

# Collective Mindfulness and Processes of Sensemaking in Health IT Implementation

Valentina LICHTNER<sup>a,b,1</sup> and Johanna I WESTBROOK<sup>b</sup>

<sup>a</sup> *Department of Practice and Policy, UCL School of Pharmacy, UK*

<sup>b</sup> *Centre for Health Systems and Safety Research, AIHL, Macquarie University, Australia*

**Abstract.** High reliability organisations operate safely in situations of high risk by organising for collective mindfulness. They do so through five ongoing processes geared towards anticipating, containing, and making sense of the unexpected. The five processes are: preoccupation with failure, reluctance to simplify interpretations, sensitivity to operations, commitment to resilience, and deference to expertise. The theory of collective mindfulness builds on Hutchins's theory of distributed cognition (the 'collective mind' of ship navigation teams) and on Langer's theory of mindfulness about individuals' interpreting information in context. However, in the theory of collective mindfulness, attention is paid not to individual cognition or decision making, but to collective processes of sensemaking emerging from individuals' interactions in dealing with an equivocal environment. In health informatics, the theory of collective mindfulness can be used to explain health information technology (IT) development and implementation, across its life cycle, and inform guidance towards mindful management of IT projects. For example, applied to a case of electronic health record implementation in a hospital context, the theory explains how mindful management of the sense-making challenges of post-roll out adaptation processes contributes to a 'successful' IT project. Further, the theory challenges a static and linear understanding of success (or failure) of health IT initiatives, supporting instead an argument for outcomes – be it reliability and safety, or IT project success – as collective, complex and dynamic achievements of mindful organising practices.

**Keywords.** Mindfulness, Sensemaking, Organisations, Technology adoption.

## Learning objectives

After reading this chapter, the reader will be able to:

1. Describe and explain the main tenets of the theory of collective mindfulness in organisations.
2. Translate and apply the theory to health information technology (HIT) implementation contexts.
3. Evaluate the strengths and weaknesses of the theory with respect to the insight it can provide on HIT implementation.

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<sup>1</sup> Corresponding Author: Valentina Lichtner, E-mail: [valentina.lichtner@mq.edu.au](mailto:valentina.lichtner@mq.edu.au)

## 1. Introduction: the theory of collective mindfulness

*Mindfulness is a state of being attentive to new information, new meanings, and different points of view [1]. It is not about meditation.*

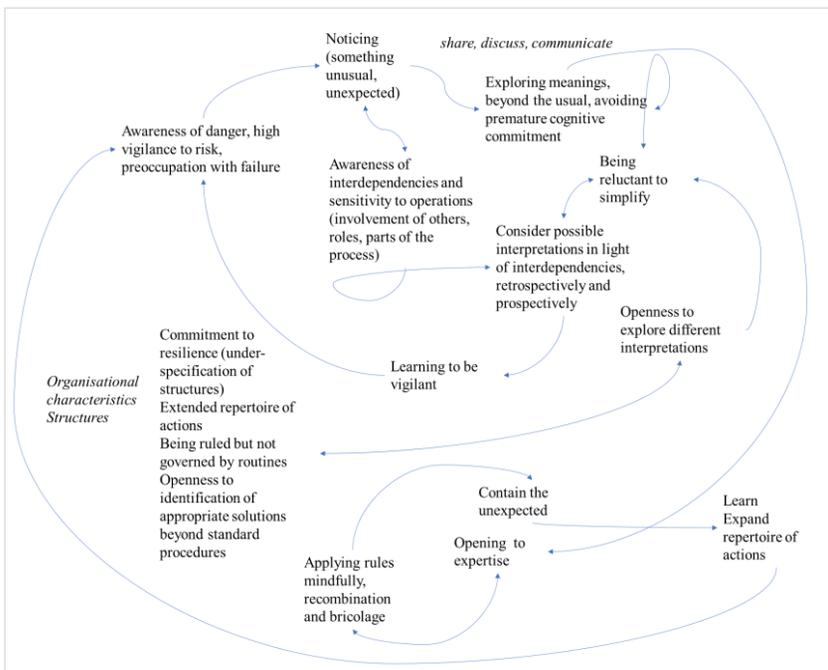
The theory of collective mindfulness originated in the mid-1990s from research that applied an organisational lens to the investigation of high reliability organisations (HRO) [2-4]. Among the originators of the theory were Karl Weick, Karlene Roberts, Kathleen Sutcliffe and other members of ‘the HRO Project’ at Berkeley (University of California). HROs are organisations operating in high levels of complexity and risk, but where serious accidents are extremely rare. Examples of these type of HRO are naval and armed forces, fire services. These organisations cannot afford to learn from trial and error as other organisations might do; instead, their ‘first error is the last trial’ [3][p32]. The theory of collective mindfulness arose from the investigation of these HROs as a way to explain how they are able to work in highly complex environments and yet ensure few major errors occur.

