Safety Evolution Guide: Transitioning Safety II concepts into Safety Management Systems

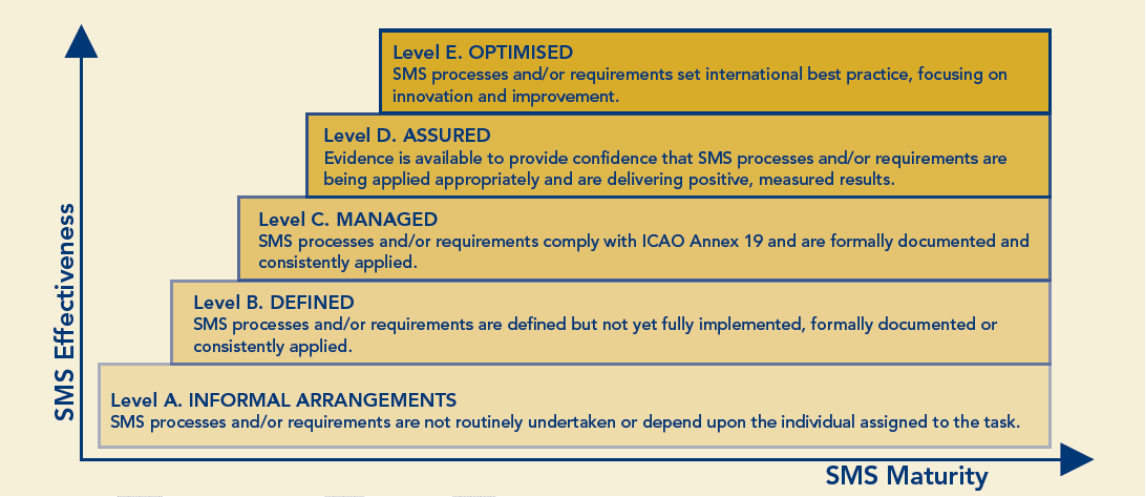
Draft example of Evolution Guide based on contemporary safety management thinking which has yet to be fully applied by any ANSP

1. OBJECTIVE OF GUIDE

Members of the Civil Air Navigation Services Organisation (CANSO) are committed to the improvement of their services. As part of this commitment, organisations share their practices in efforts transfer learning across the industry.

This guide captures either:

- the practices of an Air Navigation Service Provider (ANSP) in one element of the CANSO Standard of Excellence (SoE) in Safety Management System (SMS). The practices of this ANSP have been recognized by their peers as being an optimised practice within the industry (see Figure 1). The optimized practices have been selected on the basis of their novelty, innovation or the recognition of their potential to manage operational risks; or
- proposed practices which are based on contemporary thinking in the safety management sphere. These proposals have yet to be fully adopted by any ANSP, but they are viewed by the CANSO SSC as having significant potential in the industry's efforts to evolve how safety is managed.



Given the dynamic nature of safety management, the practices presented in this document may be superseded. CANSO will publish updated best practice guidance.

2. APPLICATION OF THE GUIDANCE

CANSO recognizes that this guidance will not be relevant to all ANSPs. The maturity of any ANSP's Safety Management System will be dependent on their specific context. This context will be a reflection of factors including the size and complexity of the organisation, domestic regulations and the risk appetite of the organisation.

ANSPs do not necessarily need to adopt all the practices and processes promoted by CANSO, but consider the relevance of the practices promoted in this guide to their operational environment.

3. SCOPE OF GUIDE

This guide addresses how Safety II concepts may be initially adopted within an ANSP's SMS. As a proposed practice, no ANSP to date has fully embraced the proposals which are included in this guide. The guide however recognizes that:

- the majority of ANSPs will not have the resources to make significant amendments to its approach to safety management, but will wish to make incremental change that allows them to integrate contemporary safety management thinking; and
- While the paradigms which underpin Safety II are not new, Safety II as a concept is relatively new. Academics and organisations are currently working to translate how these concepts can be put into operation within safety critical organisations in a cost-effective manner.

This guide does not provide detail of the Safety II thinking, and the aligned topics of resilience engineering, systems thinking or the assurance techniques which are promoted. Some sources of background reading are however presented at the end of the guide.

4. CONTEXT

Traditional safety management approaches have focused on understanding why things go wrong and then working to prevent these eventualities.

