



Safety Mindfulness

Nick McDonald, Tiziana C. Callari, Daniele Baranzini (TCD), Rogier Woltjer, Björn Johansson (FOI)

Future Sky Safety is a Joint Research Programme (JRP) on Safety, initiated by EREA, the association of European Research Establishments in Aeronautics. The Programme contains two streams of activities: 1) coordination of the safety research programmes of the EREA institutes and 2) collaborative research projects on European safety priorities.

This deliverable is produced by the Project P5 “Resolving the organizational accident” of Future Sky Safety. The objective of this deliverable is to provide a methodology description of the safety mindfulness approach.

Programme Manager	Michael Piers , NLR
Operations Manager	Lennaert Speijker, NLR
Project Manager (P5)	Barry Kirwan, EUROCONTROL

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Contributing partners

Company	Name
TCD	Nick McDonald, Tiziana C. Callari, Daniele Baranzini
FOI	Rogier Woltjer, Björn Johansson
ECTL	Barry Kirwan
KLM	Arthur Dijkstra
NLR	Sybert Stroeve

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Prepared by: <i>(name)</i>	Company	Role	Date
N. McDonald, T. Callari	TCD	Main Author	03-12-2015
Checked by: <i>(name)</i>	Company	Role	Date
Nigel Makins	EUROCONTROL	Quality Assurance	11-12-2015
Approved by: <i>(name)</i>	Company	Role	Date
Barry Kirwan	EUROCONTROL	Project Manager (P5)	04-12-2015
Lennaert Speijker	NLR	Operations Manager	15-12-2015

Acronyms

Acronym	Definition
ATC	Air Traffic Control
ATS	Air Traffic System
HRO	High Reliability Organisations
MASCA	Managing System Change in Aviation
PROSPERO	Proactive Safety Performance for Operations

EXECUTIVE SUMMARY

Problem Area

WP5.2 has the objective to develop and demonstrate a concrete and practical method of maintaining safety mindfulness in operational situations. The idea is that if operational staff are aware of the possible threats that can occur in their day-to-day activities, they can anticipate (most of) them. While operational staff are certainly aware of most of the risks, there are two sources of risk for which they may not have current information. The first is risk information that is taken from a wider pool of information than the operational layer (including supervisors) traditionally has access to. This may be risks identified by looking across several organisations or even across an industry. Such information is relevant but may take a long time to filter back down to operational staff in organisations. The second source of risk information concerns new risks that may have been noticed by one or two individuals during their daily work, but have not yet been passed up the chain and identified as risks that operational staff need to be concerned about. Such risks may be passed on from one individual to another, but this will be an ad hoc process rather than formal, and may not reach the person who really needs it in time. Both these types of risk information may eventually reach the right people, but this can take too much time, and an incident can occur before existing processes have identified, analysed and processed such information, and disseminated it to the collective workforce.

Description of Work

This document presents the FSS Safety Mindfulness concept which will be advanced to develop and demonstrate how to manage operational situations mindfully. To do so, an extensive literature review regarding the original concept developed by Weick and colleagues has been provided. In the original concept Weick and Sutcliffe sought to develop a theory which differentiated organisations that managed to have an impressive safety record despite the complexity of their organisational systems. They sought the answer in some broad psycho-social and cultural aspects of the organisation – for example, distributed decision making, effective communication and shared understanding.

The FSS Safety Mindfulness concept will address the weak areas of the current concept, by integrating lessons learnt in previous research projects/experiences, resulting in tools/applications and approaches that will offer tangible safety benefits to aviation organisations. The concept comprises different aspects which will support both the operational, supervisory and middle management layers to better understand the system they work in, and share safety knowledge-based information. To illustrate the approach that FSS Safety Mindfulness will undertake, three case studies have been selected. These provide a convergence of the different capabilities – i.e. through top-down, bottom-up and horizontal approaches - to manage and leverage change in organisations. FSS will integrate the three approaches. Overall, the three case studies demonstrated that we need to “enlarge the

perspective” – of the different goals and tasks shared by the different roles in the organization. In order to comprehend how a system works and the different processes involved (both in the manifestation in the “here-and-now”, and in what can emerge in the future along a timeline) we need to encompass all the stakeholders’ points of view.

Results & Conclusions

The proposed FSS Mindfulness concept comprises different aspects which will support both the operational, supervisory and middle management layers to better understand the system they work in, and share safety knowledge-based information. These aspects are: mindfulness principles, a model of situation awareness, temporal and specificity aspects, and learning cycles. The FSS Safety Mindfulness Concept adopts the five mindfulness processes. This includes:

- 1) preoccupation with failure/success;
- 2) reluctance to simplify interpretations;
- 3) sensitivity to operations;
- 4) commitment to resilience;
- 5) deference of expertise

The three case studies demonstrate that safety mindfulness can be enhanced in organisations, and become a powerful component of a Safe Performance System, ensuring that front-line staff and supervisors have the best and most up-to-date safety information on new and emerging safety threats and how to avoid them.

Applicability

Within P5 “Resolving the Organisational Accident”, the Safety Mindfulness concept is applied particularly at the level of operational staff, supervisors and includes management across the range of aviation organisations (e.g. airlines, airports, ATM, etc.). It is designed to support and integrate with the overall P5 concepts in applying solutions to organizational safety across the whole organization in normal and non-normal operations.

The FSS Mindfulness concept will be validated in Year 2. This will involve an extensive field study using a multi-case approach, where different domains/organisations will be analysed to understand how we can deliver an operationally effective safety mindfulness model/approach which can enable the reduction of complexity in organisations.

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1 INTRODUCTION

1.1. The Programme

FUTURE SKY SAFETY is an EU-funded transport research programme in the field of European aviation safety, with an estimated initial budget of about € 30 million, which brings together 32 European partners to develop new tools and new approaches to aeronautics safety, initially over a four-year period starting in January 2015. The first phase of the Programme research focuses on four main topics:

- Building ultra-resilient vehicles and improving the cabin safety
- Reducing risk of accidents
- Improving processes and technologies to achieve near-total control over the safety risks
- Improving safety performance under unexpected circumstances

The Programme will also help coordinate the research and innovation agendas of several countries and institutions, as well as create synergies with other EU initiatives in the field (e.g. SESAR, Clean Sky 2). Future Sky Safety is set up with expected seven years duration, divided into two phases of which the first one of 4 years has been formally approved. The Programme has started on the 1st of January 2015.

FUTURE SKY SAFETY contributes to the EC Work Programme Topic MG.1.4-2014 Coordinated research and innovation actions targeting the highest levels of safety for European aviation in Call/Area Mobility for Growth – Aviation of Horizon 2020 Societal Challenge Smart, Green and Integrated Transport. FUTURE SKY SAFETY addresses the Safety challenges of the ACARE Strategic Research and Innovation Agenda (SRIA).

1.2. Project Context

The objective of P5 “Resolving the organisational accident” is to reduce the likelihood of organisational accidents in aviation via the development and implementation of a Safe Performance System. Safety focus has traditionally been on technical failures and human errors as they occur in operations, while new and promising approaches consider the overall socio-technical system in the full operational and organizational context. This Project addresses the effects of organizational structures, processes & cultural phenomena on safety performance in aviation organizations. The key areas comprising the resolution of the next aviation accidents are safety intelligence, safety culture, safety mindfulness and an agile response capability at organisational and inter-organisational levels. These elements are all available, but they need to be focused on the daily realities of aviation-related organisations, and then integrated into a cohesive system that will work for all parts of the aviation industry, whether ground or air, operational or support. P5 answers to Theme 3 “Building ultra-resilient systems and operators”, which aims at strengthening the resilience to deal with current and new risks of the humans and the organizations operating the air transport system. Outcome of the research (2017) will be a Safety

Performance System model which will address safety in aviation under a more cohesive and collaborative approach.

P5 consists of five inter-connected Work Packages, each addressing key-safety components:

- Safety Intelligence (WP5.1)
- Safety Mindfulness (WP5.2)
- Safety Culture (WP5.3)
- Agile Response Capability (WP5.4)
- Safe Performance System (WP5.5)

TCD leads WP5.2 Safety Mindfulness in cooperation with the following partners: NLR, FOI, ECTL, SICTA and LSE.

1.3. WP5.2 objectives

The essence of WP5.2 concerns mindfulness. The idea is that if operational staff are aware of the possible threats can occur in their day-to-day activities, they can anticipate (most of) them. While operational staff are certainly aware of most of the risks, there are two sources of risk for which they may not have current information. The first is risk information that is taken from a wider pool of information than the operational layer (including supervisors) traditionally has access to. This may be risks identified by looking across several organisations or even across an industry. Such information is relevant but may take a long time to filter back down to operational staff in organisations. The second source of risk information concerns new risks that may have been noticed by one or two individuals during their daily work, but have not yet been passed up the chain and identified as risks that operational staff need to be concerned about. Such risks may be passed on from one individual to another, but this will be an ad hoc process rather than formal, and may not reach the person who really needs it in time. Both these types of risk information may eventually reach the right people, but this can take too much time, and an incident can occur before existing processes have identified, analysed and processed such information, and disseminated it to the collective workforce.

Safety Mindfulness aims to provide much faster and effective processes to give operational people these types of information, via top-down, bottom-up and horizontal information-sharing processes. Furthermore, these processes are largely in the hands of operational staff themselves, fulfilling P5's overall objective of moving towards a safe performance system.

WP5.2 therefore has the objective to develop and demonstrate a practical method of maintaining Safety Mindfulness in operational situations, by maintaining the (top-down) feed-forward of risk information from safety to operations, (bottom-up) feedback from operations to safety people, and (horizontal) safety information sharing in the operational layer, which includes supervisors.

WP5.2 develops the original Mindfulness concept from Weick and Sutcliff. In the original concept Weick and Sutcliffe sought to develop a theory which differentiated organisations that managed to have an impressive safety record despite the complexity of their organisational systems. They sought the answer in some broad psycho-social and cultural aspects of the organisation – for example, distributed decision making, effective communication and shared understanding. HRO can be referred to as a set of organising processes that allow an organisation to continuously operate under trying conditions, reduce the impacts of accidents, and help with the recovery process (Weick and Sutcliffe, 2007). HROs strive to avoid errors by stressing a commitment to consistently safe and reliable operations.

The FSS Safety Mindfulness concept will address the weak areas of the current concept, by integrating lessons learnt in previous research projects/experiences, resulting in tools/applications and approaches that will offer tangible safety benefits to aviation organisations.

1.4. Research objectives and questions

The objective of this study is to provide a methodology description of the safety mindfulness approach.

