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The three papers comprising the Safety theme showed powerful techniques for safety assessments for different aspects of air traffic control systems and operations. Overall, the quality of the papers was exceptional and represented the leading edge of scientific and engineering application of safety methods to important challenges with future ATM systems. All three papers had European authors representing government and academia, and the estimated audience participation ranged from 20 to 30.

The paper from the University of Belgrade and NLR provided a framework to feedback safety risk analysis to designers of operational concepts, notably ACAS. The research highlighted the difference between ICAO-defined encounter models and petri-based models that are flexible and have a stronger mathematical foundation. The ACAS mathematical model was found as effective compared to an ACAS simulation model as well as with use of limited historical real life data.

The paper from the Dresden University of Technology addressed model-based development of safety requirements applied to the design of an innovative virtual airport tower. The paper described an extension of traditional methods and showed how this can be used in a straightforward manner to examine the human-machine interface design to identify hazards with the remote visual system. The outcome from the approach is the identification of safety requirements such as resolution of the video display.

The NLR paper focused on an event sequence-based risk model applied to runway incursion scenarios. The contrasting of safety assessment techniques supported the socio-technical system viewpoint that studying the interactions of human operators and technical systems in the operational context is necessary to understand the level of risk elasticity. It was noted that Kevin Corker's work with Air Midas served as a framework for the multi-agent dynamic risk model. The paper also included an analysis to provide insight into which agents were the main risk contributors. Such results can be used to optimize system design from a safety perspective.

The session highlighted the importance of developing modeling agents including the human operator and for analysis of normal and off-normal scenarios. This broad set of scenarios is needed for an effective foundation for model validation and safety analysis under uncertainty and limited availability of historic data. The specificity of the conceptual model is key to sharpening the focus and assumptions of the safety analysis. However, an important shortcoming in many safety techniques is the need for improvement in how risks are subjectively identified. Continuing the trend from previous ATM Seminars, transitions of new technologies with NextGen and SESAR pose challenges to safety risk analysis and highlight the need for use of incident and accident data to refine model development. Research should continue to study approaches on how to model and assess the effect of interactions of humans with technical agents that are distributed across air and ground automation systems and approaches to study the safety of complex systems with non-trivial interaction among components. Future research directions should be shaped as concepts of operation become more detailed.