The underpinning drivers of a SMS revolve around:

- Ensuring that the organisation addresses areas which have been known to contribute to past accidents (e.g., inadequate safety culture, ineffective change management, unclear accountability structures, fatigue); and,

- Building assurance mechanisms such as safety reporting, investigation and performance monitoring to assure that the organisation has information to address potential safety issues.

Current approaches to both SMS and Air Traffic Management (ATM) system architecture work effectively, with the number accidents and significant risk bearing occurrences in the ATM domain and aviation in general, being very low. As a consequence, the amount of data on which ANSPs can make judgements as to how to improve safety within current operations or make informed design decisions is small and over time may reduce even more.

The Safety II approach, championed by Eric Hollangel, embodies a number of key concepts which focus on the need for safety management to move from ensuring that 'as few as things as possible go wrong' to ensuring that 'as many things as possible go right'. Safety II experts have been quick to assert that such statements do not infer that current practices should be thrown out, but that safety management approaches need to evolve.

There is considerable literature about the concepts and benefits of the Safety II approach but little material about how ANSPs can practically implement the concepts. The analytical techniques (eg FRAM, STAMP) which are promoted by Safety II experts have

been applied by a small number of ANSPs in the safety sphere with feedback being that while providing useful insights, the techniques are complex and labour intensive to use. As such they are unlikely to be quickly or fully adopted by ANSPs. Opportunities do however present to review how we approach safety management today and see if there are 'quick wins' which will kick-off the transition to Safety II.

5. UNDERSTANDING PERFORMANCE VARIABILITY

The vast majority of flights reach to their destination safely. Yet current safety management approaches do not focus on the **success** of the system's performance. Such performance comes at a time when systems are becoming increasingly complex, and traffic pressures increase. Humans within the system must therefore continually adjust their behaviours according to operational pressures, and other factors such as system support and the prevailing organisational culture. Despite this success, the human within the system is often viewed as a liability rather than an asset.

The challenge for safety managers and ANSPs as a whole, is to understand everyday **performance variability** and understand and exploit successful practices, rather than ignoring them. As a result, safety will defined by what happened when it is present, rather than by what happens when it is absent.

Key to understanding performance variability in any system is recognition that there is often a differential between:

- Work as imagined (WAI): what system and procedural designers, managers and authorities have specified the system should operate; and
- Work as done (WAD): what actually happens, the work-arounds and daily adjustments which people make to cope with the complexity of the environment, poorly designed systems/procedures.

The differential between WAD and WAI often provides an insight into efficiency trade-offs which are often evident after accidents. From a safety perspective, such insights are often identified too late to prevent occurrences, and more effort is required to understand the differential and then refine work practices and systems in efforts to optimise performance. Equally, expert individual operators may refine their work practices to the prevailing conditions or optimise badly designed work practices. If these practices were more evident, an organisation is able to transfer good practices to other operators and also close the gap between WAI and WAD, and in so doing reduce potential compliance breaches.

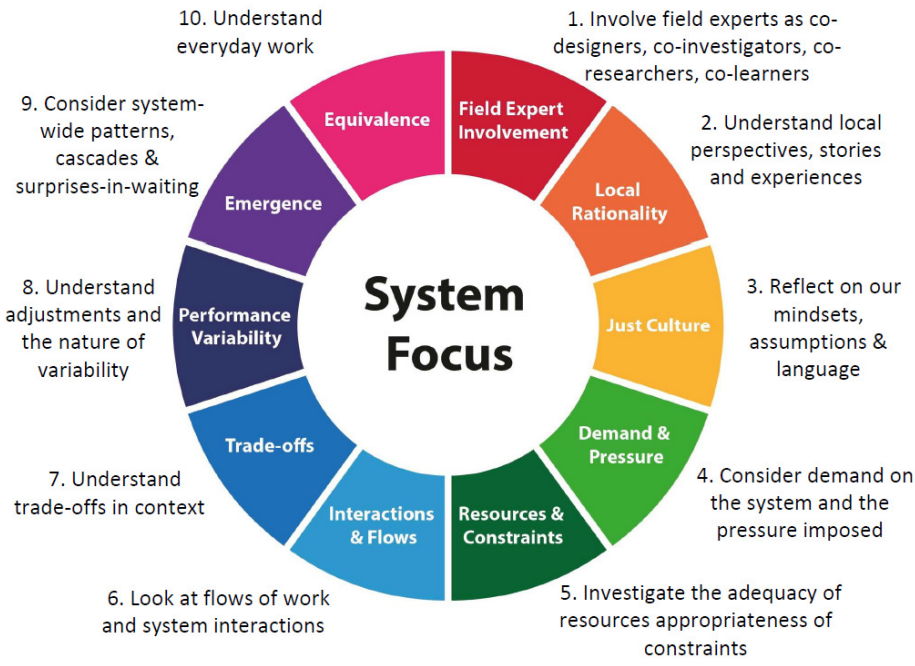
Opportunities exist to put a Safety II 'lens' over our current safety management techniques. Safety assurance techniques currently focus on identifying negative performance attributes. With a Safety II 'lens', ANSPs would seek to look for both negative and positive attributes and why such performance variabilities occur. Shifting the focus of current techniques is easier implementation strategy, and in so doing ANSPs will gain confidence and

