1. Introduction

Weick and Sutcliffe developed a mindfulness theory studying organisations that had an impressive safety record despite the complexity and coupling of their organisational systems (Weick, Sutcliffe, & Obstfeld, 1999a, 1999b). High Reliability Organisations (HROs) (such as nuclear power plants, air-traffic-control systems and medical-emergency units) utilise a set of organising processes that allow them to be ready for the unexpected, to reduce the impacts of incidents and accidents, and help with the recovery process. This is referred to as 'mindful organising' (Sutcliffe, Vogus, & Dane, 2016; Vogus, 2011; Vogus & Sutcliffe, 2012; Weick, 2015d; Weick & Putnam, 2006).

In HROs, processes and practices of mindful organizing have been associated with the ability to detect early warning signals and coping resiliently with unexpected events (Faraj & Xiao, 2006; Jordan & Johannessen, 2014; Weick & Roberts, 1993; Weick & Sutcliffe, 2001, 2007). An extensive body of research has applied these concepts in a range of HROs (Gebauer, 2012; Gebauer & Breuer, 2011; Guiette, Matthyssens, & Vandenbempt, 2014; Jordan & Johannessen, 2014; Jordan, Messner, & Becker, 2009; Levinthal & Rerup, 2006; Sutcliffe, 2011; Sutcliffe et al., 2016; Weick & Sutcliffe, 2001) and 'everyday organisations' such as business schools (Brummans, 2017; Fiol & O'Connor, 2003; Ray, Baker, & Plowman, 2011). Mindful organisations are very sensitive to variations in their environment and continually update safety assumptions and perspectives. In any dynamic situation, resilience is sustained by timely human adjustment. This adjustment is affected 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*' (Weick et al. 1999a, p.87).

What should an organisation do in practice to be mindful? How is this ability (of detecting early warning signals, and coping resiliently with unexpected events) concretely enacted and undertaken within organisations? Does the mindful organising construct and its underlining characteristics provide clear guidance on how to implement it?

These have been the over-arching research questions guiding the present study. The research has taken place in an Air Traffic Control (ATC) organisation – the Maastricht Upper Area Control Centre (MUAC), an international non-profit air navigation service provider, operated by EUROCONTROL on behalf of four States – Belgium, Germany, Luxembourg and the Netherlands. MUAC ensures that aircraft flying in the upper airspace (above 24,500 feet or 7.5 km) over the Benelux and north-west Germany can do so safely and efficiently. MUAC is one of the highest performing air traffic centres in Europe, reporting for many years high-standards of safety (i.e. very low numbers of serious incidents). To maintain and even improve these levels of safety, MUAC seeks to consolidate and improve tools and procedures able to respond to unanticipated occurrences on a daily basis, as well as to create practices and guidelines that learn from both positive and negative occurrences happening in the Ops. Room. The Air Traffic Controllers (ATCOs) and supervisors rely on tools able to record every undesired event, and pass it on for subsequent analysis. Based on the type and severity of the event (e.g., outages, HMI issues, etc.), different technical groups are involved. The 'RISC Group' meetings

39 have the specific purpose to 'make sense' of safety-related near misses and/or incidents 'grasped' in

40 the Ops Room from a multi-stakeholder perspective (Weick, 1995). Notably, they involve the incident

41 investigator, the Safety Manager, Supervisors, ATCOs, Airspace Designers, HMI specialists etc. who

42 share their understanding of the events and agree on possible recommendations/solutions that will be

43 embedded in the organisational procedures and tools.

44 The contribution of this paper is twofold. First, we add knowledge to the mindful organising construct

45 by providing empirical evidence for a deeper comprehension of the related underlying principles and

46 construct components. Second, by suggesting a critique of the current construct from an

47 organisational point of view, we paved the way for the definition of overlooked requirements to

48 advance a Mindful Governance model able to provide clearer guidance to sustain the concrete

49 implementation of mindful organising.

50 ## 1.1   Literature review

51 Mindfulness has its roots in Buddhist philosophy and was originally conceptualized in the

52 psychological literature as an "*individual learning process characterized by a heightened awareness*

53 *of the specific circumstances in a given situation*" (Jordan et al., 2009, p. 468), with mindfulness

54 enhancing the intrapsychic processes of individuals and their effects on concentration, strength of

55 insights and sense of 'being in the moment' (Sutcliffe et al., 2016). These ideas formed the building

56 blocks of the collective mindfulness concepts, transferred within the organisational literature by Weick

57 et al. in 1999, from work in cognitive and social psychology (Langer, 1989; Rasmussen, Pejtersen, &

58 Goodstein, 1994; Weick, 1979, 1995; Weick & Roberts, 1993) to theorise how HROs achieved their

59 remarkably error-free operations (La Porte, 1996; Weick & Sutcliffe, 2001; Weick et al., 1999a).

60 Formally, the authors defined it as the ability of people at the sharp-end to develop "*a rich awareness*

61 *of discriminatory detail*" (Weick, and Sutcliffe, 2007, p.32) and regulate the collective behaviours

62 accordingly (Vogus, 2011; Vogus & Sutcliffe, 2012; Weick & Sutcliffe, 2006; Weick et al., 1999a). In

63 contrast to individual mindfulness, collective mindfulness is "*a means of engaging in the everyday*

64 *social processes of organizing that sustains attention on detailed comprehension of one's context and*

65 *on factors that interfere with such comprehension*" (Sutcliffe et al., 2016, p. 61). Critically, this social

66 process is collectively enacted, and it emerges from the close interaction between sharp-end team

67 members able both to grasp/detect any variation in their environment (Hargadon & Bechky, 2006;

68 Weick & Roberts, 1993; Weick et al., 1999b), act upon (Barry & Meisiek, 2010; Levinthal & Rerup,

69 2006; Vogus & Sutcliffe, 2007), and share/communicate about it (Cooren, 2004). This suggests a

70 collective mind in which each team member is *heedful* of the others, being simultaneously aware of

71 everyone's thoughts and actions (and interaction) (Weick, 2001; Weick & Roberts, 1993). Being

72 heedful is an ongoing thinking, feeling and learning adjustment for current and future actions.

73 Collective mindfulness can be identified through five processes (Weick & Sutcliffe, 2007; Weick et al.,

74 1999a), which comprise: (1) preoccupation with failure (regularly and robustly discussing potential

75 threats to reliability); (2) reluctance to simplify interpretations (developing a nuanced understanding of

76 the context by frequently questioning the adequacy of existing assumptions and considering reliable

77 alternatives); (3) sensitivity to operations (integrating the understanding into an up-to-date big picture);

78   (4) commitment to resilience (recognising the inevitability of setbacks and thoroughly analysing,

79   coping with, and learning from them); and (5) under-specification of structure (deferring to expertise

80   rather than authority when making important decisions.

81   The development of collective mindfulness across levels in an organisation (Carlo, Lyytinen, &

82   Boland, 2012; Ray et al., 2011; Vogus & Sutcliffe, 2012) has highlighted the need to have a more

83   comprehensive construct at the system level (Carlo et al., 2012; Sutcliffe et al., 2016). This brought

84   the authors to advance the mindful organising construct. Indeed, mindful organising highlights the

85   overall commitment to recognise latent failures, deviances, and surprises that may foreshadow the

86   development of larger unwanted events (Levinthal & Rerup, 2006; Ray et al., 2011; Weick, 2015d).

