



Operational Risk: Implementing Open Norms (ORION)

Intellectual Output 1 (IO1) Report November 2021 SMS Maturity assessment

**Authors: Pernilla Ulfvengren (KTH), Nick McDonald (SCL),
Daniele Baranzini (Ergo), Vassos Lappa (KTC), Thomas
Demosthenous (KTC), Derek Ross (TCD), Siobhan Corrigan
(TCD)**

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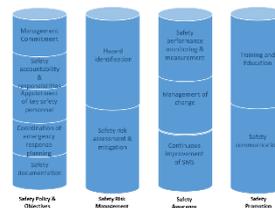
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Executive Summary

This report details the findings of the SMS Maturity Assessment conducted as part of Intellectual Output 1 of the Operational Risk: Implement Open Norms (ORION) project. The activities conducted provided understanding of the needs and requirements for designing and developing a SMS implementation training concept based on current practice and challenges identified together with ORION industry associated partners. A standard safety management system is a combined approach with safety risk management focus that has adopted a quality and process-based approach for reducing or controlling operational risk.

A standard SMS has four components:

- Safety policy and objectives
- Safety risk management
- Safety assurance
- Safety promotion

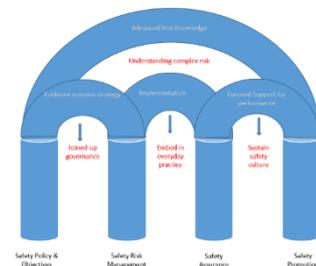


A state of art SMS implementation training is necessary and sufficient for implementing a SMS. However, our findings show that it is not sufficient for maturing a compliant SMS to the level of excellence. ORION provides a comprehensive SMS training and in addition ORION developed a training concept that address needs and requirements that address challenges to mature from compliance to excellence.

The concept is aimed for advanced risk knowledge enabling the four components of the SMS to be linked and bridged to provide for functions in the SMS that will improve safety performance, demonstrating reduced operational risk. The generation of this knowledge about the system safety requires significant amounts of data to be elicited, managed and effectively analysed in order to establish a realistic understanding of the system as close to real time as possible. The resulting knowledge needs to be transformed into actions that uphold or enhance safety of the system for its members and users. In aviation regulators require all service providers to implement a safety management system.

The SMS framework is visualized as the overarching functionalities of the SMS components that are bridged by these concepts.

- Complex risk – advanced risk knowledge.
- Fully embedded SMS – implementation
- Joined-up governance – evidence sustains strategy
- Sustain safety culture – focused support for performance



ORION provides, as a result of this work, a state of art SMS training as well as the resulting advanced training for SMS excellence.

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Introduction

This report details the findings of the SMS Maturity Assessment conducted as part of Intellectual Output 1 of the Operational Risk: Implement Open Norms (ORION) project. This report focuses on activities conducted to provide a clear understanding of the needs and requirements for designing and developing a SMS training concept based on current practice and research together with industry associated partners. The findings of the ORION project are intended to be applicable to other contexts and sectors. It is also recommended that wider literature on SMS specific to sectors is considered to support the localisation of findings presented here.

Below a brief definition and description of the Safety Management System (SMS) is provided. Following this an overview of the ORION project and the focus of Intellectual Output 1 is presented.

What is a Safety Management System (SMS)?

The International Civil Aviation Organisation (ICAO) define a Safety Management System (SMS) as, *“a systematic approach to managing safety, including the necessary organisational structures, accountabilities, policies and procedures,”* (ICAO, SMS Manual 4th edition, 2018). The overall aim of a SMS is to proactively and prospectively manage safety in order to minimise risks to system through the removal or mitigation of hazards. A SMS is based on an inclusive philosophy whereby each actor within a defined system actively contributes to safety. This is often achieved through communicating safety and relevant performance related issues through formal reporting systems. As ICAO state, *“safety management effectively implemented can lead to a documented, process-based approach to safety, as well as a better understanding of safety-related interdependencies and relationships,”* (ibid). Therefore, the generation of knowledge about the system safety requires significant amounts of data to be elicited, managed, and effectively analysed in order to establish a realistic understanding of the system as close to real time as possible. The resulting knowledge needs to be transformed into actions that uphold or enhance safety of the system for its members and users.

The ICAO SMS Framework is set around four components (also referred to as pillars of SMS).

- Safety policy and objectives:
 - Management commitment and responsibilities;
 - Safety accountabilities;
 - Co-ordination of emergency response planning;
 - SMS documentation.
- Safety risk management
 - Hazard identification;
 - Risk assessment and mitigation.
- Safety assurance:
 - Safety performance monitoring and measurement;
 - Management of change;
 - Continuous improvement of the SMS.
- Safety promotion:

- Training and education;
- Safety communication.

The ORION Project Overview

The Operational Risk: Implementing Open Norms (ORION) project has developed and implemented training to foster soft socio-technical skills for fully implementing and embedding a safety management system (SMS) and managing operational risk. ORION focuses on the skills needed to make the transition between fulfilling the formal requirements of a SMS and having a system that is fully embedded in normal operational practice so that it is fully part of the culture of the organisation, ensuring effective practice according the best practicable standards and delivering a high and constantly improving level of safety. This requires the skills and capability to productively address the systemic factors that influence and motivate people to behave in particular ways and to facilitate change. It also requires learning from others' experience.

The ORION project is co-funded by the Erasmus+ Programme of the European Union.

Objectives

The overall goal of ORION is to improve outcomes in the management of operational risk, across a wide range of risk-critical industries. Knowledge can also be utilized to contribute to a stronger economy and business model in the provision of safety related services across safety critical industries, and to promote a culture of sharing and learning from best practice in implementation among industry partners.

The aims of the ORION project are delivered through five objectives:

1. To design and develop training materials to support and facilitate implementation and embedding of SMS in norms of practice and effective management of risk in the operation.
2. The training can be delivered in short courses in the associate organisations. A common train-the-trainer programme leading to training in the ORION project Associate Partner organisations, each was directly supported by an ORION partner.
3. The training and support aims to result an implementation case study approach. This is intended to build and extend the knowledge base of evidence that links multiple implementation cases studies.
4. A validation programme starting with stakeholder needs and progressively verifying delivery on those needs and validate the project outcomes.
5. Utilising evidence on each of these activities to contribute to the development guidelines for open norms of best practice in the full implementation of SMS.

Background to the ORION Project

The background to the ORION project are framed around several complementary identified needs:

Implementing SMS and Managing Operational Risk

The Associate Partners of this project are in various stages of implementing SMS and integrating SMS with OHSAS. They need to achieve real value from this organisational effort.

Embedding SMS requires building actual norms of behaviour and performance, reporting, implementing improvement.

Creating an evidence base

An empirically grounded evidence base of SMS implementation is lacking. While ORION is based on a wide range of research in certain industries (aviation, maritime, health, emergency services), there is a need to create a more comprehensive evidence base of what works in implementing SMS across a range of industries and regions.

Best practice guidelines

There are not many standards or much guidance as to how to implement and embed SMS. One good example of best practice guidelines comes from the Civil Air Navigation Services Organisation (CANSO) who published a Standard of Excellence in Safety Management Systems (SoE in SMS) and an associated implementation guide to support ANSPs (Air Navigation Service Providers) in their safety management. The CANSO SoE in SMS is compliant with ICAO Annex 19 (ICAO. Annex 19: Safety management. International Civil Aviation Organisation; 2013). This is largely a generic standard that is easily applicable to other industries. Level E of this standard is the highest level of implementation and embedding of safety practices that are shown to be effective. Another example is Transport Canada guidelines for both development and assessment of SMS in aviation. However, while there is a strong logic to these documents it lacks a solid evidence base from actual implementation.

Generate Open Norms

Overall, it is important to demonstrate what is possible in terms of good practice in SMS implementation across a range of industries. This then shows what could and should be normal. Creating open access to this evidence in implementation case studies begins to build open norms of how to progressively improve the real functioning of SMS in dealing with the pervasive intractable problems of operational risk.