understanding in the benefits of a Safety II approach which may in time lead to organisations embracing more complex analytical techniques.

6. EMBEDDING SYSTEMS THINKING

The Safety II approach demands that safety must be considered from a systems perspective, i.e., the interaction of people, systems, events and outcomes. Most benefit from a safety perspective will be achieved if a systems focus is adopted in all facets of the systems life cycle, ie design, implementation, operation.

Eurocontrol developed a model which captures a number of attributes which support a 'systems thinking' approach. This guidance document does not provide a detailed commentary on each of the attributes as this can found at http://www.skybrary.aero/bookshelf/books/2882.pdf, but provides the graphic below which summarises the 10 attributes.



In support of its paper on System Thinking, Eurocontrol has consolidated a list of a variety of techniques which ANSPs can use in a system's thinking approach. As reflected on the Eurocontrol website: "Most of the methods are not specifically developed with safety in mind, but all can be used in a safety context. Each of the methods addresses several of the ten principles." All of the methods are in the public domain.

The systems methods require data collection via one or more fundamental methods, including:

- Observation of ordinary work with field experts
- Discussion with field experts
- Data and document review

- Survey methods"

http://skybrary.aero/index.php/Toolkit:Systems_Thinking_for_Safety/Systems_Thinking_Methods

Practical experience within organisations shows that Systems Thinking and the 10 principles present a new *Language*, a new *Philosophy* and a new *Mind-set*, which can be integrated and/or run in parallel with other safety management activities. It allows an organisation to adopt a 'total system' or Socio-technical view, i.e., not just focusing on equipment. The techniques tend to use pictorials and graphical views of the way the system works, which helps to communicate the issues and shows how work is really done. This helps to identify the weaknesses and strengths of the system, areas for possible action and a way of probing for unintended consequences.

Organisations have also found that the benefits of system thinking go beyond safety. They allow a discussion on work flow (and interruptions to flow) and can highlight requirements for processes, systems, actions etc. to improve how the work works.

The 10 system thinking attributes also present a good 'design principles' for a SMS, in that they promote the need to involve field experts, consider performance in context including the trade-offs which are being made at both an individual and system level, and aspects such viewing the system and performance against the culture of the organisation. While ANSPs may not be able to embrace the formal system thinking techniques, the design principles can be integrated into the SMS.

7. OPPORTUNITY 1: ASSURANCE TECHNIQUES

Existing assurance technique have the potential to be modified to maximise information with specific focus being placed on:

- Positive performance aspects
- Performance variability
- Work as Imagined versus Work as Done

Such adjustments will improve alignment to Safety II, and may in the longer term may provide a platform for ANSPs to adopt more complex analytical techniques.

OCCURRENCE INVESTIGATIONS

An occurrence investigation will almost certainly compare Work as Done to Work as Imagined, as effort is made to identify a sequence of events which is then tested against organisational procedures and expectations.

An occurrence investigation also provides the opportunity to extend the focus from a single person's performance to test when the actions which contributed to the occurrence were

common practice within the work place. Such information should assist the organisation determine the scope of remedial action.

