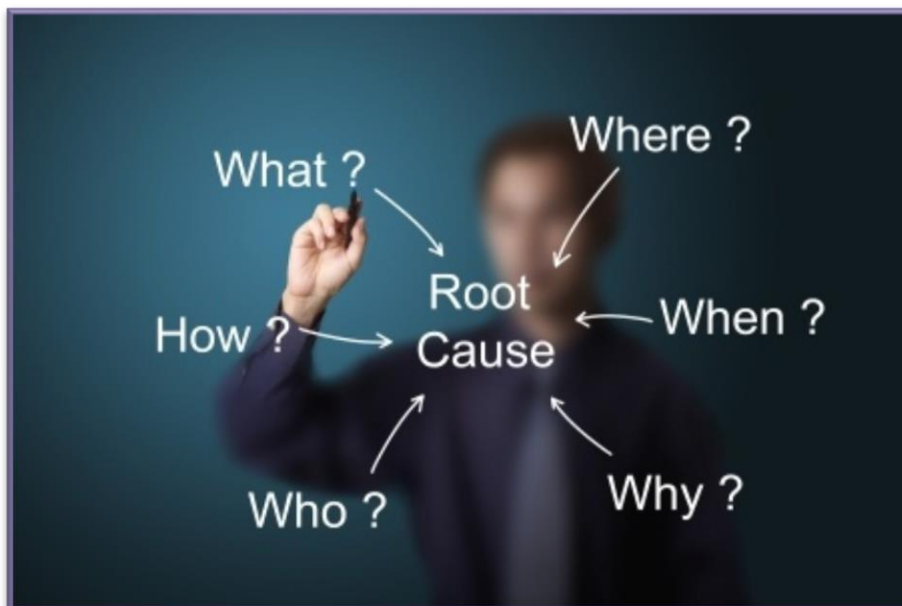


# Literature review: the relationship between psychological safety, human performance and HSE performance

## Energy Institute



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## Acronyms

Abbreviation	Meaning
EI	Energy Institute
HSE	Health, safety and environment
RQ	Research Question

## List of Definitions

Term	Definition
Blame culture	A blame culture within an organization is when leadership is unwilling to accept responsibility for mistakes and leadership find someone to blame for the mistake (Khatri, Brown & Hicks, 2009).
Error aversion	Error aversion climate denies error and is characterised by a fear of error and a reluctance to discuss error. (Hodges 2011)
Error climate	Employees shared perceptions of organisational practices regarding errors (Hodges 2011)
Error management	System in which the investigation of maintenance errors is carried out within the organisational context in which they have occurred which takes full account of the concept of a Just Culture (SKYbrary, 2017)
High Reliability Organization	A high-reliability organization is a firm that has consistent high-levels of safety performance over a long period of time (Chassin & Loeb, 2013).
Human Performance	Human performance is defined as the human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations (International Civil Aviation Organisation, 2018)
HSE performance	'A service provider's safety achievement as defined by its safety performance targets and safety performance indicators'. (Safety Management International Collaboration Group, 2013)
Just culture	A just culture is when an organization builds an atmosphere of trust and when "reporting errors and near misses are supported without fear of retribution" (Barnsteiner & Disch, 2012, p 407-408)  AHRQ defines just culture as one that "...recognizes that competent professionals make mistakes and acknowledges that even competent professionals will develop unhealthy norms (shortcuts, "routine rule violations"), but has zero tolerance for reckless behavior."
Personal Safety	Energy Institute (EI, 2011) defines Personal Safety as protecting the safety, health and welfare of people at work.

Term	Definition
Process safety	Energy Institute (EI, 2011) defines “Process Safety” as management of major accident hazards associated with releases of energy, chemicals, and other hazardous substances.
Psychological safety	The willingness of people to express an opinion, admit mistakes or unsafe behaviours, without fear of being embarrassed, rejected or punished.
Safety climate	The shared perceptions that employees have of the relative importance granted to safety issues by their organisation. Kouabenan et al 2015.
Safety culture	“...the product of individual and group values, attitudes, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organisation’s health and safety programmes...”. (ACSNI Group 1993.

# 1 EXECUTIVE SUMMARY

## 1.1 What is psychological safety?

Psychological safety can be described as:

The willingness of people to express an opinion, admit mistakes or unsafe behaviours, without fear of being embarrassed, rejected or punished.

In addition to research on psychological safety, 'safety climate', 'error management climate' and 'Just cultures' research use analogous terms, such as "openness".

## 1.2 Why is it important?

Psychological safety is thought to be a critical attribute of a team and organisation climate and to play a role in:

- Facilitating the reporting of errors and unsafe behaviours – thereby enabling these to be identified, learnt from and improvements made to prevent repetition;
- Facilitating open discussion of error, understanding errors and unsafe behaviours.

The capacity of an organisation to identify areas of weakness in safety performance (as indicated by errors and unsafe behaviours) and effectively resolve these proactively is considered to contribute to the prevention of incidents and / or prevention of the repetition of the same or similar errors and unsafe behaviours.

Psychological safety is reported to be particularly important in hierarchical organisations, complex systems, where error may have serious safety consequence, and where individuals or organisations may be held responsible for adverse consequence.

## 1.3 Aims of this rapid literature review

This rapid review aimed to:

- Discuss the current state of knowledge; and
- Identify gaps in knowledge for further research.

A systematic search for literature was completed, with articles screened against inclusion criteria and reliability ratings, with a focus on high reliability empirical research. The synthesis was led by three research questions (RQs), with findings noted below, based on 94 cited references.

## 1.4 Summary of findings

### 1.4.1 RQ1

Is there a proven correlation between Psychological Safety and HSE Performance?

There are many correlational studies that report a link between psychological safety and willingness to report one's errors and behaviours and thence resolution of underlying causes. The link to safety performance, such as incident rates, is less clear because:

- Psychological safety may lead to an increased rate of reporting of near misses, adverse events and injuries.

- The relationship between accident rates and safety climate may be mediated by hazards (level of risk), such that higher risk operations may be associated with stronger safety climates.

The evidence is drawn from many sectors, with few studies in the oil and gas industry.

Studies indicate the following factors influence psychological safety:

- a) Individual and team factors such as duration of employment and team affiliations.
- b) Organisational factors such as extent of hierarchy, professional siloes, and role of hierarchical status.
- c) Inclusive, accessible, facilitative leadership (to overcome individual, team and organisational barriers);
- d) The extent to which individuals have a sense of vulnerability if they report an error.
- e) Sense of trust that reports of incidents, near misses, errors or unsafe behaviours will be:
  - Acted on effectively;
  - Treated fairly; and
  - Used as a learning opportunity.

The confidence in effective action is in turn influenced by perception of organisational commitment to safety and past responses to reported errors or unsafe behaviour.

The research does not provide a strong basis on which to rank these factors. There is some evidence that:

- A sense of vulnerability if a person reports an error. This may mediate the impact of interventions such as facilitative leadership and reporting schemes;
- A sense of trust and facilitative leadership may overcome hierarchical barriers to speaking up.

Incentive schemes linked to HSE performance, punitive reactions to error and a focus on individual responsibility may reduce psychological safety.

The ability to learn from error is reported to be related to:

- Error being seen by the team and the organisation as a learning opportunity and a shared experience about what works and what does not work;
- Learning from error being seen to be a collective responsibility.

The research on Just Culture also cites the facets of a learning culture, such as flexibility, a questioning attitude, chronic unease and openness to change.

#### 1.4.2 RQ2

Is there evidence that building psychological safety results in an improved HSE Performance?

The correlational research indicates that higher levels of psychological safety is associated with better HSE performance. However, there is less published evidence on whether *interventions* aimed at increasing psychological safety lead to improved HSE performance. The results from interventions vary.



### 1.4.3 RQ3

What interventions in the industry have proven to be effective in increasing Psychological Safety resulting in an increased HSE performance and what interventions have proven to be ineffective?

There is a high level of guidance on how to increase the level of psychological safety. There is some evidence, limited by the small number of studies and their variable and inconsistent results, that these interventions lead to higher levels of reporting of error and subsequent HSE improvement. The extent to which an organisation trains personnel in relevant matters (see below), the use of analysis as a means of understanding error vs determining culpability and the extent to which organisations remove the fear of adverse personal consequences from error reporting appear to be key factors.

The evidence indicates the following aspects of interventions are important:

- Interventions need to overcome hierarchical barriers and fears about peer group reactions or adverse consequences by:
  - Team building (developing trusting interpersonal relationships);
  - Having (inclusive) leaders and role models facilitating learning through adoption of a set of supportive behaviours, accessibility, neutral language and positive reinforcement;
  - Generating a sense that error is a shared learning opportunity and a collective responsibility aimed at performance improvement;
  - Providing assurance of no adverse personal consequences from reporting error;
  - Demonstrating the value of speaking up by acting effectively on feedback and reporting actions back to people.
- Tools and policies to support analysis of causes of error and behaviours in a way that supports openness and learning.

The research suggests that psychological safety does not necessarily emerge as a product of a positive safety climate, especially as many models of safety climate do not specifically include psychological safety. Specific interventions are needed.

## 1.5 Research needs

Key areas for further research include:

- Benchmarking levels of psychological safety and associated levels of error self-reporting in the oil and gas industry and how/why this varies between teams, departments and organisations;
- Developing and validating measures of psychological safety specific to oil and gas;
- Evaluations of the effectiveness of interventions in increasing psychological safety and HSE performance;
- Developing guidance psychological safety specific to oil and gas HSE performance.

## 2 INTRODUCTION

### 2.1 What is psychological safety?

Psychological safety (Edmondson;1999) maybe described as:

The willingness of people to express an opinion, admit mistakes or unsafe behaviours, without fear of being embarrassed, rejected or punished.

It should be noted that this definition goes beyond reporting near misses and unsafe conditions to focus on reporting one's own errors and unsafe behaviours.

The concept of psychological safety was initially developed (see Schein and Bennis 1965) in the context of complex work environments with high levels of human interaction, particularly in healthcare, where there is a need to promote reporting of human error, learning and positive (as opposed to defensive) responses to error.

Two specific lines of work that have cited similar concepts and are included in their review are 'safety climate' and Professor James Reason's work on 'Just cultures'. These other lines of work have used terms that are analogous to elements of psychological safety. These include terms such as:

- Openness;
- Trust;
- Supportive organisational environment;
- Just culture;
- Speaking up;
- Safety communication (feeling free to communicate).

#### Safety climate and safety culture

Research into safety climate often cite a range of sub-elements, with one being either similar to psychological safety or in some cases the actual term psychological safety. This work sometimes implicitly and sometimes explicitly views psychological safety to be a sub-element of a positive safety climate.

#### Just Culture model

The Just Culture model (Reason and Hobbs, 2003) includes a set of elements including:

- An informed culture – “an atmosphere of trust in which people are willing to confess their errors and mistakes” (p146)
- A reporting culture - “..cultivating an atmosphere where people have confidence to report safety concerns without fear of blame” (Edmondson;1999).
- A just culture – where it “has agreed and understood the distinction between blame free and culpable acts” (p146)
- A learning culture – “reactive and proactive measures are used to guide continuous and wide -reaching improvements..”
- A flexible culture – “the organization and the people in it are capable of adapting effectively to changing demands”.

The definitions of informed, reporting and just culture are analogous to the concepts of psychological safety whilst covering unsafe conditions and safety concerns rather than being specific to one's own error and unsafe behaviour. Accordingly, this review has selectively identified findings from Just Culture research relevant to psychological safety.

## 2.2 Why is it considered important?

Psychological safety is considered to be an element of an effective safety culture and positive safety climate, as well as of importance in its own right. It is thought to be a critical attribute of a team and organisation climate and to play a role in:

- Facilitating the reporting of errors and unsafe conditions – thereby enabling these to be identified, investigated, learnt from and improvements made to prevent their repetition;
- Enabling people to challenge other people and query their performance;
- Facilitating effective investigation and understanding errors and unsafe behaviours, such as being able to perform valid behavioural analysis and solicit truthful statements of actions, behaviours and decision making that may have contributed to incidents.

The capacity of an organisation to identify areas of weakness in safety performance (as indicated by errors and unsafe behaviours) and effectively resolve these proactively is considered to contribute to the prevention of incidents and / or prevention of the repetition of the same or similar errors and unsafe behaviours. This is said to be particularly so where there is a need to improvise, in situations of uncertainty and made decisions without specific protocols (i.e. where people may err), Edmondson et al (2016).

Psychological safety was cited as a factor in the Texas City explosion (see Table 1 for relevant recommendation from the Baker report ), CSB (2011).

**Table 1: Baker report, recommendation 4, p249**

“BP should involve the relevant stakeholders to develop a positive, trusting, and open process safety culture within each U.S. refinery.