Collective mindfulness is an organisational state of being, or way of working, which is characterized by ‘a quality of organizational attention that increases the likelihood that people will notice unique details or situations and act upon them’ [2][p410]. It emerges from five ongoing reliability-enhancing (collective) cognitive processes geared towards anticipating and containing the unexpected (Table 1): *preoccupation with failure*, *reluctance to simplify interpretations*, *sensitivity to operations*, *commitment to resilience*, and *deference to expertise* [2, 3]. The first three processes sustain an organisation’s capacity to anticipate, and make sense of, ‘the unexpected’. For example, to anticipate a fault in equipment. The last two processes focus on dealing with, and containing, the problem, before it results in an accident or harm. Through the enactment of these processes, an organisation shows the capacity for resilience.

**Table 1.** Five dimensions of *collective mindfulness* (adapted from [2, 3, 5])

<b>Dimensions</b>	<b>Definition</b>
Preoccupation with failure	An ongoing wariness that errors are possible; paying attention to things going right, those that do not go right, and how things could go wrong; small failures and near misses are treated as indicators of potentially bigger issues.
Reluctance to simplify interpretations	Not taking the past as the only guide to the present. Making fewer assumptions, questioning usual wisdom, uncovering blind spots, bringing more perspectives to achieve understanding.
Sensitivity to operations	Creating and maintaining an integrated ‘big picture’ of the current situation in the moment, through real time information. Similar to situation awareness, it involves the envisioning of possible future states and knowledge of interconnections.
Commitment to resilience	Awareness that it is impossible to eliminate uncertainty or anticipate all situations. Capacity building. The enlarging of individual and organisational capabilities to enable recovering from the unexpected (what cannot be anticipated). Capabilities include widening of ‘repertoires of actions’, skills at improvisation, ‘recombination’ and adaptation, ad hoc networks. Ways to achieve this include incorporating lessons from the past, training and learning from feedback.
Deference to expertise (also referred to as flexible decision structures or under-specification of structures)	Enabling the persons with the greater expertise to handle the problem and make decisions regardless of rank or hierarchy. This requires flexibility in organisational structures.

These processes are interrelated as part of a dynamic whole (Figure 1). Each of the five processes depend on the other and is maintained through feedback and learning. HROs ‘socialize people to notice more’ [3] over a background of constant preoccupation with ‘things going wrong’; their organisational structures are compatible with maintaining and enhancing resilience. Once something is noticed, it is shared. Collective mindfulness depends on ongoing sharing of information, communication and interaction between individuals, so that interpretation of what is happening can be refined, beyond usual assumptions, and with awareness of overall workflows and interdependencies. This is thus a process of collective sensemaking – making sense of the situation overlaps with actions to solve or contain the problem, involving people with the right expertise, beyond hierarchical lines. Through the process, the organisation learns, broadens individual and organisational repertoires of actions, and gains collective knowledge that will inform the making sense of future uncertain, unexpected situations.



**Figure 1.** The collective mindfulness whole: a dynamic achievement

### 1.1. The cognitive dimension

The theory of collective mindfulness builds on the view of a ‘collective mind’ emerging from distributed processes proposed in distributed cognition [6]. Collective mindfulness also draws on Langer’s theory of mindfulness about individuals’ interpreting information beyond premature cognitive commitments [1]. However, collective mindfulness shifts the focus away from individual cognition, to collective processes of sensemaking emerging from interactions between people working in equivocal environments [7, 8]. Within this perspective, the ‘collective mind’ is ‘embodied in the interrelating of social activities’ [2, 4] and an organisation (or the group

or team) can be said to be mindful, or have a mindfulness capability, the same way that it is said that organisations learn or have learning capabilities [9].