This research objective is best expressed as a set of questions. The over-riding questions are as follows: How can we support the implementation of an “organizational/collective” Safety Mindfulness system? How can we support the sharing and retrieving of useful information and data to successfully mitigate/avoid incidents and accidents within ATS organizations?

1.5. Approach

To address the research objective and associated over-riding questions, we need to consider (1) bottom-up, (2) top-down, and (3) horizontal approaches. The first regards the short cycle loop between the operational people and supervisors/middle management, in which the local knowledge of *what is going on in the here and now* informs possible threats, which can then be communicated, “mindfully” shared, and retrieved. The second is based on existing organizational data and information to create an understanding of priorities that is informed by a bigger picture, based on a more global analysis of the system and the industry. The third is a relatively tight loop at the operational layer where potential threats are shared between operational people (including supervisors).

At a more detailed level, the Safety Mindfulness concept needs to respond to the following research questions:

- How is “collective mindfulness” informed?
- How is the “relevant” information derived and shared?
- How are the bottom-up, top-down and horizontal processes of data managing updated and shared?

- How do the people “feed the system for managing the information shared within the organisation” with the relevant/valid information of the knowledge that they have accumulated in the daily routines? And likewise how are they “fed by the system”?
- How can organisational procedures/processes and practices support all of this mindful organising?
- What are the conditions within the organisations which will enable a sustainable collective mindfulness process/activity?

The overall approach is to first develop the Safety Mindfulness concept, and this is the focus of this current report. This will be achieved within P5 through an extensive literature review followed by two workshops to formulate a working concept that can be developed for industrial usage.

The second part of the approach for this current document will be to highlight three case studies which offer ‘proof of concept’ for the top-down, bottom-up and horizontal components of Mindfulness. This will also support the specification of a Safety Mindfulness concept for FSS which will enable the integration of the three above-mentioned approaches “within a loop” cycle.

The final section of this document states how it is proposed to take this concept and translate it into a usable approach for industry via a set of field studies in the second year of the Project.

1.6. Structure of the document

This document divides into several different sections:

- First an Introduction is provided. This defines the context of intervention, the WP5.2 objectives and Research questions. Then the approach used in WP5.2 is outlined.
- Section 2 presents the theoretical background of the mindfulness concepts advanced by Weick and colleagues in the years.
- Section 3 introduces an integrated approach of the Safety Mindfulness model based on the latest research outcomes experienced by the project partners.
- Section 4 presents three selected case studies which illustrate how different aspects of Mindfulness can finally converge into a more comprehensive and integrated concept and approach.
- Section 5 outlines the field research design approach adopted to demonstrate WP5.2 Safety Mindfulness.
- Section 6 presents the conclusions and recommendations.

2 LITERATURE REVIEW ON THE MINDFULNESS CONCEPT

2.1. Introduction

This section presents an overview of Mindfulness as it was conceptualised by Weick and colleagues, and reviewed over time in the literature. By so doing, it intends to comment on the strengths and weaknesses of the approach, and suggest a theoretical/methodological proposal to overcome this.

2.2. Weick's Mindfulness concept

Weick and Sutcliffe are High Reliability Organisations (HROs) theorists who sought to develop a theory which differentiated organisations that managed to have an impressive safety record despite the complexity and coupling of their organisational systems. They sought the answer in broad psycho-social and cultural aspects of the organisation – for example, distributed decision making, effective communication and shared understanding. High Reliability Organisations (HROs) can be referred to as a set of organising processes that allow organisations to continuously operate under trying conditions, to reduce the impacts of accidents, and to help with the recovery process (Weick and Sutcliffe, 2007). HROs strive to avoid errors by stressing a commitment to consistently safe and reliable operations. This commitment is referred to as “collective mindfulness”.

The following questions organise this first section around Weick's Mindfulness concept:

- What is individual mindfulness?
- What is collective mindfulness?
- How does collective mindfulness happen?
- Who do we include in the 'collective'?
- Can mindfulness be measured?

2.2.1. Individual mindfulness

- a) The concept of mindfulness was originally developed as an individual concept in the psychological literature, with mindfulness being defined as an individual learning process characterized by a heightened awareness of the specific circumstances in a given situation (Jordan, Messner, & Becker, 2009). Studies of individual mindfulness show that mindfulness enhances positive outcomes in several important life domains, including mental health, physical health, behavioral regulation, and interpersonal relationships.
- b) The Eastern perspective on mindfulness has its foundations in Buddhist thought, where mindfulness is a receptive attention to, and awareness of, present events and experience occurring both internally and externally. (Brown and Ryan, 2003; Hede, 2010; Weick & Putnam, 2006)

- c) Individual mindfulness is a variant of the information-processing approach – expressed through active differentiation and refinement of existing categories, creation of new discontinuous categories out of streams of events, and a more nuanced appreciation of context and alternative ways to deal with it (Vogus and Sutcliffe, 2012).
- d) More recent theoretical work on organizational mindfulness has begun to link it to Eastern mindfulness – in terms of its effects on concentration and strength of insights. (Weick, and Putman, 2006)

The concept of individual mindfulness is the fundamental building block of collective mindfulness, and can be seen as an individual's situation awareness of risks related to a work situation. This means not only that the individual is aware about the possible threats/risks (or has heard about them), but is actively thinking about them in the situation.

2.2.2. Collective Mindfulness

- a) The mindfulness concept was conceptualised/transferred within the organisational literature by Weick, Sutcliffe and Obstfeld in 1999. They argued that HROs derive their ability to successfully manage critical conditions of complexity, dynamism and error-intolerance from organisational mindfulness (Weick, and Sutcliffe, 2001; Weick, and Sutcliffe, 2007; Weick, Sutcliffe, and Obstfeld, 1999)
- b) Formally, the authors defined mindfulness as “*a rich awareness of discriminatory detail*” (Weick, and Sutcliffe, 2007, p.32). In any dynamic situation, safety is achieved by timely human adjustment. This adjustment is effected by organising processes that increase the participants' quality of attention. This increased attention, in turn, enhances participants' alertness to details of operations, thereby enabling them to detect subtle changes in contexts and respond as appropriate – a process of mindfulness (Weick et al. 1999). Mindfulness organisations are very sensitive to variations in their environment and continually update safety assumptions and perspective. Mindfulness is focused on a “*clear and detailed comprehension of emerging threats and on factors that interfere with such comprehension*” (Weick, and Sutcliffe, 2007, p.32). As such, collective mindfulness enables an organisation to cope with unpleasant surprises by having the collective mindset necessary to detect, understand and recover them before they bring about bad consequences. In HROs “*there is variation in activity, but there is stability in the cognitive processes that make sense of this activity*” (Weick, et al., 1999, p.35). In short, it facilitates the identification and correction of potentially unsafe conditions and mistakes.
- c) A fundamental idea in Weick's writing is that organisations that encourage the sharing of narratives and storytelling will be more reliable than an organisation that does not, as “people know more about their system, know more of the potential errors that might occur and they are more confident that they can handle those errors that do occur because they know that other

people have already handled similar errors” (Weick, 1987, p. 113). Weick goes as far as seeing *storytelling and upholding narratives as a substitute for trial and error*, pointing to the fact that in many organizations, error is not an option as it would have disastrous outcomes. Instead, near misses and successful performance or recovery is used to illustrate the kind of behaviours that is encouraged by the members of the organization.

- d) Mindfulness can relate to (1) identifying and mitigating the risks associated with a task in hand or about to be carried out; (2) a more future-focused approach on what could go wrong rather than the immediate dangers. Both are about what is observed; what is the person’s past experience; and about having sufficient knowledge to assimilate the current status and to recognise what might go wrong. (Joyner and Lardner, 2008).
- e) Mindfulness as a collective capability comprises five processes: (1) *preoccupation with failure* (regularly and robustly discussing potential threats to reliability), (2) *reluctance to simplify interpretations* (developing a nuanced understanding of the context by frequently questioning the adequacy of existing assumptions and considering reliable alternatives), (3) *sensitivity to operations* (integrating the understanding into an up-to-date big picture), (4) *commitment to resilience* (recognising the inevitability of setbacks and thoroughly analysing, coping with, and learning from them) and (5) *under-specification of structure* (deferring to expertise rather than authority when making important decisions) (Weick, et al. 1999; Weick, and Sutcliffe, 2007).
- f) Organisational mindfulness is an organisation’s “enduring characteristic”. It is an “*organisational attribute that is relatively stable and enduring that results from structures and practices that is implemented by top administrators*”. (Vogus and Sutcliffe, 2012)
- g) Currently the term mindfulness is not widely used in an operational environment, but phrases such as situational awareness or risk awareness – which are elements of mindfulness – are. (Joyner and Lardner, 2008).
- h) The mindfulness existing within an organisation is a reflection of its culture, demonstrated by the way its business is conducted. In developing mindfulness the safety culture of the organisation and the benefits which come from it are realised.
- i) *Trust* and *heterogeneity* are also seen as important enablers for success as they allow members of an organization to take on different roles, and thereby increase the collective requisite variety, while still relying on and understanding each other’s roles (Weick, 1987). There is however a tension between heterogeneity and trust, as diversity usually is a poor fundament of trust.

From the above, in Weick’s concept collective mindfulness is a desirable trait for any organisation that wants to be safe. Collective mindfulness is socially constructed, and not simply a knowledge base, as there usually needs to be local interpretation and judgement of the information given the situation at hand. For example, for mindfulness to work at the collective level, there must be social aspects present

including trust and a deference to expertise over authority, as well as more cognitive tendencies such as a reluctance to simplify, and a sensitivity to operations. Many of these hallmarks of a HRO are also those of a strong safety culture.

2.2.3. “Mindful organizing”

- a) Safety is achieved through human processes and relationships (Sutcliffe, 2011). This mindful activity is “organizing” as it suggests that it is a continuing and dynamic process which comprises actions/behaviours in group settings. The social process is fed by extensive and continuous real-time communication and interaction by front-line operators (Weick and Sutcliffe, 2007).
- b) The importance of regular communication is emphasised as it is seen as an enabler of trust and building of joint action. “These patterns of interrelating are as close to a physical substrate for collective mind as we are likely to find. There is nothing mystical about all this. Collective mind is manifest when individuals construct mutually shared fields”. (Weick and Roberts, 1993, p. 365).
- c) Three claims characterize the concept: (1) it results from bottom-up processes; (2) it enacts the context for thinking and action on the front line; and (3) it is relatively fragile and needs to be continuously re-accomplished. (Vogus and Sutcliffe, 2012).
- d) Mindful organising enables individuals to continuously interact with others in the organisation as they develop shared understanding of the situation they encounter and their capabilities to act. This collective capability can potentially forestall errors (Sutcliffe, 2011).
- e) The individual’s understanding of the interrelationships between parts (his/her contribution) and whole (his/her contribution into forming a larger whole) forms a larger pattern of shared action (i.e. cognitive dimension of social capital).
- f) Mindful organising exists when it is collectively enacted, when a set of behaviours are enacted triggered by shared perceptions of similar levels of behaviours. This is also sustained by task interdependence or time working together, which can facilitate the homogenizing effects of social influence and social learning by offering ongoing opportunities for work-related interactions. (Vogus and Sutcliffe, 2012).
- g) The ability to adjust the organization of work as well as procedures is seen as an important enabler of reliability. Mindful organising thus includes the ability to recognise that the way of working must be adapted to current conditions, rather than relying on pre-defined organizational structures (Pool, 1997; Weick, et. Al., 1999).