87   Mindful organising for the unexpected means enacting a set of processes and practices that

88   successfully adapt organisational routines to increase alertness and awareness, and create the

89   capabilities to cope with what is 'seen' (Weick, 2015d; Weick & Sutcliffe, 2007). To do so, mindful

90   organising requires the achievement of (i) respectful interaction (ii) heedful interrelations, and (iii)

91   mindful infrastructure (Weick, 2015b).

92   (i)   Respectful interaction can be fostered by encouraging front-line people to surface information

93   that conflicts with the majority view by means of *trust* (i.e. organisational members respect the

94   reports of others, and are willing to base their beliefs and actions upon them), *trustworthiness*

95   (i.e., organisational members report honestly, so that others may use their observations in

96   coming to valid beliefs) and *self-respect* (i.e. organisational members respect their own

97   perceptions and beliefs, and seek to integrate them with reports of others without belittling others

98   or themselves) (D. T. Campbell, 1990; Vogus, Sutcliffe, & Weick, 2010; Weick, 2015a). The

99   achievement of respectful interaction presents a number of challenges, which may include:

100   differences in status and social structures, differences in cultures, interpersonal power and

101   conflict, conflicting roles and role ambiguity, concerns with upward influence and offending those

102   in power, capabilities to persuade others.

103   (ii)   Heedful interrelating exists when organisational members in a complex system do their best to:

104   (1) understand the big picture goal, (2) understand how their individual job fits into this big

105   picture, and (3) maintain a conscious awareness of both as they perform their duties (Trethewey,

106   2008; Weick, 2015b; Weick & Roberts, 1993; Weick & Sutcliffe, 2007). Challenges to fostering

107   heedful interrelating may include all those situations where people have only a partial perception

108   about a developing situation, as well as individualistic rather than collective cultures, and goal

109   conflicts between units and parts of the organization (Sutcliffe et al., 2016).

110   (iii) The path to a mindful infrastructure comprises the five mindfulness' processes of collective

111   capability (Weick & Putnam, 2006; Weick & Sutcliffe, 2007; Weick et al., 1999b). These five

112   principles are also considered as the foundations to mindful practices within the organisation,

113   which preserve system resilience in the face of change (Weick, 2015d). For mindful organising to

114   work at the collective level, there must be social aspects present including trust and a deference

115   to expertise over authority, as well as more cognitive tendencies/processes such as a reluctance

116   to simplify, and a sensitivity to operations (Barton & Sutcliffe, 2009; Brummans, 2017; McDonald,

117   Callari, Baranzini, Woltjer, & Johansson, 2015; McDonald et al., 2016; Vogus, 2011; Vogus &
118   Sutcliffe, 2012). Further, Weick (2015a) suggests, that '*whenever one or more of these three*
119   *components are missing, an adverse event is more likely*' (p.216).

120   Safety is achieved through human processes and relationships (Barton & Sutcliffe, 2009; Powley,
121   2009; Sutcliffe, 2011). This mindful activity is "organizing" as it suggests that it is a continuing and
122   dynamic process which comprises actions/behaviours in group settings. The social process is fed by
123   extensive and continuous real-time communication and interaction that occur in briefings, meetings,
124   updates, and in teams' ongoing work (Schulman, 1993; Vogus & Sutcliffe, 2012; Weick & Sutcliffe,
125   2007). Mindful organising enables individuals to continuously interact with others in the organisation
126   as they develop shared understanding of the situation they encounter and their capabilities to act.
127   This collective capability can potentially forestall errors (Sutcliffe, 2011). Three claims substantiate
128   this: (1) it results from bottom-up processes; (2) it enacts the context for thinking and action on the
129   front line; and (3) it is relatively fragile and needs to be continuously re-accomplished (Vogus &
130   Sutcliffe, 2012). Further, mindful organising exists when it is collectively enacted, when a set of
131   behaviours are enacted triggered by shared perceptions of similar levels of behaviours. This is also
132   sustained by task interdependence or time working together, which can facilitate the homogenizing
133   effects of social influence and social learning by offering ongoing opportunities for work-related
134   interactions (Vogus and Sutcliffe, 2012). The ability to adjust the organization of work as well as
135   procedures is seen as an important enabler of reliability (Hollnagel, Woods, & Leveson, 2006).
136   Mindful organising thus includes the ability to recognise that the way of working must be adapted to
137   current conditions, rather than relying on pre-defined organizational structures (Vogus, Rothman,
138   Sutcliffe, & Weick, 2014; Vogus & Sutcliffe, 2012).

139   Whilst there is extensive work in the area of the initial collective mindfulness concept, there is still
140   limited research that strives to comprehend how the underlined principles and capabilities of the
141   subsequent more comprehensive mindful organising construct are effectively enacted in a given
142   organisation. As such, the three high-level construct capabilities were broken down in operational
143   statements to support the in-depth description, and explanation, of mindful organising in the selected
144   case study. It is argued that this methodological approach is critical to providing insights on the extent
145   to which mindful organising is able to effectively assist and guide organisations to achieve (i)
146   respectful interaction (ii) heedful interrelations, and (iii) mindful infrastructure.

2. Methods

148   The empirical field research followed a single case study approach (Swanborn, 2010; Yin, 2014).
149   Critically, the case study method has been proven to bring more compelling evidence, and the overall
150   study is regarded as more robust (Herriot & Firestone, 1983). Further, the method supports the in-
151   depth understanding and description of complex social phenomena in contemporary real-life context
152   (Yin, 2012, 2014). The case study data collection process and outputs (e.g. sources of evidence,
153   decision points, working documents), coding and analysis was supported by NVivo (v.11 Plus for

154 Windows, ©QSR International) (Bazeley & Jackson, 2013) and performed in the ad-hoc NVivo

155 project.

2.1 Planning case study evidence

157 A test plan document was prepared and shared between the project partners ahead of the field

158 research. This included detailed information regarding the recruitment of MUAC participants, ethical

159 considerations and the protocol for data collection. The protocol for data collection included the

160 employment of multiple sources of evidence – i.e. workshop, semi-structured interviews, direct

161 observations, analysis of organisational documents/tools in use. For each source of evidence, the

162 procedure was detailed as below (see Table 1).