In contrast to other studies of cognition in organisations, understanding activities and organisations in terms of sensemaking and collective mindfulness takes us away from the traditional decision-making lens. Traditionally decision making is explained as a rational selection between options. Although seen as the combination of two processes of judgement and choice, decision making is typically studied from an individual (cognitive) perspective. The focus is often placed on the outcome (the judgment, the decision). Instead, understanding sensemaking requires a dynamic perspective and a focus on the (social) activity in context.

### *1.2. Making sense and 'the unexpected'*

Sensemaking in organisations is about making sense of unusual events, ambiguous information, or unexplained variations of performance. Organisations are complex sociotechnical environments – they are open adaptive systems. Take for example the implementation of a large clinical information system being rolled-out across multiple hospitals. In such environments it is inevitable that new events and situations will appear that could not have been anticipated, or were known to some but not made known to the designers/implementers (also referred to as ‘unknown knowns’ [10]). These situations create uncertainty and therefore require ‘making sense of’. This is what is usually referred to as *‘the unexpected’* [8], although the expression may also be used more generally to refer to any unwanted outcomes or issues (errors, accidents) in organisational processes. Examples of the unexpected in an IT implementation project may include agreed requirements that become contested, unanticipated changes in workflows, or use of an IT system to complete work in ways which had not been foreseen. The case below illustrates making sense of, and resolving the unexpected in an IT initiative requiring the involvement of stakeholders, and processes of discovery and negotiation – overall, a process of collective sensemaking.

In the organisational literature, depending on the perspective taken to understand the making of sense in organisations, attention has been paid to activities of *sense-giving* (attempts to influence others’ interpretations), *sense-breaking* (when sense is ‘breaking down’), or *sense-exchanging* (social negotiation), among others. We will return to some of these in the case discussed below.

### *1.3. Methods used to research phenomena within this theoretical frame*

Weick and Roberts explain that the word ‘collective’ “refers to individuals who act as if they are a group”. This means they “interrelate their actions” (and they do so “with more or less care”) [4][p360]. Since its beginning, empirical research on collective mindfulness has therefore attempted to capture these processes of interrelating, achieving this with in-depth ethnographic case studies (e.g. [4]). This method is the most suitable for capturing the dynamics of activities in context. In these studies, the unit of analysis often shifts between individuals and groups [3], ‘since only individuals can contribute to a collective mind, but a collective mind is distinct from an individual mind because it inheres in the pattern of interrelated activities among many people’ [4][p360].

Qualitative studies of this kind have made useful contributions to the original theory by investigating these phenomena in very different organisational contexts. For example

‘decision surprises’ in the banking sector [11], and the dialectics of collective minding in a building project of a renowned architecture firm [12].

A different type of research on collective mindfulness aims to more formally assess and measure the association between antecedents (e.g. organisational structures) and mindful organising, and between mindful organising and organisational outcomes (reliability, safety) (Table 2). Vogus and Sutcliffe designed and tested a scale to measure levels of mindful organising across healthcare organisations (nursing units). This scale was then used to examine associations between levels of mindful organising with organisational outcomes (medication errors) [13]. More recently, the scale was used in a similar, more complex, mixed-method study where mindful organising was taken as one of four reliability-enhancing work practices (REWP) (in addition to: respectful interaction; affective commitment; and organisational citizenship behaviour). A survey of 10 items capturing information about each of these REWP was administered to nurses in 95 units across 10 hospitals. They were then correlated to outcomes of patient care (medication errors and patient falls). In assessing the constructs, the authors found mindful organising correlated with respectful interaction. However, mindful organising had significant correlation with medication errors and patient falls, while respectful interaction did not [14][p.14]. The study found that scores on ‘mindful organising’ were significantly negatively associated with medication errors and falls, i.e. units with higher mindful organising scores had significantly lower rates of medication errors and falls. [14][p16]. Thus, measurements of this kind add predictive value to the theory, i.e. making it usable to predict the likelihood of positive or negative outcomes in the presence of different levels of mindful organising practices. Their drawback is loss of insight into the dynamics of collective mindfulness processes that may be specific to different organisational contexts.