Intellectual Outputs

The results of the ORION project are linked directly to the Intellectual Outputs and Multiplier Events that have been delivered through the project. Each of the Intellectual Outputs provide important results that are of value to the industries and sectors who are represented by the Associate Partners in the ORION project. These are described briefly below:

Intellectual Output 1 (IO1) SMS Maturity Assessment

Intellectual Output 1 provides a report synthesizing research evidence and best practice guidelines, together with an analysis of the current maturity level of Safety Management Systems (SMS) in the Associate Partner organisations. This analysis will support the development of SMS Implementation Training.

Intellectual Output 2 (IO2) SMS Implementation Training

Intellectual Output 2 (IOS) provides an overall training design for train the trainers within the partnership as well as training SMS facilitators within the Associate Partners (including design of the facilitation and training to be offered by the facilitators in their organisations). This training includes developing an implementation case study approach. An initial training design and development activity occurred ahead of training events delivered to each of the Associate Partners that supported the full SMS implementation activity.

Intellectual Output 3 (IO3) SMS Implementation Validation

The purpose of Intellectual Output 3 (IO3) is to demonstrate how to undertake validation to provide confidence that the concept being developed and implemented meets the stated objectives in practice. Key activities of the validation tasks in ORION are to:

- Ensure the SMS needs are fulfilled.
- Iteratively verify and validate components and activities through stages of concept, design, implementation and operations during project.
- Feedback to various providers of progression according to requirements along the development stages.

Intellectual Output 4 (IO4) SMS Implementation Framework

In Intellectual Output 4 (IO4) best practice guidelines are consolidated the initial evidence base, the training designed and delivered, and evaluated and validated using a case-based approach. This draws on the lessons learned about implementation to inform guidelines for best practice in implementation.

Intellectual Output 5 (IO5) SMS Norms of Practice Manual

Intellectual Output 5 (IO5) offers guidance on SMS Norms of Practice and consolidates lessons representing the core aspects of each of the previous outputs. This is designed to maximise transferability and impact by presenting in appropriate media the essential content of the ORION programme. This is innovative in providing concise evidence-based standards of good practice in SMS implementation, that are carefully designed to be easily transferable between organisations, across industrial and service domains, and spanning different regions. The SMS Norms of Practice provides a material report for the that can be used to support ORION SMS activities.

Intellectual Output 1 (IO1) - SMS Maturity Assessment

This report presents the work conducted in order to provide a clear understanding of the needs and requirements for designing and developing a SMS training concept based on current practice and research together with industry associated partners.

The tasks that have been performed and reported in IO1 are as follows:

1. Compiling research evidence on SMS implementation
2. Reviewing best practice models of implementation
3. Compiling needs and requirements of associate partners
4. Developing a SMS training concept

These tasks were consolidated in a safety management system (SMS) maturity assessment including a gap analysis between a standard SMS and current maturity level of Safety Management Systems (SMS) within the associate partner organisations. Common challenges and needs identified lay the ground for requirements for training that can contribute to improve outcomes in the management of operational risk in a wide range of risk-critical industries

Method

The project started with a kick-off meeting where the overall objective with ORION was introduced and at which all ORION project partners shared and discussed best practice and research from SMS implementation and SMS training leading up to the ORION project. The ORION project partners have participated as full partners and as external end-users in multiple EU funded research projects lead by the Centre for Innovative Human Systems (CIHS) at Trinity College Dublin for more than 10 years.

Our series of research projects over more than a decade has served as the main basis for research evidence on SMS implementation. A full literature review was not conducted, however, continuous research give us confidence to state that there are few, empirical studies demonstrating successful implementation of SMS. The HILAS-project (EU Fp7, 2005-2009) resulted in two case studies during the early age when SMS was first regulated in aviation. These have contributed to our knowledge and experience leading up to ORION.

Activities for compiling needs and requirements for SMS implementation and training from industrial partners were initiated in parallel with review of earlier research and searching for best practice models. Each ORION project partner paired up with a local industry associated partner and conducted a mix of observations, interviews and workshops. The local teams of project and associate partners already had an established working relationship which facilitated access to the field and transparency and learning from the beginning.

The task of reviewing best practice models of implementation of SMS was performed using recommendations rather than existing best practice models of fully implemented SMS. Regulatory bodies provide documents like the ICAO SMM (ICAO, 2018) CANSO SMS maturity model and the Transport Canada's SMS implementation guidance. However, the approach taken to identify as-is and best practice was to assess our industry partners' safety activities and safety management systems with respect to these guides. Further a comparison

between all project teams' gap analyses provided indications of common challenges with implementation of SMS.

After reviewing common guides and concluding that they had many similarities the UK SMS assessment checklist, based on the standard ICAO SMS structure, was selected. Each partner performed a maturity assessment of their current practice and SMS components and elements. The data was gathered in a mix of industrial partner self assessment, complementary interviews, workshops and observations with industrial partners. Our subjects were part of the safety departments or had a role in safety and quality functions in their organisations.

The ICAO SMS or UK CAA was used across all ORION research teams, regardless of the type of operations partners have in order to be able to compare partners' current practice. Using the same tool for all gap-analyses between safety management activities in associate partner organisations and a standard SMS allowed for consolidating and comparing results.

In addition to the maturity assessment of their SMS, needs and requirements on perceived challenges with general organisational capabilities, implementing and sustaining change and how to manage reports and data effectively were central issues. It was up to each partner to identify their main focus and needs for improvements that they would like to develop support for within ORION by identifying training needs for further implementation of each partner's SMS.

Research evidence on SMS implementation

In order for a management system for operational safety or occupational safety and health to be effective, it needs to be fully embedded in everyday practice so that good safety practice becomes part of the norms and culture of the organisation. Yet most organisations find it enormously challenging to make the transition from having a management system 'on paper' to living it on a day-to-day basis. It requires the skills and capability to productively address the systemic factors that influence and motivate people to behave in particular ways and to facilitate change.

Organisations facing risk to personnel or public in their operations are required, or have aspirations on their own initiative, to implement a safety management system. It is known that independent of aspirations there is a great difference between the formal requirements and having a system that is fully embedded in normal operational practice and one that functions fully in ensuring improved safety according to best practice. Developing and implementing an SMS typically follows stages of forming structure and process. This usually includes policy and strategy for safety, administrative arrangements and standard processes for reporting and risk management. Making this work in practice is then left to /up to the collective effort of all playing their various roles – but this does not happen spontaneously and requires focused attention on the 'soft' side of managing people and fostering organisational culture.

In earlier research dating back to 2008 and the HILAS EU-project, the second draft for the ICAO SMS was produced by regulatory bodies in aviation. Already then two aspects stood out in this new approach to managing safety. First the integration of the management of

safety into the overall management system of the organization; and second that this should be a performance-based regulation, capable of demonstrating its implementation and effectiveness in terms of measurable operational outcomes, related to safety (Ulfvengren et al., 2009).

Pre-implementation concerns were raised against the anticipated challenges with these new aspects. Aviation as any domain of organisations ought to have similar difficulties in implementing changes and sustain these over time, system safety models that could translate measurable outcome into safety are rare and the fact that actual events are very rare in aviation the time allowed for evidence to be presented would be uncertain. There were also positive hopes for the integration aspect to provide balancing forces against commercial interests undermining safety risk. A growing general concern at the time since new business models for aviation industry had introduced low cost airlines. It was also questionable that a safety regulator actually could mandate such an integration since this would be a much broader scope of dictating the management of the business, which is not a safety regulators mandate, due to the assumed relations between the management and organization as a whole with its value producing operations, where safety is manifested. These concerns implicated that there was a real risk that the new regulatory SMS would become a paper product and not become the intended integrated management system.