In most instances, an investigator will be called upon to investigate an incident rather than an accident. This means that something occurred which prevented a more serious outcome, or something when right. Therefore the ANSP should assure that as much focus is placed on understanding why certain risk controls worked as identifying why others failed.

HAZARD REPORTS

ANSPs often implement hazard reporting programs in efforts to identify issues. Reports of peak workload are often cited as being good examples of such programs. In such cases, it is possible to use investigatory style techniques working with the reporter to identify how they were able to deliver exceptional performance. Maintaining a focus on the attributes of the person and their approach to the task as performance demands increased has the potential to provide very useful information.

SURVEYS

Surveys are an under-utilised way in which ANSPs can gain information from staff about the strengths of their system, and also situations in which there is wide deviation between work as imagined and work as done. Depending on the safety culture of the organisation, such surveys may need to be completed in a confidential, or even anonymous, manner.

OBSERVATION METHODS

A growing number of ANSPs have moved to adopt observational methodologies, while perhaps not recognized at the time such methodologies do provide an appreciation of WAD. These methods include:

- *Normal Operating Safety Survey*: observations focus on identification of threats, errors and their management which gives an appreciation of WAD. Validation of threat and error management techniques occurs with Subject Matter Experts. Good practices at both an individual and unit level are identified in observations with a view to transfer learnings.
- *Day-to-day survey*: observations are conducted to identify WAD, training interventions are then made to re-dress areas of weakness and deliver more alignment between WAD and WAI. Further observations are made to validate the training intervention has been effective.

Observation does not necessarily need to be as structured as the techniques mentioned above, time spent observing any work when conducted with an appreciation of the rules and procedures which should be applied should provide useful insights. However, it will always be necessary to put the behaviour into context to appreciate why deviations from WAI have occurred, and what intervention is required.

WORKSHOPS

Workshops provide great opportunities for information to be gained our how a system is operating, and identify major differences between WAD and WAI. Allowing system operators to interact and focus on both the negative and positive aspects of the workplace has the potential to provide an easy way via which Safety II thinking can be demonstrated to line controllers and engineers. Posing open questions such as "what works well around here" or more structured workshops have been demonstrated in many work places to deliver significant safety insights.

8. OPPORTUNITY 2: ALIGNMENT OF SMS

As referenced above, System Thinking is a core component of Safety II. The 10 System Thinking attributes provide good design principles for a SMS. In many instances, system thinking is already embedded in the CANSO standards, recommended practice and guidance. For example: Safety by Design requirements in the Standard of Excellence in SMS emphasises the need to factor both a failure and success argument into any design process. However there are opportunities to improve and the tables below present both how the principles can be applied to the SMS, and then using the same core information which SMS elements where specific system thinking principles would be present the best opportunities to embed System Thinking principles.

As is evident from the tables, ANSPs are likely to gain greatest benefit from aligning their SMS to System Thinking principles by:

- enhancing their assurance practices; and
- focusing of process in relation to Safety by Design and Management of Change, these will aim to improve up stream decision making about the ATM system architecture, HMI and other supporting core processes which impact on our service delivery.

Table 1: System Thinking Principles Application within SMS

Principle	Summary	Application within SMS Elements
Field Expert Involvement	Involve field experts as co-designers, co-investigators, co-researchers and co-learners	• Coordination of Emergency Response Plan • Safety Interfaces • Safety by Design • Fatigue-related Risk management • The Management of Change • Safety Reporting Investigation and Improvement • Operational Safety Surveys and SMS Audits
Local rationality	Understand local perspectives, stories and experiences; Gain insights alignment between WAD and WAI	• Safety Reporting Investigation and Improvement • Operational Safety Surveys and SMS Audits