163 *Table 1: MUAC protocol for data collection*

#	Source of evidence	Participants	Scope	Procedure
1	Workshop	RISC meeting participants/attendees	Highlight the needs and expectations to employ the mindful organising construct within MUAC Agree on the over-arching study aim	- Present the study aim - Share and agree on the protocol for data collection
2	Semi-structured interview	ATCOs	Understand how controllers construct and maintain joint and coordinated actions through a common understanding of the situation at hand	- Present the objective of the research - Handout: Briefing Information - Handout Consent form (signature required) - Handout: Profile form (fill out from participant) - Share procedure of interview – i.e. use audio recorder; approx. one hour interview - Follow interview schedule - Close interview and thanks
3	Semi-structured interview	Supervisors/ Managers	Investigate the formal means of information/knowledge in place to communicate to the ATCOs new processes/procedures Investigate the current means to record and retrieve safety data	- Present the objective of the research - Handout: Briefing Information - Hand out Consent form (signature required) - Share procedure of interview – i.e. use audio recorder; approx. one hour interview - Follow interview schedule - Close interview and thanks
4	Direct Observations	ATCOs @ Ops Room	Understand how controllers construct and maintain the social and cultural fabric of the system through the 'talk' – seen and *coordination* (i.e. talk between controllers and pilots) and *cooperation* (i.e. talk between controllers of	- Follow observation schedule

#		Source of evidence	Participants	Outputs
5		Documentation /tools in use	N/A	Understand the different data-sources the MUAC ATCOs/ supervisors can rely on/refer to.	- Review available material - Record references

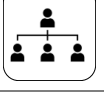| #	Source of evidence		Participants	Outputs

the same shift)

| 5 | Documentation /tools in use | N/A | Understand the different data-sources the MUAC ATCOs/ supervisors can rely on/refer to. | - Review available material
 - Record references |
| 6 | Organisational charts/ job description | N/A | Map the current information/knowledge flow and the controllers work activity | - Review available material
 - Record references |

164

2.2   Collecting case study evidence

166 The field research took place in Maastricht at the MUAC premises in April 2016 (see Table 2 and

167 Figure 1 for an overview of the data collection process).

168 *Table 2: Overview of outputs from the case study data collection*

#		Source of evidence	Participants	Outputs
1		Workshop	n=13 RISC meeting participants n=2 external attendees	n=1 minutes of the meeting/workshop
2 & 3		Semi-structured interviews	n=9 ATCOs n=4 managers from the MUAC Safety staff	n=13 validated transcripts
4		Direct Observations	n=3 observation to n=6 ATCOs in the Ops Room	n=3 filled out observation templates/notes
5		Documentation /tools in use	N/A	Notes/comments (as memos in the NVivo project)
6		Organisational charts/ job description	N/A	Notes/comments (as memos in the NVivo project)

169
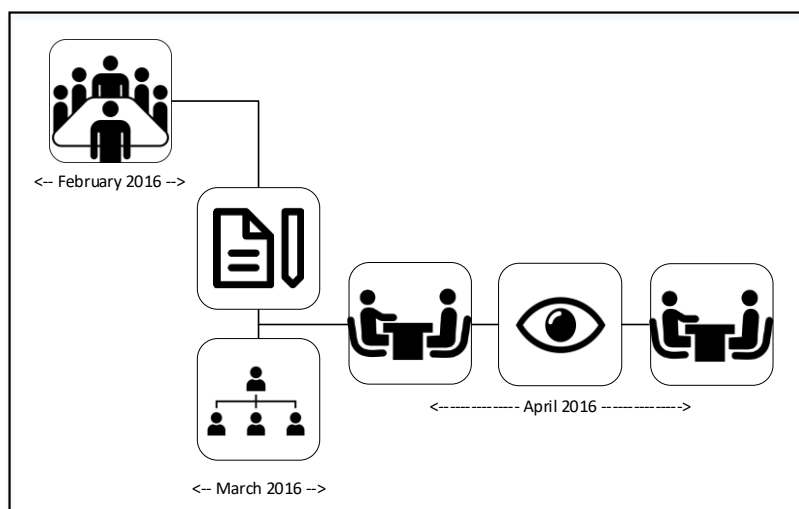
170

171 *Figure 1: Case study data collection process*

In February 2016 two researchers of this study were invited to attend the 'RISC meeting' in MUAC and a (1) workshop was organised. That was an opportunity to present the study's over-arching aim, and collect the needs and expectations of managers and ATCOs. Further, the draft protocol for data collection was shared for approval about the requested resources required from MUAC. (5) Documents and (6) material were provided under request and analysed. The related extracted data/information were then recorded in the NVivo project as well.

In relation to (2) and (3), n=13 semi-structured interviews were conducted during April 2016. Interviewees were n=9 ATCOs (i.e. - I.1-9), and n=4 managers from the MUAC Safety staff (i.e. - I.10-13). The participant recruitment was mediated by MUAC directly. This involved staff members with side-tracks[1] in various domains, who by contract are required to devolve a number of hours for research activities/interventions. MUAC assisted in the interview schedule. Of the nine ATCOs, eight were male and one was female. The majority of the ATCOs ranged 35-39 years old (n=4 ATCOs). Two controllers aged between 40-44 years old, whilst one controller was of age 30 to 34, one of age 45-49, and one 50-54. No controller representative below 29 years old and above 50 years old participated in the research. Very experienced ATCOs were involved, as the least experienced recorded ten years of work record in MUAC. Overall, N=7 ATCOs ranged between ten to sixteen years of experience in the role. Two controllers had more than 24 years of experience in the role. The interview sessions took place in a meeting room at the MUAC premises. The recruited participants were invited via email to attend the interview session. The interviews averaged 60 minutes in length and were recorded digitally. The recordings were then transcribed verbatim as Word documents (they averaged from 6-9 pages long). The transcripts were sent to all interviewees for review and approval. Once approval was received, the interview transcripts were uploaded into the NVivo project, for subsequent coding and analysis. All transcripts have been approved by the interviewees

The (4) observation sessions took place at the MUAC Ops Room. Three shifts were observed, and three handovers were witnessed. The shifts were non-consecutive. Three different ATCO pairs on duty were observed. Overall, each observation lasted 45 minutes and involved in-depth observation of the interaction of ATCOs between them, with the Supervisor, and with the workstation console. The Supervisors desks are located at the centre of the room; the ATCO workstation positions are identified by sector of reference, and are located around the room (see Figure 2[2]). The observation notes were transcribed as a Word document and uploaded into the NVivo project. The observation sessions happened after half of the interviews were conducted, to provide the researchers with 'hands-on' information of the operational context and activities.

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[1] Side-track involves controllers to provide a professional opinion based on the work experience in the upcoming changes advanced by the organisation.

[2] The picture is taken from the official MUAC website, as no pictures and videos were allowed in the Ops Room.

204

205　*Figure 2: Overview of the Supervisor workstation positions (©MUAC)*

2.3　Analysing case study evidence

207　The Thematic Analysis method was followed to make sense of the empirical material gathered
208　(Boyatzis, 1998; Braun & Clarke, 2006). A concept-driven codebook was set up in the MUAC NVivo
209　project. The categories reflected the mindful organising core underlying components (Vogus, 2011;
210　Weick, 2015d; Weick & Sutcliffe, 2007). Decision rules were included to support the coding process
211　(see Table 3). During the coding activity of the empirical material, new categories were created to
212　record new emerging concepts/dimensions from the data that could not be coded in the given
213　concept-driven codebook (Saldana, 2012).