Two case studies from aviation during this early age of regulated SMS has contributed to our knowledge and experience leading up to ORION. One case was studying initial implementation and development of an SMS in an airline (Ulfvengren et al., 2015), and the other case study demonstrated a combined approach of performance improvement and hazard identification in a maintenance and repair organization (MRO) (Ward et al., 2010).

Both organisations' environments were dominated with quality and lean production systems aspirations to reduce costs and waste. In the airline case the core initiative was to develop a state of the art SMS, including an updated safety management manual as well as improving existing use of safety risk data and in particular visualizing data across departments in a process-based approach. In the MRO case safety and risk management activities were integrated with Lean and Six Sigma projects.

These case studies also gave evidence of the enormous financial pressure that aviation faced during the project time. The MRO was closed down and the airline was hours from bankruptcy.

Still, these case studies were in many aspects successful, especially the MRO went through an extraordinary experience with a successful integrated organizational change which lead to tangible and measurable outcomes resulting from an intentional change initiative. The airline did manage to implement an SMS and became compliant in time for the regulatory deadline for airlines to keep their AOC (air operator's certificate) and was also awarded for their safety activities.

Given the concern that integration with other management system could become problematic, the lean and quality initiatives were seen as potential guarantee for the SMS to actually become integrated into current management processes (for example products,

supply, operations and control functions). From experiences working with manufacturing organisations with mature lean production systems' best practice of organizational capabilities for evidence-based and process-based improvement work had been observed. However, lean production systems as well as traditional quality management was developed in manufacturing and not in complex and safety critical operations such as aviation, health care and emergency response services.

There is little empirical results demonstrating that adopting performance- and process-based approach, integrating safety and quality, in a safety management system actually facilitates improvement work in safety critical systems that are operating in complex and dynamic contexts. The integration between safety and quality is still unresolved and more recent research report on efforts of total safety management, replacing Quality in traditional TQM with Safety. Here researchers make a push for, for example, the business value that is latent from safety and risk-based considerations in organisations (Kontogiannis, Leva and Balfe, 2017).

In three consecutive research EU-projects (HILAS; MASCA; PROSPERO) operational risk management and management of system change was studied in relation to aviation safety. A set of components, processes and functions were identified as essential to make the SMS components function well together. These are considered as socio-technical processes that connects the "in-betweenness" between components and elements.

In attempts to fully implement an SMS this research developed a methodology for analyzing these sociotechnical aspects along a "full cycle of managing operational risk". These cycles or loops are sociotechnical processes including information (from data or knowledge) that flows from operations through various layers in the organization, between departments, persons, meetings etc. with the purpose to manage operational risk. This is independent of where in the safety management processes or what SMS method or tool is being used.

[Best practice models SMS implementation assessment guides](#)

In the introduction the basic components of a standard SMS is presented (ICAO, 2018). In another standard like the Transport Canada guidelines (TC, 2008) it is stated that "an SMS is an explicit, comprehensive and proactive process for managing risks that integrates operations and technical systems with financial and human resource management, for all activities related to a CAD (civil aviation document)".

"Practically speaking, a SMS is a business-like approach to safety. In keeping with all management systems, a SMS provides for goal setting, planning, and measuring performance. It concerns itself with organizational safety rather than the conventional health and safety at work concerns. An organization's SMS defines how it intends the management of air safety to be conducted as an integral part of their business management activities. A SMS is woven into the fabric of an organization. It becomes part of the culture; the way people do their jobs."

"The organizational structures and activities that make up a SMS are found throughout an organization. Every employee in every department contributes to the safety health of the organization. In some departments safety management activity will be more visible than in

others, but the system must be integrated into «the way things are done» throughout the establishment. This will be achieved by the implementation and continuing support of a safety program based on a coherent policy that leads to well-designed procedures.” (Transport Canada, 2008)

In TC document fully implemented can be compared with descriptions like “woven into the fabric of an organization. It becomes part of the culture; the way people do their jobs”, “the system must be integrated into «the way things are done» throughout the establishment” and “every employee in every department contributes to health and safety” etc.

TC (2008) argues that there is no definitive meaning attached to the term «SMS» and that every organization, and industry has its own interpretation of what it is.

TC (2008) describes five generic features to characterize a SMS:

1. A comprehensive systematic approach to the management of aviation safety within an organization, including the interfaces between the company and its suppliers, sub-contractors and business partners.
2. A principal focus on the hazards of the business and their effects upon those activities critical to flight safety.
3. The full integration of safety considerations into the business, via the application of management controls to all aspects of the business processes critical to safety.
4. The use of active monitoring and audit processes to validate that the necessary controls identified through the hazard management process are in place and to ensure continuing active commitment to safety.
5. The use of Quality Assurance principles, including improvement and feedback mechanisms.

Depending on how an SMS is characterized the distinction between compliance and fully implemented may vary. It has been discussed (Ulfvengren and Corrigan, 2017; Dijkstra, 2006) that despite the intention with SMS as a performance based regulation in aviation, compliance may still be a “tick-box activity” with presence of various functions assessed sufficient, but without having a fully implemented system that works as a whole. The difference between an organization and documented structure and documented processes manual between functionality that demonstrates safety performance. TC (2008) stress this fact: “Attention should also be given to the linkages between the individual components; they should be linked in a systematic way, rather than appearing to be stand-alone units”.

SMS maturity assessment

A maturity assessment is commonly used to identify areas in need of improvement. The maturity is defined as how well the various system components works, the SMS’s effectiveness. A scale is used when assessing each component and sub-components of the SMS. A SMS element, component or process is categorized according to these definitions for individual markers:

- Present- There is evidence that the ‘marker’ is clearly visible and is documented within the organisation’s SMS Documentation.
- Suitable- The marker is not unsuitable based on the size, nature, complexity and the inherent risk in the activity that would also consider the industry sector

- Operating- There is evidence that the marker is in use and an output is being produced
- Effective- There is evidence that the element or component is effectively achieving the desired outcome

A consolidation of the overall assessment is then ranked on a scale to determine what level of maturity the SMS reaches, figure 1, according to these definitions:

- Effectiveness Not Achieved - The overall effectiveness of that element has not yet been achieved
- Effectiveness Achieved - All compliance + performance markers are at least operating and the overall effectiveness for that element is achieved
- Signs of Excellence - Effectiveness is achieved as above and up to half of the excellence and best practices markers are at least operating
- Excellence - Effectiveness is achieved as above and at least half of the excellence and best practices markers are effective



Figure 1: Maturity levels in SMS assessment.

An example of the template and difference between assessment criteria for compliance and excellence is shown for the element of Hazard identification (table 1-2). See more details in a standard SMS maturity assessment template for detailed information of each part being assessed.

Table 1. 2.1 Hazard identification – for compliance

COMPLIANCE + PERFORMANCE MARKERS	
2.1.1	The organisation has a reporting system to captures errors, hazards and near misses that is simple to use and accessible to all staff.
2.1.2	The organisation has proactively identified all the major hazards and assessed the risks related to its current activities.
2.1.3	The safety reporting system provides feedback to the reporter of any actions taken (or not taken) and, where appropriate, to the rest of the organisation.
2.1.4	Safety investigations are carried out to identify underlying causes and potential hazards.
2.1.5	Safety reports are acted on in a timely manner.
2.1.6	Hazard identification is an ongoing process and involves all key personnel and appropriate stakeholders.
2.1.7	Personnel responsible for investigating reports are trained in investigation techniques.
2.1.8	Investigations establish causal/contributing factors (why it happened, not just what happened)
2.1.9	Personnel express confidence and trust in the organisations reporting policy and process.

Table 2. 2.1 Hazard identification – for excellence

EXCELLENCE AND BEST PRACTICE MARKERS	
2.1.10	There is an active reporting system indicated by reporting levels of more than 1 report per employee per year.
2.1.11	Safety Reports include the reporter's own errors and events that the reporter would not normally report (events where no-one was watching)
2.1.12	The reporting system empowers personnel to propose preventative and corrective actions.
2.1.13	The reporting system is actively used throughout the organisation.
2.1.14	The reporting system is available to contracted organisations and customers to make reports.
2.1.15	There is a process in place to analyse reports and hazard logs to look for trends and gain useable management information.