Weick suggests that collective mindfulness can spontaneously emerge when people share a common understanding of a given situation and action in context. The inter-personal aspect means that it may be a challenge to create mindfulness across diverse groups, or for example shift teams or crews who

only rarely see each other. This suggests that to achieve collective mindfulness across such diverse or dispersed groups may benefit from some kind of tool/application that connects them. This will be returned to in Section 4 when presenting the case studies.

2.2.4. Actors contributing to the Mindfulness Role in organization

In the organisational hierarchy the groups which contribute to mindfulness/mindful organising are: (1) top administrators; (2) middle managers; (3) front-line employees. (Vogus and Sutcliffe, 2012)

(1) Top administrators are the ones in charge of the strategic issues in an organisation, and as such to the related organisational mindfulness. As such, it takes a top-down approach. (Ray, Baker, and Plowman, 2011).

(2) Middle managers are the actors bridging organisational mindfulness and mindful organising. As perception of organisational mindfulness of top administrators (i.e. top administrators' continuous scanning of information and on the fringes of current operations) might not coincide with the information at the front-line (front-line employees' mindful organising) the middle managers (such as technical department heads) play a crucial role in linking the top and the bottom of an organisation. As "reliability professionals" the middle managers play a crucial role in creating organisational mindfulness by reconciling the need for anticipation and careful causal analysis with the need for flexibility and improvisation in the face of unexpected change. They act as "translators" of real-time data from the front lines for the top administrators and creating structures that can guide front line actions. (Roe, and Schulman, 2008).

(3) Front-line employees – as the "HROs bringing-knowledge people with the greasy hands" are the crucial actors able to detect/anticipate the weak signals and the possible threats to reliability. Front-line operators face high variability and uncertainty in their task environment and are required to recognise and act on emerging and weak signals, which could necessitate the need to identify and analyse often obscure interdependencies. As such they will enhance both process and occupational safety, the environment and health along with reliability, productivity and commercial performance (mindful organising). (Vogus and Sutcliffe, 2012)

Vogus and Sutcliffe (2012) suggest that mindfulness needs to operate across organizational levels to produce strategic and operational reliability. Organizational mindfulness shall be created by top managers, synchronized across levels by middle managers, and translated into mindful organising actions on the front line. (Ocasio, 2011; Rerup, 2009).

In Sutcliffe and colleagues' latest work (Barton, Sutcliffe, Vogus, & DeWitt, 2015; Beck, and Plowman, 2009; Vogus, and Sutcliffe, 2012) more attention has been put in specifying the roles that top managers, middle managers and operational people have in promoting mindfulness in the organisation. As such,

the challenge is in connecting these three groups and finding ways to translate and share information across the various ‘layers’. There can be weak signals at all levels. It is an oversimplification to say that safety is only managed at the front line. Each level brings its distinctive view on the operation and the threats it faces. All of these groups will have different ‘world views’, and so translation becomes key. Added to this is that in reality most organisations are far more complex, with many sub-layers as well as compartmentalised groups.

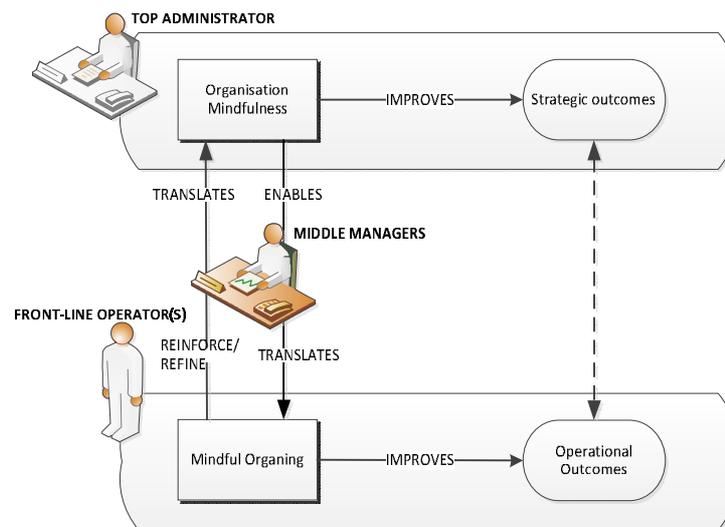


Figure 1: Actors and roles to develop mindful organisations (revised from Vogus and Sutcliffe, (2012))

2.2.5. Scales

Several scales have been developed to empirically validating the organizational mindfulness constructs and exploring and its constituent processes (Ie, Ngnoumen, & Langer, 2014). The scales reported below have been validated. As such, this in turn serves as an indication for the concept of mindfulness itself.

2.2.5.1. The Collective Mindfulness scale

Weick and Sutcliffe’s (2001) examined the construct of mindfulness 47-item questionnaire intended for managers to assess the capacity for mindfulness in their organizations. The table below presents the items measured using a three-point Likert scale (from 1 = “not at all”, 2 = “to some extent”, 3 = “to a great deal”).

Table 1: The Collective Mindfulness scale (Weick, and Sutcliffe, 2001, p. 103-115)

#	Concept	SOS Survey Item
1	Preoccupation with failure	<ul style="list-style-type: none"> - We focus more on our failures than our successes - We regard close call and near misses as a kind of failure that reveals potential danger rather than an evidence of our success and ability to avoid disaster - We treat near misses and errors as information about the health of

		<p><i>our system and try to learn from them</i></p> <ul style="list-style-type: none"> - <i>We often update our procedures after experiencing a close call or near miss to incorporate our new experience and enriched understanding</i> - <i>We make it hard for people to hide mistakes of any kind</i> - <i>People are inclined to report mistakes that have significant consequences even if nobody notices</i> - <i>Managers seek out and encourage bad news</i> - <i>People feel free to talk to superiors about problems</i> - <i>People are rewarded if they spot problems, mistakes, errors or failures</i>
2	Reluctance to simplify interpretations	<ul style="list-style-type: none"> - <i>People around here take nothing for granted</i> - <i>Questioning is encouraged</i> - <i>We strive to challenge the status quo</i> - <i>People in this organisation feel free to bring up problems and tough issues</i> - <i>People generally prolong their analysis to better grasp the nature of the problems that come up</i> - <i>People are encouraged to express different views of the world</i> - <i>People listen carefully; it is rare that anyone's view is dismissed</i> - <i>People are not shot down for surfacing information that could interrupt operations</i> - <i>When something unexpected happens, people are more concerned with listening and conducting a complete analysis of the situation than with advocating for their view</i> - <i>We appreciate sceptics</i> - <i>People demonstrate trust for each other</i> - <i>People show a great deal of mutual respect for each other</i>
3	Sensitivity to operations	<ul style="list-style-type: none"> - <i>On a day-to-day basis, there is an ongoing presence of someone who is paying attention to what is happening and is readily available for consultation if something unexpected arises</i> - <i>Should problems occur, someone with the authority to act is always accessible and available, especially to people on the front lines</i> - <i>Supervisors readily pitch in whenever necessary</i> - <i>During an average day, people come into enough contact with each other to build a clear picture of the current situation</i> - <i>People are always looking for feedback about things that aren't going right</i> - <i>People are familiar with operations beyond one's own job</i> - <i>We have access to resources if unexpected surprises crop up</i> - <i>Managers constantly monitor workloads and are able to obtain additional resources if the workload starts to become excessive</i>
4	Commitment to resilience	<ul style="list-style-type: none"> - <i>Forecasting and predicting the future is not that important here</i> - <i>Resources are continually devoted to training and retraining people on the properties of the technical system</i> - <i>People have more than enough training and experience for the kind of work they have to do</i> - <i>This organisation encourages challenging assignments</i> - <i>People around here are known for their ability to use their knowledge in novel ways</i>

		<ul style="list-style-type: none"> - <i>There is a concern with building people’s competence and response repertoires</i> - <i>People have a number of informal contacts that they sometimes use to solve problems</i> - <i>People learn from their mistakes</i> - <i>People are able to rely on others</i>
5	Deference to expertise	<ul style="list-style-type: none"> - <i>People are committed to doing their job well</i> - <i>People respect the nature of one another’s job activities</i> - <i>If something out of the ordinary happens, people know who has the expertise to respond</i> - <i>People in this organisation value expertise and experience over hierarchical rank</i> - <i>In this organisation, the people most qualified to make decisions make them</i> - <i>If something unexpected occurs, the most highly qualified people, regardless of rank, make the decisions</i> - <i>People typically “own” a problem until it is resolved</i> - <i>It is generally easy for us to obtain expert assistance when something comes up that we don’t know how to handle</i>

2.2.5.2. The Safety Organizing Scale (SOS)

The Safety Organizing Scale (SOS) (Vogus, and Sutcliffe, 2007) is a 9-item 1-factor scale assessing the behaviours towards safety culture and patient safety of members of a workgroup collectively engaged towards a common goal. The scale was developed in a health care centre, with a sample of 1,685 registered nurses on hospital nursing units. 13 hospitals were involved in the case study from different American geographical locations, size (i.e. from 89 beds to 478 acute care beds), and a wide array of in-patient units (i.e. n. 125). The scale was designed based on the theoretical literature on HROs that identifies safe performance as being a function of collective mindfulness (see Table below). The table contains all nine survey items measured using a seven-point Likert scale (from “not at all” to “to a very great extent”). Mindful organizing is then constructed for a collective by averaging all nine items across all respondents. It is important to note that all items are behavioral (to capture the fact that mindful organizing is a social process) and that the referent of each item is “we” (to capture the fact that mindful organizing is a collective capability). In terms of reliability and convergent validity, the Cronbach’s alpha for the SOS was 0.88.