Overall, it is important to remember that studying, or measuring, collective mindfulness is not the same as studying, or measuring, individual mindfulness. The latter is increasingly of interest among researchers of users’ behaviour with technology, and can be achieved, for example, by use of the generic Langer’s mindfulness scales, or scales designed more specifically to capture individual’s mindfulness with IT. But studying individual mindfulness does not reveal collective capabilities, organisational processes or outcomes (and there is no evidence yet that individual mindfulness directly produces collective mindfulness [2]).

**Table 2.** Examples of methods used to empirically study *collective mindfulness*

Aims	Examples of methods
<i>Exploring</i> how collective mindfulness unfolds and why; <i>understanding</i> the dynamic processes (and possible mechanisms) that lead to positive or negative outcomes (reliability/failures)	Qualitative research; in depth case studies.
<i>Measuring</i> collective mindfulness (presence/absence or levels)	Design of scales distributed and tested through surveys
<i>Assessing/Testing association</i> between organisational characteristics (antecedents) and mindful organising, or between mindful organising* and organisational outcomes (e.g. reliability/failures)	Scales and surveys; mixed methods.

\* Mindful organising here is equivalent to ‘an intervention’ (e.g. to improve reliability or safety). However, to our knowledge there have been no studies that introduce organisational mindfulness as an intervention and then test its effects on outcomes.

#### 1.4. *Collective mindfulness and IT implementation*

The theory of collective mindfulness has been applied in the field of information systems (IS) to both explain aspects of IT implementation and as a recommendation for improvement [15]. For example, in relation to information system development, Butler and Gray [9] suggest that a collective mindfulness approach may lead to more successful IT projects (better able to manage project risk). They argue that agile development techniques, in contrast to formal development methods, may promote mindfulness by focusing attention on ‘what is needed and what exists, rather than the abstractions of what is expected or promised’ (with risks of premature cognitive commitments) [9][p220]. Once systems are implemented and put into use, they are often found to be ‘fundamentally unreliable’ [9][p217]. Butler and Gray [9] argue that collective mindfulness can explain how organisations using such systems achieve reliability, for example, by mindfully managing business continuity and disaster recovery and organising operations of a ‘technical support’ unit. The authors also point out how paradoxically, systems designed for ease of use may have negative implications on users’ ability to achieve reliable outcomes when they ‘provide results tailored to one perspective, and avoid revealing alternative perspectives’ [9][p220]. Here they argue that such design approaches may hinder *collective mindfulness* when they ‘mask unexpected variation’, ‘promote efficient routinized behaviour’ and restrict choice [9][p221].

## 2. Use of collective mindfulness in health informatics

A rare case of the application of the theory of collective mindfulness in health informatics, is Aanestad and Jensen’s study [16] of a Norwegian hospital adoption of an electronic health record (EHR) system. Their interest lies in the post-implementation adaptation processes, and in particular those changes that ‘technology triggers’ after implementation is officially over and ‘the dust has settled’ [16][p15]. With respect to the traditional life-cycle of an IT implementation, understanding these processes is an important part of the evaluation phase, where evaluation overlaps with, and informs, further adaptive design and development.

### 2.1. *The case, as recounted in Aanestad and Jensen, 2016 [16]:*

A Norwegian hospital rolled-out an EHR system to achieve paperless workflows. However, the new EHR system did not initially replace patient (paper-based) records as other information about the patient remained on paper. Thus, in parallel to EHR use, digital records were printed and kept in storage together with any other paper-based documents (e.g. incoming letters). After about three years from the initial EHR roll-out, the organisation decided to address the sustainability issue of this practice by purchasing scanners, including small ones that clinical departments would use to scan paper-based documents to add to the electronic record. This was considered a low-cost ‘IT project’, ‘entailing simple hardware purchase and installation’, without the perceived need for changes in workflows or specifically allocated resources. This scanning project began with a pilot of four hospital units, but without an implementation strategy. The researchers were able to observe how this initiative was received by the users in one of these units (the Women’s clinic).

From the start, it became apparent that the staff of the clinic encountered several 'sensemaking challenges': how many scanners were needed? Who should scan the documents and when? Should there be changes to the workflow? What should be the processes for handling, distribution, registration, and further processing of documents? And why? Exceptions to initial assumptions surfaced as staff began to explore answers to these questions. The process of making sense took place through tentative plans, meetings, communication with the IT team and other hospital services, mapping workshops, discussion and negotiation, that progressively involved the entire hospital, over a background of other concurrent change (e.g. the upgrade of the local area network infrastructure).