“develop a positive, trusting, and open process safety culture”—

(f) distinguish more clearly between acceptable and unacceptable employee acts such that the vast majority of unsafe acts or conditions can be reported without fear of punishment. A strong process safety culture facilitates the sharing of information that will reduce safety risks. As a result, BP's refineries should operate in such a way as to permit the reporting of the vast majority of unsafe acts or conditions by employees and contractors without fear of punishment. While unsafe acts that are reckless or particularly egregious may warrant some type of sanctions, the culture of each U.S. refinery should promote sharing of information relevant to safety even when that information indicates that workers have made mistakes;

(g) establish a climate in which

- workers are encouraged to ask challenging questions without fear of reprisal, and
- workers are educated, encouraged, and expected to examine critically all process safety tasks and methods prior to taking them;

## 2.3 Aims of this rapid review

### 2.3.1 Aims and research questions

This rapid review aimed to identify and summarise research findings, evidence, and theoretical and methodological contributions to the issues covered by the three research questions as follows:

1. Is there a proven correlation between Psychological Safety and HSE Performance?
  - If so, what are the most important contributing factors, can those be ranked? Include the following themes, but not limit to:
    - Optimising learning from mistakes and incidents through a culture where people feel safe to openly discuss these failings to learn the lessons from them and improve systems and behaviours in the future.
    - A culture of active reporting will help uncover system weaknesses and prevent incidents rather than relying on learning from an incident after it has occurred. Lack of psychological safety and engagement will drive down reporting.
2. Is there evidence that building psychological safety results in an improved HSE Performance?
3. What interventions in the industry have proven to be effective in increasing Psychological Safety resulting in an increased HSE performance and what interventions have proven to be ineffective?

Relative to each of the above research questions, this review aimed to:

- Discuss the current state of knowledge; and
- Identify gaps in knowledge for further research.

### 2.3.2 This report

This report contains:

- Section 3 of the report provides a summary of the method.
- Section 4 provides summary of findings. This is a synthesis of the evidence in the cited studies.
- Section 5 provides conclusions and suggestions for further research.
- The appendix A1 lists references.
- Appendix A2 provides tabulated evidence, namely summaries of specific studies.

## 3 METHOD

### 3.1 Scope of review and definition of terms

After consultation with the project sponsor the scope was agreed as:

- Focus on high hazard and safety critical sectors, including but not limited to energy, mass transportation, defence, medical, mining, shipping, emergency services and aerospace.
- Culture and ‘feelings’ regarding ‘safely’ reporting individual mistakes and errors, fatigue, your own non-compliance, i.e. reporting of your own human performance;
- How to proactively identify issues to prevent incidents;
- How to learn from human performance and develop effective defences.

Key terminology were defined to guide the review, including Human Performance; HSE performance; and Psychological safety.

The entire review and reporting was completed in three weeks, as a rapid review.

### 3.2 Search terms and sources

#### 3.2.1 Search terms

The term “Psychological Safety” may not be explicitly used in all the relevant literature, so the search also included literature that deals with the concepts of Psychological Safety (speaking up, team trust, openly discussing errors and mistakes etc). Therefore, a wide range of search terms was used to identify relevant literature, including:

- Reporting, self-reporting and error, mistakes, non-compliance, non-adherence, unsafe behaviour, fatigue, conscious error awareness;
- Openness, reporting culture, admitting error, active reporting, willingness, openly discussing error, speaking up, psychological safety, behavioural integrity, no blame culture, just culture, trust, team trust, negativity, high performing teams, error management, error climate;
- Organisational change, agility, adaptability; learning from error; willingness to learn, organisational responsiveness, challenge culture, no blame;
- Evaluation, impact, research, outcomes.

The terms evolved in response to initial search results.

#### 3.2.2 Sources

The search drew on the following sources:

- Google scholar and other online search engines (Science Direct, EBSCO, Psych Info);
- Key researchers/academics and institutes, such as Amy Edmondson;
- Harvard Business review;
- Authoritative guidance, such as CCPS, EPSC etc.

### 3.3 Key word search and ‘snowballing’

The purposive search was conducted using the terms and sources agreed above, followed by responsive searching through ‘snowballing’ and ‘reference chaining’ using initial articles obtained.

### 3.4 Screening against inclusion criteria

The review primarily covered peer reviewed and published literature but also include particularly pertinent grey literature, particularly the application of Psychological Safety in other corporate organisations. The found literature was screened against the following inclusion criteria:

- Relevant sectors
  - Firstly, oil and gas, nuclear, shipping, mining, defence, aviation and
  - Secondly health and other, and high reliability organisations
- Relevant to the research questions.
- Reliability and quality of literature (Weight of evidence), with a focus on medium and high-quality evidence.

14 of the shortlisted articles were screened out as not sufficiently relevant to the research questions upon closer review.

#### Weight of Evidence

The EPPI Centre’s Weight of Evidence (WoE) framework was used as part of the Weight of Evidence process. The framework is composed of four elements:

- a) WoEA-quality of conduct of study;
- b) WoEB-suitability of the study design;
- c) WoEC-relevance of the study; and
- d) WoED-overall quality score which is based on the average score of the three components.

The qualitative rating guidance is shown in Table 3. The overall Weight of Evidence is categorised as High, Medium and Low using the following scale in Table 2.

**Table 2: Overall WoE rating scale**

Overall WoE	Rating scale
High	>2.4
Medium	1.66 to 2.4
Low	<1.66

### 3.5 Synthesis against research questions

For each research question the review produced:

- A concise evidence statement of key findings (see the executive summary in section 1);
- A summation of recommended good practice (RGP) as per section 5.3;
- Theoretical and methodological models, where cited;
- A summary of any uncertainties and conflicts in findings;
- An overview of gaps in the evidence base, noted and prioritised for further research (as per section 5.2).

**Table 3: Weight of evidence rating guidance**

	Quality	Design	Relevance
High (3)	<p>Peer reviewed (High quality journal)</p> <p>Contains and addresses research elements i.e. aims, objectives, method, analysis/results limitations, etc.</p> <p>Study is reliable and easy to replicate;</p> <p>It is a main study rather than Pilot.</p> <p>Primary rather than secondary research; or secondary research (systematic review) of a high quality.</p>	<p>Research is representative of the target population (as set in research aims - e.g. use of target population rather than student samples).</p> <p>Experiment/control group present.</p> <p>Longitudinal design rather than cross-sectional design.</p> <p>Between group comparisons, confounding variables.</p> <p>Sample sizes are sufficiently large.</p> <p>Use of mixed method (quantitate and qualitative data collection).</p> <p>Data collection tool is validated (Factor analysis, Cronbach's alphas) or use of already validated tools.</p> <p>High quality analysis – reporting statistical significance. E.g. correlation values, regressions, themes and subthemes etc.</p> <p>Limitations are recognised.</p>	<p>Partial or full relevance to research question.</p> <p>Addresses all or most of the sub questions.</p> <p>Covers oil and gas sector.</p>
Medium (2)	<p>Not peer reviewed or Peer reviewed (Low quality journal).</p> <p>Contains research elements but does not address them sufficiently i.e. aims, methods, etc.</p> <p>Study is of questionable reliability, but limitations are addressed, and future research recommendations proposed.</p>	<p>Sample is representative of the target population or closely matched.</p> <p>Cross sectional design.</p> <p>Limited /no presence of control groups.</p> <p>Evaluation made but comparisons were minimal.</p> <p>Adequate sample size.</p> <p>Single method of data collection (e.g. quantitative data only).</p> <p>Validation methods used but no robust statistics or significance.</p> <p>Qualitative findings contain limited report on themes and subthemes.</p> <p>Limitations are partially recognised.</p>	<p>Partially answers research question and/ or inferences can be drawn to the research question.</p> <p>Inferences can be drawn to all or some of the sub questions.</p> <p>Sample involves other high hazard or safety critical operations service e.g. nuclear power, etc.</p>



	Quality	Design	Relevance
Low (1)	<p>Not peer reviewed or just abstract.</p> <p>No/limited elements of research listed.</p> <p>Study is unreliable and inconsistent in approach.</p> <p>Pilot research only.</p>	<p>Sample does not use the target population (e.g. use of student samples).</p> <p>Cross-sectional design.</p> <p>No control group.</p> <p>No comparisons or evaluation.</p> <p>Low sample size.</p> <p>No statistical significance &amp; no validation.</p> <p>Limited reporting of qualitative findings.</p> <p>Limitations of study not recognised.</p>	<p>Low/no relevance to the research topic/question and sub-questions.</p> <p>It is not possible to draw any inferences to research questions.</p> <p>Sample does not include safety critical sectors.</p>

## 4 SUMMARY OF FINDINGS

### 4.1 Weight of evidence

Table 4 shows the number of articles per research question and their weight of evidence ratings. Table 5 shows the number of articles (94 in total) cited in this report and their Weight of Evidence ratings. As per Table 6, most studies dated since 2000.

It can be noted that:

- There is a reasonably high number of studies, particularly in the context of healthcare errors, aviation safety, safety climate, error management and Just Culture.
- There are relatively few published studies specifically on psychological safety in the oil and gas sector.
- There is a high number of studies indicating a link between psychological safety and human/HSE performance, especially on human performance such as reporting error.
- Many studies explore the impact on measures such as safety climate, behaviours, reporting of errors and incidents, as opposed to HSE performance outcome measures such as accident rates.
- There is limited evidence on which to rank factors that contribute to psychological safety, although important factors have been identified.
- There are fewer high reliable studies of the effectiveness of interventions, mostly in healthcare.
- Despite the widespread adoption of Just Culture in aviation, relatively few published evaluations of its impact in aviation could be identified.

Some studies covered more than one question. The total number of studies included in the review was 189, of which 94 are cited in this summary of findings or evidence tables in Appendix A2 .

**Table 4: Weight of evidence per research question (all)**

RQ	N	Quality			Design			Relevance			Overall		
		Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
RQ1	114	12	61	41	23	73	18	29	63	22	15	82	17
RQ2	37	5	22	10	9	19	9	8	23	6	2	29	6
RQ3a	84	9	53	22	16	58	10	17	53	14	8	70	6
RQ3b	53	3	35	15	10	33	10	10	33	10	3	43	7

**Table 5: Weight of evidence per research question (Cited)**

RQ	N	Quality			Design			Relevance			Overall		
		Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
RQ1	45	3	22	20	7	28	10	0	33	12	2	32	11
RQ2	17	1	11	5	4	8	5	2	11	4	0	14	3
RQ3a	52	5	34	13	11	33	8	4	35	13	3	44	5
RQ3b	39	3	26	10	9	24	6	3	26	10	2	33	4

**Table 6: Year of publication**

Year of publication	Number
Undated	19
<1990	3
1990-1999	13
2000-2009	59
2010-2018	95

As per Table 7, only 15% of the articles were specific to oil and gas. Healthcare is the single most common sector for relevant research.

**Table 7: Sector of research**

Aviation	Blue light services	Healthcare	Oil and gas	Manufacturing	Rail	Nuclear	Construction	Other and general
19	1	54	29	13	6	5	6	57
10%	1%	29%	15%	7%	3%	3%	3%	30%

The following sections provide a summary of findings per research question.

## 4.2 RQ 1: Does psychological safety correlate with HSE performance?

### 4.2.1 Introduction

RQ1: Is there a proven correlation between Psychological Safety and HSE Performance?

- If so, what are the most important contributing factors, can those be ranked? Include the following themes, but not limit to:
  - Optimising learning from mistakes and incidents through a culture where people feel safe to openly discuss these failings to learn the lessons from them and improve systems and behaviours in the future.
  - A culture of active reporting will help uncover system weaknesses and prevent incidents rather than relying on learning from an incident after it has occurred. Lack of psychological safety and engagement will drive down reporting.

This question comprises two sub-questions which are answered, as information permits, below.

### 4.2.2 Correlation between Psychological Safety and HSE Performance

There are a number of lines of research that have directly or indirectly explored the correlation between Psychological Safety and HSE Performance. The key findings are noted in Table 8 (page 41). The evidence is summarised below. A series of studies have explored what they term 'Error management climate', especially in aviation safety and in studies specifically on reporting behaviour. This concept is very similar to psychological safety.

HSE 'performance' is taken here to refer to both safety behaviours such as reporting of incidents and outcomes such as accident rates.

#### 4.2.2.1 Healthcare research

The role of psychological safety has been extensively researched in the context of healthcare, with a series of studies led by Amy Edmondson (1996, 1999, 2003, 2004, 2016, 2018). Indeed, this is the most common sector in which the concept of psychological safety has been researched as a factor in safety performance, especially with respect to reporting, learning from and resolving human error. This indicates a climate of openness is related to a willingness to report and learn from error and thence to high standards of safety performance;

This research led to the concept of self-correcting teams, namely the ability to report and resolve errors without consequence as part of a high performing team with self-correcting performance and a focus on patient outcomes. This is reported to be particularly important in hierarchical teams with 'powerful' norms and where human error is a safety critical factor.