Table 2: SOS items (Vogus, and Sutcliffe, 2007, p. 48)

#	Concept	SOS Survey Item
1	Preoccupation with failure	<ul style="list-style-type: none"> - <i>When giving report to an oncoming nurse, we usually discuss what to look out for</i> - <i>We spend time identifying activities we do not want to go wrong</i>
2	Reluctance to simplify interpretations	<ul style="list-style-type: none"> - <i>We discuss alternatives as to how to go about our normal work activities</i>
3	Sensitivity to operations	<ul style="list-style-type: none"> - <i>We have a good “map” of each other’s talent and skills</i> - <i>We discuss our unique skills with each other so we know who on the</i>

		<i>unit has relevant specialised skills and knowledge</i>
4	Commitment to resilience	<ul style="list-style-type: none"> - <i>We talk about mistakes and ways to learn from them</i> - <i>When errors happen, we discuss how we could have prevented them</i>
5	Deference to expertise	<ul style="list-style-type: none"> - <i>When attempting to resolve a problem, we take advantage of the unique skills of our colleagues</i> - <i>When a patient crisis occurs, we rapidly pool our collective expertise to attempt to resolve it</i>

2.2.5.3. The Organisational Mindfulness Scale for Business School

Ray, Baker and Plowman (2011) developed a scale to explore the usefulness of mindful organizing for the educational context. They examined organizational mindfulness in a sample of 154 U.S. business schools, collecting 225 completed surveys, of which 34 responses from deans, 66 from associate deans, 106 from assistant deans, and 19 from department chairs. Respondents used a 5-point Likert-type scale (1 “extremely inaccurate” to 5 “extremely accurate”) to indicate how well each statement described their college. In terms of reliability and convergent validity, the Cronbach’s alpha for the scale to assess the capacity of mindfulness was 0.96.

Table 3: The Collective Mindfulness scale for Business Schools (Ray, et. al., 2011, p. 194)

#	Concept	SOS Survey Item
1	Preoccupation with failure	<ul style="list-style-type: none"> - <i>We often update our college procedures after experiencing a problem.</i> - <i>We value problems and miscues in this college.</i> - <i>In this college, we spend more time focusing on negative experiences rather than positive experiences.</i> - <i>People in this college try hard to hide mistakes of any kind.</i> - <i>People in this college are inclined to report mistakes that have significant consequences even if nobody notices.</i> - <i>The leaders in our college seek out and encourage information that may be considered “bad news.”</i> - <i>People in this college feel free to talk to superiors about problems.</i> - <i>People in this college are rewarded if they spot problems, mistakes, errors, or failures.</i>
2	Reluctance to simplify interpretations	<ul style="list-style-type: none"> - <i>People in this college take nothing for granted.</i> - <i>Questioning is encouraged at all levels within the college.</i> - <i>People in this college listen carefully to each other; it is rare that anyone’s view is dismissed.</i> - <i>People in this college are not shot down for surfacing information that could interrupt operations.</i> - <i>In this college, sceptics are appreciated.</i> - <i>In this college, we strive to challenge the status quo.</i> - <i>People in this college demonstrate trust for each other.</i> - <i>When something unexpected happens in this college, people in this college are encouraged to conduct a complete analysis of the situation rather than advocate their view.</i> - <i>People in this college generally prolong their analysis of an issue to develop a broad understanding.</i>

		<ul style="list-style-type: none"> - People in this college are encouraged to express different views of the world to college administrators. - People in this college feel free to bring up problems and tough issues to college administrators. - People in this college show a great deal of respect for each other.
3	Sensitivity to operations	<ul style="list-style-type: none"> - During an average day in our college, people come into enough contact with each other to build a clear picture of the current situation. - People in this college readily pitch in to help out others whenever necessary. - The leaders of our college pay close attention to the day-to-day operations of the college. - Should problems occur in this college, someone with the authority to act is always accessible and available, especially to staff on the front lines. - People in this college are always looking for feedback about things that aren't going right. - People in this college are familiar with operations beyond their own specialty. - We have access to resources if unexpected surprises crop up. - We constantly monitor workloads to determine the need for additional resources.
4	Commitment to resilience	<ul style="list-style-type: none"> - This college encourages challenging "stretch" assignments. - In this college, resources are continually devoted to training and retraining people in their areas of expertise. - People in this college are able to rely on others. - People in this college are known for their ability to use their knowledge in novel ways. - There is concern with building the competence and the response repertoires of the people in this college. - People in this college have a number of informal contacts that they sometimes use to solve problems. - People in this college, generally, learn from their mistakes. - People in administrative positions in this college have more than enough training and experience for the kind of work they have to do
5	Deference to expertise	<ul style="list-style-type: none"> - If something unexpected occurs in this college, the most highly qualified people, regardless of rank, make the decisions. - People in this college respect the nature of one another's work. - People in this college value expertise and experience over hierarchical rank. - In this college, the people most qualified to make decisions make them. - It is generally easy for us to obtain expert assistance when something comes up that we don't know how to handle. - People in this college are committed to doing their jobs well. - If something out of the ordinary happens, people in this college know who has the expertise to respond.

3 FSS SAFETY MINDFULNESS

3.1. Introduction

In this section the FSS Safety Mindfulness concept is presented.

In WP5.2 the main focus is on the operational, supervisory and middle management layers. WP5.1 deals with top management and will be connected to WP5.2 in the final year of the Project. Overall, the privileged role of the operational person is recognized, but the principles in this section apply equally to operational and supervisory staff, and middle management.

3.2. Features of the FSS Mindfulness concept

The FSS Mindfulness Concept comprises different aspects:

- Mindfulness Principles
- A model of situation awareness
- Temporal and Specificity aspects
- Learning cycles

3.2.1. Safety Mindfulness Principles

The FSS WP5.2 Safety Mindfulness Concept adopts the five mindfulness processes (Weick, et al. 1999; Weick, and Sutcliffe, 2007)- i.e. (1) preoccupation with failure/success; (2) reluctance to simplify interpretations; (3) sensitivity to operations; (4) commitment to resilience; (5) deference of expertise (which replaced the process ‘under-specification of structure’ in later versions (Weick, and Sutcliffe, 2006, 2007). Our interpretation of these principles is detailed below.

(1) Preoccupation with failure and ‘success’

In Weick and colleagues’ work this process refers to the ability of detecting weak and mixed signals or deviations from what is routinely expected before they amplify to serious errors or catastrophes.

We argue that we should also pay attention to factors/aspects that supported success stories should be considered as a preoccupation with maintaining reliable performance. This would include appreciation for work strategies that operators use to get their work done in everyday situations with conflicting goals and constraints that are difficult to reconcile. In addition, an organizational understanding of actual working conditions and the resulting work-as-done in everyday operations should be promoted to support recommendations/best practices of all situations/events occurred which led to a failure or a success. This would feed a shared bottom-up system to support the organisational collective mindfulness. This system/application can support a regular and up-to-date discussion and sharing of potential organisational threats to reliability. By so doing, regular and robust reporting is encouraged

within the organisation to support the specification of behaviours which may be addressed to improve safety culture and interventions.

In FSS we will encompass the full range of failures/successes from our field research case studies to learn from them, and we will consider the perspective of the collective/organization, to overcome the individual experience for a system risks appraisal.

(2) Reluctance to simplify interpretations

In the original concept, this process refers to the ability to retain the distinctiveness of the unexpected changes in the organisation and current details of an uncertain course of events. In fact, labels and clichés (or pre-determined categories) can stop one from looking deeper into events and understanding the complexity of the situation that occurred. The operators should be able to use the categories and labels that are assigned in the system/application in a flexible way, so that the variation in the environment can be grasped and different interpretations can be given in relation to the specific situation/event presented. In so doing, the existing knowledge, skills and abilities are recombined into a novel configuration. The Safety Manager and the operational people will refer to this to make sense of unexpected events, register and understand the social complexity of the situation.

In FSS we will work on the information/situations gathered, to understand what knowledge is currently shared, and what knowledge can leverage to build on new processes, practices for a collective mindfulness system. This is necessary to bring to bear all relevant information that can support a valid interpretation. This will include the understanding and formalisation of the different skills and knowledge in play.

(3) Sensitivity to operations

In Weick and colleagues' work, the process 'sensitivity to operations' means monitoring "expectable interactions" and responding promptly to the unexpected. It is about seeing what is actually done regardless of what is supposed to be done (work 'as is' rather than work 'as imagined'), based on intentions, designs, and plans. Systems are dynamic and nonlinear in nature. As a result it becomes difficult to know how one area of the organization's operations will act compared to another part. Constant interaction deepens people's understanding of the interdependent workings of the complex system itself. This supports people to cope more effectively with unexpected surprises. To enable the operational people to understand the changes and the complexity of a novel (unexpected) situation/event, interdisciplinary and inter-departmental activity should be promoted, so that an integrated "big picture" of collective mindfulness is established.

In FSS we recognise that all levels/roles of the system have distinctive "operational"/organisational goals to be pursued. As such, we need to address the specific issues in different/distinctive

systems/applications – e.g. a system used by the operational people and supervisors, a system by the middle managers/safety managers, and a system by the top managers. These systems then may reconcile the different mindfulness needs of the different roles involved. To do so, critical attention will be focused on how the distinctive roles - and in particular we will start from the operational people - will be able to feed the system with information/local knowledge, and how the system (e.g. hard data) likewise will inform the operational people.

(4) Commitment to building resilience

Formally resilience is the “capability of a system to maintain its function and structure in the face of internal and external changes and to degrade gracefully when it must. Resilience occurs when the system continues to operate despite failure in some of its parts” (Weick, 1987, p.68). The organization must maintain function during high demand events. This will allow operational people to be mindful about errors that have already occurred and to correct them before they worsen and cause more serious harm. This means ensuring that lessons learned become part of current practice.

This process involves the soft skills of the people involved. This includes training to build people’s skills and mindset in mentally simulating different events/situations, how they can unravel, and how they might be corrected. This involves training the ability to make sense out of an emerging pattern. This, in addition, requires leadership within the organization to reinforce commitment to resilience.

In FSS we will formalise how this expanded knowledge will become part of collective knowledge for the organisation to learn how to get out of a tricky situation quickly. The lessons learnt will be formalised and become part of the current process/practices. This new flow of information collected in the form of lessons learnt/recommendation will support effective organisational adaptation and change.

(5) Under-specification of structure/deference of expertise

This process includes deference downward to lower ranking members of the organization. “Expertise resides in the heed with which people view their inputs as contributions rather than as solitary acts, represent the system within which their contributions and those of others interlock to produce outcomes, and subordinate their contributions to the well-being of the system, constantly mindful of what that system needs to remain productive and resilient” (Weick, 1987, p.78). Expertise is relational, is an assemblage of knowledge, experience, learning, and intuition which is seldom embodied in a single individual. As such, expertise defers to the expert with greater emphasis on an assembly of knowledge, experience, learning, and intuition. Credibility, a necessary component of expertise, is the mutual recognition of skill levels and legitimacy.