Overall, 'a seemingly trivial change (the installation of scanners) triggered a larger organisational change process than what had initially been expected.' [16][p24]. Completion of the project took time, but in the end, based on the experiences of the pilot, flexible procedures and organisational standards were developed, workflows were changed, scanning was implemented across all departments and this eventually completed the transition to paperless activities initiated with the initial EHR roll-out.

## *2.2. How the theory was applied to the case*

Aanestad and Jensen took collective mindfulness to be an organisational capability founded on processes of sensemaking. In seeking to understand the hospital implementation of the EHR system, they therefore asked what sensemaking processes occur during post-implementation adaptations and how these processes can be supported for the organisation to achieve this capability. Having had the opportunity to learn about the hospital decision of installing scanners to deal with paper records that remained in use after EHR roll-out, they observed the unfolding of this IT project, participated in meetings and interviewed the staff involved.

They mapped the 'sensemaking challenges' encountered in the hospital by the people who were tasked with making sense of how to adapt their work practices around 'the scanning'. Sensemaking activities were refined in terms of '*making, giving, demanding and breaking sense*' [p24] which were then 'translated' into the five processes of collective mindfulness modified to be applicable to 'an action-oriented context'. For example, preoccupation with failure was translated into preoccupation with constraints and preconditions. Deference to expertise, was manifested in the seeking out of an appropriate mix of expertise (Table 3).

In this case study, the collective mindfulness lens reveals the collective cognitive processes and associated activities necessary to bring the initiative to completion hospital wide. The five dimensions are also proposed as an intervention towards future 'successful' implementations. This we discuss in the next section.

**Table 3.** Dimensions of collective mindfulness in HRO compared to those of a HIT project

Concerns	Collective mindfulness processes in HROs	Collective mindfulness processes in HIT project	Description
Anticipating the unexpected	Preoccupation with failure	Preoccupation with constraints and preconditions	Widespread questioning of preconditions and effects of decisions, seeking to check and validate the assumptions acted upon before decisions were implemented. [16]
	Reluctance to simplify interpretations	Reluctance to premature commitment	Unwillingness to proceed on insufficiently known ground. Decisions and proposals questioned and examined for their upstream and downstream requirements and consequences. Plans considered tentative. [16]
	Sensitivity to operations	Sensitivity to interdependencies and continuous prioritisation	Collectively constructed understanding achieved through collaborative workflow mapping and graphical charting to detect interconnections and dependencies between elements in the work system. [16]
Containing the unexpected	Commitment to resilience	Commitment to avoid disruptions	Maintaining as smooth an operation as possible and minimising disruptive changes as guiding principles in the decision processes. [16]
	Deference to expertise	Seeking out appropriate mix of expertise	In considerations of the effects of planned changes, seeking appropriate mix of expertise - a constellation of actors that would be able to cover the necessary domains and ensure that preconditions and consequences are noticed. [16]

### 3. Explanations of success or failure of the health IT implementation

Practitioners and researchers of HIT implementations are often concerned with the success or failure of projects. They seek rules or guidelines as ‘paths to success’, or to prevent or solve HIT implementation failures. What does the theory of collective mindfulness, applied to the case above, contribute to this perspective?

The theory of collective mindfulness originally described activities of HROs as mindful organising enabling the achievement of reliability (prevention and containment of hazards) in high risks businesses. In this light, success and failure pertained to organisations as a whole and reflected the actualisation (or not) of hazards.

Instead, the case explored in this chapter draws attention to the ongoing processes of adoption that make organisational IT evolve and change. From this perspective, the definition of ‘implementation success’ is rather loose and fuzzy. The hospital eventually reached the goal of ‘going paperless’ – what we may call ‘success’ – but in a more roundabout way than originally envisaged and taking longer than planned. Surprises and

unexpected changes are inevitable, given the adaptive complex sociotechnical system where implementation takes place, and the inevitable limitations of all technologies. The case study hospital EHR implementation is not an exception. The theory of collective mindfulness applied to this case gives insights into the ways ‘the unexpected’ (i.e. the inevitable surprises during implementation) is dealt with, that may turn a problematic implementation process into a ‘success’.