#### 4.2.2.2 Safety climate and safety culture research

Safety climate research has explored the correlation between sub-elements of climate and HSE performance, including safety behaviours and accident rates. Some of the safety climate studies report on sub-elements that are analogous to psychological safety, such as Christian et al (2009) and Jones (2014). Bhattacharya (2015) cites a review of safety culture studies which reported that the 12 most common elements of safety

culture models include ‘focus on learning from problems rather than allocating blame’ and “Visible mutual trust between stakeholders”, which are analogous to concepts of psychological safety.

Many safety climate models and studies of safety climate do not clearly include psychological safety (see Hystad et al 2014 and Yule 2003 for example). Of nine safety culture models, cited by the US Transportation Research Board report (TRB, 2016) on strengthening offshore oil and gas safety culture, seven cited an aspect of psychological safety such as speaking up. Of 28 safety climate studies cited by Yule (2003) four cited factors analogous to psychological safety. This reflects the point that safety climate models vary in terms of their sub-elements and often focus on perceived management commitment and the management of production vs safety commitments. Gad et al (2002) in a review of safety climate models found that even when studies used the same model they report different factors. This also means that many safety climate studies have not measured or tested the role of psychological safety.

Where safety climate research has covered psychological safety (see Table 8) it indicates:

- Psychological safety is an important sub-element (sometimes termed an antecedent) of safety climate and safety behaviours (along with other sub-elements);
- Safety climate has a statistically significant but weak relationship with safety outcomes such as accident rates.

Those studies that have assessed psychological safety suggest that psychological safety is an important sub-element of safety climate if less important than factors such as perceived management commitment.

A number of correlational studies as summarised by Kouabenan et al (2015) have noted a statistically significant but weak relationship between safety climate (as a whole) and safety outcomes, with stronger relationship between climate and behaviours. A series of reviews have sought to explain why safety climate (and its antecedents such as psychological safety) may have a weak statistical relationship with accident rates, for example Ceri (2014). These have noted the following:

- Personal injury rates can be low and so may be a poor measure of safety performance.
- Positive safety climates may lead to a higher level of accident reporting (for example see Ceri 2014).
- Incident rates may be predictive of safety climate, i.e. higher incidents rates may be associated with stronger safety climates.
- Accident performance may lag behind safety climate, such that a supervisor climate may be associated with better performance in subsequent years, hence current climate and performance may show lower correlations. Tholen et al (2013) found in a longitudinal study of tunnel construction workers that safety climate had a lagged effect on safety behaviour, for example.
- The relationship between safety climate (and its antecedents) and accident rates may be mediated by hazards.

In addition, the research into safety climate has focused on personal safety rather than

process safety.

Whilst these points have been made in the content of safety climate they may equally apply to psychological safety. Thus, the weaker evidence of a relationship between psychological safety and accident rates may be due to mediating variables such as hazard level, the limitations of accident data and the possibility that positive safety climates lead to more accident reporting.

#### 4.2.2.3 Just culture model

The Just Culture model is based on an assessment of case studies of major incidents and the factors that have contributed to them and by examination of attributes of high performing organisations. This body of work is attributable to Professor James Reason (Reason 1997, 1998), whose Just Culture model emerged from well known accidents such as the shuttle challenger accident of 1986, where an engineer's warnings were not listened to regarding safety and the Challenger exploded. This includes reference to:

- Appropriately responding to honest mistakes and intentional or reckless behaviour;
- Balance between processes and commitments by safety specialists and judiciary;
- Willingness to examine assignment of blame and punishment;
- Encouragement for providing essential safety-related information but clarity regarding what constitutes as acceptable or unacceptable behaviour.

These characteristics describe the Just Culture model and the type of environment that allows employees to willingly submit reports of error and near-misses voluntarily (Coan, 1999), i.e. psychologically safe.

As much of the research addressing Just Culture and its effects are case studies, the evidence will reflect this, making it primarily qualitative or narrative. As of 2000, Reason (2000) investigated three types of high reliability organisations: US Navy nuclear aircraft carriers, nuclear power plants, and air traffic control centres. Lekka (2011) agrees that research on high reliability organisations tend to look into those types of organisation and also adds that there is little evidence of cause-effect relationships between specific HRO processes and safety performance. This is corroborated by Edwards (2018) study that purports to be the first to assess the impact of a Just Culture in a longitudinal experimental design (see section 4.4.2.3 for findings).

### 4.2.3 Most important contributing factors

#### 4.2.3.1 Overview

This question can be split further into what factors contribute to psychological safety and what factors contribute to the effectiveness of learning from error. Obviously, there is a common point that a sense of psychological safety contributes to the reporting of error and the validity of root cause analysis, without which learning would be constrained. However, the quality of learning can be considered as a subsequent activity.

The research in high hazard sectors provides a limited basis on which to indicate rank order of importance of factors towards psychological safety, as follows:

- Many studies (see Table 9) have cited individual factors or offered qualitative insights rather than a quantitative assessment of the relative weight of factors contributing to psychological safety.

- Few studies (see Table 9) in the high hazard sectors have systematically assessed factors that contribute to psychological safety. They have explored analogous topics such as just and reporting culture.

Whilst psychological safety is reported to be a sub-element of safety culture, Tuyl (2016) asserts that “..cultures of non-report exist within some organisations in spite of noble efforts to foster a supportive safety culture” (p15). Tuyl (2016) cites a study of safety programs in five construction companies that, whilst representing good practice, reported ongoing non-report practices. This implies that there are specific factors that have a particular impact on psychological safety and that a ‘good’ safety climate does not necessarily lead to a sense of psychological safety.

The authors of this review would also note that as many models of safety climate omit psychological safety, safety climate interventions based on these models may not target the factors specific to psychological safety. Indeed, Martinex et al (2015) found in a healthcare study that teamwork and safety climate scales were not associated with self-reported speaking up behaviour. The evidence suggests that there are specific factors related to psychological safety.

Research on the specific concept of psychological safety in healthcare has explored contributory factors (see Table 9, page 47).

#### 4.2.3.2 Factors influencing psychological safety

Findings are noted in Table 9 (page 47) with key points drawn out below.

##### Psychological safety research

Psychological safety is reported (e.g. Edmondson et al 2016) to be a product of a team and organisational environment where people feel safe to express opinions and report matters such as mistakes without adverse consequences. Key attributes of a climate that engenders psychological safety include:

- Trust in how people will respond to your opinion and statements, such as whether you might be ridiculed, criticised, embarrassed, ostracised or blamed etc vs being thanked and supported;
- Trust in the actions people or your employers make or may not take in respond to your opinions or admissions, such as whether they take disciplinary action or not, down grade your performance assessment etc versus positively rewarding your openness.

Previous research into psychological safety identified a range of individual, organisational factors and leadership factors that influence psychological safety, including:

- Individual and team factors
  - Number of years employed, and years employed in current team;
  - The extent of social affiliation within a team (which can increase fear of social stigma from reporting or challenging).
- Organisational attributes:
  - Hierarchy – the degree of authority and respect afforded to individuals based on their position.

- The extent to which professions are siloed.
- Hierarchical status - Higher grades such as supervisors have higher levels of psychological safety.
- Accountability culture
  - The extent to which individuals are accountable / have a sense of vulnerability if they share (for example) a need to learn.
- The organisational climate with respect to whether “speaking up” is an aspect of professional behaviour.
- Leadership, particularly:
  - Acknowledging fallibility and proactively seeking input.
  - Explicit display of openness, availability and accessibility;
  - Staff perceptions that leaders acknowledge their contribution;
  - Staff provided with opportunity to contribute ideas that may challenge norms and may be seen as risky.

#### Safety climate and safety culture research

As per Table 8 (page 41) and Table 9 (page 47), the research on safety climate and safety culture indicates the following contributing factors contribute to the level of psychological safety:

- Sense of trust that reports of incidents, near misses, errors or unsafe behaviours will be:
  - acted on effectively
  - treated fairly and
  - used as a learning opportunity;
- Perceived management commitment to safety;
- Satisfaction with safety;
- Supervisor competence, openness and supportive supervisory styles;
- Perceived risk of impact on one’s social status amongst peers;
- Practicality and effectiveness of reporting procedures.

Trust, cohesive and supportive relationships, openness, honest conversations, frequency of communication and fairness are cited (e.g. O’Dea and Flin, 2003) as attributes of a positive psychologically safety environment contributing to the *willingness* to report.

Management commitment to safety and their perceived propensity to act in a timely, fair and effective manner on reports is related to the perceived *value* of reporting. This includes whether management are perceived to use incidents as a learning opportunity for system improvement versus attributing error to the individual. These attributes are related to:

- The behaviour/leadership of supervisors and managers;
- The effectiveness of processes such as incident investigation and feedback



processes; and

- The general safety climate of an organisation.

Safety climate and psychological safety have a potentially reciprocal relationship, with one supporting the other.

The application of the safety culture research can be seen in authoritative guidance, such as WANO's (WANO 2013), which states the need for a safety conscious work environment (an environment for raising concerns) where personnel "...feel free to raise nuclear safety concerns without fear of retaliation, intimidation, harassment or discrimination.." (p32)

#### 4.2.3.3 Factors influencing learning from error

Table 10 (page 52) summarises selected studies on learning from error.

##### Learning culture

There is extensive advice (Table 11) on learning cultures, especially in the context of Prof Reason's research and guidance on Just Cultures. This research (e.g. Reason 1997, 1998) is not limited to responding to self-reports of error, including responding to reports of unsafe equipment, safety concerns and lessons learnt from incidents. The work focuses on the well reported topics of organisational learning and a learning culture, including:

- An organisational motivation to learn and a willingness change;
- A focus on identifying and resolving underlying causes of error.

##### Learning from error

Specific to learning from error, the research notes the importance of:

- An organisation viewing error as a latent hazard to be learnt from; and
- To collectively act to avoid the same errors in the future.

This has led to the concept of error management culture. Guchait et al (2014) define error management culture as:

"An error management culture involves organizational practices related to communicating about errors, sharing error knowledge, quickly detecting and handling errors, and helping in error situations."

Indeed, Krauss and Casey (2014) argue that:

"...error management climate creates an opportunity for aligning and improving both safety and operational performance".

They refer to error management climate as:

"...employees' perceptions of the extent to which the organization encourages communication about and management of errors and mistakes in the workplace."

Error is seen as a positive learning opportunity and a means by which teams and organisations can improve their performance. A collective response to error is thought to help move attention away from the individual and towards a shared sense of responsibility that in turn leads to a focus on the "system" related causes of error.

#### 4.2.4 Key findings for RQ1

The key findings on RQ1 are:

- There are many correlational studies that report a link between psychological safety and willingness to report one's errors and behaviours and thence resolution of underlying causes.
- The link to safety performance, such as incident rates, is less clear because:
  - Psychological safety may lead to an increased rate of reporting of near misses, adverse events and injuries.
  - The relationship between accident rates and safety climate may be mediated by hazards (level of risk), such that higher risk operations may be associated with stringer safety climates.
- There is evidence indicating a range of factors influence psychological safety including:
  - Individual and team factors;
  - Organisational factors such as extent of hierarchy;
  - Inclusive, accessible, facilitative leadership;
  - The extent to which individuals have a sense of vulnerability if they report an error.
  - Sense of trust that reports of incidents, near misses, errors or unsafe behaviours will be acted on effectively and used as a learning opportunity.
- The ability to learn from error is reported to be related to:
  - Error being seen as a learning opportunity and a collective responsibility.
  - A learning culture, such as questioning attitude and openness to change.

### 4.3 RQ 2: Does building psychological safety improve HSE?

#### 4.3.1 Introduction

RQ2: Is there evidence that building psychological safety results in an improved HSE Performance?

The core notion is that building psychological safety leads to a higher rate of reporting of error and unsafe behaviours, thereby enabling learning from error and preventing incidents. The research summarised for RQ1 indicates that there is evidence of a link between the level of psychological safety and reporting.

This research question asks for evidence of the outcome of psychological safety **interventions**, such as team building exercises, on HSE performance. The third RQ asks about the relative effectiveness of alternative interventions. Ideally evidence would be available in the form of:

- Comparing measures of psychological safety and HSE performance before and after implementation of an intervention;
- Comparing HSE performance between matched organisations that have and have not implemented a psychological safety intervention.

#### 4.3.2 Key findings for RQ2

This review sought longitudinal evaluations with a robust before and after dataset, and evidence of whether any effects were sustained.