For each individual being asked they might report evidence for each component and element above, some at compliance level and some at the excellence level. Still the overall assessment is that the SMS is still not fully implemented if central elements or functions are missing. With the SMS assessment practice currently used it is argued that all aspects may be functioning well in parts but it may not be clear how all individual parts contribute to the whole in a systemic way. The components are perceived as “silos” within the organization to some extent representing the four pillars, figure 2. The SMS pillars are necessary to assure a safety risk perspective is taken in the organization. However, the implementation of the elements of each pillars may not be sufficient to manage operational risk as a whole and support development towards a level of excellence.

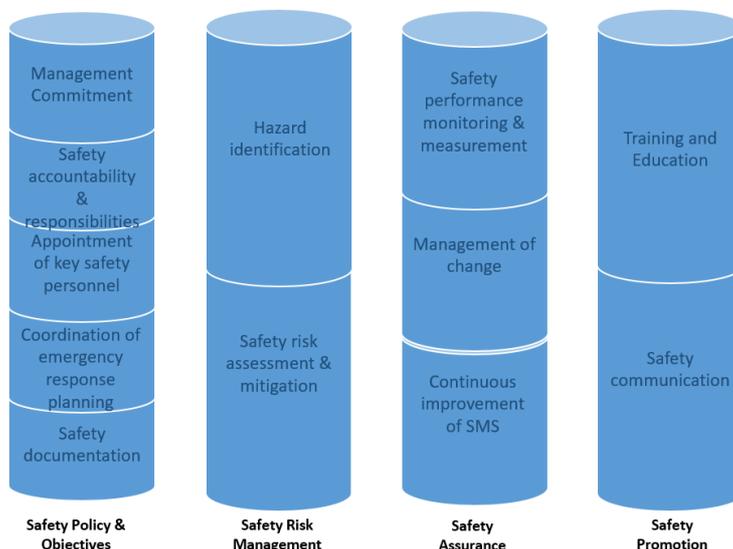


Figure 2. The SMS “pillars” or components and their elements.

ORION partners descriptions - operations and SMS aspirations

Emergency response - SMS aspiration and maturity

Safety is a core motivation to the operation of Emergency Services; the nature of these services is oriented toward responding to safety events. This, as participants have reported, is both the core of the mission of their service, and is also contradictory to most other organizational approaches to safety – most organisations aim to avoid adverse safety events, while Emergency Services aim to attend them.

The participating Emergency Service provides fire and rescue, and emergency medical response for a municipal area with a population of over one million people. It is very important to note that unlike some other sectors (e.g. aviation) that an SMS is not mandated for this emergency service and they are only one of very few similar organisations who have pursued a SMS agenda. This is something that the organization and its members pride themselves in, and it is important to their identity, philosophy and culture.

Emergency Service: Main Issues Identified through the Gap Analysis

ICAO FRAMEWORK		Fire brigade
Safety Policy and Objectives	Management commitment and responsibilities	<p>The personnel who have direct responsibility for SMS demonstrate a clear commitment to its establishment, development, and implementation. This is evident from the analysis undertaken by the master's thesis that was completed by a senior officer of the fire service as well as discussions with other members of the service.</p> <p>The Chief of Service has overall responsibility for service and safety. An Assistant Chief was appointed to take overall responsibility for management of SMS. The SMS Safety Team, which is made up of representatives from senior officers, operational officers and non-officer/fire fighter grades deliver the SMS within the organisation. This lists the roles and responsibilities of key people in the organisations in relation to safety – this is viewed as a legal requirement under national health and safety legislation.</p> <p>The SMS includes a management review of safety issues that need to be addressed across organization.</p> <p>A Safety Office has been established as part of the SMS</p> <p>A SMS central database has been established which includes: audit outputs tracked; integrated data; responsibility for track to closure of reports; management review meetings; cross department to progress.</p> <p>Observation forms exist that personnel can fill and send to safety unit when a potential hazard, risk or safety event is noted.</p> <p>There are formalised safety objectives and planning, which is a natural fit for SMS</p> <p>Legal compliance is a key focus of the fire service with growing legislation e.g. chemical, clinical, hazard, etc. legislation applied.</p>
	Safety accountabilities	<p>There are clearly established lines of accountability for SMS among the officer grades. The Chief of Service is ultimately the legally responsible person for the service operations and performance, including SMS. In addition, an Assistant Chief holds responsibility for the SMS portfolio. A team made of up operational officer grades are responsible for delivering the SMS to the organization.</p>

		<p>There is a list of the roles and responsibilities of key people in the organisations in relation to safety – this is viewed as a legal requirement under health and safety (H&S) legislation.</p> <p>H&S team coordinate SMS – procedures, accident reporting and recording processes (forms used, where they go, safety unit following up and closing out report)</p> <p>A safety committee exists that is made up of representatives from operations, emergency call and dispatch, the training school, equipment services and maintenance – usually 3-4 core people attend meetings</p> <p>The safety office not responsible for all safety issues – watch commanders/station officers take direct responsibility for implementing SMS in operations</p>
	Appointment of key personnel	<p>A Safety Office has been established as part of the SMS</p> <p>A safety committee exists that is made up of representatives from operations, emergency call and dispatch, the training school, equipment services and maintenance – usually 3-4 core people attend meetings</p> <p>There is a list of the roles and responsibilities of key people in the organisations in relation to safety – this is viewed as a legal requirement under health and safety (H&S) legislation.</p>
	Co-ordination of emergency response planning	<p>Emergency response planning is a fundamental of the business service that fire brigade offer. They are adept in emergency response. Part of their planning for surge events includes ‘business continuity’ to ensure core services remain functional when the operation is at risk of being stretched beyond existing resources (e.g. drawing in additional personnel from other services).</p>
	SMS documentation	<p>SMS documentation exists in various forms. As the SMS meets ISO and OHSAS standards, it is an auditable system. This means that the SMS is operational at the functional level as a minimum. Reporting documentation also exists, which is linked to a resolution process.</p> <p>Maintaining documentation includes updating H&S procedures (internally and externally e.g. national health and safety regulatory body)</p> <p>Notification and guidance from associated bodies are taken in account (e.g. Chief of Services Association, national guidance authorities, local, regional, and national policies including SOGs, legal register of revisions to regulations, national medical standards including clinical practice guidance).</p>

		<p>The H&S business plan is designed to complement the services corporate business plan to ensure legal compliance, audit and review, standards, and standardization. This also links to the business plan where developments are needed and are conducted through internal and external audit three year cycle.</p> <p>Top level strategic safety documentation includes corporate safety statement and where the relevant functional area is large an ancillary safety statement is published.</p> <p>The safety policy is reviewed and updated yearly.</p> <p>Quality management plan includes KPI for key safety areas and these are measured (e.g. number of SOG reviewed).</p> <p>H&S team coordinate SMS and procedures for accident reporting and recording (forms used, where they go, safety unit following up and closing out report).</p> <p>Safety action items closed out through a managed process including retro fits; time lines where practical; feedback loop to reporters of safety issues and a log of action items and their progress.</p> <p>Audit and review are undertaken regularly.</p> <p>A SMS central database has been established which includes: audit outputs tracked; integrated data; responsibility for track to closure of reports; management review meetings; cross department to progress.</p> <p>Observation forms exist that personnel can fill and send to safety unit when a potential hazard, risk or safety event is noted.</p>
Safety Risk Management	Hazard identification	<p>In incident response operations are safety based on and use Dynamic Risk Assessment and Standard Operating Guidance to afford a risk based response under the Incident Command. Officers undertake hazard identification and risk assess following a standard risk assessment matrix. This helps to inform decisions on the use of PPE, Breathing Apparatus, etc</p> <p>Safety alerts also capture and share information on safety risk management. Observation forms are used for this.</p>