In the specific case study described, the organisation demonstrated the capacity to support the discovery of ambiguities, solve emerging issues and progress with an otherwise ambiguous ill-defined project (‘the scanning’). The five dimensions of collective mindfulness were present, both to anticipate and contain the unexpected (e.g. issues for others’ clinical work generated by changes in workflows). Crucial elements and fundamental premises for collective mindfulness were: widespread questioning of assumptions, of preconditions and of effects of decisions; collective discussion; under-specification of structures; support from project management. These enabled sensemaking activities akin to those practiced in user-centred system design, such as ‘co-design sessions’ and ‘workflow mapping exercises’.

The project team also encountered barriers that made the sensemaking activity more difficult. For example, clinicians were too busy to participate in meetings; expertise in ‘their part of the workflow’ was missing from the ‘appropriate mix’ necessary to understand repercussions of proposed changes across the whole process. This was addressed by taking note of necessary questions that one of the team members would ask doctors after the meeting. There was also the inevitable tension of most HIT implementations between standardisation and local customisation. The solution that worked for this hospital was the design of a ‘hierarchy of standards’: a level 1 hospital-wide procedure, and a level 2 specific to each local department. This structure allowed for a standardised flexibility where local work redesign would take into account interconnections with other departments.

Overall, the case shows how ‘mindful managers of change’ ‘can draw on the five characteristics of mindfulness to ensure more productive organizing to support mindful sensemaking’ [16, p26].

#### **4. Discussion and conclusion**

The theory of collective mindfulness has been challenged on a number of grounds. HROs as an organisational type remain ill-defined; achieving reliability is not necessarily equivalent to achieving safety; and the five mindful organising principles could be viewed as representing more ideals an organisation may aspire to than a description [17-19]. The five principles are not sufficient on their own for an organisation to operate safely, but need to build on structural preconditions, such as human resources practices that foster trust and respect, and selection and allocation of resources, including IT [20]. The HRO model represents the appropriate organisational response to a certain type of risks and environment, but must not be considered the right response for all environments [21]. Recommendations for practice drawn from the theory may be challenging to put into effect as they involve, for example, changing organisational culture or communication practices.

Despite some criticisms and limitations, the theory of collective mindfulness has been used in healthcare as foundation for informing the development of interventions proposed to improve quality, safety and resilience [18, 22]. However, the theory of

collective mindfulness has rarely been applied in health informatics. As shown in the case discussed in this paper, a process of translation may be necessary to make the theory applicable to HIT implementations. Through this act of translation, the case shows how the theory of collective mindfulness can enrich our understanding of organisational processes of adoption and adaptation post-implementation. Indeed, the case also suggests the theory's potential to explain and support the entire HIT project life-cycle – from design, to implementation and evaluation. For example, some of the experiences of the scanning team are akin to those eliciting requirements for system development, or those pre-implementation steps when decisions are taken on what needs to be done, including the necessary changes to workflows. It also shows how theory-based qualitative evaluations of HIT projects based on dimensions of collective mindfulness can explain implementation outcomes.

Healthcare services are high reliability-seeking organisations, struggling to eliminate errors and low-quality patient care. Improving patient safety is the main objective underlying many health IT initiatives – i.e. technology has been endorsed with the key task of helping healthcare organisations achieve safe and reliable patient outcomes. The theory of collective mindfulness explains how HROs achieve reliability of operations. A dimension of these organisations' 'success' is the capability to manage 'the unexpected' despite uncertain and risky conditions. Building on these foundations, we conclude this chapter with a proposal for a twofold definition of success for HIT projects, that others may wish to test:

- HIT is successful when it fosters reliable and safe patient outcomes by sustaining collective mindfulness capabilities.
- HIT implementations are successful not when they avoid 'the unexpected' (perhaps an impossibility) but when they manage the unexpected-related challenges through a mindful *collective mind*.

### Teaching questions for reflection

1. What recommendations for HIT practice could be drawn from the application of the theory of collective mindfulness to the implementation of health IT?
2. How can the theory of collective mindfulness assist in evaluating the impact of HIT?
3. What would be the metrics for a mindfulness scale aimed at measuring HIT implementations? And could the scale be used to predict outcomes of HIT project 'success' or 'failure'?
4. How could the theory of collective mindfulness to HIT implementations be translated to consider 'organisations' that are ill-defined, such as in telecare for community care, or in the implementation of patient facing systems, such as a patient portal?