As noted for RQ3 (see Table 13), there is:

- Limited empirical evidence on the effectiveness of psychological safety and Just Culture *interventions*, in part due to the limited number of evaluations.
- Variable results from interventions aimed at encouraging reporting have contributed to improved rates of reporting and improved safety performance, with some reporting improvements and some not reporting improvements in performance.

### 4.4 RQ 3: What interventions work?

#### 4.4.1 Introduction

RQ3: What interventions in the industry have proven to be effective in increasing Psychological Safety resulting in an increased HSE performance and what interventions have proven to be ineffective?

This question can be split into two parts, firstly how can psychological safety be developed (Table 12, page 56) and then whether there is evidence of how each type of intervention improves HSE performance (Table 13, page 59).

#### 4.4.2 Which interventions increase psychological safety?

There is a substantial body of guidance (Table 11, page 55) on how to increase psychological safety. Some of this comprises 'opinion pieces' rather than empirical research. There are fewer empirical studies that evaluate the impact of interventions on psychological safety and thence HSE performance. Key findings from empirical research are noted in Table 12.

##### 4.4.2.1 Psychological safety research

The most directly relevant work remains that completed by Amy Edmondson specifically on psychological safety of reporting one's own error. It is noted that reporting one's own errors of commission is a greater challenge than reporting unsafe equipment due to the fear of reprisal (Edmondson 1996), as are social barriers in speaking up about colleague's behaviour (Martinez et al 2015). This is said to lead to the need for some specific practices for supporting reporting of one's error.

##### 4.4.2.2 Psychological safety in healthcare

There is a series of healthcare programs in US, Canada, Scandinavia and the UK aimed specifically at encouraging reporting of error and learning from error, such as US Joint Commission healthcare accreditation organisation's guidance (2017).

The research suggest key points are:

- Psychological safety does not necessarily emerge as a product of a positive safety climate;
- Interventions need to overcome hierarchical barriers and fears about peer group (social) or organisational reactions by:

- Team building (developing trusting interpersonal relationships);
  - Having (inclusive) leaders and role models facilitating learning through adoption of a set of supportive behaviours, accessibility, neutral language and positive reinforcement of reporting;
  - Generating a sense that error is a shared learning opportunity and a collective responsibility aimed at performance improvement;
  - Demonstrating the value of speaking up by acting effectively on feedback and reporting actions back to people, Holmstrom (2017).
- Interventions can include tools to support analysis of causes of error and behaviours in a way that supports openness and learning, such as incident decision trees.

Thus, the guidance focuses on:

- Building trust and teamwork amongst peers and between staff and management;
- Supportive managerial and organisational processes and behaviours.

#### 4.4.2.3 Just culture research

The research into Just Culture discusses how to develop the elements of Just culture, reporting culture, learning and flexible culture, which are analogous to the concepts of psychological safety.

There has been widespread adoption of Just Culture in US healthcare and the aviation sector. For example, Edwards (2018) reports that there has been widespread adoption of the Just Culture model in US hospitals, reported as 79% of acute hospitals and from another study 70% of Pennsylvania hospitals in 2008.

There have been some evaluations of these initiatives. The key points are noted in Table 11.

The evidence regarding the success of Just Culture interventions is inconsistent. For example, Edwards (2018) reports mixed results from the widespread adoption of Just Culture in US hospitals, with:

- Evidence of an improvement in clinical peer review; but
- No significant evidence of an impact on event reporting or people's fears about reporting.

The research indicates that, in practice:

- The success of Just Culture is, in part, a product of the extent to which an organisation embeds the principles and practices through training and education of Directors, managers and staff.
- The effectiveness of arrangements for reporting, analysis and feedback of actions.
- Whether staff feel they can more easily resolve an error locally than report it, and whether reporting a locally resolved error has a purpose.

There is a series of studies from the aviation sector. A key finding relates to the treatment of reports. Harper & Helmreich (2005) report that the US Federal Aviation Administration (FAA) granted pilots "immunity" from punishment for voluntary reports of error, contributing receiving more than 30,000 reports per year. The healthcare research

cites ongoing fears of reporting with a suggestion that the remaining fear of adverse consequences (no granting of 'immunity') curtails the impact of Just Culture initiatives. This does raise the question of how effective Just Culture interventions are without the granting of 'immunity'.

In addition, Edwards (2018) discussion casts doubt on the practical application of a Just Culture algorithm for evaluating 'blame worthy' vs 'blameless' acts (i.e. does it lead to blame) and whether the Just Culture model takes sufficient account of the need for trust and the factors influencing organisational learning.

This and other research cited in Table 13 suggest that the specific means by which a Just Culture is sought are important, including:

- The extent to which personnel at all levels are educated in human fallibility, causes of error and the need to identify and resolve underlying causes of error;
- The level of openness;
- The practical ease of reporting;
- The level of staff confidence in being able to report without fear – influenced by the means of reporting, team and organisational climate and level of 'immunity' or anonymity;
- The extent to which reporting is positively encouraged and supported, such as by recognition of people who report and demonstrations of management commitment, such as regular safety briefings and opening all meetings with an open discussion of safety issues;
- The validity of tools (specifically the 1997 version of the Just Culture culpability decision tree, see Reason 1997) for analysing error and whether they effectively ascertain underlying causes or inadvertently lead to blaming individuals;
- The level of confidence that effective action will be taken in response to reports.

Anonymity is particularly important where there is a fear of adverse individual consequences for reporting error.

#### 4.4.3 Key findings for RQ3

The key findings for RQ4 are:

- There are limited and inconsistent results on which interventions are effective.
- The evidence indicates the following aspects of interventions are important:
  - Overcoming hierarchical barriers and fears about peer group reactions or adverse consequences;
  - Having effective tools and policies to support analysis of causes of error and behaviours in a way that supports openness and learning.

The research suggests that psychological safety does not necessarily emerge as a product of a positive safety climate. Specific interventions are needed.

## 5 CONCLUSIONS AND RESEARCH GAPS

### 5.1 Overall conclusions

#### 5.1.1 Correlation with HSE performance

Correlational studies report a strong link between psychological safety and willingness to report one's errors and behaviours and thence resolution of underlying causes. The link to HSE performance, such as incident rates, is less clear, possibly because psychological safety may lead to an increased rate of reporting of near misses, adverse events and injuries.

#### 5.1.2 Factors influencing psychological safety

Studies indicate the following factors influence psychological safety:

- a) Individual and team factors such as duration of employment and team affiliations.
- b) Organisational factors such as extent of hierarchy, professional siloes, and role of hierarchical status.
- c) Inclusive, accessible, facilitative leadership (to overcome individual, team and organisational barriers).
- d) The extent to which individuals have a sense of vulnerability if they report an error.
- e) Sense of trust that reports of incidents, near misses, errors or unsafe behaviours will be:
  - Acted on effectively;
  - Treated fairly; and
  - Used as a learning opportunity.

The confidence in effective action is in turn influenced by perception of organisational commitment to safety and past responses to reported errors or unsafe behaviour.

The research does not provide a strong basis on which to rank these factors. There is some evidence that:

- A sense of vulnerability if a person reports an error may mediate the impact of interventions such as facilitative leadership and reporting schemes; and
- A sense of trust and facilitative leadership may overcome hierarchical barriers to speaking up.

Incentive schemes linked to HSE performance, punitive reactions to error and a focus on individual responsibility may reduce psychological safety.

#### 5.1.3 Learning from error

The ability to learn from error is reported to be related to:

- Error being seen by the organisation as a learning opportunity and a shared experience about what works and what does not work;
- Learning from error being seen to be a collective responsibility.

The research on Just culture also cites the facets of a learning culture, such as flexibility, a questioning attitude, chronic unease and openness to change.

#### 5.1.4 Effectiveness of interventions

There is a high level of guidance on how to increase the level of psychological safety and Just Culture. There is some, inconsistent, evidence that interventions can lead to higher levels of reporting of error and subsequent HSE improvement.

The research indicates that a multi-faceted approach is needed, including the following:

- Team building is required to develop trusting interpersonal relationships;
- Interventions need to overcome hierarchical barriers and fears about peer group reactions or adverse personal consequences, such as by inclusive leadership;
- Personnel at all levels in an organisation need to understand human fallibility, the causes of error and unsafe behaviour, the role of error reporting and for this to be seen as a part of performance improvement;
- Organisational level commitment to openness and acting on causes of error;
- Tools and policies to support analysis of causes of error and behaviours in a way that supports openness and learning.

The research suggests that psychological safety does not necessarily emerge as a product of a positive safety climate, especially as many models of safety climate do not specifically include psychological safety. Specific interventions are needed.

The healthcare research suggests that a fear of adverse organisational reactions to reports of error can undermine reporting behaviour even where Just Culture initiatives have been introduced, whilst the provision of 'immunity' in aviation may have overcome this fear to a greater extent.

## 5.2 Further research needs

Key areas for further research include:

- Benchmarking levels of psychological safety and associated levels of error self-reporting in the oil and gas industry and how/why this varies between teams, departments and organisations.

This review did not identify any published assessments of the current extent to which personnel in the oil and gas sector are willing or unwilling to report error nor of the effectiveness of organisational responses to self-reported error.

The added value of new interventions will depend in part on the baseline level of psychological safety. The absence of oil and gas data limits the ability to indicate a) the need for interventions aimed at increasing psychological safety or b) how psychological safety varies across the sector (and hence where further work would offer best value).

- Evaluations of the effectiveness of interventions in increasing psychological safety and HSE performance.

There are few, if any, real world evaluations of the effectiveness of interventions aimed at increasing psychological safety and HSE performance in the oil and gas sector. Such evaluations should ideally include before and after longitudinal evaluations, preferably with control groups, and use a combination of measures covering psychological safety, reporting behaviour and improvements in safety from learning.



- Measures of psychological safety/ Just culture

Whilst this review did not assess measures, it is suggested that the extent to which assessment tools, such as safety climate questionnaires, include psychological safety/ Just culture and/or the need to adopt discrete psychological safety/ Just culture measures could be further researched. Whilst some measures have been developed (for example Petschonek et al (2013) for a measure of Just Culture, Bitar et al (2018) for measures of trust and leadership, and elements of the Agency for Healthcare Research and Quality 'Hospital Survey on Patient Safety Culture' for psychological safety), their application and validation in the context of oil and gas or other high hazard operations could be further researched.

It may be noted that not all elements of BP's Trust index could be validated and the Leadership Expectation question set (including speaking out) did not correlate with outcomes. This indicates there is a need for further research into the measures.

- Guidance on psychological safety

Whilst there are many guides on psychological safety, these are not specific to oil and gas HSE performance.

### 5.3 Implications for practice

A summary of good practice for building psychological safety and learning from error is given below.

#### Interactive education

A re-orientation and hearts and mind forms of engagement and training at all organisational levels on:

- Human fallibility, the causes of error and unsafe behaviour;
- Why people may fear reporting errors and behaviours;
- The value of incident and error reporting;
- How reducing error and improving safety culture aids safety performance.

This should aim to achieve:

- A common recognition and acceptance throughout the organisation of the value of reporting error and unsafe behaviours in respect of improving performance.
- Recognition that employees may fear reporting/speaking up and that specific steps must be taken to facilitate reporting and learning.

#### Team building and trust building behavioural interventions

This may include:

- Development of inclusive leadership skills through non-technical skills training specific to creation of psychological safety, including:
  - Inclusive leadership and supportive facilitation of employee engagement
  - Accessible, respectful, collegiate, open, neutral, positive language etc).

This should aim to achieve:



- Trust exists between peers, between professions and between employees and managers;
- Teamwork with high quality interpersonal relationships;

### Supportive organisational environment

A supportive environment should be created, such as by:

- Non-punitive approach to reporting of error and unsafe behaviour;
- Positive response to reporting of error;
- Demonstration of management commitment to learning from error and open discussion;
- Learning performed as a collective exercise;
- Championing and rewarding (recognition) people who report errors and unsafe behaviours;
- Reporting and learning from error held up to be an aspect of professional behaviour and collective performance improvement.

This may include:

- Aforementioned leadership skills;
- Adoption of policies and procedures, such as regarding response to error, and behavioural codes;
- Implementing processes for reporting, assessing, learning from, feeding back and responding to error;
- Communication and engagement methods for showing organisational commitment, e.g. open discussion sessions at meetings, and reinforcement of reporting behaviours, e.g. schemes for recognising reporting behaviour.

### Demonstrating value of reporting and speaking up by

The value of reporting and evidence of management commitment should be reinforced

- Timely and effective responses;
- Feedback on actions taken.

### Learning from error

The following attributes are cited at both the team and at the organisational level:

- Learning and improvement are objectives;
- Error is seen to be an opportunity to learn and a means of improving performance;
- Learning is a shared and collective responsibility;
- Awareness and acceptance of a systems approach to causation of error and unsafe behaviour and need to address underpinning causes;
- Feedback to personnel on actions taken;
- Openness to change.