214　*Table 3: Concept-driven codebook used to code the empirical material*

# Mindful organising dimensions	Decision rules for data coding
(i) Respectful interaction	• How reports are a means to learn from others' experiences (*trust*) • How reports are considered a valid means to share own experiences (*trustworthiness*) • How own perceptions and beliefs are maintained, and integrated with the ones of others' (*self-respect*)
(ii) Heedful interrelations	• Information feeding to enable ATCOs to gain 'a big picture of the system'
(iii) Mindful infrastructure	*(1) Preoccupation with failures* • How critical events/failures happened in the past have been recorded • How these events supported the definition of practices and recommendations • How recommendations are shared/support the definition of a mindful organising data base
	(2) Reluctance to simplify interpretations • How 'variation' supports the definition of potential changes that need to be made

	• How the organisation supports the different skills and knowledge in play, to handle 'complexity' • How actual performance is revised to potentially change the organisational processes
	(3) Sensitivity to operations • How ATCOs display high levels of situation awareness • How ATCOs develop an overall big picture of the organisation's operations, so that they can prevent future accidents and/or failures
	(4) Commitment to building resilience • How the lessons learnt have become part of the current process/practices • How this new flow of information has been reinforced
	(5) Under-specification of structure/deference of expertise • How decisions are supported • How feedback from different decisions is shared

2.4   Assuring evidence trustworthiness

Three tests and 'case studies tactics' were used to judge the quality of the research process, from the planning of case study evidence, to the presentation of the findings (Yin, 2012, 2014). This included (1) construct validity, (2) internal validity, and (3) reliability. (1) Construct validity involves the identification of operational measures for the concepts under investigation, from the '*use of multiple sources of evidence to support convergent lines of inquiry*' (Yin, 2014, p. 120), the establishment of a chain of evidence, and/or the involvement of key-informants to review the findings. This was achieved by planning and carrying out a test plan which involved the collection of data from multiple sources, by providing traceability of the data collected, coded and analysed using NVivo, and by ensuring that the findings were validated by MUAC and all project partners (representatives of different organisations from the aviation domain). (2) Internal validity refers to the conduct of the study such that inferences from the data are accurate (i.e. valid), i.e., the extent to which research findings are a true reflection or representation of reality rather than being the effects of extraneous variables. We achieved this by asking all interviewees to validate the interview transcripts, and by asking a MUAC representative to validate the observation notes during the observation sessions in the Ops Room. (3) Reliability regards achieving stability and accuracy of the tools for data collection (e.g. interview guideline) and analysis (e.g. codebook), and the ability to corroborate the findings and the conclusions in a systematic and transparent way (J. L. Campbell, Quincy, Osserman, & Pedersen, 2013; Krippendorff, 2009; Krippendorff & Bock, 2009; Nowell, Norris, White, & Moules, 2017). This has been achieved as described in the Methods section. Additionally, NVivo acted as a social platform, supporting the monitoring and traceability of the case study development by all team researchers.

3. Results

The results are presented following the categorisation used to collect and make sense of the empirical data. This includes the three underlying components of mindful organising, namely: (1) mindful infrastructure, (2) respectful interaction, and (3) heedful interrelations.

3.1   Mindful infrastructure

Preoccupation with failures

This principle focusses on the way organisations and its members detect, record and deal with failures (e.g. deviations, risks, bad news items, surprises, things out of context, near misses and errors). In our analysis, this was expressed in the tools/instruments that an organisation puts in place to 'grasp' these failures. MUAC has in place distinctive sources/tools to collect safety-related issues. These differ in terms of scope: (1) the formal 'Incident' form, i.e. loss of separation or other incidents that have to be reported, and (2) the 'Remedy' form, i.e. for all other safety-related occurrences and issues. Overall, when safety-related issues occur while the controllers are performing the job, these can be notified by pressing the 'supervisor attention button' on the HMI of the workstation, and the supervisor in charge to the sector will come over to the position, and collect the issue.

In relation to (1), the 'Incident' form is started when an incident occurs. This can refer, for example, to a loss of separation. The ATCO informs the supervisor via the 'supervisor attention button' and the controller is handed over a paper form to be completed. The paper form includes straightforward information on the incident – e.g. what has happened, time and data on the incident, a free text box to explain what has occurred (what led to the incident); some drawings about the incident can also be made. Depending on the nature of the incident, completing the form can take from 3 up to 15-20 minutes. The form is completed by the controller directly, either after the work shift, or immediately after the incident has occurred (and another controller will take over the position). Once the form is completed, it is handed to the supervisor and the incident is analysed. There is an investigation team in-house that traces the data and looks at each specific incident. The information is analysed and possible solutions are addressed also in the RISC Group meetings. The reporter and anyone mentioned on the form will be informed and e-mailed of the outcome of such investigation.

In relation to (2), 'Remedy' is the reporting system in use in the Ops Room. The occurrences recorded may include HMI issues, or events related to airspace traffic. The Remedy is considered a 'big log-book of all the events' [I.3; I.4; I.7.; I.8; I.11][3], and it offers poor usability in the management:

> *"Everything is put in the Remedy system. […] it is the most the intuitive system".* [I.6]

The Remedy log is used for every occurrence and technical safety assessments that happen during the work activity and it is also governed by the supervisory staff. The main aspect in maintaining the role of the supervisor in completing the forms in Remedy is that currently there are limited provisions

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[3] Source evidence/category saturation is provided. This is reported using the code 'I' for interview; 'O' for observation, and number for identification/traceability of the specific source. The NVivo project acts as main Data Base and traceability record

270 to substitute the controllers when something happens during the shift. The occurrence is then
271 analysed by the MUAC technical groups. The outcome of this analysis is notified back to the
272 controller/supervisor via the e-brief. Remedy allows only to have two names attached to the event: the
273 name of the person reporting and the name of the supervisor (this allows both to be notified when the
274 log has been resolved). However, the ATCOs highlighted how this sometimes does not happen, if the
275 supervisor does not include the ATCO's name in the log[4].

276 "*This goes wrong quite often; the supervisor may fill in the wrong name or put his/her*
277 *name in the box of the person reporting".* [I.8].

278 The Remedy system does not allow to keep track of what is happening, and/or make statistics, etc.
279 [I.5; I.8]. That is how OPRA developed as an analysis tool/database. The Safety staff copies the data
280 from Remedy into OPRA. OPRA takes the incidents from the Remedy system, and from there data
281 are processed with feedback and follow-up. Over the years, OPRA has become the reference tool for
282 ATCOs to look up incident reports, even if controllers have declared that the system is not very usable
283 [I.3; I.4; I.7; I.10; I.11]:

284 "*The OPRA presents the infringement of separation minima reports, whilst the Remedy*
285 *presents all the safety related issues. In OPRA you can sort geographically, or by time, and you*
286 *can read each report by incident. I don't think that you can sort by recommendation. But each*
287 *report has its recommendation.*" [I.6]

288 "*You can look up in OPRA if you have a specific interest (also to support your side track*
289 *activity). It could be a useful tool to learn from other experiences*". [I.5]

290 Mindful organisations are able to demonstrate a commitment to resilience by promoting a free-of-
291 blame environment able to deal effectively with errors and unexpected events. To do so,
292 EUROCONTROL has promoted a 'Just Culture' approach within the organisation. It has been
293 recognised that punishing air traffic controllers and pilots with fines or by suspending their licences
294 can discourage the front-line operators from reporting any kind of mistake, with a consequent
295 reduction in safety information. Hence, the MUAC management believes it is important to encourage
296 the development of an environment in which occurrences are reported and the necessary processes
297 for investigate and develop preventive actions (such as procedure changes, HMI improvements,
298 improving supervision of on-the-job training, etc.) are put in place. The ATCOs interviewed confirmed
299 that there is a positive 'Just Culture' in place, and that they feel free to report whichever safety issue
300 occurs [I.2; I. 3; I.5; I.7; I.9].

