SEVENTH FRAMEWORK PROGRAMME

AREA 7.1.3.4. OPERATIONAL SAFETY

PROSPERO PUBLISHABLE SUMMARY

PROactive Safety PERformance for Operations

Grant agreement n° 314822

Background

New international regulation for aviation organizations and for states demands an approach to safety that is preventive and proactive rather than reactive, is performance driven, and able to deliver verifiable improvement. However, this cannot be realized without the capability to anticipate and prevent complex system accidents and this is lacking in the following ways. The most used risk assessment methodologies are based on expert judgment unsupported by extensive data. Anticipation of specific risks is not fine-tuned enough for preparation for potential emergencies to be integrated into normal everyday operational planning. There is no integrated risk metric for the Air Transport System that allows risks of different types and sources to be assessed with reference to each other. The lack of a system-wide risk metric makes it impossible for system improvements to be evaluated against a projected risk reduction target. There is no standard for safety performance that a regulator can use to audit, evaluate or require an operator to improve its safety system.

As stated in the PROSPERO description of work (DoW) the project planned to develop, implement and evaluate a prototype management system for identifying and actively managing systemic risks in the Air Transport System, including complex and novel interactions. This included the following components:

- A common operational concept of performance indicators representing inputs, ongoing activity as well as outputs of the ATS. These performance indicators will link safety to other operational goals.
- A methodology for operational system analysis that can support hazard and risk assessment, investigation, modeling and simulation of future systems, managing organizational change and system redesign. A new taxonomy will build on and extend the range of ADREP to encompass a full range of aviation socio-technical system concepts.
- A generic system-risk-management process involving all ATS stakeholders. This is based on the premise that “the risk is built in before the operation starts and needs to be managed through the whole operational lifecycle”. This includes
    - The production of risk information from operational monitoring and analysis

    - The supply of information on system status, including the aircraft and other technologies, route, personnel, weather, traffic.
    - Risk management across the operational cycle – design, planning and supply, operational management (dispatch, operations)
    - Feedback and learning
- A software system to support the socio-technical analysis and redesign of ATS, data integration, data monitoring and analysis, learning, capturing tacit knowledge, hosting on appropriate technologies and interfaces and links with complimentary applications.
- A dissemination and exploitation process will manage active real-time engagement with the wider aviation community and key institutional stakeholders, including the following: SESAR, SES PRB, EASA, IATA, ACI, FAA, ICAO, so as to ensure that PROSPERO delivers what the industry requires and that there is a clear path to the adoption and implementation of its methodologies, tools and organisational framework.