These values should be developed through the education training and inclusive

leadership styles mentioned above.

#### Tracking success

Tools such as surveys of psychological safety, employee perceptions of the risk of reporting and reporting behaviour may be used to track and measure success of interventions.

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### A1.1 Topic 1

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## A2 Appendix 2: Evidence tables

### A2.1 RQ1a: Link between psychological safety and HSE performance

Table 8: Research findings on correlation between Psychological Safety and HSE Performance

Study reference	Key findings
Healthcare research	
Edmondson (1996)	<p>In a review of eight hospital unit teams, potentially harmful drug-related errors were identified over a 6-month period alongside a confidential system to allow unit members to report incidents. It was found that detected error rates were strongly associated with high scores on:</p> <ul style="list-style-type: none"> <li>• Nurse manager direction setting (<math>r = .74</math>),</li> <li>• Coaching (<math>r = .74</math>),</li> <li>• Perceived unit performance outcomes (<math>r = .76</math>), and</li> <li>• Quality of unit relationships (<math>r = .74</math>).</li> </ul> <p>It was concluded that in certain units, a climate of openness facilitated discussion of error and thence detected error rates. Detected error rates then were found to be correlated with willingness to report errors (<math>r = .55</math>), and perceptions that making a mistake in their unit will not be held against them (<math>r = .44</math>).</p>
Gilmartin et al (2018)	<p>Gilmartin et al (2018) assessed the relationship between psychological safety and reported adherence to a checklist in a nursing task (inserting 'lines' into patients), such as hand hygiene and use of sterile gloves. Data was acquired from 76 medical units of over 1900 nurses. They found very high levels of checklist adherence (0.14% to 0.49% non-adherence) and no relationship between checklist adherence and psychological safety. It was concluded that the very high levels of adherence made it difficult to detect the impact of psychological safety.</p>
Appelbaum et al (2016)	<p>Appelbaum et al (2016) reported a study of 106 physicians finding that:</p> <ul style="list-style-type: none"> <li>• Leader inclusiveness (<math>\beta = 0.51</math>) and perceived power distance (<math>\beta = -0.26</math>) predicted psychological safety;</li> </ul>

Study reference	Key findings
	<ul style="list-style-type: none"> <li>Psychological safety predicted intention to report adverse events (<math>\beta = 0.34</math>).</li> </ul>
Landgren et al (2016)	Landgren et al (2016) in a survey of 50 paediatric physicians found that personal safety concerns, efficacy and contextual factors were the main barriers to 'speaking up' about (for example) adverse events.
Leroy et al (2012)	Leroy et al (2012) in a study of nurses found that psychological safety was positively reported to reported treatment errors ( $\beta = 0.28$ ).
Safety climate and safety culture research	
Carmeli and Gittell (2009)	Carmeli and Gittell found that psychological safety is significantly related to learning from failures and psychological safety is significantly associated with high-quality relationships in a cross-sectional self-reported study. Due to the nature of the design a strong causal relationship can't be interpreted however the effect psychological safety has on learning from failures would support the Safety Culture model which has positive association with safety performance.
Christian et al (2009)	<p>Christian et al performed a statistical meta analysis of 90 peer reviewed research into the relationship between elements of safety climate with safety behaviours and safety outcomes such as accident rates, covering a wide range of manufacturing, chemical oil and gas, construction and other sectors. They found:</p> <ul style="list-style-type: none"> <li>Safety knowledge (0.61) and safety motivation (0.57) were strongly correlated (on a scale of 0 to 1) to safety performance behaviours, followed by group safety climate (0.51) and psychological safety (0.49, a moderate correlation).</li> <li>Group safety climate (-0.39) had the relatively strongest association with accidents and injuries.</li> <li>Psychological safety had a very low correlation with safety outcomes of -0.14.</li> </ul> <p>All correlations of safety climate factors with accidents and injuries were low or very low. Psychological safety was a strong moderating factor in safety climate but weak factor in accident rates.</p>
Triplett and Loh (2017)	Triplett and Loh (2017) found that trust can be used as a moderator for psychological safety but also cite psychological safety as having an association with behaviours with that facilitate a safe environment.
Mearns and Flynn (2001)	Mearns and Flynn (2001) compared safety climate across nine North Sea oil and gas installations to self reported accident rates. This included a sub-element of "willingness to report accidents". They report:



Study reference	Key findings
	<ul style="list-style-type: none"> <li>• The willingness to report accidents was a significant predictor (0.62) of personal accident involvement, along with management commitment to safety (0.71).</li> <li>• Willingness to report accidents was strongly negatively correlated (-0.8) with unsafe behaviours, i.e. fewer unsafe behaviours amongst personnel who are more willing to report accidents.</li> <li>• Willingness to report accidents was associated with perceived management commitment to safety (0.74), satisfaction with safety activities (0.64) and perceived supervisor competence (0.51).</li> </ul>
Cox and Cheyne (2000)	<p>In a factor and reliability analysis of 221 offshore worker safety climate questionnaires, they reported on ‘Supportive environment’ as one of nine factors. ‘Supportive environment’ was eight out of the nine elements in respect of reliability (using Cronbach alpha measure of 0.6 which is a ‘questionable’ level of reliability). The factor loadings for the six sub-questions ranged from 0.639 for “I am strongly encouraged to report unsafe conditions” to 0.323 for “Co-workers often give tips to each other on how to work safely”. The study did not test the association with HSE outcomes.</p>
Bhattacharya (2015)	<p>In a study of 337 Indian ship officers, it was found that “Just culture – No blame” was one of seven safety culture factors related to perceived levels of safety, with the third highest factor loading of 0.863.</p>
Conchie & Donald (2006)	<p>In a study of 203 offshore gas workers it was found that a measure of ‘trust’ accounted for 7% of the variance in accidents and incidents. Trust in management was the main factor in the all industry measure, whilst trust in workmates was the main local factor. They assessed ‘trust’ as a general concept and not just as an aspect of psychological safety.</p>
Hofmann and Stetzer (1998)	<p>In a study of 1420 utility company outside workers, they found that ‘safety communication’ including whether people felt comfortable discussing safety issues and free to discuss safety with their supervisors mediated (<math>r = 0.4</math>, moderate strength) the relationship between safety climate and the likelihood that it was accepted that workers contributed to accidents. This was cited to be an important factor in enabling root cause analysis and learning from negative events.</p>
Jones (2014)	<p>Jones (2014) as part of a review of meta-analysis noted that what they termed ‘upward communication’ was related to safety performance, such as reporting safety issues and safety climate, by facilitating information sharing and feedback. The relationship between communication and safety outcomes was reported to be mediated by other, unstated, factors.</p> <p>They also found that what they termed upward communication had a strong correlation with safety climate (0.77) and was the largest (37%) explanatory factor of safety climate in a survey of 255 construction employees in a high hazard sector.</p>

Study reference	Key findings
Probst and Estrada (2010)	Probst and Estrada (2010) from a survey of 425 employees in 5 industries found that under reporting of accidents was associated with safety climate and supervisory practices. Factors included perceptions of whether “anything would be done to fix the problem”, whether it was considered important, whether it would make work unpleasant, not wanting to break an accident free record or safety scorecard.
<b>Just culture models</b>	
SKYbrary, Human Error in Aviation and Legal Process (2018)	“There is a need to learn from accidents through safety investigations so as to take appropriate action to prevent the repetition of such events. In addition, it is important that even apparently minor occurrences are investigated, in order to prevent catalysts for major accidents... it is therefore necessary important that an environment exists where occurrences are reported, the necessary processes are in place for investigation and for the development of necessary preventative actions such as re-training, improved supervision, etc.”
Coan and Kanki (1999)	Coan and Kanki look into how a communicational approach contributes to Safety Culture and the purpose and impact of blame in high-risk human systems. They explore blame as an indicator of systemic issues within and across work domains. Their findings show a variation in reports blaming themselves and reports blaming others which Coan and Kanki attribute to constraints implied in regulations, policies or even organisational norms i.e. “the influence of the semiotic and broader cultural levels on the linguistic production of narratives”.
Reason (2000)	“Effective risk management depends crucially on establishing a reporting culture. Without a detailed analysis of mishaps, incidents, near misses, and “free lessons,” we have no way of uncovering recurrent error traps or of knowing where the “edge” is until we fall over it. The complete absence of such a reporting culture within the Soviet Union contributed crucially to the Chernobyl disaster. Trust is a key element of a reporting culture and this, in turn, requires the existence of a just culture—one possessing a collective understanding of where the line should be drawn between blameless and blameworthy actions.”
Tuyl (2016)	When safety performance metrics are valued over human safety, attitude formation in relation to reporting values and practices are influenced, leading to non-reporting practices amongst some members of the employee team/group. A culture of non-report presents itself as a subculture of safety culture when there is a deficiency of humanistic components and the human side of safety (elements that do not fit within the traditional physical safety model [i.e. focusing solely on preventing injuries versus supporting the overall wellbeing of personnel]).

Study reference	Key findings
Operating discipline	
Bitar et al (2018)	<p>Bitar et al (2018) reported that BP developed a corporate “trust index” of four questions (covering trust in the company and management, pride in working for the company, leader listening to all perspectives) and a measure of Leadership expectations (which included being able to speak out without fear) as part of a study on operating discipline. Operating discipline is a wider concept than psychological safety, including for example the principle of procedural compliance.</p> <p>A survey was completed of 3514 BP personnel with responses regressed against a battery of personal safety, process safety and operational measures. It found:</p> <ul style="list-style-type: none"> <li>• The measures of Trust had a statistically significant if low association with Recordable Injury Frequency (<math>R^2 = 0.23</math>) and Loss of primary containment (<math>R^2 = 0.24</math>), which would be classed as moderately powerful correlations.</li> <li>• A measure of communication of Operating Discipline also had a statistically significant if low association with Non-control of work near miss frequency (<math>R^2 = 0.1</math>) and control of work near miss frequency (<math>R^2 = 0.18</math>).</li> </ul> <p>The correlation of Trust and Leadership Expectations with near miss frequency were not significant and so were not reported. There was no discussion of the lack of influence of Leadership Expectations (including of the speaking out question) on outcomes.</p>
Error management climate	
Casey and Krauss (2013)	<p>Casey and Krauss (2013) found that from a mining study:</p> <ul style="list-style-type: none"> <li>• Organizational error management climate predicted co-worker and supervisor safety support, and safety behaviour.</li> <li>• Co-worker safety support and safety communication exhibited particularly strong relationships with safety performance as compared to the influence of supervisor safety support and upwards safety communication.</li> </ul>
Cigularov et al (2010)	<p>From a study of 235 union construction workers employed by 15 US contractors found significant main effects for safety communication and error management climate on safety behaviours and pain.</p>
Fruhen and Keith (2014)	<p>Fruhen and Keith (2014) found from a study of 30 fire fighting teams (N = 199) significant effects of error management culture, error aversion culture and task cohesion on accident occurrence.</p>

Study reference	Key findings
Gold et al (2013)	Gold et al (2013) stated that an error-management climate is "high" when errors are accepted as part of everyday life to be learned from and not repeated. They performed an assessment of error climate in a professional services firm, confirming a relationship between error-management climate and the reporting of error. They also noted that this relationship was stronger for conceptual errors than calculational errors. I.e. people are more likely to feel able to report calculation errors than conceptual errors.
Hodges (2011)	Hodges (2011) performed a survey of error climate (employees shared perceptions of organisational practices regarding errors) amongst s189 Royal New Zealand Air Force aviation maintenance personnel. It was reported that higher levels of error management culture were associated with better supervision and psychological health and lower levels of error aversion, violations and errors.