	Risk assessment and mitigation	<p>SAME AS ABOVE</p> <p>In incident response operations are safety based on and use Dynamic Risk Assessment and Standard Operating Guidance to afford a risk based response under the Incident Command. Officers undertake hazard identification and risk assess following a standard risk assessment matrix. This helps to inform decisions on the use of PPE, Breathing Apparatus, etc</p> <p>Safety alerts also capture and share information on safety risk management. Observation forms are used for this.</p>
Safety Assurance	Safety performance monitoring and measurement	<p>As part of the fire service's quality management plan KPI are established for key safety areas and measured (e.g. number of SOG reviewed)</p> <p>H&S team coordinate SMS including procedures, accident reporting and recording (forms used, where they go, safety unit following up and closing out report)</p> <p>Safety action items are closed out through a process with a log of action items. Where practical the actions include a feedback loop to reporters</p> <p>Audit and review are part of the safety performance monitoring and measurement. The audits and reviews can be conducted by internal and external groups. Some are outsourced. The audit and review are process focused according to standards set by national regulatory and advisory bodies including national standards institutes, clinical care council, national fire service advisory body.</p> <p>A central database includes audit outputs tracked with integrated data including responsible persons or groups, tracking safety actions to closure, outcomes of management review meetings, reports on cross department to progress.</p> <p>Safety alerts are included in the safety performance monitoring and measurement.</p> <p>Indicators of success include accreditation from relevant bodies and evidence of a living SMS where applied practice is seen, for example fire station staff checking equipment, using PPE, training, and drills, highlighting safety good catch system.</p> <p>Observation forms are used to collect information on safety issues and SMS application through the completion and submission of reports to the safety unit.</p>

		<p>Structured management review focuses solely on safety issues, support and direction, communications from these are part of the safety assurance process.</p>
	Management of change	<p>An example of SMS change management was a H&S sub project that was addressing post incident decontamination for fire fighters. The equipment and training roll out for this was supported by safety committee. This included standard operating guidance (SOG) for turning out and closing down incident. Post incident hygiene /decontamination was being built into this SOG.</p> <p>Part of the change and improvements to SMS includes an induction day on SMS. Also, officer training has SMS improvement with a focus on workplace SMS supervisors.</p>
	Continuous improvement of the SMS	<p>For this fire service, the SMS is continuing to mature, be refined and develop. There has been a 5 year safety goal to achieve accreditation to OHAS 180001. This process has provided a structure to achieve an international standard. It includes policy, operations control, internal/external audit, and review, and monitored KPI.</p> <p>Notification and guidance from associated bodies are taken in account (e.g. Chief of Services Association, national guidance authorities, local, regional, and national policies including SOGs, legal register of revisions to regulations, national medical standards including clinical practice guidance). The H&S business plan is designed to complement the services corporate business plan to ensure legal compliance, audit and review, standards, and standardization. This also links to the business plan where developments are needed and are conducted through internal and external audit three year cycle.</p> <p>The fire service still considers their SMS to be aspirational as they seek to achieve continuous safety improvements.</p> <p>One of the recent improvement processes has been as a result of safety alerts concerning the need for an ambulance decontamination area.</p> <p>Part of the change and improvements to SMS includes an induction day on SMS. Also, officer training has SMS improvement with a focus on workplace SMS supervisors.</p>

		<p>Indicators of success include accreditation from relevant bodies and evidence of a living SMS where applied practice is seen, for example fire station staff checking equipment, using PPE, training, and drills, highlighting safety good catch system.</p> <p>Continuous improvement is also dependent on funding as this is required for SMS improvement, e.g. better PPE etc.</p>
Safety Promotion	Training and education	<p>The competence of fire and rescue, and emergency medical personnel is key to the ability of the organization to function effectively. This understanding was clearly established in the EU funded FIRE-CMPD project. Safety of fire fighters and paramedics is essential to the capability and resilience of the system as well as the members of the public who may require their response. A rigorous training and development framework (learning management system) helps to ensure individual competence and organizational capabilities are maintained. An initial phase of training established basic fire fighting and medical competence. Subsequent on-the-job training that rotates roles to develop and maintain competence.</p> <p>In terms of SMS training the fire service acknowledge that more is needed to be done. One of the challenges faced by them is the size of the organization both in terms of numbers, shift patterns and geographical spread of fire stations and other infrastructure. Some actions to manage this more effectively include:</p> <ul style="list-style-type: none"> • An ongoing e-learning project • Continued training cycles in work environment supported by training coordination, ongoing training, and performance monitoring • Improvements to SMS spread using Induction day on SMS, officer training course includes SMS improvement content, and workplace supervisors who focus on safety • Other techniques such as Human Factors can be applied to support safety
	Safety communication	<p>Scale of the organisation is a challenge to ensuring communication is effectively delivered to all relevant personnel. However, the management structure helps to ensure that communication is delivered to all personnel on all shifts during a period of shift rotation. Management follow up of this reduces the risk of information being missed.</p>

The SMS maturity analysis of the Emergency Service revealed that the aspiration is to continually improve and further embed an effective SMS within the organization. One of the challenges noted by the Emergency Service was the difficulty in systematically delivering SMS that penetrates all levels of the organization. This is in part due to the scale of the organization and the communication mechanisms currently available to support these initiatives. An example offered during the interview with the Emergency Service Officer with responsibility for initially setting up the SMS project relates to post emergency response incident decontamination. The number of personnel (in the region of 1000), and the 24/7 operations and corresponding shift patterns mean that it can take considerable planning, coordination, and time to deliver a new safety intervention into the service. During the delivery and implementation process it is possible that different personnel could be operating on different systems of practice. This risk needs to be effectively managed. The Emergency Service anticipate that ORION will help them to advance their SMS to support such change processes in a safe manner for the operation, their personnel and the public they serve.

It is evident from the findings outlined above that the Emergency Service have an established SMS. According to their own analysis based on the standard SMS and CANSO approach, the SMS is at the 'Functioning' level.

Airline Operations – SMS aspiration and maturity

International regulations require an Airline Operating Certificate (AOC) in order to operate as an air service provider. This is also required for other services such as airports and air traffic control.

In an airline the main production areas, in operations, which require an AOC are: Flight Operations, Technical Operations, Ground Operations and Maintenance Part-145. In addition there is Training that may be organized either under production areas, usually flight operations or under support functions like Safety and Security. Another support function is a Maintenance organization that may or may not be a part of the airline.

Flight operations is the actual planning and resourcing of each flight as well as the flight itself. The crew consist of both the cabin and pilot personnel. The performance of a flight is dependent on a range of aspects: Scheduling crew with regard to training, experience and rostering. Rostering is a regulated planning for allowed flight hours, per day and over several flights as well as depending on longer flights with effects of jet-lag; Flight plan prepared by support functions and at the day of flight also by pilots. A flight plan report includes essential information about the condition of the flight, departure, destination, weather, loading, passengers.

Pilots perform flight specific preparations and estimate fuel, balancing of aircraft due to loading etc. In addition the flight performance is dependent on other components as well:

The airworthiness is guaranteed by Part-M and part- 145. The service around the aircraft is operated by several ground functions coordinated by the ground operations. After take-off they manage the aircraft and communicate with air traffic controls at departure airport and in various sectors along the route and air traffic control at destination airport. Airport capacity determine both take-off time and landing sequencing which may cause delays in both ways depending on congestions on ground or in air.

Ground operations is contracted by suppliers at all destinations of the airline, but airlines might have their own ground services at major destinations, which in turn may be contracted to other airlines. Ground operations mainly support everything after landing until take-off and coordinate for example fuelling, catering, loading of luggage and passengers, and cleaning.