In FSS we will address how decisions can be supported and how feedback from different decisions can be shared, to enhance the collective knowledge-base of decision making.

3.2.2. A model of situation awareness

Fundamentally, collective mindfulness is about being proactive, about having the best and most up-to-date information when carrying out the task. It is about having a “shared” perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future (Endsley, 1988). Shared situational awareness describes “the degree to which team members possess the same situational awareness on shared SA requirements” (Endsley & Jones, 2001, p. 48). Implicit in this definition is the fact that team SA requires (1) a high level of SA in individual team members for aspects of the situation necessary for their job; and (2) a high level of shared SA between team members, providing an accurate common operating picture of those aspects of the situation common to the needs of each member.

In the FSS Concept, this is realized in four ways, as illustrated by the Situation Awareness Bubble shown below (which has been also developed by TCD in the ACROSS project (PF7, Contract n. 314501)

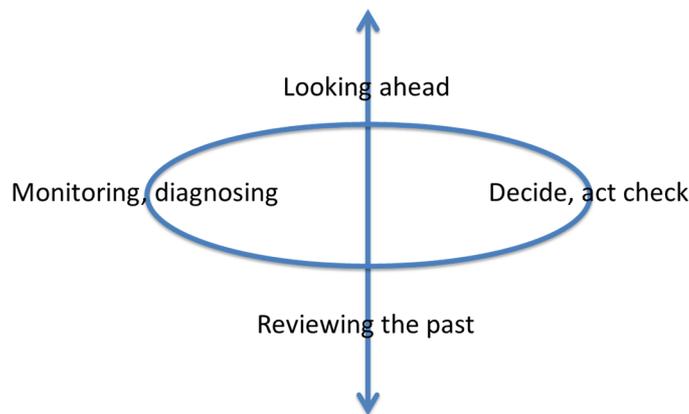


Figure 2: Situation awareness bubble

- (1) Looking to the future and anticipating events – staff in all layers need to consider novel demands, new conditions, and possible threats. At the operator layer generally this will be in terms of providing information and knowledge on how to manage and anticipate possible threats of foreseeable situations. The supervisor layer may have a broader set of events/situations that can happen, but depending on the supervisors’ closeness to operations, these may be less detailed or nuanced. Those in the management layer (both safety and operational management) will tend to consider bigger events and disturbances which are less likely but can have more dramatic consequences.
- (2) Monitoring and diagnosing refers to managing and analyzing the present, i.e. being able to understand and monitor what is currently happening in its context, updating safety assumptions and perspectives, and forewarning possible changes. This is closest to the core definition of mindfulness, as it refers to being in the ‘here and now’. It requires being able to

detect subtle changes in contexts, and responding as appropriate. Mindfulness is focused on a “clear and detailed comprehension of emerging threats and on factors that interfere with such comprehension”. The notion of emerging threats could refer to, on the one hand, threats that can emerge in the future along a timeline, or threats that are manifest in terms of an increasing comprehension of the complex pattern of the “here-and-now”. Hence the emergence seems to encompass elements of (1) anticipation and of (2) analysis/monitoring of the current situation. This may require a collaborative leadership style to enable, facilitate and draw out the collective mindfulness – to overcome individual .v. group boundaries. The sharing of knowledge in the organisation needs to be promoted to support the understanding of the organisation as a whole. Overall, the collective mindfulness should rely on a system built on local experiences integrated with a more global analysis. Appropriate information can then be tailored to the particular circumstances to create informed mindfulness.

- (3) Deciding and acting accordingly is the key determinant of safety, as it affects the outcome of the task or situation. This refers to making the right decision about what to do given the information available, as well as activating prepared actions or adjusting the current mode of functioning. This involves dimensions of self-awareness and others’ awareness. People need to have the collective mindset necessary to detect and comprehend emerging threats, and weigh and judge them, and then act appropriately and decisively before they bring about bad consequences.
- (4) Looking to the past is important in collective mindfulness, to ensure that we can include multiple perspectives from different actors with different goals, i.e. learning from the past experiences, and lessons, to strengthen/reinforce what has worked well and what needs to be changed/adjusted. Narratives and storytelling are means for understanding possible organizational patterns using a bottom-up approach. This learning process needs to build on both qualitative and quantitative sources which can provide as comprehensive systemic picture of risk as possible

3.2.3. Temporal and Specificity Aspects of Mindfulness

There are important temporal considerations in the Safety Mindfulness concept. At the operational ‘sharp end’, transmission of safety information can be very fast, ranging from real-time to within several days, e.g. telling colleagues immediately, during a break, at the end of a shift, or when they next come on shift. Such information has immediacy, is highly contextual, and is understood by those who receive it.

At the next level, information transmitted up the chain to supervisor level will be considered and weighed in terms of its importance and its specificity – if it is very localised or has relevance to other

operational areas (e.g. sectors or flight legs). If it is of generic value, it will be transmitted back down to ensure that all relevant operatives are aware. This process typically takes anything from several days to a month.

At the next level, threat information has either been raised to the safety management layer from the operational or supervisor layer, or else has been identified at the safety management layer as important based on internal analysis or risk information received from outside the organisation. Such information is analysed and judged not only on its own importance, but also relative to all other risks in the overall ‘risk picture’. The feedback loop from safety to operations, mediated through the supervisory layer, is typically in the range of months to years.

These time-frames can therefore be summarised as follows:

- Immediate – from real-time to days – data and information are ‘raw’
- Considered – from days to a month – data and information are ‘homogenised’
- Analysed – from months to years – data and information are generalised

These temporal considerations, as well as the degree of processing of the information and its resultant specificity, are important aspects when trying to engineer a Safety Mindfulness system, and so are part of the Concept.

We need to build a “stable mindful infrastructure” – having mindful processes of understanding, evidence collection, detection, evaluation, and revising.

3.2.4. Learning cycles (feedforward / feedback loops)

To promote a collective mindfulness within the organization possible approaches of knowledge building can be undertaken – i.e. top-down, bottom-up and horizontal approaches. These approaches have the high-level objective to expand knowledge and situation-awareness within different layers of the organization, to improve the information flow between the units/departments, the system efficiency, and ultimately to leverage change for improved safety culture. Organisations may suffer from gaps in sharing knowledge and best practices within the workgroups which could be critical to face unexpected threats or events/situations, but the challenge remains on how to create a knowledge feedforward (i.e. from top to bottom) and feedback (from bottom to top) loop across the different layers (see the left-side infographic below which shows possible “discontinuities” in the flow of sharing knowledge/information within the same layer of the organization, and across layers).

The FSS Mindfulness Concept in relation to this “collective-situation-awareness-building” is based around the three information streams: top-down, bottom-up and horizontal. The challenge is to create continuous knowledge loops within/across the different layers of the organization. These can be implemented initially separately as building blocks as each of the relevant layers (i.e. operational,

middle management, top management) towards the ultimate FSS Safety Mindfulness concept of a fully-integrated information-sharing within the organization (see the right-side infographic below showing a continuous circular loop of knowledge/information crossing and linking each layer of the organization). In Year 2 we will start analyzing the operational layer, and link to the different layers in Year 3, in integration with the other WPs of FSS P5.

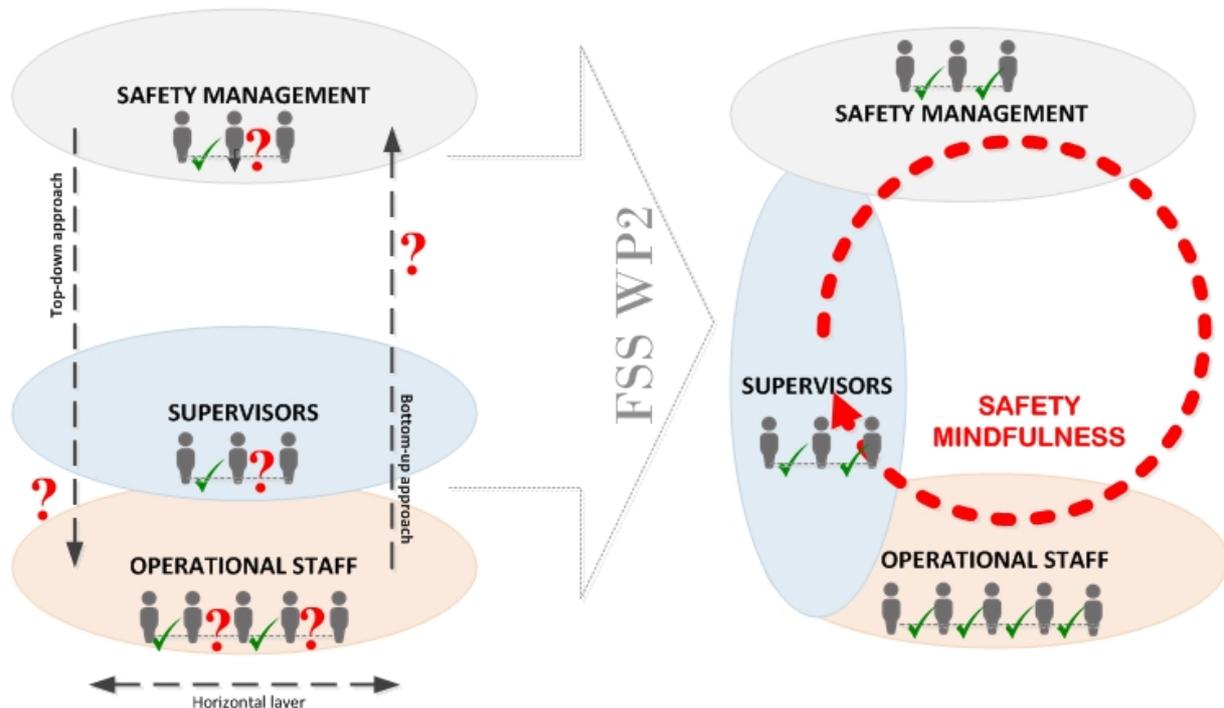


Figure 3: FSS WP5.2 Safety Mindfulness approach

These loops are the essential ‘engines’ of safety mindfulness, and transport (and translate) safety-related information (knowledge) between individuals, groups, and layers in the organization.

3.3. Discussion

Although Weick’s ideas on Mindfulness are popular, they have proven difficult to implement, and so far there is no accepted measure of organizational mindfulness (Ray et. al., 2011). This is possibly because they have remained ‘ideals’ and principles rather than concrete proposals on how to support or even engineer better mindfulness into organisations. The FSS Safety Mindfulness concept will address the still open issue for concretising the approach and supporting safety mindfulness as a living process in organisations.