## A2.2 RQ1b: factors influencing psychological safety

Table 9: Factors influencing level of psychological safety

Study reference	Key findings
Healthcare	
Martinez et al (2015)	<p>In a study of six medical centres, it was found that:</p> <ul style="list-style-type: none"> <li>• A measure of “speaking up climate for professionalism” had a low correlation with self reported speaking up about patient safety breaches.</li> <li>• Safety climate was not related to self reported speaking up about patient safety breaches or unprofessional behaviour.</li> </ul> <p>The majority of respondents had low scores on their willingness to speak up.</p>
Edmondson (1996)	<p>Edmondson (1996) in the review of the level of reporting of hospital drug errors identified differences in nurse-physician relationships, and nurse managers behavioural styles as key factors, particularly:</p> <ul style="list-style-type: none"> <li>• Unit climate (blame oriented vs. learning oriented),</li> <li>• Openness,</li> <li>• Nurse manager attire,</li> <li>• Nurses’ trust in their nurse manager, and</li> <li>• Perceived supportiveness of both nurse manager and peers.</li> </ul> <p>Leadership behaviour (a climate of fear or of openness) was reported to influence the way errors are handled, which in turn influences staff perceptions of the consequence of a mistake and their willingness to report mistakes.</p>
Edmondson et al (2016)	<p>A comparison of healthcare and educational organisation (Edmondson et al 2016) found that a range of factors influence psychological safety, including:</p> <ul style="list-style-type: none"> <li>• Hierarchy – the degree of authority and respect afforded to individuals based on their position.</li> </ul>

Study reference	Key findings
	<p>They also mention the extent to which professions are siloed.</p> <ul style="list-style-type: none"> <li>• Hierarchical status</li> </ul> <p>Persons with greater status (i.e. higher grades such as supervisors) had higher levels of psychological safety.</p> <ul style="list-style-type: none"> <li>• Accountability culture – the extent to which individuals are accountable / have a sense of vulnerability if they share (for example) a need to learn.</li> </ul> <p>Workgroup factors accounted for 66% of the variance in psychological safety across workplaces.</p> <ul style="list-style-type: none"> <li>• Leadership</li> </ul> <p>Leadership was a key factor with a correlation of 0.74 with psychological safety, particularly:</p> <ul style="list-style-type: none"> <li>○ Acknowledging fallibility and proactively seeking input.</li> <li>○ Explicit display of openness, availability and accessibility;</li> <li>○ Staff perceptions that leaders acknowledge their contribution;</li> <li>○ Staff provided with opportunity to contribute ideas that may challenge norms and may be seen as risky.</li> </ul> <p>They did not find a relationship between the type of work people did and their psychological safety.</p>
Nembhard and Edmondson (2006)	<p>Nembhard and Edmondson (2006) in a study of 23 neonatal units found that:</p> <ul style="list-style-type: none"> <li>• Psychological safety was correlated to: <ul style="list-style-type: none"> <li>• Number of years employed and years employed at the unit;</li> <li>• Professional status.</li> </ul> </li> <li>• Gender and hours worked was not related to psychological safety;</li> </ul> <p>Psychological safety varied across teams, with professional status playing a greater and lesser roles in different teams. The role of professional status was mediated by leadership inclusiveness behaviour (<math>R^2</math> of 0.55).</p>

Study reference	Key findings
Rahmati and Poormirzaei (2018)	Rahmati and Poormirzaei (2018) found from a survey of 170 nurses that psychological safety had a low correlation (from a multiple regression) to self-forgiveness ( $\beta= 0.3$ ).
Other sectors	
Tuyl (2016)	<p>Tuyl (2016) conducted in depth interviews with 19 oil and gas personnel regarding reporting and an extensive literature review. Five factors were cited including:</p> <ul style="list-style-type: none"> <li>• Workplace pressures, such as project performance;</li> <li>• Reporting processes and procedures, such as amount of paperwork, timeliness of feedback, whether feedback was framed in a positive manner, depth of feedback, extent of sharing of feedback, focus on work practices;</li> <li>• Trust between workers and supervisors/managers especially concerning use of reports to prevent repetition rather than punish the individual, existence of a professional and open relationship, approachable supervisors/managers, valued employee engagement, encouragement of reporting, fair investigation, transparent feedback and enacted values match espoused values;</li> <li>• Fear of repercussions versus using incidents to help people learn;</li> <li>• Workplace environment impact on self image preservation and social perceptions, such as fear of ostracism.</li> </ul> <p>Tuyl also cites research that reports the payment of safety performance bonuses encourage workers to not report injuries out of fear of loss of their bonus and impact on their peer's view of them.</p>
Gad et al (2002)	<p>Gad et al (2002) in their review cite research that notes:</p> <ul style="list-style-type: none"> <li>• Reporting behaviour is linked to the perception of whether managers would take notice;</li> <li>• Management reaction to a report may be a measure of perceived management commitment to safety, which again influences reporting behaviour.</li> </ul>
Mitchell (2008)	In a study of 179 transport maintenance business, it was concluded that employee willingness to report near misses was related to their perceptions of whether it would be addressed effectively and whether they trusted that reporting would make a difference

Study reference	Key findings
	and be treated fairly.
SKYbrary 2018	Lack of trust of employees prevents the management from being properly informed of the actual risks. Managers are then unable to make the right decisions to improve safety.
Air Safety Support International, (2014)	Punishing the workforce with fines or suspended licences can discourage front-line operators from reporting any kind of mistake, with a consequent reduction in safety information.
Ceri (2014)	<p>Ceri (2014) as part of a review of meta-analysis noted that:</p> <ul style="list-style-type: none"> <li>• “..management demonstrating a committed and non-punitive approach to safety management, promotes open communication and a free-flowing exchange of information...” (p56)</li> <li>• ‘Defensive communication’ where workers feel they must escape blame for fear of retribution or punishment tends to occur in a negative safety climate focused on blame.</li> </ul> <p>This was thought from the meta-analysis to be related to the relationship between employees and their leaders, perceived organisational support and safety climate. This was further supported from their own statistical analysis of a survey of high hazard construction workers.</p>
Rausch, Seifried, and Harteis (2017)	The individual disposition to openly discuss one’s own errors is related to the experience of positive states such as motivation and curiosity during an error situation.
Hofmann and Morgeson (1999)	Hofmann and Morgeson (1999) report that employees’ perceptions of organisational support, open two way and frequent communication (termed supportive supervision) were related to employee willingness to communicate on safety.
Beatrice (2011)	From a survey of 138 UK offshore oil and gas workers Beatrice noted frank and open safety meetings, management’s action to suggestions, clear and open communication as factors in employee engagement. Trust between management and employees was the most common barrier, especially the possibility of a negative reaction to safety related issues.



Study reference	Key findings
Transportation Research Board (2016)	<p>The extensive TRB (2016) reports summarises an extensive body of safety culture work and draws out the role of many factors, including:</p> <ul style="list-style-type: none"><li>• Creating a respectful work environment conducive to raising safety concerns without fear of punitive action (and avoiding a macho culture which can inhibit disclosure);</li><li>• Trust permeates the organisation with a focus on teamwork and collaboration, made possible by high quality relationships between staff and supervisors;</li><li>• An environment for raising concerns without fear of retaliation;</li><li>• An inquiring attitude that continuously considers potential error without hesitation.</li></ul>
Jeffe et al (2004)	<p>Jeffe et al (2004) in a study of error reporting in hospitals found, from focus groups, found that:</p> <ul style="list-style-type: none"><li>• There was uncertainty about reporting less serious errors or near misses.</li><li>• Nurses were more knowledgeable than physicians about how to report errors.</li><li>• All groups mentioned barriers including fear of reprisals, lack of confidentiality, time, and feedback after an error is reported.</li></ul>

## A2.3 RQ1c: Factors influencing learning from error

Table 10: Summary of evidence on learning from error

Reference	Summary
TRB (2016)	<p>TRB (2016) cite the following key points:</p> <ul style="list-style-type: none"> <li>• Cultivating a questioning attitude;</li> <li>• Seeking to distinguish between error and culpable acts;</li> <li>• Embracing learning;</li> <li>• Openness to change;</li> <li>• A chronic sense of unease and preoccupation with failure (mindfulness).</li> </ul>
Edmondson (1999)	<p>Error is seen as a learning opportunity and a shared experience about what works and what does not work. This contrasts with seeing error as an individual fault and not as a shared learning opportunity. This also relates to the idea of error being an opportunity for shared learning and that learning from error is a collective responsibility. Indeed, the ability to learn as a team reinforces the sense of psychological safety to speak up (Edmondson,1999).</p>
Tuyl (2016)	<p>Tuyl (2016) draws on the pathological to generative typology of organisations to characterise organisational response to incidents, including:</p> <ul style="list-style-type: none"> <li>• Suppression – punishing the person (typical of a pathological environment);</li> <li>• Encapsulation and local fixes – isolate the individual or address the one instance without assessing if it could occur elsewhere (typical of a bureaucratic environment);</li> <li>• Global and inquiry – acknowledge it may not be an isolated incident, conduct root cause analysis and attempt global fix (typical of generative environment).</li> </ul> <p>This is also reported by Tuyl (2016) to be related to whether management attribute error to the individual versus it being a reflection of the work environment.</p>

Reference	Summary
Tucker and Edmondson (2002)	<p>Tucker and Edmondson (2002) in a review of learning from failures by hospitals identify the following factors:</p> <ul style="list-style-type: none"> <li>• A focus on individual responsibility to solve problems as they arise- thereby encouraging independence, solving the immediate issues and not identifying issues with the system of work.</li> <li>• A focus on efficiency leaving little time for staff to explore and resolve underlying issues.</li> <li>• Empowerment (or abdication of managerial responsibility) leaving staff unsupported to resolve issues.</li> </ul> <p>These organisational behaviours are thought to influence the propensity to report error, the ability to talk about error and the effectiveness of response to error.</p>
Homsma et al (2007)	<p>In a study of the influence of error incident characteristics on organizational learning among operators in the chemical process industry Homsma et al (2007) found that the severity of consequences related positively to learning, wherein there is higher level of communication for errors with more severe consequences.</p>
Göktürk et al (2017)	<p>In a study of error management in Turkish university they found that organizational and national culture elements, particularly collectivism, high power distance and relatively low future orientation significantly interacted with error management practices. They report that error detection was slow and hindered because of negative emotional reactions to errors, lower reporting, restricted communication, potential face loss considerations and lack of feedback.</p>
Dyck (2000)	<p>Dyck (2000) argues from a review of previous psychological safety and high reliability organisation research and theories that:</p> <ul style="list-style-type: none"> <li>• Error prevention may prevent learning from error, and that error is required as a learning opportunity;</li> <li>• Training that involves making errors leads to higher standards of performance than error free training;</li> <li>• An error management approach may focus on preventing adverse consequences of error whilst permitting error to occur.</li> <li>• A positive error climate is required to allow people to report and learn from error. This includes: <ul style="list-style-type: none"> <li>○ “an orientation toward developing ability, taking failure as a challenge to be mastered, generating effective strategies and maintaining effective striving under failure” (p55)</li> <li>○ Error is anticipated and accepted.”..the organization accepts that it is sometimes necessary and useful to risk an error (p56)</li> <li>○ Error Aversion (or lack of it) where people are punished for error, causing people to hide errors that then accumulate</li> </ul> </li> </ul>

Reference	Summary
	over time. The impact of these attributes on company performance was validated in a study of a database management company.
Krauss and Casey (2014)	Krauss and Casey (2014) in a study of 700 oil and gas workers explored how error management climate related to safety communication, safety climate, and safety performance. They found that “perceptions of error management climate remain relatively low and weak.”

## A2.4 Summary of guidance on increasing psychological safety

Table 11: Guidance on developing a just culture

Element	Guidance
Just	A no blame culture is not feasible or desirable as a blanket amnesty on all unsafe acts would lack credibility in the eyes of employees and could be seen to oppose natural justice (SKYbrary, 2018). In order to prescribe the appropriate response distinguishing between reckless, deliberate, or unjustifiable risks and unintentional errors is a paramount feature of a Just Culture, this can be achieved through using James Reason's culpability model i.e. a flow chart based on questions assisting in assessing the degree of culpability following an investigation (Reason, 2004).
Informed	The organisation collects and analyses relevant data, and actively disseminates safety information (CAA, 2014). The informed culture is the safety system that gathers data from previous accidents and near misses and merges them with information from other hands-on measures (Beatrice, 2011; Reason, 1998). This creates an atmosphere of trust and can be achieved by enhancing communication and training initiatives and arrangements between parties relevant parties e.g. safety specialists, judiciary, law enforcement (Eurocontrol, 2014).
Reporting	Create an atmosphere that gives confidence to employees to report safety issues. This organisation should encourage, or even reward, people for providing safety-related information. SKYbrary (2018) states encouragement can come in the form of a published statement summarising the fundamental principles of a just culture that are applied at all levels of organisation.
Learning	Just Culture supports learning from unsafe acts in order to improve the level of safety awareness through the improved recognition of safety situations and helps to develop conscious articulation and sharing of safety information. A feature of this might be to abolish penalties and implement a debriefing process after any incidents to support and develop normalisation of incidents (Air Safety Support International, 2014)
Flexible	The organisation and the people in it are capable of adapting effectively to changing demands (CAA, 2018). As such they should aim to be able to reconfigure themselves to suit local circumstances (Reason, 2000).