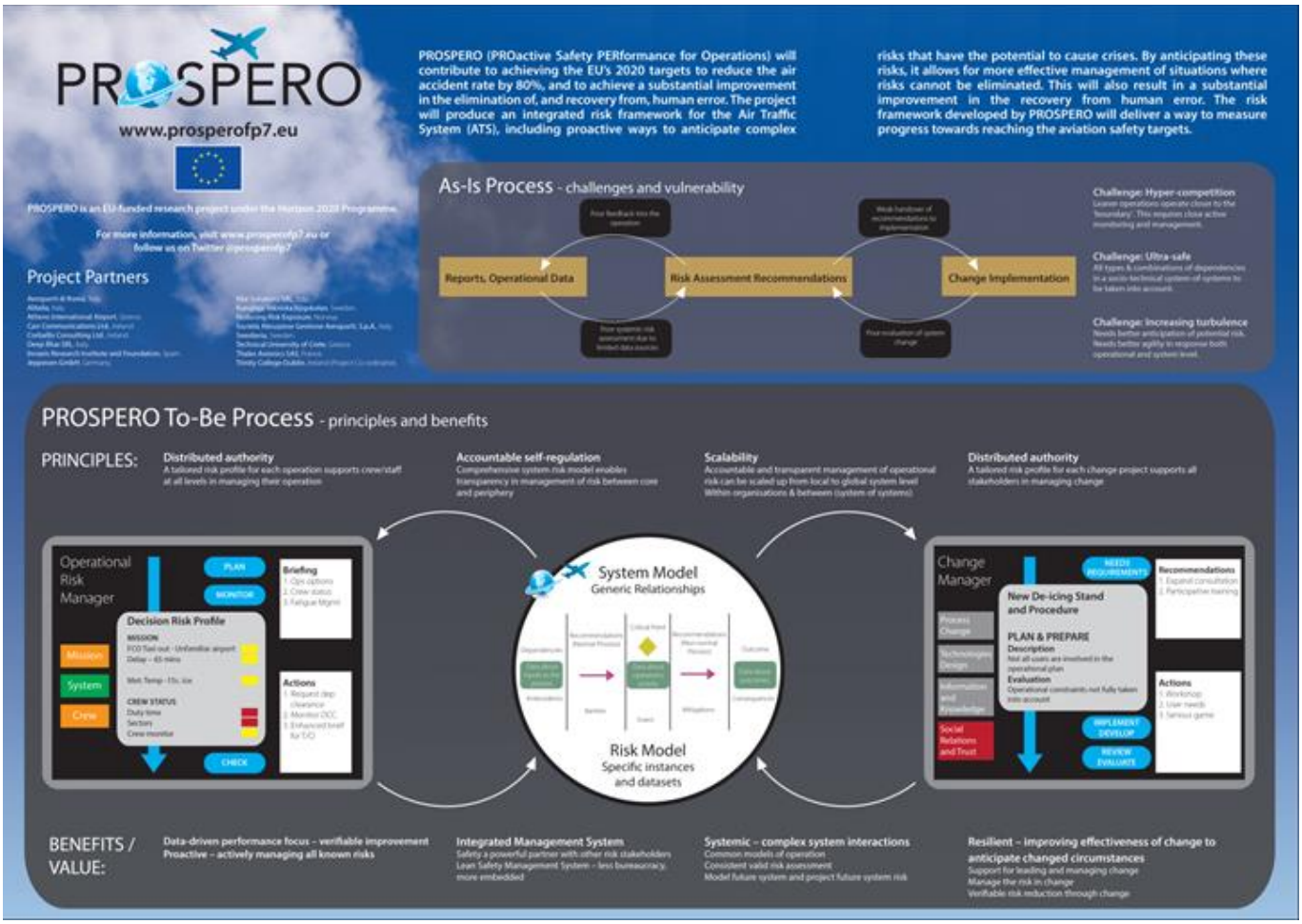

Figure 1 Overview of PROSPERO Concept

Achievements

PROSPERO delivered on these objectives in two parallel work streams: the development and demonstration of the core PROSPERO system as a data and information transformation process; and as a set of case studies concerned with the organisational aspects of the implementation of the system.

PROSPERO System

The PROSPERO architecture was defined in terms of four core elements as follows:

1. Data Providers (DP): *The end users providing access to risk data*
2. Risk Information Analysis Providers (RIAP): *The network of services to organise and process risk data*
3. Risk Intelligence Distribution Providers (RIDP): *The network of services that allows the risk data exchange and communication*
4. Risk Intelligence Use (RIU): *The end users receiving the new knowledge on risk and how to apply such knowledge for risk management, advanced SMS uses, system design and change management uses.*

The PROSPERO system was then modelled in three ways:

- PROSPERO Information Flow system – *mapping the step-by-step data transfer / communication flow across the PROSPERO system users*
- PROSPERO Aviation Integration Process – *mapping the tasks and actions of coordinated multi-partners developing system risk models*
- PROSPERO Role maps – *mapping all expected roles allocated to various risk functions*