The following section shows three case studies that demonstrate how the three proposed learning cycles can each be supported in aviation organisations. There will still be much to do, but these case studies show that safety mindfulness can begin to move from a set of ideals and principles, to

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supported processes and properties of operational organisations. Following these case studies, the final section will give a brief overview of the remaining work to be done and the first steps to be taken in making safety mindfulness reality.

4 CASE STUDY

4.1. Introduction

Three case studies have been selected to illustrate the different approaches which will be integrated in the FSS Safety Mindfulness concept – i.e. the (1) top-down approach, the (2) bottom-up approach and the (3) the horizontal approach.

The first case study presents a project in which critical situations experienced by pilots during their mission are shared through stories, to provide recommendation for problem-solving/decision making. Data are inserted by pilots in an application including fields to categorise/analyse information. The second case study derives from a European funded project called MASCA (EU FP7 Grant Agreement - No. 266423) and illustrates a web-based tool to support operational people in a small Italian airport in the daily management activity. The application design and implementation was characterised by a participatory approach to outline tasks and process mapping of the current practices carried out by the operational staff. This then enabled a better involvement of staff in solving problems and improvement initiatives. The third case study derives from a European funded project called PROSPERO (EU FP7 Grant Agreement - No. 314822) and introduces a Change Management application addressed to the Middle Management, to leverage organisational change. This application was implemented within the PROSPERO project, which was coordinated by TCD from 2012-2015.

4.2. Case Study 1: The horizontal approach (Story-Telling and Story-Sharing)

4.2.1. Background

Conversations between aviation professionals very often concern operational issues. Within one operational domain (e.g. ATC or Flight) the sharing of stories is to some degree already organised -e.g. pilots talk to pilots during training and via safety publications.

4.2.2. The research outcome: expertise sharing

An application has been created to support the spontaneous sharing of stories across the operation layers/the system (Dijkstra, 2013). This has been enabled by creating a format for telling about incidents and events that people can relate to. The format contains the following categories:

- Please tell your story in such a way the other aviation professionals can learn from it:
- Please give your story a descriptive title:
- Please provide some keywords that fit your story
- What is the lesson you draw from this event
- Who should read this story?
- What lesson should others draw from this event?
- What is your function?
- What was your role?

- How many years of experience do you have in this function?
- How did you feel just after the event?
- How long will you remember this event?

This provides a system for horizontal learning – the operational field is learning from itself. The learning loop needs no data interpretation, categorisation, classification, risk assessment, etc.. The stories need only be tagged with date, location, story title and keywords. These meta-data can be assigned by the story-teller. Therefore this learning loop can be fast (stories can be available very shortly after the event).

4.3. Case Study 2: The bottom-up approach (MASCA)

4.3.1. Background

The MASCA project (2012-2015) was conceived and developed in order to address the high failure rate of change initiatives and to provide guidance and support for how to do it better. The MASCA Change Management System (CMS) aimed to deliver an integrated change management capability approach through its deployment in selected change management case studies. One of these was represented by a small Italian airport facing problems of downsizing in personnel, from the one side, but increase of air traffic operations from the other. The work practices carried out in the airport by operational people showed little sharing of knowledge of the difficulties met, little interaction among departments, and best practices left at a personal patrimony level. To meet the challenges of the current scenarios a holistic performance management approach was developed. The intervention followed a bottom-up and collaborative approach, involving the operational staff in the design and implementation process of a web-based tool to support the operational daily activities. The data collected are analysed to measure day to day performance and potential hazards in procedures, equipment and human factors.

4.3.2. The research outcome: the “Daily Journal”

A web-based tool was designed to support the process of change management and analysis around day-to-day performance and potential hazards in procedures, equipment and human factors. A database was also designed to support the new Safety Management System within the airport. Subtasks pertaining to each constraint are recorded in a dedicated Risk Register and analysed during scheduled meetings attended by staff and management in order to identify appropriate corrective actions. This is part of a major strategy to create a more business-oriented framework which is critical to the organization’s survival.

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Load Flights

Arrivals

Fly No.	A/C REG	STA	ATA	From	Delay Code	Notes	Actions
AZ 1685	HBACD	11:00	11:00	FCO			[Icons]
FR 6726		14:15	14:15	HHN			[Icons]
AZ 1243		14:50	14:50	LIN			[Icons]
AZ 1687		16:30	16:30	FCO			[Icons]
FR 5016		19:40	19:40	CRL			[Icons]
W6 3121		21:25	21:25	OTP			[Icons]
AZ 1241		22:05	22:05	LIN			[Icons]
AZ 1689		23:00	23:00	FCO			[Icons]
FR 4015		23:00	23:00	BGY			[Icons]

ADD NEW

Departures

Fly No.	A/C REG	STD	ATD	To	Delay Code	Notes	Actions
AZ 1242	EIRDO	07:00	07:00	LIN			[Icons]
AZ 1686	HBACD	07:35	07:35	FCO			[Icons]
FR 6727	EIEVN	10:10	10:10	FCO			[Icons]
AZ 1688	HBACD	11:50	11:50	FCO			[Icons]
VK 745		14:00	14:00	TIA			[Icons]
AZ 1244		15:25	15:25	LIN			[Icons]
AZ 1690		19:00	19:00	FCO			[Icons]
FR 4016		20:05	20:05	BGY			[Icons]
FR 983		20:45	20:45	STN			[Icons]
W6 3122		21:55	21:55	OTP			[Icons]

ADD NEW

Shift Handovers Task/Notices Handling

- Flight Not defined**
PLS NON INSERIRE I RITARDI IN ARRIVO MA SOLO IN PARTENZA !!!! I CODICI DEI RITARDI IN PARTENZA SONO IMPORTANTI PER LA CARTA DEI SERVIZI. Grazie mille!
opened by Diana Del Sordo on the 15-10-2015 | Edit | Close
- Flight Not defined**
Potreste inserire gli orari in partenza reali perché Fabio ha inserito un'applicazione per i KPI che devo registrare? Grazie, Diana
opened by Diana Del Sordo on the 04-11-2015 | Edit | Close

ADD NEW

Thu, 03
Dec 2015

< Dec 2015 >

sun	mon	tue	wed	thu	fri	sat
	1	2	3	4	5	
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Shifts

ADD NEW

Last solved blockers

- NO MSG FROM FCO
- nil
- PASSEGGERI LAMENTANO LA CARENZA DI CARRELLI PORTABAGAGLI NELLE AREE ARRIVI INTERNAZIONALI E NAZIONALI. INVIATA MAIL
- Atte Michele, Please rispondere
- MALFUNZIONAMENTO ambulift
- AMBULIFTO RIPARATO DAL RESISTENTE MEZZI
- ARRIVATI RITARDI

ACTIVITIES COORDINATION
RE. FLIGHT ARRIVALS

CALENDAR OF INDEXED
ACTIVITIES

ACTIVITIES COORDINATION
RE. FLIGHT DEPARTURES

COMMENTS/FEEDBACK RE. CORRECTIVE
ACTIONS WHICH ARE IMPLEMENTED

SHIFT HANDOVERS

Daily Journal | 2015-12-03-2015
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Figure 4: SAGA Airport's Daily Journal web-based tool [1/2]

ARR FR 4035 BGY - 09:25 - 15/10/2015

Person	Activity	Blockers
D'intino Daniela	Verifica inserimento display nel sistema AOS	<div style="border: 1px solid blue; padding: 5px;"><p>Description System off line</p><p>ADM in turn: Caputi Elena</p><p>Severity: Medium</p><p>Category: Airside infra structures</p><p>Solved: <input type="checkbox"/></p></div>
Nobody	Inserimento o verifica matrice di volo in DCS	<div style="border: 1px solid blue; padding: 5px;"><p>Description</p><p>ADM in turn:</p><p>Severity: Medium</p><p>Category:</p><p>Solved: <input type="checkbox"/></p></div>
Nobody	Informativa ad enti di stato - opzionale (Mod 016)	<div style="border: 1px solid blue; padding: 5px;"><p>Description</p><p>ADM in turn:</p><p>Severity: Medium</p><p>Category:</p><p>Solved: <input type="checkbox"/></p></div>
Nobody	Informazione servizi di assistenza a rampa (Mod 18)	<div style="border: 1px solid blue; padding: 5px;"><p>Description</p><p>ADM in turn:</p><p>Severity: Medium</p><p>Category:</p><p>Solved: <input type="checkbox"/></p></div>
Nobody	Ricezione messaggistica operativa PSM,CPM, LDM, MVT Info spec.	<div style="border: 1px solid blue; padding: 5px;"><p>Description</p><p>ADM in turn:</p><p>Severity: Medium</p><p>Category:</p><p>Solved: <input type="checkbox"/></p></div>
Nobody	Aggiornamento display Info ed annunci sonori	<div style="border: 1px solid blue; padding: 5px;"><p>Description</p><p>ADM in turn:</p><p>Severity: Medium</p><p>Category:</p><p>Solved: <input type="checkbox"/></p></div>
Nobody	Invio messaggi di landing / block, stampa DUV	<div style="border: 1px solid blue; padding: 5px;"><p>Description</p><p>ADM in turn:</p><p>Severity: Medium</p><p>Category:</p><p>Solved: <input type="checkbox"/></p></div>
Nobody	Assistenza in sala arrivi, eventuale PIR	<div style="border: 1px solid blue; padding: 5px;"><p>Description</p><p>ADM in turn:</p><p>Severity: Medium</p><p>Category:</p><p>Solved: <input type="checkbox"/></p></div>
Nobody	Prelievo Docs a bordo (loadsheets, Pax list)	<div style="border: 1px solid blue; padding: 5px;"><p>Description</p><p>ADM in turn:</p><p>Severity: Medium</p><p>Category:</p><p>Solved: <input type="checkbox"/></p></div>
Nobody	Update del file di volo (Mod-033)	<div style="border: 1px solid blue; padding: 5px;"><p>Description</p><p>ADM in turn:</p><p>Severity: Medium</p><p>Category:</p><p>Solved: <input type="checkbox"/></p></div>
Nobody	Fatturazione servizi o cristallizzazione servizi	<div style="border: 1px solid blue; padding: 5px;"><p>Description</p><p>ADM in turn:</p><p>Severity: Medium</p><p>Category:</p><p>Solved: <input type="checkbox"/></p></div>

Save

Figure 5: SAGA Airport's Daily Journal web-based tool [2/2]

The application is driven by the following key-principles:

- Evaluation of everyday operational activities to support SMS and company efficiency, effectiveness and reliability in a continuously changing environment;
- Data collection embedded in the shift log.
- Establish a database and risk register to support the proactive and predictive safety analysis.
- Collaborative risk assessment involving operational and management staff at all levels for process improvement