Table 12: Guidance on increasing psychological safety

Study reference	Key findings
Psychological safety research	
Edmondson, 2004 Nembhard and Edmondson, 2006	<p>Inclusive, neutralising and facilitative engagement on error:</p> <ul style="list-style-type: none"> <li>• Avoiding threatening terms such as “errors” and “investigations” in favour of terms such as “accidents” and “analysis” (Edmondson, 2004);</li> <li>• Managers actively appreciating others’ contributions (Nembhard and Edmondson, 2006) by soliciting their input and cultivating a sense of inclusiveness by reducing the sense of status differences;</li> <li>• “Pardoning” employees who make and share unintentional mistakes (Edmondson, 1996);</li> <li>• An empowering leadership style that prompts employees to think, speak up and learn by doing.</li> <li>• Inviting input;</li> <li>• Answering challenges in a respectful way.</li> <li>• Leaders demonstrate fallibility by admitting mistakes.</li> </ul>
Schein (2010)	<p>Schein (2010) states that psychological safety is increased by:</p> <ul style="list-style-type: none"> <li>• A positive vision;</li> <li>• Formal training;</li> <li>• Learner involvement;</li> <li>• Positive role models;</li> <li>• Practice in environments where you can make errors;</li> <li>• Coaches and feedback;</li> <li>• Support groups where learning can be shared.</li> </ul>

Study reference	Key findings																				
Martinez et al (2014)	Martinez et al (2014) found from a survey of 884 medical students that training on how to respond to errors had the largest independent, positive effect on attitudes towards disclosing errors, along with positive role models.																				
Martinez et al (2015)	<p>Martinez et al (2015) cite other studies which mention:</p> <ul style="list-style-type: none"> <li>• Encouraging collective accountability for learning, including the link between speaking up, professionalism and safety;</li> <li>• Providing role models;</li> <li>• Reducing hierarchy in favour of teamwork and collective accountability for safety;</li> <li>• Demonstrating meaningful change following speaking up;</li> <li>• Non-punitive systems for collecting and tackling concerns about behaviour.</li> </ul> <p>These options are cited on the basis of correlational research rather than evaluation of interventions.</p>																				
Francis (2015)	<p>The UK “Freedom to Speak up” review of the UK National Health Service (Sir Robert Francis 2015) cited 20 principles aimed at enabling reporting of adverse events, concerns and error:</p> <table border="0" style="width: 100%;"> <tr> <td style="width: 50%;">Principle 1 – Culture of safety</td> <td style="width: 50%;">Principle 12 – Support to find alternative employment in the NHS</td> </tr> <tr> <td>Principle 2 – Culture of raising concerns</td> <td>Principle 13 – Transparency</td> </tr> <tr> <td>Principle 3 – Culture free from bullying</td> <td>Principle 14 – Accountability</td> </tr> <tr> <td>Principle 4 – Culture of visible leadership</td> <td>Principle 15 – External review</td> </tr> <tr> <td>Principle 5 – Culture of valuing staff</td> <td>Principle 16 – Coordinated Regulatory Action</td> </tr> <tr> <td>Principle 6 – Culture of reflective practice</td> <td>Principle 17 – Recognition of organisations</td> </tr> <tr> <td>Principle 7 – Raising and reporting concerns</td> <td>Principle 18 – Students and trainees</td> </tr> <tr> <td>Principle 8 – Investigations</td> <td>Principle 19 – Primary Care</td> </tr> <tr> <td>Principle 9 – Mediation and dispute resolution</td> <td>Principle 20 – Legal Protection should be enhanced</td> </tr> <tr> <td>Principle 10 – Training</td> <td></td> </tr> </table>	Principle 1 – Culture of safety	Principle 12 – Support to find alternative employment in the NHS	Principle 2 – Culture of raising concerns	Principle 13 – Transparency	Principle 3 – Culture free from bullying	Principle 14 – Accountability	Principle 4 – Culture of visible leadership	Principle 15 – External review	Principle 5 – Culture of valuing staff	Principle 16 – Coordinated Regulatory Action	Principle 6 – Culture of reflective practice	Principle 17 – Recognition of organisations	Principle 7 – Raising and reporting concerns	Principle 18 – Students and trainees	Principle 8 – Investigations	Principle 19 – Primary Care	Principle 9 – Mediation and dispute resolution	Principle 20 – Legal Protection should be enhanced	Principle 10 – Training	
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Study reference	Key findings
	Principle 11 – Support
Boucher et al (2018)	<p>In an opinion piece Boucher et al (2018) cite the following methods for creating an environment of psychological safety, in the context of pharmacy safety and an Ontario College of Pharmacists Medication Safety Program:</p> <ul style="list-style-type: none"> <li>• Promotion of trusting interpersonal relationships and social support to encourage team collaboration and the support of peers willing to provide constructive feedback and report incidents without fear of repercussions;</li> <li>• Supportive and clarifying management processes, such as inclusiveness, trustworthiness, openness and behavioural integrity – to foster team learning and engagement in reduction of errors;</li> </ul> <p>Supportive organisational practices, such as small team discussions about concerns and incidents.</p>
SKYbrary	<p>The SKYbrary provides extensive guidance on reporting schemes, including:</p> <ul style="list-style-type: none"> <li>• Error reports should be used to find the root causes of the errors, not to establish blame or liability.</li> <li>• Personnel involved in reporting should be given feedback of the results of the error analysis.</li> <li>• The use of a non-punitive approach to reporting is recommended to encourage personnel to report errors.</li> <li>• The mechanism for reporting errors should be made straightforward and easily accessible at all organizational levels.</li> <li>• The electronic or hard copy reporting forms should be made unambiguous and easy to use.</li> </ul>



## A2.5 RQ2 and 3: Evaluation of effectiveness of interventions

Table 13: Impact of psychological safety and Just Culture interventions

Reference	Summary
<b>Psychological safety</b>	
Ginsberg and Bain (2016)	Ginsberg and Bain (2016) evaluated an intervention which included a role-playing simulation workshop, teamwork climate data feedback and facilitated discussion with the interprofessional team (discussion briefings), and other department-led initiatives to promote trust, teamwork, and speaking up among interprofessional team members.  They compared before and after measures of teamwork climate in a unit with the intervention against a unit without the intervention. Teamwork climate was statistically significantly higher (10% higher) afterwards in the intervention unit.
Sayre et al (2012)	Sayre et al (2012) evaluated the impact on 'speaking up' of an educational intervention which used scenarios, personal reflection, and peer support in small groups of registered nurses. Results showed a statistically significant difference in speaking-up behaviours and scores in the intervention group.
Evans et al (2007)	Evans et al (2007) assessed the effectiveness of an intense education intervention with a range of reporting options and changes in report management and enhanced feedback, on incident anonymous reporting rates in Australian hospitals (10 intervention and 10 non-participating hospitals). The scheme aimed to reduce fear of reporting, overcome barriers to reporting and increase feedback. They reported for inpatient areas significant increases in the number of incident reports, a wider range of reports and fuller reports, compared to non-participating hospital units. Intensive care units did not report increases. The increases in reporting were large in absolute terms, such as doubling. Reporting amongst doctors rose more than nurses.
Elstegeest (2016)	Elstegeest (2016) had a police force fill a survey before and after a team-building intervention to examine the change it would have on psychological safety. The results indicated that participants who initially experienced low psychological safety benefited from improved psychological safety after the intervention. Those who experienced high psychological safety initially did not benefit from the intervention. It should also be noted that this was a cross-section study without a control group therefore no causal inferences can be made.
Herrmann (2018)	The unnamed oil and gas company Herrmann worked with transformed communication styles within teams, had leaders open up about personal histories to build trust, and employed the Marshall Goldsmith exercise to identify and adapt to team members' work styles. The company also produced a set of guidelines for handling team disagreements. The result was successful engagement in organisational change, and more than half of the leaders reporting a positive impact on relationship with peers

Reference	Summary
	and stakeholders. It should be noted that this was not a peer reviewed empirical study but a case study, so no causal inferences can be made.
BP U.S. Refineries Independent Safety Review (2007)	<p>Interventions that have proven to be <u>ineffective</u> at improving psychological safety include two case studies from The BP U.S. Refineries Independent Safety Review (2007).</p> <ul style="list-style-type: none"> <li>• “Tr@ction” is a computer-based system through which incident, near misses, or other safety concerns could be reported, tracked, and closed out. It was concluded to be ineffective due to lack of consistent use across sites, lack of accessibility, user-unfriendliness, and irrelevant or superfluous data logged in.</li> <li>• “Open talk” is a confidential hot line maintained by an independent third party. It anonymously raised any type of complaint or concern but a lack of communication about it resulted in employees not having heard of it. There was also scepticism regarding it’s anonymity from those who had heard of it. Some also believed there would be repercussions if incidents or accidents were reported.</li> </ul>
Healthcare programs	
Verbakel et al (2015)	<p>Verbakel et al (2015) evaluated the impact on reported incidents of two safety culture interventions on event reporting in 30 medical General Practices. One intervention included reviewing results of safety culture questionnaire. The other involved an educational workshop on patient safety, Human Factors and safety culture led by an independent GP. It was found that:</p> <ul style="list-style-type: none"> <li>• The number of incidents increased in both intervention groups however the ‘workshop’ intervention reported a far greater increase in reporting than a ‘questionnaire’ group.</li> <li>• There were no statistically significant differences in staff perception of patient safety culture at follow-up between the two intervention and one control group.</li> </ul> <p>Some GP joined an accreditation scheme which requires event reporting during the study. The study found no increase in reporting associated with joining the accreditation scheme.</p>
Joint Commission (2017)	<p>The US healthcare Joint Commission (2017) report (without citing supporting evidence) the following methods are effective in improving safety performance:</p> <ul style="list-style-type: none"> <li>• Creating codes of professionalism to address unprofessional behaviour, educating staff in why and how to report unprofessional behaviour, leaders acting on reports. This is reported to have led to improved patient safety culture and</li> </ul>

Reference	Summary
	<p>higher event reporting.</p> <ul style="list-style-type: none"> <li>• Recognising teams who report adverse events and close calls and providing feedback on reports, such as by feedback in 'unit huddles' and visual management boards.</li> <li>• Teams developing action plans using results from safety attitude questionnaires.</li> <li>• Joint teams tasked with identifying unsafe conditions and finding reliable solutions.</li> <li>• Using incident decision trees to assess errors without fear of consequences.</li> <li>• Debriefs to learn from error.</li> <li>• Safety ambassadors.</li> <li>• Embedding safety culture into quality improvement projects.</li> <li>• Ensuring safety culture assessments cover psychological safety, and then using repeat measures to review and sustain improvement.</li> </ul>
Turner et al (2018)	<p>In a synthesis of healthcare research, Turner et al (2018) summarise the attributes of facilitation behaviour that supports openness and learning, including:</p> <ul style="list-style-type: none"> <li>• Fosters participant learning;</li> <li>• Supportive, inclusive and empowering;</li> <li>• Immediate and respectful feedback;</li> <li>• Maintains professional integrity;</li> <li>• Honesty, flexibility and adaptability.</li> </ul>
Harper & Helmreich (2005)	<p>Harper &amp; Helmreich (2005) found from a review of reporting schemes that whilst 90% of staff were aware of 'close call' reporting schemes and 70% thought they helped identify causes:</p> <ul style="list-style-type: none"> <li>• 93% felt close calls were important to address and that they have a personal and professional responsibility to address minor problems;</li> <li>• More than one-third of the respondents believed it would be easier to address problems directly rather than submitting a</li> </ul>

Reference	Summary
	<p>report to the mandatory reporting system;</p> <ul style="list-style-type: none"> <li>• 51% agreed that significant changes could result from an anonymous close-call reporting system;</li> <li>• A general perception held by physicians that the reporting of errors is an administrative task that falls under the responsibility of the nurse.</li> </ul> <p>It was concluded that whilst staff accepted their responsibility for reporting, they had less confidence that reporting would lead to improvements. They report that the following factors contribute to successful reporting:</p> <ul style="list-style-type: none"> <li>• Customised reporting scheme (specific to the profession);</li> <li>• Feedback on actions taken;</li> <li>• Clear statement of reporting responsibilities;</li> <li>• Nonpunitive, trusted source of reporter protection.</li> </ul>
<b>Just culture</b>	
Reason (2004)	Reason (2004) cites a report from Naviair, Denmark's air traffic service provider, reported that after a June 2001 change to Denmark's law making confidential and non-punitive reporting possible for aviation professionals, the number of reports in Danish air traffic control rose from approximately 15 per year to more than 900 in the first year alone.
Reason (2000)	Reason (2000) examined high reliability organisations, exemplars of the system approach i.e. building defences to avert or mitigate errors around the conditions under which individuals work. In this research three types of high reliability organisations were investigated: US Navy nuclear aircraft carriers, nuclear power plants, and air traffic control centres. His research found that high reliability organisations regard human variability, not as unreliability but as potentially an important safeguard in adapting to dynamic safety events. For example, in routine situations a hierarchical way of work is employed but in emergency situations control may shift to experts and back seamlessly, as the situation dictates.
RSSB (2018)	A report from RSSB (2018) reveals that over the last 15 years a 90% reduction in SPADs (Signals Passed at Danger) has been seen in the rail industry and they attribute it, in part, to an "open and mature safety culture" as well as acknowledging that each accident needs to be investigated thoroughly in a Just Culture in order to understand the root causes and benefit from the learning. Though it should be noted that this information is derived from a public summary report of RSSBs safety performance regarding SPADs and therefore the extent to which Just Culture contributed to the reduction is not explored.

