

# Risk-based Approach to UAS Traffic Management System Development in South Korea

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This paper introduces the risk-based approach to derive the required UAS safety requirements and airspace design concept of UAS traffic management system in South Korea. Third-party risk on the ground is considered as the most important target level of safety for UAS operations. In this regard, the ground risk model and air risk model are utilized to quantitatively evaluate the associated risks and it becomes the basis to define the relevant airspace and requirements. Especially for the air risk model, the collision risk model used in manned aviation is applied.

**Key Words:** UTM, Risk-based Approach, Ground Risk Model, Air Risk Model, eVTOL

## 1. Risk-based Approach for UTM

With the increase of the use of unmanned aircraft system (UAS), the need for the proper traffic management system is increasing. Accordingly, the efforts to develop the UAS traffic management (UTM) system including its operational concept and regulation are continuing on worldwide. In many countries, a risk-based approach is adopted as a baseline for UAS operational concept.<sup>1,2)</sup> The risk-based approach means that the UAS requirements, airspace design, relevant UTM services depend on the associated risk of the operations.

In January 2019, the JARUS (joint authorities of rulemaking of unmanned system) published the guidelines on specific operations risk assessment (SORA) to support risk assessment of UAS operation.<sup>3)</sup> In SORA, the operational risk of UAS is composed of the ground risk and the air risk. And the requirements applied to the UAS operation vary with determined ground risk and air risk level for UAS operational approval.

Also, in Europe the airspace volume for UAS operation is designed into three types, X, Y, Z.<sup>2)</sup> The criteria for classification are the ground risk, the air risk, public acceptance factors, etc. And according to the volume types, the provision of UTM services are different and also the access requirements of UAS are different.

In South Korea, the prototype of UTM system for small UAS operation under 150m is under development since 2017. And the research to extend the application of this system to eVTOL (electronic vertical take-off and landing) aircraft is underway since 2021. In keeping with the global trend, the quantitative risk evaluation technique to define the over whole operational concept including airspace volume and access requirement is investigated. In this study, the third-party risk on the ground is considered as the most important target level of safety. To analyze the third-party risk on the ground, the ground risk model and air risk model

need to be simultaneously considered.

For development of the ground risk model, few sub-component models should be determined; failure model, impact location model, recovery model, stress model, exposure model, incident stress model, harm model.<sup>4)</sup> The ground risk map that quantitatively express the fatality caused by UAS crash from specific location is developed by choosing appropriate sub-component models from various existing researches. Based on the ground risk map, the airspace volume segmentation is introduced.

For the air risk model, the various air risk model is already available in manned aviation. The well-known Reich model is utilized to compute the air risk of UAS (including eVTOL aircrafts) corridors.<sup>5)</sup> Then the third-party risk caused by UAS crash after the collision between UASs on the corridor can be computed from the ground risk map and estimated collision rate of the corridors.

## Acknowledgments

This research was supported by a grant (PN: 20016489) from R&D Program funded by the Ministry of Trade, Industry and Energy (MOTIE, Korea).

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