Following the definition of the architecture, the activity was to adapt the partners' IT capacities and to develop the new features required to reach the system demonstrator definition in accordance with the retained case studies covering organizational and systemic level. It addressed the risk information production (Risk pattern production, Risk monitoring or pattern patching, Risk information bulletin) and the management of change (Risk pattern's evolution due to change). Then, the data collected from the case studies and provided by the end-user partners were integrated within the platform demonstrator as the PROSPERO IT capacities to enable the PROSPERO system demonstrator. The finalisation work was to validate the PROSPERO demonstrator by executing the demonstration with respect to the case studies and analysing the results. The successful final demonstration (D4.16) in June 2015 to the EC where the PROSPERO platform demonstrator was presented through the demonstration of 3 case studies. Although the collaboration at systemic level (i.e. between organizations) is a real challenge in sharing data (not from technical perspective), it was demonstrated that even with few operational datasets from different stakeholders, the data analysis brings value in risk assessment and monitoring. The predictive capacities are an innovative safety approach which focuses on the precursor's analysis to better monitor operations and changes.

Case Studies

The overall objectives of WP5 were to organise and perform a set of Case Studies to support the actual development and implementation of the PROSPERO methodology at different levels of application. Three sets of Case Studies were designed and carried out in accordance with the three level of complexity of the PROSPERO approach. The case-studies commenced at *organisational level*, in which each industrial stakeholder within the Consortium will develop and implement a case study properly shaped on its everyday activities. The second set of case studies, referred as *systemic level case studies*, proposes one common scenario focusing on integration of an operational situation engaging different types of stakeholders. Finally, the overall integrated PROSPERO approach enabled the implementation of a single case study at *regulatory level*, where all lessons learned in the previous case studies will be integrated in a regulatory perspective.

At organisational level, Five Case Studies were undertaken in the project, which ranged from new risk analysis based on cross-organizational big data analysis and predictive statistics to shared stakeholders change initiatives with very-long term horizons. The Case studies are as follows:

Case study 1 investigated the feasibility of identifying, integrating multiple data sets and domains (in Aeroporti Di Roma airport and Alitalia airline) successfully and identifying risk patterns as defined in Deliverable 3.6 and 3.8 of PROSPERO. A Key objective was to prove capacity of integrating and predicting bird-strike events as key hazard selected in the Project.

Case study 2 analysed the change and risks related to a complex procedural change in de-icing operations at the apron. A Change Management methodology was set and applied to test what kind of issues could arise from this change and how the company could manage and control risk in change.

Case Study 3 analysed the provision of a performance management system to support a full cycle of SMS on core operations for a small regional airport, linked to the airport core strategic objectives and the evaluation of the organizational changes initiated through this process. A combination of Prospective and Retrospective risk analysis support company operations and performance monitoring/evaluation.

Case Study 4 studied and supported the full implementation of ACDM at Arlanda airport. This involved the collaboration of a wide range of operational partners together with the airport authority.

Case Study 5 developed a risk metric for representing the complexity of air traffic in a sector to support air traffic controller decision-making and operational risk management. An ATM dashboard has been developed integrating aspects of complexity, safety and operations in air traffic control.

At systemic level: taken as a whole these case studies illustrate the PROSPERO system at the level of the Air Transport System (ATS). They illustrate both the operational loop of risk data and the change management loop, both of these involving different actors in the ATS. In essence, the "bird-strike" case study (Case Study 1) and the ATM complexity (Case Study 5) represent the Prospero Operational loop (combined as an ATS solution). The ADR and ACDM cases (Case Study 2 and 4) represent change; not just airport change, but also the other ATS partners. SAGA case about SMS implementation (Case study 3) represented both the Operational to the Change management loop with a whole system risk assessment airport, airline, ATM, emergency services. A complete system level case.

The case study at regulatory level consisted in a workshop held at the end of June 2015 at EASA premises in Cologne, with the following objectives:

- To present an overview of the PROSPERO concept and its realisation in a set of case studies;

- To discuss ways in which the PROSPERO approach addresses current regulatory activities in Europe concerning, for example, performance, safety, risk, reporting and organisational requirements;
- To discuss potential benefits for regulation and for national and European authorities that could arise from implementing the PROSPERO approach in aviation organisations;
- To address future developments in areas like software systems, safety services and research priorities.

