1.3 The pace of change has recently increased as non-traditional participants enter the aviation sector, bringing with them novel product development and testing practices, and expectations that regulators will accommodate them. This challenges the traditional prescriptive approach to regulation.

1.4 Prescriptive regulation may inhibit the development of more sophisticated systems and risk management practices that could be adopted to better address safety risks and meet public expectations. The development of new and revised technical standards in the aviation sector is generally slow, and despite the best intentions of regulators, the pace of regulatory change will tend to lag behind the pace of technological change.

1.5 Performance-based regulation enables States to set minimum performance objectives that must be met, while providing a degree of flexibility to enable the regulatory system to rapidly adapt to technological changes as they occur.

1.6 The advantages of performance-based regulation do not necessarily mean that it is always the best regulatory strategy. Effective performance-based regulation depends ultimately on a thorough understanding of the nature of the problem that calls for regulatory intervention, including a clear account of the causes of and contributors to that problem...

## **2. BENEFITS AND OBJECTIVES OF USING PERFORMANCE-BASED REGULATIONS**

2.1 The complexity of the aviation sector has resulted in highly specific and detailed regulations, which are designed for well-known technologies undergoing relatively small evolutionary changes. Although this regulatory approach has proved effective for the more established parts of the aviation sector, the volume and specificity of the regulations can prove challenging for a new entrant seeking to introduce a radically different or innovative technology.

2.2 The key benefit of performance-based regulation is that it allows for flexibility and innovation. As performance-based regulations can be applied effectively to a broader range of technologies and situations, manufacturers and regulators have greater flexibility in the types of aviation products that they develop and certify. This flexibility supports innovation, as product development is not constrained by out-of-date or narrowly defined technical requirements and the slow pace of regulatory change.

2.3 With the rapid expansion of the new and emerging aviation technology sector, ICAO and States will come under increasing pressure to provide flexible compliance pathways for aircraft and systems that do not fit existing prescriptive regulatory frameworks. Performance-based regulations provide a means for enabling such pathways. However, they may not be appropriate in all situations, and there will be instances where prescriptive requirements remain the most appropriate means of ensuring safety.

### **3. RISKS ASSOCIATED WITH PERFORMANCE-BASED REGULATION, AND THEIR MITIGATION**

3.1 One of the primary objectives of a performance-based system is to accommodate innovation in the aviation sector. However, the reality of dealing with performance-based regulation in a sector where the technology is emerging is the uncertainty that the design parameters would ensure that new and innovative products will be compliant.

3.2 Experience in other sectors that have shifted to performance-based regulatory systems has provided the aviation sector with example areas that must be carefully considered in the design and implementation of performance-based regulatory frameworks. These include:

#### **3.2.1 Technical competence of the regulator**

3.2.1.1 A performance-based regime requires complex technical decisions. Assessing compliance with prescriptive regulation is quite different to assessing whether a participant has identified an appropriate means of compliance to meet a performance outcome.

3.2.1.2 Regulators must be able to apply an appropriate level of relevant technical competency alongside evaluative knowledge and intuitive judgement. These qualities are necessary to ensure that predictions and risk assessments can be made about new technologies, and therefore that appropriate certification methodologies are used. Evidence suggests that the application of superior expertise and wisdom to decision-making offers strategies to mitigate risk of failure.

#### **3.2.2 Competence of the sector**

3.2.2.1 When developing performance-based regulations, States must keep in mind how compliance can be demonstrated by regulated parties. Consistency and accessibility are important features of technical requirements.

3.2.2.2 Regulated parties must have the appropriate competencies to evaluate the risks associated with the technologies they are introducing and be able to articulate to regulators how these are to be mitigated. Regulators should in turn consider the capacity of regulated parties to do manage risks, and whether it is feasible and proportionate to ask them to undertake a given compliance process.

#### **3.2.3 Education**

3.2.3.1 Regulators and regulated parties need to understand how the performance-based regulatory system operates, and the differing responsibilities imposed on all parties working within it. Without appropriate education to embed knowledge of the principles of performance-based regulation, there is a risk that parties will fall back on more familiar prescriptive means of demonstrating compliance.

3.2.3.2 There is also a risk that parties will fail to recognise the importance of rigorously ensuring that compliance with performance requirements are met, and that processes for demonstrating compliance may be more complex and onerous than they might be for more prescriptive regulatory frameworks. This in turn creates a risk of under-regulation.

#### 3.2.4 Standards and guidance

3.2.4.1 Performance-based approaches are enabling but can be ineffective if they are not supported by accessible operational standards and guidance. The development of appropriate standards and guidance material is necessary to ensure regulated parties can understand regulatory boundaries and undertake required compliance processes.

3.2.4.2 Guidance material is especially important to support less well-resourced or less mature operators to comply with performance-based regulation. It can set out how to demonstrate acceptable means of compliance, provide examples of what compliance might look like, and direct participants to resources or organisations that might be able to assist.

3.2.4.3 Without specifically focussed guidance, regulated parties may lack the ability to determine appropriate means of demonstrating compliance, which leads to greater uncertainty and therefore more time and resources needed to achieve compliance.

3.2.4.4 There is a risk that the use of overly prescriptive standards and guidance material may effectively reduce the level of flexibility provided by the overarching regulations. This would have the effect of reducing some of the benefits associated with a performance-based approach, such as flexibility. This can be mitigated by ensuring that standards and guidance are developed using a robust method, adopted only where appropriate and in a manner that continues to provide a sufficient degree of flexibility

### 4. **EMERGING TECHNOLOGIES ARE SOMETIMES EXPERIMENTAL IN NATURE**

4.1 The concept of experimental emerging technologies could be reflected in ICAO guidance and legislation as an encouragement to pursue or facilitate innovation.

4.2 For any agreed principles around emerging technologies to be effective, it needs to be clear that innovation involves experimentation, which in turn carries with it a risk of failure.

4.3 If this is not clear, then there can be two possible outcomes. The first is that the regulatory system is overly risk averse as decision-makers do not feel adequately empowered to permit experimentation. The second is that the regulatory system is not sensitised to risk-taking that informally occurs and behaviours do not evolve that are orientated to managing risks.

4.4 The ability to identify and manage risk, and particularly the risks of new technologies that impact safety in aircraft, is paramount. The primary failure experienced in other sectors was not the use of performance-based systems, but how they were implemented and not having a strategy in place to monitor how the new technologies performed on the ground.