Technical Operations – Part M, the engineering department works with the predictive and proactive maintenance planning. They keep track of each individual aircraft and schedule maintenance according to routes and where the airline has base and line maintenance. An essential part of their work is to update manuals and procedures with updates from manufacturers.

Maintenance, Part-145 is the organisation that perform maintenance and repair of aircrafts according to part-M planning. Base maintenance is scheduled work in a hangar, often only at particular bases or destinations. Line maintenance may be performed reactive and continuously.

The airlines are compliant to the SMS and has a mature documented structure and processes for all essential parts of the SMS. However, there is a need to assess further where there are gaps and needs for improvement. Airline 3 has for many years had on-going development for better utilization of data for safety analyses and improvements. The

company has also, over many years, undergone major changes to their business model and a series of cost cutting programs as run in parallel.

Airline 1 and 2: Main Issues Identified through the Gap Analysis

ICAO FRAMEWORK		Airline 1	Airline 2
Safety Policy and Objectives	Management commitment and responsibilities	There seems to be a high level of commitment by the Senior and Middle Management. The policy is signed by all managers and displayed all around the building. The challenge is to gain the trust of the employees	The safety policy exists only in the SMS Manual. Just Culture, even though it is recorded in the policy, seems to be very weak in the company.
	Safety accountabilities	Managers seem to be fully aware of their SMS roles and responsibilities. Employees are partially aware. Especially front line staff, even though they are safety minded, they don't really understand their responsibilities in relation to SMS	Management does not seem to fully comprehend the importance of SMS Implementation and seems to lack basic SMS knowledge. There seems to be lack of basic knowledge of SMS by the majority of personnel.
	Appointment of key personnel	A Safety Manager is appointed with relevant background and knowledge	Operations Manager has been assigned some duties of the Safety Manager while some other duties are performed by the Station Manager
	Co-ordination of emergency response planning	The new management didn't have the chance to test the ERP yet	Airline 2 takes part at the yearly ERP Exercise carried out by the airport operator. They also perform evacuation drills occasionally
	SMS documentation	OK	OK
Safety Risk Management	Hazard identification	There is an electronic platform (IQMS), which enables hazard and confidential reporting. Only some personnel (mostly pilots) identify and report hazards. A hazard registry is kept. Considerable work is being done on identifying hazards through various means – Reporting, Audits, Incident investigation. Human performance related hazards are very rarely identified	Reporting is through a hard copy form or via email. No confidential reporting in place. Some hazards are identified through incident investigations which are carried out but not as deeply as to identify underlying causes. Quick fixes and relevant punishment are in play. Very rarely some personnel identify, and report hazards mostly in relation to Health and Safety. No hazard registry is used. There seems to be lack of awareness and knowledge in relation to hazards related to Human Factors

	Risk assessment and mitigation	Risk assessments are carried out departmentally and an evaluation matrix is used. There is a Safety Action Group meeting every 3 months and ad-hoc when required. Corrective actions are recorded in meeting minutes and in a special registry. There is a Safety Review Board meetings every 3 months	Risk assessment, the evaluation of level of risk and any mitigation measures are decided through a discussion during a managers' meeting. Corrective actions are recorded in the meeting minutes.
Safety Assurance	Safety performance monitoring and measurement	Safety Office in collaboration with each department sets the SPIs and the SPTs. Risk mitigations and controls being verified/audited to confirm they are working and effective. It's a loop process feeding back to Risk Assessment. Contracted and sub-contracted organisations are audited. Relevant Risk Assessments are carried out.	Some SPIs are set by Management. Risk mitigations and controls being verified/audited to confirm they are working and effective. It's a loop process feeding back to Risk Assessment. Contracted and sub-contracted organisations are audited. Relevant Risk Assessments are not carried out in a structured manner
	Management of change	The company undergoes many changes (change of management, aircraft, operation, premises). Risk Assessments and are carried out for these changes and mitigation and control measures are put in place.	MOC processes are documented but have not been activated as no major change has occurred recently.
	Continuous improvement of the SMS	SMS is periodically reviewed for improvements in safety performance	SMS is periodically reviewed for improvements in safety performance
Safety Promotion	Training and education	Safety Management training requirements are based only on the legal requirements. No structured TNA performed	Safety Management training requirements are based only on the legal requirements. No structured TNA performed
	Safety communication	Significant events and investigation outcomes are occasionally communicated to staff but not in a structured manner.	Significant events and investigation outcomes are occasionally communicated to staff but not in a structured manner.

Airline 3: Main Issues Identified through the Gap Analysis

ICAO FRAMEWORK		Airline 3	
Safety Policy and Objectives	Management commitment and responsibilities	Improvement needed: The safety policy is reviewed periodically to ensure it remains current There is commitment of the organisation's senior management to the development and ongoing improvement of the safety management system.	Link between strategic level, safety, and operations
	Safety accountabilities	Improvement areas There is evidence of employee involvement and consultation in the establishment and operation of the SMS. There is evidence that safety management system principles have penetrated all levels of the organisation and safety is part of the everyday language.	Link between strategic level, safety, and operations
	Appointment of key personnel	Excellent performance	
	Co-ordination of emergency response planning	Excellent performance	
	SMS documentation	Excellent performance	
Safety Risk Management	Hazard identification	NEEDS Handling a large flow of reports Categorization and integration of hazards across functional areas Integrate Safety and Quality SMS-like collaboration among contractors Integrating contractors, reports, hazards Prioritization between hazards and resources Best practice sharing among areas Each area deals with hazards internally – need for more integration between silos, systemic approach How to assure that relevant hazards are known. Improve integration and systemic approach	Complexity of data and reports need integration Cross-functionality for data, hazards, risk profile System boundaries need to extend to contractors in a complex global organisation Systemic risk needs to allocate resources Everyday work needs to be acknowledged as SMS where appropriate
		Review of what is reported and what information is needed from reports To make this a cross functional process and systemic for mgrs. to act	Assure known and potential unknowns Record and register of decision, flow of information and organisational memory
	Risk assessment and mitigation	NEED To link better on-going activities and identify them as everyday risk assessment and mitigation. Links to safety / quality discussion. Avoid formality to kill the drive. Review ALARP and develop methodology for this. Continuous change is on-going. Works best in serious matters and when risk concern several functions. Compared to flow of reports, need to have an on-going "change register". Timing of controls and validation. Support of human factors linked to behaviour. Operations and managers in problem solving and change needs "documentation support/system" for organizational big picture information available over time and learning. Not in all areas and not when nothing happens. Proactive development less priority. Assure person with mandate get relevant information. Assure action and change Opportunity in ORION	See above
Safety Assurance	Safety performance monitoring and measurement	Systemic risk profile SPI or other measures development, more in some areas than others A platform for airline data exists but utilization needs work. Serious issues are captured. Striving towards a combined know-how from operations (eyes and ears) and data. Risk to over trust data.	See above

		<p>A combination of quantitative and qualitative analysis for each area and integrated as a whole. How to collaborate in this development. Continue SPI development How to prioritize hazards, risk, systemic impact, and resources. Review aggregation and dispersion of risk information flow. Systemic depends on system boundaries Future depends on predictive approach Integrate safety with projects and business, beyond safety and operations. integration of the areas</p>	
	Management of change	<p>NEED To assure an operational risk perspective. Improve project based approach to operational risk and effects from change Propagation of risk between projects. Top down change, verify functions still intact. Mgmt. of change and risk assessment need to be less reactive in top driven changes. See areas above linked to measurement and mitigation</p>	
	Continuous improvement of the SMS	<p>Work is on-going in missing areas with contractors Opportunity in ORION in this area</p>	
Safety Promotion	Training and education	<p>Compliant but areas of improvement within ORION participation</p>	
	Safety communication	<p>Compliant but areas of improvement within ORION participation Sharing, best practice, conferences</p>	

Health care - SMS aspiration and maturity

A fully implemented SMS system is not present. There are fragmented instantiations for Quality assurance, Reporting, Emergency management and formal documentations respectively. However there is not a fully implemented and operational SMS system in place, which is the case for the Italy Healthcare system in general since an SMS *is not mandatory for Healthcare, Hospitals and related fields.*

- Safety strategy is “by interpretation” and case-by case approach prevails over a systemic (SMS) approach.
- SMS Procedures are NOT MANDATORY. Their preliminary application is more on the voluntary actions.
- MOST SMS functions are clearly deployed on the “reactive side”: emergency management procedures.