Just Culture	Reflect on our mindsets, assumptions and language	• The Management of Change • Safety Reporting Investigation and Improvement • Operational Safety Surveys and SMS Audits
Demand and Pressure	Consider demand on the system and the pressure imposed Gain insights alignment between WAD and WAI	• Safety by Design • The Management of Change • Safety Reporting Investigation and Improvement • Operational Safety Surveys and SMS Audits
Resource constraints	Investigate the adequacy of resources appropriateness of constraints	• The Management of Change • Safety Reporting Investigation and Improvement • Operational Safety Surveys and SMS Audits
Interactions and Flows	Look at flows of work and system interactions	• Safety by Design • The Management of Change • Safety Reporting Investigation and Improvement
Trade-offs	Understand trade-offs in context Gain insights alignment between WAD and WAI	• Safety by Design • The Management of Change • Safety Reporting Investigation and Improvement
Performance variability	Understand adjustments and the nature of variability	• Safety Reporting Investigation and Improvement • Operational Safety Surveys and SMS Audits
Emergence	Consider system wide patterns, cascades and surprises in waiting	• Risk Management Process • The Management of Change • Safety Performance Monitoring and Measuring • Safety Reporting Investigation and Improvement • Operational Safety Surveys and SMS Audits
Equivalence	Understand every day work	• Safety by Design • The Management of Change • Safety Reporting Investigation and Improvement • Operational Safety Surveys and SMS Audits

Table 2: SMS Element Alignment to System Thinking Principles

SMS Group	SMS Element	Principle
Safety Culture	Safety Culture	• Just Culture
Safety Policy & Objectives	Safety Policy	
	Organisational and individual safety responsibilities	
	Compliance with international obligations	
	Coordination of Emergency Response Plan	• Field Expert Involvement
	Safety Management System Documentation	

Safety Risk Management	Risk Management Process	• Emergence
Safety Achievement	Safety Interfaces	• Field Expert Involvement
	Safety by Design	• Field Expert Involvement • Demand and Pressure • Interactions and Flows • Trade-offs • Equivalence
	Fatigue-related risk management	• Field Expert Involvement
Safety Assurance	Safety Performance Monitoring and Measurement	• Emergence
	The Management of Change	• Field Expert Involvement • Just Culture • Demand and Pressure • Resource Constraints • Interactions and Flows • Trade-offs • Emergence • Equivalence
	Continual Improvement of the SMS	
	Safety Reporting, Investigation and Improvement	• Field Expert Involvement • Local Rationality • Just Culture • Demand and Pressure • Resource Constraints • Interactions and Flows • Trade-offs • Performance Variability • Emergence • Equivalence
	Operational Safety Surveys and Audits	• Field Expert Involvement • Local Rationality • Just Culture • Demand and Pressure • Resource Constraints • Performance Variability • Emergence • Equivalence
Safety Promotion	Safety Communication	
	Training and Education	

9. SUMMARY

The CANSO SSC recognizes that Safety II concepts have significant merit particularly as the sources of information (ie safety occurrences) on which current safety improvement decisions are premised will, hopefully, reduce over time.

CANSO promotes the need for SMSs to be aligned to the size and maturity of the ANSP which they support. Those ANSPs who have commenced thinking about extending safety management process to embrace Safety II thinking are not surprisingly the larger, mature and better resourced organisations. These are also the organisations who are most in need

of implementing new approaches given that they have probably already reaped much of the benefit from Safety I. However, all ANSPs can benefit from adopting Safety II thinking.

This guides aims to promote practice and approaches which can be easily integrated into existing practice in efforts to ensure that Safety II thinking is embedded. The proposals recognise that any SMS takes significant organisational effort to sustain and evolve, and the value proposition for any change needs to be demonstrated to all stakeholders.

The practices and approaches presented in this guide could be implemented in part or full, over a number of years, by any ANSP as they work to continually improve their SMS.

10. BACKGROUND READING

The following are information sources which may assist in understanding the background to this topic:

Safety II (White Paper): https://www.eurocontrol.int/news/safety-focus-what-goes-right

Safety II: Erik Hollnagel (2014) Safety I and safety II: the past and future of safety management. (Ashgate)

Systems Thinking:
http://skybrary.aero/index.php/Toolkit:Systems_Thinking_for_Safety/Systems_Thinking_Methods

Resilience Engineering: https://www.eurocontrol.int/content/hindsight Edition 22

Resilience Engineering (White Paper):
https://www.eurocontrol.int/search/resilience%2Bengineering

Work As Done:Work as Imagined: https://www.eurocontrol.int/content/hindsight Edition 25

Normal Operating Safety Surveys: http://www.eurocontrol.int/articles/normal-operations-safety-survey-noss

Functional Resonance Analysis Method: http://www.functionalresonance.com/

Systems-Theoretic Accident Modelling and Processes:
http://shemesh.larc.nasa.gov/iria03/p13-leveson.pdf