EASA Work-Shop

The workshop combined presentations of the PROSPERO concept, the system and the case studies alongside presentations from EASA on: mandatory and voluntary reporting, SMS, risk assessment; performance of the whole Air Transport system. The EASA focus is to try to make this work as a system, not just as a set of rules and standards. Thus it is required under the reporting directive to report the analysis of the event and the implementation of actions, and to encourage more comprehensive voluntary reporting. They want to make the ECCAIRS database that holds all this data more accessible and usable by the aviation community. This is part of a shift in thinking towards considering regulation as part of a global SMS. EASA are very interested in large data, sharing of data between organisations and responded with interest to the ideas put forward about this being a knowledge business, and about gathering risk data from all the services along a process, integrating and then reapportioning the resulting risk information to each service provider according to its process, creating networks of sharing through nodes (airports, ATM) so that competing airlines are not forced to directly share, but only indirectly through common interest and common value. They were impressed with the range of work and the depth of involvement with the operational organisations. There was a good discussion on the issue of confidentiality and the possibility of configuring this in a slightly different way, including how protections could be built in. The Single European Sky is in Reference period 2 (2015-1019) but are already planning for RP3 (2020). This is where they hope to be able to achieve an effective safety performance metric. PROSPERO could be seen as part of the solution to this. There are important opportunities both for a commercial PROSPERO solution and for a follow-on project to contribute tangibly to this strategic goal.

Validation

PROSPERO functionality has been validated in three case studies: (a) managing the risk of change in European airports, (b) Air transport system risk assessment based on shared data between airports and airlines, and (c) supporting compliance with and satisfaction of European regulatory requirements. The following functions have been successfully validated: (1) the Structured Enquiry to support the change management loop, (2) data sharing among aviation stakeholders, (3) data integration, (4) data mining, (5) risk pattern matching, and (6) risk intelligence distribution.

The following challenges have been identified that should be investigated in further work:
(a) Access to data and data quality remain a crucial issue. Ways for overcoming barriers to data sharing should be investigated, and the benefits of data sharing need to be clearly articulated and demonstrated to stakeholders.
(b) The bird strike example was a convenient case study as it facilitated access to data, but it limited the utility of the PROSPERO functions. Further case studies should explore the extent to which the data integration, data mining, risk pattern matching, and risk intelligence distribution functions enhance the existing risk model for other types of events.
(c) The bird strike example operated with partially simulated data. Further work should investigate the feasibility of data integration, data mining, risk pattern matching and risk intelligence distribution in a live environment with large amounts of disparate data.

(d) At the regulatory level, further work should explore practical ways in which PROSPERO can support not only compliance with regulatory requirements, but also facilitate regulatory oversight functions themselves.

Future

PROSPERO promises to deliver a new concept of safety management based on the concept of risk knowledge. Risk knowledge comes from large and diverse data sources accumulated along a process, analysed and fed back to the process owners. Its emphasis on the antecedents or precursors of risk identifies what needs to change to gain the maximum leverage in preventing and mitigating risk. It supports the management of change, through in-depth analysis, collaborative participation and monitoring progress; it creates accountability for the implementation of recommendations for change. Through sharing of selected data it enables the building of comprehensive system risk models in which shared risks can be effectively controlled and providing oversight over suppliers and sub-contractors. It is a bottom-up approach that empowers all participants from the operational sharp-end to strategic management, to monitor, manage and improve the risk profile for which they are responsible.

Immediate goals for PROSPERO in the period after the project, include the consolidation and further development of an integrated software system to serve flight operations, airport ground operations, aircraft maintenance. An ATM performance and risk concept should fully integrate with this, based on complexity metrics developed in the project. This will be collaboratively implemented in a network of operational users serviced by a multi-functional knowledge business. A wider interest group developing and disseminating these ideas in a learning community will be supported by the new Masters programme on Managing Risk and System Change in TCD.

PROSPERO fulfills the current SMS requirements for all aviation organisations to be proactive, systemic and performance focused. This approach will enable the development of an integrated Air Transport System (ATS) safety performance management concept that can fulfil the safety goals of Single European Sky for reference period 3 (commencing in 2020).