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## References

- [1] E. Langer, *Mindfulness*. 1989: Addison-Wesley.
- [2] K.M. Sutcliffe and T.J. Vogus, *Organizing for Mindfulness*, in *The Wiley Blackwell handbook of mindfulness*, A. Ie, C.T. Ngunoumen, and E. Langer, Editors. 2014. p. 407-423.
- [3] K.E. Weick, K.M. Sutcliffe, and D. Obstfeld, *Organizing for High Reliability: Processes of Collective Mindfulness*. *Research in Organizational Behavior*, 1999(21): p. 81-123.
- [4] K.E. Weick and K.H. Roberts, *Collective mind in organizations: Heedful interrelating on flight decks*. *Administrative science quarterly*, 1993: p. 357-381.
- [5] K.M. Sutcliffe and K.E. Weick, *Mindful Organising and Resilient Healthcare*, in *Resilient Health Care*, E. Hollnagel, J. Braithwaite, and R. Wears, Editors. 2013, Ashgate: London. p. 145-156.
- [6] E. Hutchins, *Cognition in the wild*. 1995, Cambridge, Mass.: MIT Press.
- [7] K.E. Weick, *Sensemaking in organizations*. 1995, London: Sage.
- [8] K.E. Weick and K.M. Sutcliffe, *Managing the unexpected: Resilience performance in an age of uncertainty*. 2nd ed. 2007, San Francisco, CA: Jossey-Bass.
- [9] B.S. Butler and P.H. Gray, *Reliability, Mindfulness, and Information Systems*. *MIS Quarterly*, 2006. **30**(2): p. 211-224.
- [10] T. Aven, *Implications of black swans to the foundations and practice of risk assessment and management*. *Reliability Engineering & System Safety*, 2015. **134**: p. 83-91.
- [11] R.W. Eastburn, *Organizational Mindfulness in Banking: A Discriminating Factor for Firm Performance*. *Journal of Managerial Issues*, 2018. **30**(1).
- [12] J.L. Carlo, K. Lyytinen, and R.J. Boland Jr, *Dialectics of collective minding: Contradictory appropriations of information technology in a high-risk project*. *MIS Quarterly*, 2012: p. 1081-1108.
- [13] T.J. Vogus and K.M. Sutcliffe, *The impact of safety organizing, trusted leadership, and care pathways on reported medication errors in hospital nursing units*. *Medical care*, 2007. **45**(10): p. 997-1002.
- [14] T.J. Vogus and D. Iacobucci, *Creating Highly Reliable Health Care: How Reliability-Enhancing Work Practices Affect Patient Safety in Hospitals*. *ILR Review*, 2016. **69**(4): p. 911-938.
- [15] S. Dembecher and R. Beck, *The concept of mindfulness in information systems research: a multi-dimensional analysis*. *European Journal of Information Systems*, 2017. **26**(2): p. 121-142.
- [16] M. Aanestad and T.B. Jensen, *Collective mindfulness in post-implementation IS adaptation processes*. *Information and Organization*, 2016. **26**(1-2): p. 13-27.
- [17] A. Hopkins, *The problem of defining high reliability organisations*. National Research Center for Occupational Safety and Health Regulation. January, 2007.
- [18] M.A. Sujan, *High Reliability Organisations: Making Care Safer through Reliability and Resilience*, in *Improving Healthcare - A Handbook for Practitioners*, L. Baillie and E. Maxwell, Editors. 2017, Routledge: London. p. 101-114.
- [19] N. Leveson, N. Dulac, K. Marais, and J. Carroll, *Moving Beyond Normal Accidents and High Reliability Organizations: A Systems Approach to Safety in Complex Systems*. *Organization Studies*, 2009. **30**(2-3): p. 227-249.
- [20] K.M. Sutcliffe, L. Paine, and P.J. Pronovost, *Re-examining high reliability: actively organising for safety*. *BMJ Quality & Safety*, 2017. **26**(3): p. 248-251.
- [21] R. Amalberti, *Navigating safety: Necessary compromises and trade-offs - Theory and practice*. 2013: Springer.
- [22] S. Hines, K. Luna, J. Lofthus, et al., *Becoming a high reliability organization: operational advice for hospital leaders*, in *AHRQ publication*. 2008, Agency for Healthcare Research and Quality: Rockville, MD.