The application is well inserted in the operational loop providing better adherence to and control of existing processes, with an interface that supports the current daily work and does not create additional stress to the operator. Here, the participative approach to process mapping created a set of maps with strong ecological validity, so that they could support, in a clear and effective way, additional steps in the process which were seen to be beneficial – creating a daily journal of activities to be checked off and an anomalies report. Again, creating a common functional logic of the process system was a critical first step (McDonald, 2014)

4.4. Case Study 3: The top-down approach (PROSPERO)

4.4.1. Background

The PROSPERO project (2012-2015) will produce an integrated risk framework for the Air Transport System (ATS) including proactive ways to anticipate complex risks that have the potential to cause crises. By anticipating these risks, it allows for more effective management of situations where risks cannot be eliminated. A top-down approach, consisting of selected criteria to organise change related data and information, was developed in PROSPERO to determine the intelligent knowledge usage (mindful exploitation of change knowledge) to change events, or the context of a change. Change initiatives (i.e., formal organisational change projects like reshaping an entire taxiway system close to a specific runway) with and across organisations are maintained under control and oversight with higher awareness of change details. This satisfies all three temporal aspects of Mindfulness (see previous sections). The approach is based on the following key concepts:

- Detailed hazard and condition assessment of organisational change initiatives
- Collaborative framework instantiation in applying the change process. Put simply all stakeholders involved in a change project are implementing formal and dedicated procedures to share and collaborate on several topics of the change project.
- Tracking (the process and results) of change recommendations out of the collaborative effort in augmented knowledge awareness on change insights
- Outcome: a shared augmented knowledge on risk assessments and collaborative results

A Change Manager (CM) application was developed. This provides innovation in planning, controlling and managing change initiatives and change project in a direct (up-to-date) and easy way. This is done by consolidation of “different conditions” recorded at different stages of a change initiative over time. The specific conditions consolidated over time are 1) the hazards and their estimated risk impact on the change process (called in PROSPERO the Change Hazards), 2) the recommendations designed for those hazards, 3) the estimated expectation to minimize such hazards and 4) the expectations to meet the change project objectives overall. Such activity is shared across all stakeholders in the project and is performed several times over the course of a change initiative that could have time-frames ranging from 1 week to several years.

Specifically the Change Manager is mostly dedicated to support design and development of effective recommendations based on risk evidence that changes over time. Put simply, the change is a non-stationary system itself and changes of objectives, recommendations and hazards could modify constantly over time. Thus CM supports effective provision of new (evolving) recommendations based on the most problematic risk in change evolution detected over time. This is an innovation in change

management as the implementation of recommendations over certain hazards evolves over time as the problems are not stationary elements but evolve over time.

4.4.2. The research outcome: the “Change Manager”

As shown in the red coloured boxes in Figure 6 below, the Change Manager (as software) gathers “change information/knowledge” (e.g. “Team assignment not regulated by a change management procedure”) from all the organisation levels exposed to a change, and then it translates such augmented knowledge (collective mindfulness) in “change hazard assessments”. Such assessments are impact estimations performed in dedicated focus groups that will trigger a full collaborative effort (all change stakeholders involved) in sharing, interpreting and delivering “change recommendations” that are true collective efforts. Such efforts are then tracked over time, as the CM application is repeated several times over the course of a change project, to detect both meaningful variations in risk dimension/type and, more important variations in recommendation evolutions. This is done to “monitor and control over time the implementation” of recommendations and effects.

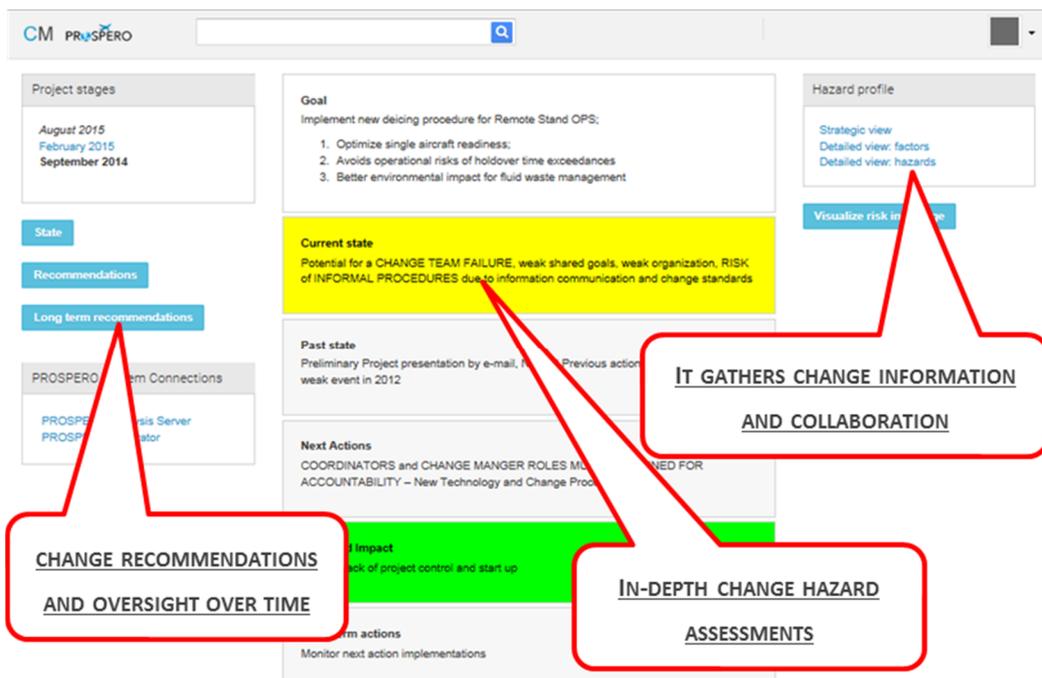
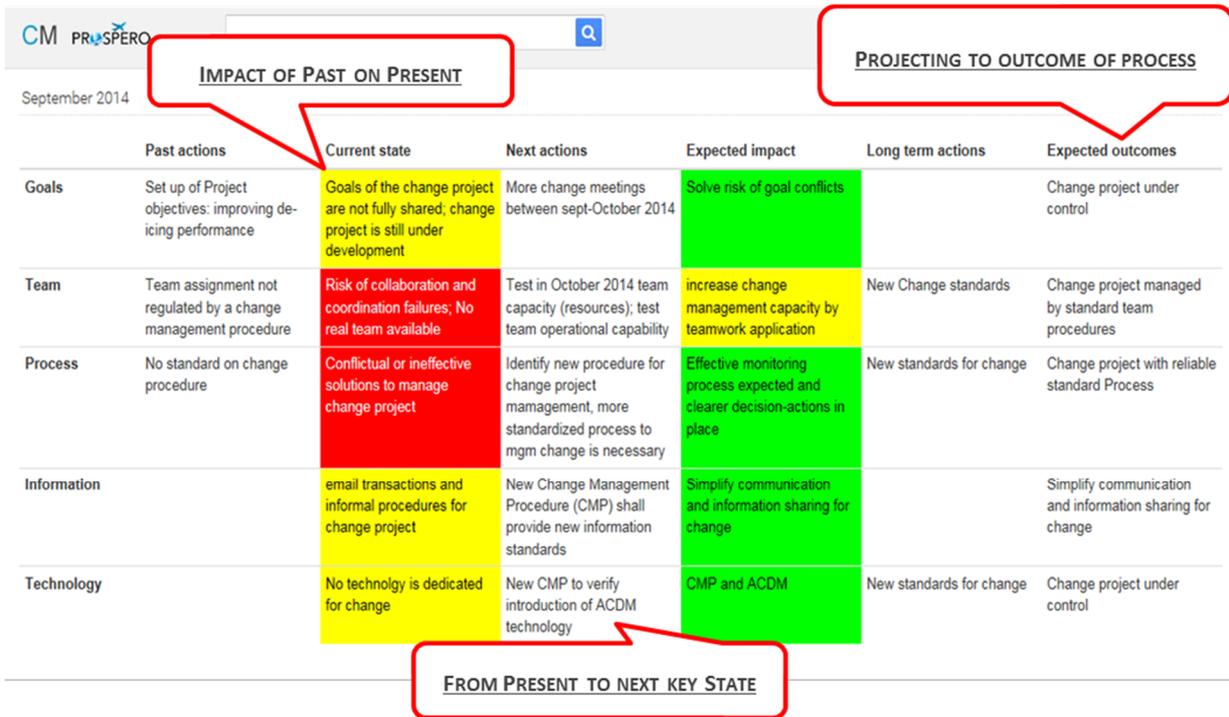


Figure 6: Change Manager layout

Overall, depending on the specific period of the Change (organisational project), a more detailed view of the change status is still easy to understand in terms of “current states”, “past actions”, “next actions” and “expected impact of recommendations to implement. This is shown in Figure 6 below where the “effects of past over the present” situational awareness and states is controlled more in detail. This first form of *backward loop* will generate richer knowledge to “step from the present condition to the next key state”. Finally such collective effort and reasoning will allow “projecting

forward” (expectations generation) to the outcome of the process to be controlled. Notably the system is designed to break down change information silos and transforms the Change into collaborative actions across departments of entire network of large organizations with a clear effect of augmenting shared awareness and mindfulness respectively.



	Past actions	Current state	Next actions	Expected impact	Long term actions	Expected outcomes
Goals	Set up of Project objectives: improving decisioning performance	Goals of the change project are not fully shared; change project is still under development	More change meetings between sept-October 2014	Solve risk of goal conflicts		Change project under control
Team	Team assignment not regulated by a change management procedure	Risk of collaboration and coordination failures; No real team available	Test in October 2014 team capacity (resources); test team operational capability	increase change management capacity by teamwork application	New Change standards	Change project managed by standard team procedures
Process	No standard on change procedure	Conflictual or ineffective solutions to manage change project	Identify new procedure for change project management, more standardized process to mgm change is necessary	Effective monitoring process expected and clearer decision-actions in place	New standards for change	Change project with reliable standard Process
Information		email transactions and informal procedures for change project	New Change Management Procedure (CMP) shall provide new information standards	Simplify communication and information sharing for change		Simplify communication and information sharing for change
Technology		No technology is dedicated for change	New CMP to verify introduction of ACDM technology	CMP and ACDM	New standards for change	Change project under control

Figure 7: Change Manager - "Strategic view"

4.5. Discussion

Some lessons learnt from the different experiences undertaken in the selected case study support the integrated approach that will be developed in the FSS Safety Mindfulness.