301 "*Here we are good in the 'Just Culture'. Even if you do a mistake and report it, of course*
302 *you have a feedback but you are not really punished - like fired. You would be told what*
303 *you did wrong, but it will be a constructive feedback. And this is positive.*" [I.3]

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[4] This system has been redesigned in the time between the interviews (2016) and the authoring of this paper (2019).

304 "*We have a strong 'just culture'- you report that voluntarily and there are no*
305   *consequences to you.*" [I.7]

Reluctance to simplify interpretations

307 This principle focusses on the organization's ability to manage variation and identify signs that the
308 unexpected is unfolding. In MUAC, when incidents happen, they are addressed in the RISC Group
309 Meeting. Technical offices deal with specific issues, and trends are also analysed by the safety staff.

310   "*The RISC Group meeting involves participants from different domains. Based on the*
311   *shared experienced there, they decide if anything can be learned from these incidents,*
312   *and to group such information and publish by other means to the ATCO group.*" [I.9]

313   "*The RISC Group involves controllers from the incident sectors group, people from the*
314   *training department, people from the operational safety area, people from air space and*
315   *procedures area are also involved, operational people from the HMI which were involved*
316   *in the main HMI changes. They are all involved and we review the facts of an incident and*
317   *try to make some meaningful recommendation about what we can do in order to prevent*
318   *those incidents.*" [I.10]

319 Further, the direct involvement of controllers with side-track activity supports MUAC in providing input
320 to the systematic analysis of incidents to identify their root causes and incident types or trends within
321 the organisation.

322   "*I often access the OPRA system but not only for the safety issues, also for the statistics*
323   *which I need also for my side track*". [I.1]

Sensitivity to operations

325 This principle highlights the ability of operational people to display high levels of situation awareness.
326 This may be achieved if the organisation is able to train and inform operational people with useful
327 'critical/relevant' data so that they could form an overall big picture of the organisation's operations.

328 In MUAC this is undertaken at different levels. Some are formal, some are informal. The formal events
329 include briefings/training, and the means to spread the information from top to bottom, so that
330 controllers are always 'in the loop' in relation to changes, and/or safety-related events. Different
331 methods are used to feed back to ATCOs dependent on what they need to be informed about. This
332 includes: (1) e-briefs (daily information), (2) the periodic magazine 'Beyond the radar', and (3)
333 leaflets/printouts in the Ops Room.

334 The (1) e-briefs are the way the organisation communicates to the ATCO varying levels of information
335 the controller should be aware of before starting the work shift. This is an electronic system which
336 presents 'briefings' to be addressed by each controller before starting working in the Ops Room. If
337 something critical happened, the investigation team can broadcast using the briefing. E-brief contents
338 are mandatory or optional. Before the start of each shift the ATCO needs to mark all relevant ones for
339 the current day as read.

340 "*The system is being designed in such ways that if you take responsibility and respect*
341 *your contractual working time, then there is plenty of time to read all the items in the e-*
342 *briefs. You have 30 min per day to read it. It is more than enough to absorb the most*
343 *complex information ever given in the e-brief.*" [I.6]

344 "*The number of emails we can receive daily varies a lot. Sometimes we can receive*
345 *nothing, and sometimes like the other day- it took me almost 30 min to go through them.*
346 *Quite often the information is not filtered well enough. […] Sometimes the priority is set*
347 *wrong. I think there is some room for improvement in the definition of priority in the e-brief*
348 *acknowledgment. I can imagine it is not an easy job to set priorities: this is done by*
349 *people in the office - engineers – and to really think like a controller and translate it into a*
350 *controller's language is not easy. Maybe there should be a new side-track that has to look*
351 *at it and check the content before publishing*". [I.4]

352 Further, printouts are distributed to the individuals, as well as presented on the position if they are
353 urgent. If not they can be grouped and presented in the (2) magazine '*Beyond the Radar*' which is
354 periodically updating on the operationally related safety aspects of the Centre. In the magazine
355 technical aspects and experiences are presented with pictures.

356 "*The magazine is produced every six months. In there we put incidents, little articles of*
357 *interest – e.g. the voluntary reporting system, changes of regulations, topics that are*
358 *important. This is one way for feeding back to Ops and technical staff.*" [I.12].

359 Training minima requirements are met by the organization every year [I.10]. Two main events are
360 conducted in MUAC: the (1) Refresher Training and the (2) Team Resource Management (TRM).
361 With reference to (1), this refers to the formal training each organization should address yearly, while
362 (2) consisted of a 1-2 day practical training opportunity, in which some incident examples occurred in
363 the past were addressed and discussed collectively.

364 Information is also spread 'informally' in the Ops Room. Events and occurrences happening in the
365 Ops Room are brought up by controllers and shared between the shifts.

366 "*The most crucial information that you really need to know is still in the person to person*
367 *handover when taking over the position in the Ops room. No colleague would leave*
368 *another one irrespective of the e-brief position without something crucial, without*
369 *something that has recently happened: 'Did you hear of …' is the practice. I see this all*
370 *the time: very crucial information is always passed on, it is a key-element of our job and*
371 *everybody takes it very seriously!*" [I.3]

Commitment to building resilience

373 Mindful organisations are able to demonstrate a commitment to resilience by dealing effectively with
374 errors and unexpected events. System resilience can be sustained by organisational members and
375 front-line people show a safety-related attitude for investigation, learning and acting. Overall, this
376 could refer to safety culture. In MUAC, to monitor the organisational culture, safety culture surveys are

377 promoted, and a plan was launched in 2016 to address the weak areas that emerged from the most
378 recent survey. The safety culture survey is generally conducted every five years. The safety culture
379 survey is a resource intensive activity, which involves all staff across the Centre. This activity involves
380 questionnaires distributed to staff, analysing those questionnaires and then having workshops to see
381 where particular issues are highlighted, understanding more about the staff feedback and what kind of
382 recommendations we should pick up.

383 "*A new survey has been recently conducted. Our productivity is already the best in Europe and*
384 *yet we are trying to squeeze more out of the people - so I suspect that this will probably come*
385 *up.*" [I.10].

386 Tools and procedures to sustain the resilience against the unexpected are in place in MUAC (e.g.
387 Remedy –i.e. the system to track every occurrence from the Ops Room; OPRA -the system ATCOs
388 may look into for past incidents; etc.) [I.8; I.9; I.11].

