

## **Summary**

### **Towards Enhanced Safety Management in ATM**

Safety is vital to the survival of any industry engaged in providing safety-related services. In Air Traffic Management (ATM), considerable resources and efforts have been invested by Air Navigation Service Providers in implementing Safety Management Systems (SMS) to current international standards. However, new pressures and threats to safety continue to emerge with the potential to erode the effectiveness of SMS. This means that today's SMS cannot be assumed to be sufficient to meet future needs.

The research presented in this thesis examines the need and the means to increase the future effectiveness of SMS in ATM over the next decade in order to avoid a progressive decline in aviation safety. Six development paths for enhancing the effectiveness of SMS are analysed: –

- Three in the category of ‘opportunities’ where proactive measures may be self-initiated as part of SMS management and development – Enhanced SMS Management, New Safety Thinking and SMS Knowledge Transfer.
- Three in the category of ‘threats’ where protective measures are required in order to respond to factors, external to the scope of operation of the SMS, which have the potential to degrade ATM safety levels – Institutional Change, Cybersecurity and Unmanned Aviation.

For each development path, enhancement measures are proposed which, if implemented, will contribute to an overall increase in levels of SMS effectiveness. However, progressive development of SMS in this way points to the need for a methodology to determine how effective these new enhancements are in improving SMS effectiveness in ATM.

Measurement of SMS maturity, as a measure of effectiveness, is well established and is regularly used by more than 50 countries in Europe and Worldwide. While development of a completely new measurement system was considered, existing measurement systems were also reviewed as potential platforms and the EUROCONTROL/CANSO measurement frameworks were selected as a basis for development of an enhanced measurement methodology which can: -

- Serve as the extended basis for effectiveness measurement,
- Enable the assessment of performance of the SMS with the proposed enhancement measures applied – as compared with SMS performance without enhancements - and
- Identify the relative benefit of each enhancement to be identified, thus maximising the value and priority of the work involved in applying each enhancement measure.

These requirements have led to the development of a mathematical model using Bayesian analysis designed for adaptation by Air Navigation Service Providers to their local environments. The research undertook simulations of enhanced SMS at two levels of complexity of SMS architecture.

The use of Bayesian Networks, supported by propriety software, enables dynamic, real-time adjustment of enhancement inputs to the SMS.

The research conducted, and presented in this Thesis, offers a comprehensive portfolio of measures designed to enhance the management of ATM safety. These provide a means to offset the degradation of safety levels over the next decade that would otherwise take place due to the challenges and threats facing the industry over that time.