Overall, the three case studies demonstrated that we need to “enlarge the perspective” – of the different goals and tasks shared by the different roles in the organization. In order to comprehend how a system works and the different processes involved (both in the manifestation in the “here-and-now”, and in what can emerge in the future along a timeline) we need to encompass all the stakeholders’ points of view.

In the “story-telling” the initiative involves the horizontal layer. Stories might contain weak signals that are not yet visible in safety analysis in the respective organisations and as such provide feedback to the respective organisational management layers. In addition, cross domain sharing of stories between operational people is not yet organised. Suppose a day of severe weather occurs at a busy airport. The sharing of stories between the different groups involved would be very informative for all. Each group

has its own particular issues for operations on a busy airport during severe weather. Sharing these issues creates an understanding of the problems of the others and possibly improves cooperation with each other. The stories can support peers to take similar decisions and provide recommendation/input to be used in similar situations. Access to raw stories (not edited, categorised, abstracted etc.) provides a valuable understanding of others working in the same system, having shared goals (safe) but also own constraints (e.g. flight schedules, noise limitations). Joint mixed analysis teams (from different domains) can analyse these stories and extract how “work is done” as opposed to “work is imagined”. The gap between the two is relevant for conversations between all parties involved, including the regulator.

In MASCA the initiative escalated upwards. The initial focus was on the operational processes, but new software systems at the operational level create opportunities and demand for new more effective management processes grounded in real data from the operation. The availability of data enhances a range of management processes - monitoring, co-ordinating between departments, reporting back to customers or the regulator, generating improvements, and more specifically the development of SMS is made more real by these activities, together with the hazard identification and risk register. As a result of this, a better compliance with the procedures, and a much clearer focus of what needs to be done following the “real” procedure was achieved. The application resulted also in a powerful instrument for the management to understand the operations and take into account the “weak signals” which weren’t considered before. The new information was put into the management domain. As a consequence, the middle management has now a better understanding of what is happening. This improves coordination between different operational units, both within the airport organization and the other organisations that operate with the airport. Finally, this has improved the relationship with outside stakeholders because of better information about the airport operation.

In PROSPERO the initiative started to support the Middle Management to manage different change initiatives and actions (i.e., ADR’s new de-icing in remote stand procedure). The results of this experience showed the importance of not only managing the change, but supporting the escalation and implementation of (new) processes that have being changed. As such, for effective change management we need to understand the operations that have to be changed. Common problems that were uncovered concerned the involvement of all ‘stakeholders’ in the process, understanding diverse goals in a common change initiative, the depth of understanding of critical aspects of the process, and ensuring that new systems fully encompass all of these dependencies. The Change Manager facilitates new collaboration and knowledge sharing across the diverse participants in a change initiative, including functions which were not initially engaged to share knowledge on such terms. Thus it reaches down into the operation creating a stronger collective mindfulness of what needs to change and how it can be done. At the same time it has allowed the change process itself to be better understood and

given importance. This process for instance culminated in at least one large Airport (i.e. Aeroporti di Roma, Italy), to the appointment of a formal dedicated new function called “Change Manager”. The new role was necessary to formalize and coordinate the new approach to the change process that was put in place by the case study deployment at the Airport.

In FSS we need to build a set of applications to support the enlargement of a global understanding/mindfulness of the activities carried out in an organisation. This application should include the specific different goals and tasks the different roles in the organisation perform. This will leverage the capacity to exploit knowledge about possible changes emerging across multiple stakeholders.

5.2. The research design approach in WP5.2

An embedded multiple-case design approach will be adopted in FSS WP5.2. The cases will be represented by ATS organisations. In principle, this will include organisations domains such as ATM, airports, flight operations, etc. In principle, organisations already participating in FSS will be contacted (e.g. ENAV for the ATM domain, KLM for the aircraft sector, etc.), but TCD will also approach organisations from own contacts/previous EC projects. It is possible that different organisations from the same domain will be recruited.

For each of the selected case/domain, two distinctive units of analysis will be investigated. This will include:

- (1) EMBEDDED UNIT OF ANALYSIS 1: the specificities of each domain under analysis (e.g. organisational specificities, ATM, airline, aircraft, etc.)
- (2) EMBEDDED UNIT OF ANALYSIS 2: the possible interfaces between the domains/organisations analysed

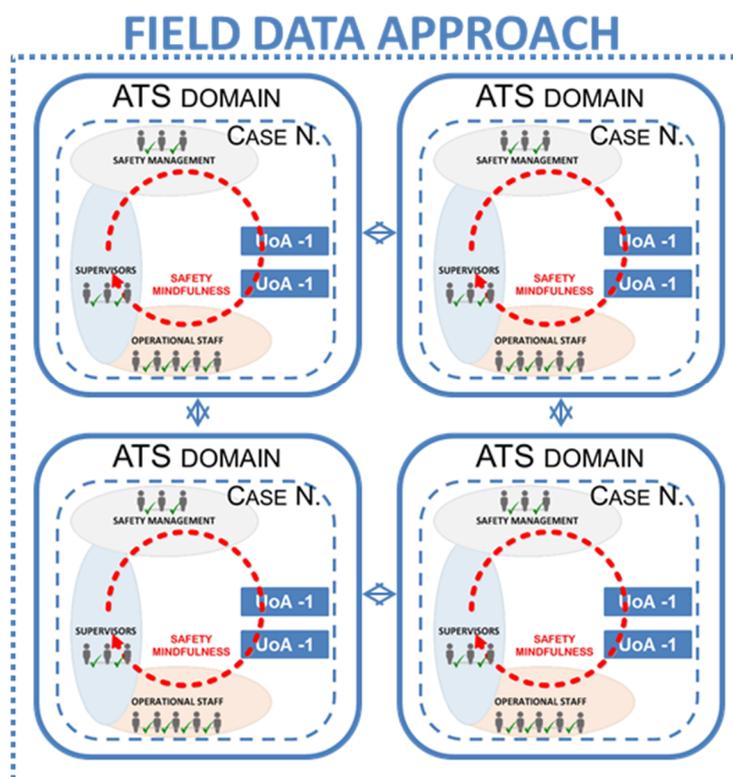


Figure 9: Field data Approach

Overall, a qualitative approach will be used. The data collection protocol will make use of different sources of evidence to build up the evaluation picture. This will involve semi-structured interviews, focus group/collaborative sessions, observations, analysis of formal and informal documents, and

where possible pictures and videos. The data analysis will make reference to FSS Mindfulness Concept Coding Frame. The Coding Frame will include the following dimensions:

- (A) Mindfulness principles - i.e. (1) preoccupation with failure/success; (2) reluctance to simplify interpretations; (3) sensitivity to operations; (4) commitment to resilience; (5) under-specification of structure
- (B) Time line Awareness Bubble (i.e. - reviewing the past, monitoring/diagnosing, decide/act/check, and looking ahead)
- (C) Three Safety Mindfulness approaches (i.e. Top-down Bottom-up, Horizontal)

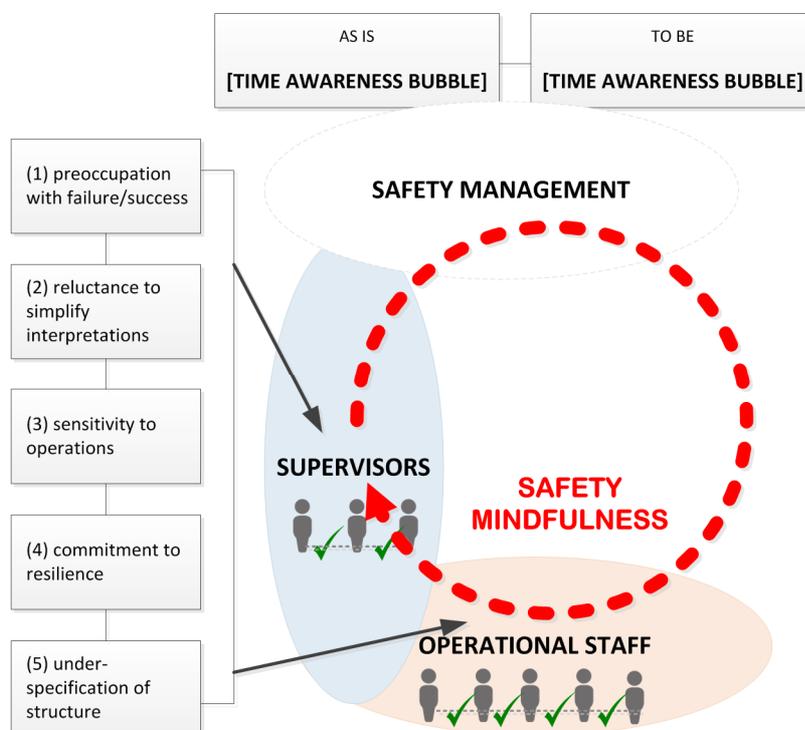


Figure 10: Categories for data collection

The multiple sources of evidence used will be categorised and analysed in the proposed categories of the Safety Mindfulness concept coding frame. This will support the researchers to record/provide traceability of the multiple sources of evidence used in the validation activities throughout the field study.

5.3. Discussion

The field research will take place in Year 2 and is expected to involve at least three different organisations from the ATS. Operational people and supervisors will be recruited for each selected case. The definition of the protocol for data collection and analysis will support data validity and reliability.

The field research will support the conceptual demonstration of the FSS Safety Mindfulness concept, and the definition/validation of requirements.

6 CONCLUSIONS AND RECOMMENDATIONS

This document presents the FSS Safety Mindfulness concept which will be advanced to develop and demonstrate a practical method to manage operational situations mindfully. To do so, an extensive literature review regarding the original model developed by Weick and colleagues has been provided, and the key concepts have been commented on, in order to provide an integrated approach to address the weak areas of the current concept and make it more “concrete” and implementable.

The proposed FSS Mindfulness concept comprises different aspects which will support both the operational, supervisory and middle management layers to better understand the system they work in, and share safety knowledge-based information.

To illustrate the approach that FSS Safety Mindfulness will undertake, three case studies have been selected. These provide a convergence of the different capabilities – i.e. through top-down, bottom-up and horizontal approaches. FSS will integrate the three approaches. Overall, the three case studies demonstrated that safety mindfulness can be enhanced in organisations, and become a powerful component of a Safe Performance System, ensuring that front-line staff and supervisors have the best and most up-to-date safety information on new and emerging safety threats and how to avoid them.

The FSS Mindfulness concept will be validated in Year 2. This will involve an extensive field study using a multi-case approach, where different domains/organisations will be analysed to understand how we can deliver an operationally effective safety mindfulness model/approach which can enable the reduction of complexity in organisations.

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Reference ID: FSS_P5_TCD_D5.2
Classification: Public



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