Under-specification of structure/deference of expertise

390 This principle regards roles and responsibilities particularly in emergencies in dealing with the
391 problem. In MUAC a systematic analysis process for incidents is in place to identify their root causes
392 and incident types or trends within the organisation. This originates from the Ops Room (with
393 compilation of forms), then the process includes technical staff who deal with the raised
394 event/occurrence, and further, incidents/trends are also analysed by the safety staff.

395 "*In MUAC every year there are a number of occurrences (e.g. Human-Machine Interface*
396 *issues); incidents we may have 30-40 separation infringements out of 1.5 million of*
397 *aircraft flying in the airspace; very few technical outages – e.g. 1 every 1-2 years but they*
398 *are very infrequent; occurrences like medical emergencies, and similar - but we don't fully*
399 *investigate these kinds of events.*" [I.10].

400 Recommendations from incidents are discussed in the RISC Group meetings, in which
401 representatives from different departments of the organisation attend to define recommendations
402 intended to contain the harm of all possible forthcoming unexpected events. During the RISC Group
403 meetings the incident is analysed, the preliminary outcome from the analysis is shared, and the
404 proposed improved recommendations agreed collectively.

3.2   Respectful interaction

406 MUAC has in place means to support ATCOs to freely express themselves and report situations that
407 may feel uncomfortable. Besides the instruments to report safety-related events, and tools (such as
408 OPRA) that represent the system to go back to for investigating past events, ATCOs may count on
409 the 'overload reporting' form. This form is completed whenever a controller feels/perceives overloaded
410 because of, for example, too much traffic given to the sector he/she works for. The form can be
411 anonymised, is very user-friendly and can be easily compiled. In addition to this, the safety culture
412 questionnaire launched by MUAC every five years is a 'monitoring' tool for the organisation to
413 highlight issues advanced by the staff that need attention and intervention.

414　However, respectful Interaction implies certain characteristics of the flow of information: learning from

415　others, sharing one's own experiences, and integrating these two in a set of valid beliefs. In relation to

416　the information flow, the process from the ATCOs back to the organisation (i.e. *feeding back*) to

417　record all system variations is managed via the Remedy system, and OPRA (mainly to perform

418　statistical analysis). Every time the controller needs to raise the issue, a log entry into the 'Remedy'

419　system is started. The current system shows weaknesses in the recording and overall the system

420　usability is evaluated poor; hence, a parallel system has developed to tackle this – i.e. OPRA. The

421　current systems are designed to categorise each occurrence by predetermined categories (which can

422　support data analysis and statistics); while the incident report (e.g. when a minima infringement

423　happens) supports a narrative description of the event. Further, there are three main types of

424　communication means in which the organisation informs the ATCOs (i.e. *feeding in*) about safety

425　critical information: E-briefs (daily); the 'Beyond the Radar' magazine (twice a year); posts in the Ops

426　Room (upon need). All means are both (a) informative (i.e., the content of the communication is

427　meant to keep the ATCOs up-to-date with information useful for their daily work, such as airlines

428　strike in country X on day Y), and (b) formative (i.e. the content of the communication is meant to

429　transfer new knowledge that the ATCO should learn for their daily work, such as new waypoints

430　added in sector Z). The current system is designed to be self-manageable, i.e. it is the responsibility

431　of the ATCO alone to (a) read and understand, and (b) learn and apply the content contained in the

432　above types of communication means, and offers less regular opportunities of formal sharing and

433　discussion. Overall, the current information flow in MUAC is very safety-focussed, traceable and

434　systemic, but we argue that its circularity (i.e. feeding in and feeding out) has been attenuated given

435　the change in the rostering. The mindful organising construct focuses on facilitating social processes

436　able to detect and correct errors and unexpected events, but it does not provide clearer guidance to

437　help identify countermeasures and/or solutions to support a purposeful circular flow of safety-related

438　information that actively supports people's capability to act (i.e. they are accountable of their actions)

439　to fulfil their particular role and authority (at whatever level).

440　ATCO involvement in the development of the change and simulations is an important dimension, as a

441　certain number of new changes are found not to work well enough, and are 'rolled back,' i.e. taken off-

442　line and then re-developed. This is one of the few KPIs at the time of this study giving the senior

443　management some 'pushback', and reminding them not to be complacent, keeping their minds on

444　safety. MUAC managers are always reminded that their main role is to keep an open mind and to

445　ensure that people could speak up on safety or on any other issue. Several of the senior managers in

446　MUAC are indeed ex-operational themselves, and so knew what it was like to work the radar screens.

3.3　Heedful interrelations

448　Heedful interrelating exists when organisational members have the opportunity to form a 'big picture'

449　of the system they work in. Challenges to fostering heedful interrelating may include, for example,

450　production/performance pressures, changes in staff (also changes in shifts), and cross boundary

451　interactions. At the organisational level, MUAC has moved from a team-based roster to a shift-based

452　one, with very flexible shifts, and colleagues might only meet again after weeks. Before the new roster

453 came into place, the roster was organised in a team-based structure. This means that there were pre-
454 defined teams for given sectors. ATCOs reported that this roster facilitated the 'collective'
455 understanding and sharing of the work; on the other hand, this created working styles specific for the
456 sector(s):

457   *"We* are *missing regular face-to-face briefings, e.g. once a month to discuss about*
458   *events, etc. this could bring benefits. These could be organised like small training*
459   *sessions, where episodes/incidents are discussed collectively. Further, it is important to*
460   *have pictures/maps to address in the discussion"* [I.6]*.*

461   *"[…] If these learning sessions are left to the individual – we already have some*
462   *information conveyed with pictures, like slides. We should improve the feedback on this"*
463   [I.4]

464 The current shift-based roster is considered as giving an advantage of higher social freedom (e.g.
465 adapted to specific social needs, e.g. looking after children) [I.3; I.9; I.11], and a more streamlined
466 working style (*that is beneficial to the job* [I.9]). The perceived disadvantages converged to a
467 diminished familiarity of co-workers compared to the past (e.g. you could influence the overall work
468 performance more easily if you knew, for example, the colleague's personal situation/attitude); to less
469 opportunities to have formal collective moments of discussion [I.4; I.7; I.9; O2].

470   "*Before, the supervisor prepared the briefing and made sure that the people got all the*
471   *information. Now you have to look for the information yourself if something is not clear.*
472   *And it could be that the supervisor during my shift is from another sector group - so this*
473   *means I have to wait to have a clarification to my question. So I would ask my*
474   *colleagues."* [I.1].

475 As a consequence of the current roster and lack of team-structure, in which information and events
476 were shared by the team members in more formal meetings (every Monday before the start of the
477 week shift), ATCOs are used to spread the news more 'informally' [I.3; I.4; I.9; O1].

478 ## 3.4   Novel dimensions

479 Two overlooked dimensions emerged from the data, providing information and insights of the
480 organisational contexts in which mindful organising is enacted within MUAC.

481 ### Coordination between groups

482 ATCOs with side-track support the development of new procedures, processes and controller tools,
483 which can be addressed in the different technical groups' activity. The organisation does require
484 qualified controller inputs to better assess the impact of such changes. These are then either
485 addressed in the Centre Working Group meetings, or by the Safety & Human Factors staff. These
486 changes are then communicated via the different means of communication in place at MUAC.