Health care: Main Issues Identified through the Gap Analysis

ICAO FRAMEWORK		Health care partner
Safety Policy and Objectives	Management commitment and responsibilities	<p>An overall systematic safety policy in the health care organisation is not in existence. There are some instantiations about emergency policy management but not for the entire SMS system. The (fragmented) safety policies do not regularly include a commitment to involve personnel at all levels in the establishment.</p> <p>Senior Management does have a clear commitment to safety programs, despite a lack of a systematic policy</p> <p>Non-Punitive Safety Reporting Policy</p> <p>There is a policy in place that provides immunity from disciplinary action for employees that report safety deficiencies, hazards, or occurrences. However, such policy is not "explicit enough" enough or shared accordingly to be fully effective.</p> <p>Unfortunately, personnel do not express confidence and trust in such policy. A blame and reactive culture might be in place.</p>
	Safety accountabilities	<p>The accountable executive has limited/constrained financial and human resources required for the proper execution of his/her SMS responsibilities.</p> <p>Safety authorities, responsibilities and accountabilities of personnel and partners at all levels of the organization are not clearly defined and documented into a structured way.</p> <p>The accountable executive does not demonstrate wide commitment to safety within the organization on a daily basis.</p> <p>In theory, there should be evidence that SMS (or safety general) procedures have penetrated all levels of the organization. In practice, this does not occur!</p>
	Co-ordination of emergency response planning	<p>The organization has an emergency preparedness procedure, appropriate to the size, nature and complexity of the organization.</p> <p>The Emergency preparedness procedures have been documented, implemented, and assigned to a responsible manager.</p> <p>The organization has a process to distribute the ERP procedures and to communicate the content to all personnel.</p> <p>The emergency response plan contains procedures for periodic testing of the adequacy of the plan and for reviewing the results in order to improve its effectiveness (more investigation required)</p> <p>A procedure exists for recording activities during an emergency response (more investigation is required)</p>

	SMS documentation	<p>There is consolidated documentation that describes the safety management system and the interrelationship between all of its elements.</p> <p>The consolidated documentation is readily accessible by personnel.</p> <p>Documentation reflects (at least in paper and formal procedures) functional coordination within the management system that ensures the organization works as a system and not as a group of separate or fragmented units.</p> <p>The organization does not have a process to identify changes within the organization that could affect company documentation.</p>
Safety Risk Management	Hazard identification	<p>The reporting processes are not systematic and may vary across departments or healthcare units. This can influence safety and quality improvement overall.</p> <p>The safety reporting is still in the reactive/punitive approach. A blame culture may reflect this (more investigation required)</p> <p>The organization does NOT have a process or system that provides for the capture of internal information including incidents, accidents, and other data relevant to SMS.</p>
Safety Assurance	Safety performance monitoring and measurement	<p>It is unclear if there is a formal process to develop a coherent set of safety goals necessary to achieve overall safety objectives. (under review).</p> <p>Safety objectives and goals are not explicitly publicized and distributed.</p> <p>There is not a formal process to develop and maintain a set of performance parameters to be measured.</p> <p>There is unclear linkage between Leading and lagging performance parameters and relations with early forms of SMS goals.</p>
	Safety communication	<p>There are communication processes in place within the organization that permit the safety management system but the safety oriented communication system is not effective as it is structured. I can otherwise signal via formal communications about events with planned roles dedicated to react to my safety communication.</p> <p>Company wide, uncomplicated, reciprocal communications related to safety and quality issues are not evident.</p> <p>There is not an established means of inter-departmental communication to spread information on SMS related matters.</p> <p>Some process for safety communication strategy via electronic communication, dedicated meetings, automatic alerting and reporting is in place but in a reactive mode only. Nonetheless, periodic, scheduled or planned safety bulletins or programmes are not ready yet.</p>

Results SMS maturity assessments in ORION

Collating the SMS implementation needs and requirement of the different associate partners has identified both commonalities and differences between industries, operations and how operations are organized. From the cases we found differences among the partners in overall maturity, size of organization and different operations and risk due to context. Some partners have worked with SMS for many years and some have just started to systematically identify what is an SMS and what is required for compliance.

However the SMS consist of similar processes and methods for managing operational risk and the differences are not in focus, but rather to identify the common challenges to make the SMS provide intended functions for the respective operational context and organisations. A brief result from the maturity assessments for each partner is provided in appendix 1.

Needs and requirements for training concept development

The main issues and challenges identified with fully implementing an SMS and mature to excellence are consolidated here and were identified in the components of Safety risk management and Safety assurance.

Hazard identification in Safety risk management

Integration between areas of operations and between operations and safety

- Unlimited numbers of hazards may be reported. However there are challenges in comparing them with other operational issues. For example few operational aspects show other than “green” in board meetings.
- Process confirmation is used for hazard identification in some areas.
- Many times it is difficult to separate quality aspects from safety.
- In parallel each area resolves issues internally.
- It is a big challenge to manage risk in contracted operations.
- Hazards means different in each operation and not always directly related to flight safety. Quality in one place may be safety in another. Same event rated differently depending on area.

Reporting and data

- The sheer amount of reports brings a lot of workload. It is a continuous flow that needs to be managed.
- Structure for data and reports are there but do not come together as a whole

This raised questions of desired functionalities:

- What hazards do we not know about?
- Of all the hazards, which do we address for most value?
- How to trend, find relevant categories of common antecedents?

Risk assessment and mitigation in Safety risk management

- Integration between areas of operations and between operations and safety
 - Mitigations are conducted in continuous improvement manner in normal operations (Lean processes)
 - Some activities are quality and safety related, but not addressed as part of SRM or known to safety functions.
 - The SMS works when identified as one of SMS described processes. There is a risk that formality kills the drive.
 - System works best when serious matters that have a common interest to more than one function appears, then people work hard and act. They make phone calls, discuss, solve things and go on. This is good, but it is not always known to others and very little is documented on the daily bases of risk management.
 - Contracted are controlled by agreement, very little mitigation within the organisation to deliver to Airlines' standards.
- Reactive and proactive
 - Common practice still with reactive action to events.
 - The SMS does not seem to take place when nothing happens.
 - Little time to work proactively or to assess the value and effect mitigations have had.

Questions raised:

- How to make sure the person who can change things get relevant information?
- Difficult to decide what is a trend that requires action and what is a momentary behaviour that resolves itself?
- When is system change needed? When is it behaviours that needs to change?
- What actions will deliver this change when needed?

Safety performance monitoring and measurement in Safety assurance

- Aggregating and integrating data and information
 - Our ears and eyes should be out there. Not sure data has the same view.
 - Each area needs to query their data and this needs to be integrated centrally to get the big picture. More collaboration required since data is not enough. Who gets the AHA, the bigger picture?
 - How to capture cross-functional issues in data analytics or in safety meetings. A combination of quantitative and qualitative analysis, perhaps. Most are doing a good job in their area but the interfaces are not norm.
 - Mitigations in one area, not known to another. How to monitor "side effects". Cross functional risks.
- What to measure and how to analyse
 - Serious issues are captured, so obviously some things work well!
 - How to assess effect? How much time should be allowed before we validate? How long or how often do we need to make assessments of things we have resolved? When do we let go?
 - SPI development needed. Operational data is collected and there are systems for managing data.

- There is concern that if this is not done proper, we will rely on the system and most definitely miss things.