487 The most relevant incidents/safety events that are addressed in the Team Resource Management or
488 Refresher Training, are also informally broadcast in the Ops Room, as ATCOs are used to sharing

489 main events collectively [I.6; I.7; I.9]. These aspects suggested the need to create a category to
490 highlight how MUAC supports the coordination between groups to act to fulfil their responsibilities
491 throughout the system. Indeed, it is argued that those with specific responsibilities for safety are
492 required to be fully in the loop so that this becomes an integral part of the organisation's capability to
493 ensure a safe and effective system.

494   "*I have a side-track, it is about two days per month to support the safety team in safety*
495   *assessments of changes. For me personally that means that I give my professional opinion*
496   *based on my work experience in upcoming changes when the safety team provides an*
497   *assessment – e.g. for a procedural change or a system change. They do require qualified*
498   *controller input to better assess the impact of such change. Therefore I'm trained to give such*
499   *input in a useful way.*" [I.6]

500 Accountability

501 'Coordination between groups' suggested the emergence of a second data-driven category (as the
502 other side of the same coin). Themes about 'being responsible', 'being acknowledgeable', 'report to'
503 were raised by both the interviewed managers and the ATCOs when referring to their activities, tasks,
504 and expected duties, supporting the specification of an 'accountability' category. Indeed, in terms of
505 responsibility/accountability of safety-related actions within the organisation, the information flow,
506 processes, and procedures to report, analyse, and address/solve any safety-related incidents
507 occurring in the Ops Room are expected to be transparent and traceable. This includes, for example,
508 the e-briefs (i.e. the daily electronic briefings about new procedures and waypoints that are to
509 implement in the Ops Room) that every ATCO is required to acknowledge. Before starting the shift
510 the ATCOs need to either from home or from the computer at work, log in into their personal account
511 where all the briefing items are listed and marked as read or unread. These include mandatory and
512 optional e-briefs. As a manager stated:

513   "*We use the different tools by importance of information, meaning how quickly the*
514   *information gets to the recipient. E-briefs is the most critical one because you cannot start*
515   *working in the Ops room without having completed the daily briefing. If something critical*
516   *happened the investigation team will have it broadcasted through the briefing.*" [I.11]

517 Before the start of the shift every ATCO needs to acknowledge – i.e. that they have read (and
518 understood) all mandatory ones and mark them for the current day as read.

519   "*By ticking the read/unread button they share responsibility of the communication*
520   *provided.*" [I.8].

521   "*Any important information is conveyed in the e-brief. E-brief items contain headers - you*
522   *open the item, <please take note of the following information>, and open the attachment*
523   *– it is stored on the server. Then you click- mark as read.*" [I.4]

524 Whether a recommendation comes from an incident investigation process or from an internal or
525 external audit/surveys, or from a safety case when a change is implemented and there are still actions

526   outstanding, they all go into the database. MUAC has put an effort to improve the feedback and
527   traceability to ATCOs reporting any specific and outstanding problem, as a manager commented:

528   "*This will enrich the feedback to who is reporting and will allow him to monitor how things*
529   *are improving with respect to his issue in later stages.*" [I.12]

530   "*We just need to make sure that the people are assigned, we know what all the corrective*
531   *actions will be, and we know the date for it to be closed. Just to monitor the progress on*
532   *the actions.*" [I.5].

4. Discussion

534   Weick and Sutcliffe (Sutcliffe, 2011; Sutcliffe et al., 2016; Weick, 2015d; Weick et al., 1999a, 1999b)
535   argue that successful HROs attentively pursue failures and anomalies, and mistakes are viewed as a
536   welcomed valuable source of information about the system. Studies of disasters show how errors
537   build up slowly, but go unnoticed because of expectation-driven perception (Reason, 1990, 2000,
538   2001). We reviewed this by suggesting that the tools and instruments MUAC have in place to record
539   the anomalies detected by the ATCOs in the Ops Room could represent an operational medium for
540   'preoccupation with failure'. In their work, the authors specifically focus on failures and seem not to
541   recognise the value that also success stories may bring to the redesign of a more resilient system
542   (Dijkstra, 2013; Ward, McDonald, Morrison, Gaynor, & Nugent, 2010; Woods, 2015). We argue that
543   leaning from both failures and success past experiences, enables discrepant information to surface
544   that could put at risk the resiliency of the system. Indeed, successful performance or recovery should
545   be used to illustrate the kind of behaviours that are encouraged by the members of the organization.
546   This was also emphasised by the ATCOs in MUAC who shared how successful practices are the
547   ones that are used during the training activities to support an enduring ability in the Ops Room to
548   contrast possible forthcoming safety-related threats.

549   Learning provides a means and commitment for organisations to build people's general response
550   repertoires and competences so that they can better cope with surprise in the moment (Barton &
551   Sutcliffe, 2009; Barton, Sutcliffe, Vogus, & DeWitt, 2015; Bayraktar & Ndubisi, 2014; Bjurström, 2012;
552   Klockner, 2017; La Porte, 1996; Powley, 2009; Vogus & Sutcliffe, 2012; Weick, 2015b; Woods, 2015).
553   ATCOs in MUAC showed some concerns with regard to the less opportunities in having collective
554   moments in which they could raise and discuss their operational issues. This has been also an effect
555   of the organisational change in the rostering. Before the new roster came into place, the MUAC roster
556   was organised in a team-based structure. This meant that there were pre-defined teams for given
557   sectors. ATCOs reported that this roster facilitated the 'collective' understanding and sharing of the
558   work, mainly because the team members' capacity/performance was known within the group, and at
559   the beginning of each cycle the supervisor briefed the team, sometimes about the incidents as well.
560   On the other hand, this created working styles specific for the sector(s). The current shift-based roster
561   was commented to give the advantage of higher social freedom (e.g. adapted to specific social needs,
562   e.g. looking after children), and a more stream-lined working style. The perceived disadvantages
563   converged to less knowledge of the co- workers than in the past (e.g. you could influence the overall

564 work performance more easily if you knew, for example, the colleague's personal situation/attitude); to
565 less and less opportunities to have formal collective moments of discussion. Critically, Vogus and
566 Sutcliffe (2012) emphasise that mindful organising can spontaneously emerge when people share a
567 common understanding of a given situation and action in context. The interpersonal aspect means
568 that it may be a challenge to create a collective mindset across diverse groups, or for example shift
569 teams who only rarely see each other. A social platform collecting and sharing experiences,
570 feedbacks, examples could facilitate this process.

571 Reluctance to simplify interpretations and sensitivity to operations increase the organisation's ability to
572 manage variation in the system by detecting the signs of the unexpected is about to happen, and this
573 is reinforced by strong situation awareness of the front-line people about how to develop an overall
574 big picture of the organisation's operations (i.e. 'heedful interactions') (Weick & Sutcliffe, 2001, 2015;
575 Weick et al., 1999a). Although Sutcliffe and Vogus (2016) argue that these principles do not relate to
576 intra-psychic processes, but rather they imply the engagement of '*social processes of organising that*
577 *sustain attention on detailed comprehension of one's context and on factors that interfere with such*
578 *comprehension*' (p.61), we struggled to code empirical data that could infer/suggest the achievement
579 of situation awareness and/or the big picture. We suggested that the process needed to generate
580 awareness (e.g. the social process resulting from meetings to support the collective capability for
581 detecting and correcting errors and unexpected events), could be the way to represent these
582 principles. Notably, the RISC Group meetings involving the organisation's stakeholder to address
583 safety-related issues supports this, as a valid practice to collect multiple perspectives to make sense
584 of possible deviations within the system.

585 There are several implications on the management side. Organisations will inevitably differ in the
586 challenges they face and the ways in which they address these. MUAC is an ultra-safe organisation
587 with relatively few formally reportable incidents or events that could generate an active flow of
588 information characteristic of mindful organising. There is a flow of safety information, both formal and
589 informal. Events are reported, analysed and appropriate measures taken; feedback takes the form of
590 safety bulletins to be read and signed for, with a twice-yearly safety magazine. There is a periodic
591 safety culture survey. Both the gathering of this information and the feedback are constrained by the
592 busy schedule of work. Informal conversations and handovers deal with relevant safety issues,
593 though changes in the shift arrangements have attenuated these somewhat and the opportunities for
594 knowledge exchange in training have also been reduced. Thus, information feedback through safety
595 bulletins and the magazine may not fully engage a 'collective mind'. These considerations suggested
596 the design of a prototypical 'mindful organising application' to enable ATCOs and others to share their
597 experiences with their peers. This would include but also extend beyond the kind of information
598 currently circulated, in the spirit of Respectful Interaction. This is briefly described in McDonald,
599 Callari, Baranzini, & Mattei (2019).

600 The formal information tends to be highly detailed and contextualised. As such information (safety
601 intelligence) is passed up the management hierarchy, to persons with (usually) less current
602 operational expertise (or no operational expertise whatsoever), this intelligence needs to be simplified.

603 This is a challenge to the idea of a collective mind for an organisation. The danger is that key details
604 are omitted or the issue is 'dumbed down' so the threat severity or its resolution are not adequately
605 perceived by senior management.

606 Keeping a closed feedback loop with the originators of the issues and concerns involves asking them
607 if the problem has indeed been resolved by the actions instigated by management. If not, then clearly
608 something has been 'lost in translation,' in the vertical channelling of the information and its resolution
609 actions. In MUAC this feedback loop is enacted by having operational people on task forces until
610 certain actions are indeed deemed to be resolved by the operational layer.

611 The further issue concerns management's use of Key Performance Indicators (KPIs). MUAC, as in
612 many organisations, uses the 'classic' KPIs associated with safe performance (e.g. losses of
613 separation of varying degrees; controller overloads, etc.). Since these remain mostly in the 'green
614 zone' they don't actually tell management much. However, the management found additional, less
615 'orthodox' KPIs (such as rejected new changes) that are perhaps more indicative of 'true' safe
616 performance and of safety margins. This suggests that management needs to be continually sensitive
617 to finding 'emergent' KPIs as well as traditional ones, that can act as 'sentinels' indicating when safe
618 performance may be under pressure.

619 On the theoretical side, what this research illustrates is that as we try and specify a mindful organising
620 construct, we are increasingly forced to look at the role of organisational processes outside of the
621 operational situation, which are inherently involved in the support of sustaining a 'collective mind' not
622 only at operational level, but of extending this focus across the organisation. These include processes
623 for reporting, analysis and feedback of safety information, performance management, management of
624 change, human resources policies and practice, including training; planning and resource
625 management in rostering and handovers between personnel. How well do all these processes come
626 together in a joined-up way to foster this collective mind? Beginning steps in the process are made in
627 the results in identifying two additional dimensions – 'Coordination between groups' and
628 'Accountability'. The former draws attention to the 'working with' relationships between functional
629 groups across the organisation (and beyond); the latter brings into focus the 'reporting to'
630 relationships that structure the organisational hierarchy. Mindful organising requires not only a flow
631 but also a transformation of information to create a valid appraisal of the operation and its challenges,
632 in order to support action – after all, organising is about enaction. This is not just a spontaneous
633 process – as we have seen, it is supported by formal processes of the organisation; and the informal
634 processes, which, arguably, are at the core of mindful organising are themselves conditioned and
635 constrained by structures and processes of the organisation. To address this, it is necessary to
636 develop more powerful concepts of organisational governance that can show how those apparently
637 spontaneous processes of mindful organising can be deliberately fostered and developed. This
638 argument is taken forward in McDonald et al. (2019).

639 Limitations of this study are as follows. To understand the mindful organising construct fully, we
640 should have involved all organisational layers (i.e. top, middle, and bottom), so as to collect the

641 different perspectives and needs. In this study we were able to engage with ATCOs and managers.
642 Supervisors could not be involved in this research, and this is one limitation of the study. Another
643 limitation of this study could be referred to the number of participants that is relatively small. Further,
644 we could not achieve gender balance in our sample, as only one female's perspective could be
645 included for the data analysis.

5. Conclusions

647 The present research took place in an ultra-safe/HRO ATC centre, with the objective to investigate
648 the mindful organising construct within the organisation – e.g. how ATCOs are sensitised to detect
649 and manage unwanted events, how the system develops collective problem-solving capabilities to
650 face the unexpected and promptly react to it in a variable manner, how real-time communication and
651 flow of information is promoted. Seeing as MUAC is one of the highest performing air traffic centres in
652 Europe, it was the ideal context to understand to what extent the mindful organising construct is able
653 to concretely guide organisations in being resilient against unexpected events, and therefore show
654 how to implement continuous improvement actions. To do so, we strove to operationalise the
655 construct in its main underlining characteristics, to identify 'key decision rules' able to support the data
656 collection (e.g., in the way the questions were posed during the interview sessions) and the data
657 coding and analysis (i.e. in the way we made sense of the empirical data under the lenses of the
658 given coding frame). Critically, we faced a number of challenges during the data coding activity, and
659 the most notable issue was that several aspects could have fallen into more than a single category of
660 the codebook reflecting the mindful organising construct principles, suggesting that its principles are
661 not mutually exclusive. We provided an account of this in the Discussion.

662 While Weick's original concept of mindfulness had its strongest exposition amongst operational
663 groups, developing a truly organisational concept requires explaining how the notion of a collective
664 mind out of a process of heedful interrelating can extend to a wider set of roles at different
665 management levels. The two additional dimensions that emerged from the fieldwork – 'Coordination
666 between groups' and 'Accountability' – hint at some of the links into this wider organisational context.
667 However, this 'heedful interaction' has a different logic in the wider organisational context and we
668 need to pay attention to the types of organisational processes that could support developing a more
669 global 'collective mind'. This issue is taken up in a subsequent research (McDonald et al., 2019), in
670 which a Mindful Governance model is presented and tested in two case studies. This subsequent
671 research will address the theoretical and practical challenges in developing a viable concept of
672 mindful governance.

Conflicts of interest

674 The authors have no conflicts of interest to report.

Acknowledgments

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