Management of change in Safety assurance

- Integrating operations/quality and safety risk
 - Much risk management in projects are not related to safety risk (side effects), from an operational risk perspective.
 - Safety needs still to migrate up above operations in the organisation.
 - Little is known how changes affect risk in operations. From top or cross-functional changes.
 - Functions are lost in some cost saving programs and this is not always remembered or known. So sometimes there is misunderstanding that someone is working on things when there is no one there to do that.
 - Sometimes decisions are made and it is news to us. Then we do a management of change and risk assessment after decision.
 - Safety department asked to do management of change on big organisational changes. So there is some understanding from top about safety. But many projects and how each of these effect is not managed. How can this be done even?
 - Even in our own operations how does even three projects affect each other and safety?

Continuous improvement of SMS in Safety assurance

- Safety policy not frequently revised.
- Can we change the requirement of the SMS?
- The process describes how it is supposed to work but how to do it raise other questions. Too few talks about what we should do and many about what happens.
- Mitigation links to changing behaviour in operations which needs support. Same logic applies for implementing SMS for managers.
- SPI development is on-going...
- What about safety II, should we develop something else?
- Collaboration with similar organisations would help not to reinvent the wheel and use best practice.

Maturity assessment method analysis

An SMS assessment for compliance verifies that all components are in place and implemented in the organization. It can be misleading to do an assessment and ask for parts, since this does not really give information whether these parts are available or functioning in all departments or various areas of operations. For example there might be a risk assessment functioning in flight operations, but not really in ground handling. Still in the SMS assessment it will be noted as evidence for risk assessment being present and suitable in part. In practice this means that components may be effective in some required areas of the organization but not necessarily in all relevant areas or to the same extent.

Our findings show that the SMS assessment template did not capture the complexity of operational areas and their various contexts or how they were organised. It was also found that SMS components may be compliant but the assessment gives little evidence of how well they function and contribute to the overall functioning of the whole SMS. We also found that much safety work and activities are on-going but may not be captured in the SMS assessment, one reason being that employees do not identify every day on-going operations management as safety activities per se. An SMS assessment that results in excellence requires the implemented SMS to validate all functions of an SMS.

ORION training concept - aimed for SMS excellence

Traditional SMS training provides the basics of an SMS and each of the components and elements. This training is effective for implementing SMS for regulatory compliance, given that it is a sufficient requirement to have evidence that all components are implemented in the organisation.

But as part of a performance-based regulation in time regulators will expect that a compliant SMS will have improved its functionality and become “fully embedded”. This would be demonstrated by climbing on the maturity scale and the goal is to have an SMS in which all these components and pillars are working well together as a whole towards the level of excellence.

An important finding in our research is that organisations that are compliant and have high ambitions, still face challenges in further implementing their SMS and mature towards excellence, even after years of compliance. There are challenges for organisations to actually improve from a level of compliance to a level of excellence.

Traditionally failing to get these components to function as a whole is commonly explained by lack of safety culture or a safety management weakness such as:

- Inadequate corporate culture
- Lack of understanding about safety management system
- Lack of direct involvement by Senior Management and Accountable Manager

All these are highly relevant reasons. ORION has reviewed and provide a full scale, state of art, SMS training which is essential and required for compliance and necessary base for advanced training for SMS excellence.

However, our research explains lack of excellence to the lack of particular organisational capabilities that are not necessarily found in safety and risk literature or traditional SMS training. This is both directly related to the SMS but also to the organisation into which the SMS is expected to become embedded in. In complex and safety critical systems in which humans has a central role both in operations and in the organisation developing operations sociotechnical principles have traditionally been put forward as an effective approach to operations management and development work such as in lean production systems. In addition to the SMS components and elements assessment a sociotechnical analysis of the operational and organisational processes could provide complementary information of organisational capabilities that would support SMS implementation. Another is fundamental

to safety performance and demonstrating safety assurance is to develop organisational capabilities for implementing change in general.

In addition to the needs identified from the SMS maturity assessment and gap analyses, needs were identified through findings indicating weaknesses that depends on current organizational capabilities. Combining these needs resulted in requirements that may be verified with an ORION training concept. This training concept provides SMS training that address challenges to mature by developing training that links the four “silos” of the SMS pillars (see figure 3). Between the pillars of Safety Risk Management (on the one hand) and Safety Assurance (on the other) is a lot of work of implementation, mitigating risk in operations, improving the system through targeted projects, achieving strategic safety objectives activities that is core and should effectively be embedded in every-day practice. It is this work that can, in turn, make Safety Policy and Objectives more proactive, flexibly engaged with new and emerging issues and actively monitoring improvement. Joined up governance – different departments working together – enables the gathering of evidence that sustains strategy. This dynamic activity makes it possible to provide a new level of tailored and focused support for operational performance, embedding good practice in everyday operations through Safety Promotion. These links are underspecified in the SMS regulation – but they are essential to a strategy for sustaining the SMS as a functioning system that is aware of the complex risks it faces, able to adjust to mitigate those risks and thus able to purposely achieve is strategic goals to improve quality and safety, and, at the same time, sustaining a positive safety culture.

To visualize our consolidated framework for training for SMS excellence the overarching functionality of the safety risk system perspective is presented as arches bridging the four SMS pillars.

- Complex risk – advanced risk knowledge.
- Fully embedded SMS – implementation
- Joined-up governance – evidence sustains strategy
- Sustain safety culture – focused support for performance

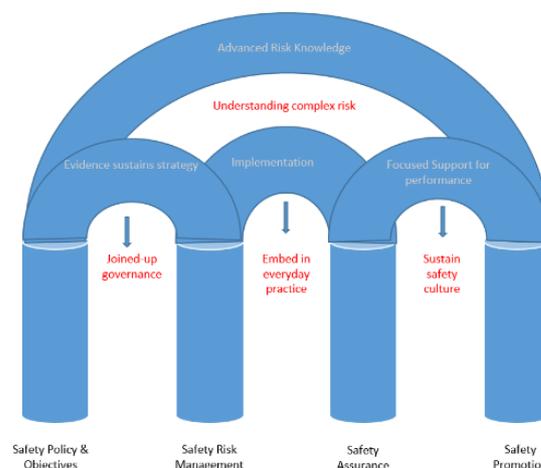


Figure 3. ORION training concept for advanced risk management.

In ORION we have based advanced SMS training on the following three emergent capabilities:

- New large data streams to support analysis of input, activity and output
- Qualitative analytic methods on socio-technical dimensions (in normal operations, change and crises) complement data/information in implementation case studies
- Big data analysis plus model-based reasoning, identifying generic socio-technical system characteristics

In addition the training concept should include norms and best practices for human-centered management known to foster for example participation in development and change. This links to integrating the way things are done already with particularities in SMS functionalities. This will be further discussed in terms of ORION implementation framework, in intellectual output four (IO4), including a concept for a new productive governance. One that builds evidence, enable learning and guide the work. The desired function should develop and follow a virtuous and full cycle of development enabled by:

- a combination of data rich analysis and modelling leading to a strong programme of implementation
- Implementation leading to a further flow of data and analysis of multiple cases
- The whole leading to a body of increasingly sound evidence (operational process, implementation and change process and process of governance itself)

In intellectual output two (IO2) the state of art SMS training as well as the resulting advanced training modules for SMS excellence are described and presented.

Conclusion

This intellectual output synthesized research evidence and best practice guidelines initiating a baseline for analysis of the current maturity level of Safety Management Systems (SMS) in the associate partner organisations. This analysis supports the verification of state of art SMS implementation training as well as identified needs and requirements for the development of the ORION SMS training concept for advanced risk management aimed for supporting implementation from SMS compliance to SMS excellence.

The state of art SMS training material as well as the resulting advanced training modules for SMS excellence are described and presented in intellectual output two (IO2). Findings from the work reported in IO1 has also contributed to the development of the ORION implementation framework, including a concept for a new productive governance described and developed in intellectual output four (IO4).

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