Reference	Summary
Baines (2008)	<p>A presentation from Baines (2008) indicated there was an increase in reporting in Rolls-Royce, the Attack Helicopter Depth Support Unit, BAE systems, Air France KLM, and air safe and its attributable to adopting a Just Culture.</p> <p>It should be noted this is not a peer reviewed article therefore the quality of the study is low and a causation cannot be confirmed.</p>
Steel et al (2016)	<p>An evaluation of introduction of a Just Culture in a cancer unit found:</p> <ul style="list-style-type: none"> <li>• A decrease in the number of respondents who reported feeling fearful of reporting in in 2012 (33%) compared to 2014 (28%);</li> <li>• The number of reported near misses increased by 181% from 2012 to 2014;</li> <li>• The number of errors reported increased by 45% from 2012 to 2014.</li> </ul> <p>Thus, despite only a small change in fear of reporting, there was a large increase in reporting.</p>
Vogelsmeier, Scott-Cawiezell and Miller (2010)	<p>Vogelsmeier, Scott-Cawiezell and Miller (2010) report on the state wide 20 month Missouri Just Culture Collaborative, with 52 reporting hospitals that had undertaken Just Culture Training for Healthcare Managers. The hospitals varied in their level of deployment of Just Culture, categorised as level 1 (minimal) to level 4 (training on site staff). The Agency for Healthcare Research and Quality's Hospital Survey on Patient Safety Culture (HSOPSC) was completed by hospital 'leaders' before and after the collaborative.</p> <p>Hospitals self-directed their level of engagement in the Just Culture Training.</p> <p>They report that:</p> <ul style="list-style-type: none"> <li>• The most engaged healthcare organizations showed a positive change of only 1.1%;</li> <li>• The lesser engaged healthcare organizations showed a positive change of more than 17%, moving toward strongly agreeing that nonpunitive approaches were the standard approach of the organization.</li> </ul> <p>The findings were attributed to the most engaged hospitals having a more valid view of their culture than the least engaged hospitals, with the least engaged hospitals claiming few if any barriers to reporting.</p>
Edwards (2018)	<p>Edwards (2018) stated that an impact assessment on Just Culture has never been investigated using a longitudinal experimental design. Edwards applied measures of the extent to which Just Culture had been adopted, measures of perceived impact of (for example) clinical peer review, patient safety culture and frequency of events reported over 2007 to 2016. Edwards found, from a</p>

Reference	Summary
	<p>2015-16 study, that:</p> <ul style="list-style-type: none"> <li>• 211 of 270 responding US acute care hospitals (79%) indicated that their hospital has adopted Just Culture.</li> <li>• 83% believed that it had a positive impact, ranging from Strongly positive (16%), Positive (37%) to 'somewhat positive' (33%).</li> <li>• As regards clinical peer review: <ul style="list-style-type: none"> <li>○ The strength of Just Culture adoption (from strongly positive to strongly negative) predicted greater clinical peer review scores after controlling for Quality Improvement model scores.</li> <li>○ The adoption of Just Culture per se did not predict greater clinical peer review scores.</li> </ul> </li> <li>• As regards measures of safety performance: <ul style="list-style-type: none"> <li>○ The self-rated degree of impact of Just Culture was associated with measures of safety performance:</li> <li>○ There were fewer correlations between adoption of Just Culture per se and safety performance.</li> </ul> </li> <li>• As regards measures of safety culture: Non-punitive response to error remained the lowest scoring category in the Hospital Survey of Patient Safety Culture, at 45% positive. <ul style="list-style-type: none"> <li>○ There was very little evidence of an upward trend in non-punitive responses to error across 2007 to 2016.</li> <li>○ There was a small upward trend in people feeling that "When an event is reported, it feels like the person is being written up, not the problem".</li> <li>○ The average improvement was 2% for non-punitive of response to error.</li> </ul> </li> </ul> <p>Edwards noted there was considerable variation in the strategy for program implementation which it was thought influenced success. Edwards (2018) review highlighted that the following contributed to successful implementation:</p> <ul style="list-style-type: none"> <li>• Feedback to reporters and recognition of reporters ("Patient safety heroes" and "Good Catches");</li> <li>• Demonstrations of management commitment, such as regular safety briefings and opening all meetings with an open discussion of safety issues.</li> </ul> <p>The GSB authors of this review note that there was a high level (about 73%) of reporting of events that could harm patients at the outset (2007) which rose very little by 2016. The reporting of events that could not harm patients rose more so from about 54% to about 62% between 2007 and 2016.</p>

Reference	Summary
Solomon (2014)	<p>Solomon (2014) evaluated the influence of introducing the just culture model through staff engagement in an interactive workshop amongst 76 acute care staff using a before and after measure of Agency for Healthcare Research and Quality Hospital Survey on Patient Safety Culture. Statistically significant improvement in perception scores were reported (<math>\mu = 3.5</math> before, <math>\mu = 3.7</math> afterwards), including on teamwork (60% to 88%), openness (68% to 75%) and event reporting (72% to 92%).</p> <p>There was no change in perception of nonpunitive response to error (pre 60.2%, post 59.7%).</p>
Eurocontrol (2006)	<p>Eurocontrol designed a report to guide users in adopting a Just Culture. They use examples of successful adoption from airlines such as:</p> <ul style="list-style-type: none"> <li>• Finland – An anecdotal report of having seen a clear change in thinking in small Finnish aviation/ATC communities where the majority of employees knew each other and there was a clear stigma in informing or gossiping. The positive results of change are attributed to, <ul style="list-style-type: none"> <li>○ Having a clear need for proper information that is recognised and mandated at the highest levels of organisation,</li> <li>○ Assigning a trusted person at all levels as project manager,</li> <li>○ Openly discussing the dilemma of data integrity and designing a compensatory system for reporters and data users,</li> <li>○ A lack of anonymity, in order to discuss report with reporter and to reach the first person within the organisation who can affect change i.e. line manager,</li> <li>○ Confidentiality, which allows the organisation as a whole to learn from incidents or systems without focusing on who made the report thus also shielding the individual from blame culture,</li> <li>○ An equal opportunity for all those responsible for reacting to a safety accident/incident to provide their own comments,</li> <li>○ A clear distinction between occurrence reporting and normal safety communications, i.e. this reporting system should not replace alarm bells for instance,</li> <li>○ A strong feedback loop for all along the line,</li> <li>○ Good follow up for decisions made, and</li> <li>○ A log of all occurrences.</li> </ul> </li> <li>• UK - the Safety Investigation and Data Department, responsible for the UK Mandatory Occurrence Reporting scheme with the objective of storing, protecting, and disseminating data to improve flight safety not to attribute liability. The Safety</li> </ul>

Reference	Summary
	<p>Investigation and Data Department indicates the CAA receives over 10,000 reports every year under the MOR Scheme and only approximately 20 of these are reported as 'Confidential'. This alludes to a high degree of trust in the scheme, belief in its objectives, and reflects well on the actions of employers.</p> <p>British Airways gave assurances that they would also not "shoot the messenger" in order to get information from pilots, mechanics, and others for their BASIS system. Many other airlines around the world concluded that they must do the same in order to obtain information they need to be proactive about safety, for example, the FAA developed a regulation in 2001 that prohibits that approved reported information cannot be used for enforcement purposes. Alaska airlines and TAP Portugal have also rescinded their decision to undertake disciplinary action to anyone who participated in the error investigation process.</p>
Evaluation of other schemes	
Chen (2010)	Chen (2010) evaluated the Taiwan Civil Aviation safety reporting (TACARE) system for maintenance personnel, with 605 respondents, finding that 61.7% were aware of TACARE, 90% would agree it was important to submit reports, only 9% saying they would not use it and 3.6% using it.
Mick et al. (2007)	Mick et al evaluated the 'Good Catch' program, designed to encourage reporting. The 'Close Call' program operating before 'Good Catch' at health institutions was developed to allow anonymous reporting of close calls, near misses, and potential errors, however on 175 were gathered during the first 2.5 years of the program. The 'Good Catch' program adopted a more positive spin on reporting e.g. "increased reporting of near misses helps the hospital learn how to prevent future errors". They also held executive leadership sponsored incentives such as competitions to encourage reporting. The M.D. Anderson Cancer Centre received 2744 reports of potential errors during the initial six months of the pilot program.
Tani (2010)	<p>Tani looked at empirical studies of participants working or intending to work in the aviation industry in order to uncover factors influencing individuals' intentions to report safety concerns in aviation and to whom such reports might be made. They found over all that there is confusion in the New Zealand aviation workplace over what and to whom to report. They also found evidence of six factors that may influence both individuals' perceptions of safety issues at the workplace, and their intentions to report wrongdoing:</p> <ul style="list-style-type: none"> <li>• Seriousness of wrongdoing;</li> <li>• Direct or indirect involvement in wrongdoing;</li> <li>• Working environment;</li> <li>• Legal protection of the reporter;</li> </ul>



Reference	Summary
	<ul style="list-style-type: none"> <li>• Motive of the wrongdoer; and</li> <li>• Relationship to the wrongdoer.</li> </ul> <p>Evidence was also found that when participants do act upon being confronted with wrongdoing situations, they may not do so in a manner that is fully consistent with improving aviation safety.</p>
Timmel et al. (2010)	Timmel et al implemented and evaluated the Comprehensive Unit-based Safety Program (CUSP) (which incorporates a culture of teamwork and learning from mistakes as part of its model) in a clinical setting. They found that staff had implemented several interventions to reduce safety hazards and improve culture such as a team-based goals sheet was implemented to improve communications.
Wick et al. (2012)	Wick et al designed a study to evaluate the association between implementation of a surgery-based CUSP and post-op Surgical Site Infection (SSI) rates in a longitudinal study. After commencement of interventions, the SSI rate was 18.2% (59 of 324 patients) for the subsequent 12 months—a 33.3% decrease (95% CI, 9–58%; $p < 0.05$ ). This decrease was attributed to the formation of small groups of front-line providers addressing patient harm using local wisdom and existing evidence.
Pitts et al. (2017)	The impact of CUSP on safety climate and teamwork was assessed through a pre-post comparison of results on the validated Safety Attitudes Questionnaire following its implementation in a clinical setting. Six months following CUSP implementation, large but non-statistically significant increases were found for the percentage of survey respondents who reported knowledge of the proper channels for questions about patient safety, felt encouraged to report safety concerns, and believed that the work setting made it easy to learn from the errors of others.
Miller et al. (2016)	<p>Two ICUs implemented CUSP tools and developed local interventions to reduce safety problems. Miller et al measured central line–associated bloodstream infections (CLABSIs), catheter-associated urinary tract infections (CAUTIs) and ventilator-associated pneumonia (VAP) during baseline, the CUSP period, and a post-CUSP period and found:</p> <ul style="list-style-type: none"> <li>• CLABSIs decreased from 3.9 per 1,000 catheter days at baseline to 1.2 during the CUSP period to 0.6 during the post-CUSP period.</li> <li>• CAUTIs decreased from 2.4 per 1,000 patient days to 1.2 during the post-CUSP period.</li> <li>• VAP rate decreased from 2.7 per 1,000 ventilator days to 1.6 during the CUSP and post-CUSP periods.</li> <li>• Device utilization decreased significantly in both ICUs.</li> </ul>
Saint et al.	Saint et al conducted a pilot study of a regional ‘No Preventable Harms’ campaign to reduce health-care associated infections.

Reference	Summary
(2015)	This campaign centred around utilising shared data and information to best learn from mistakes whilst guidance and evaluations were implemented to communicate and learn from efforts made. Quantitative data showed a significant reduction in CAUTI rates per 1,000 catheter days for non-intensive care units across the region ( $P = .001$ ) but no improvement in the intensive care unit rate ( $P = .16$ ). Qualitative data highlighted the need for considering local context and the importance of communication when developing and implementing regional initiatives.
Neuspiel, Guzman, and Harewood (2008)	Neuspiel employed voluntary, anonymous, nonpunitive reporting, paired with a team-based system analysis and change implementation in order to investigate the effectiveness of team-based reporting, systems analysis, and redesign to address medical errors in paediatric ambulatory care. In the first year following an evaluation, 80 errors were reported, compared with only 5 errors reported during the prior year via a traditional incident reporting system. At the time of the evaluation 65 % of reports have resulted in completed interventions.



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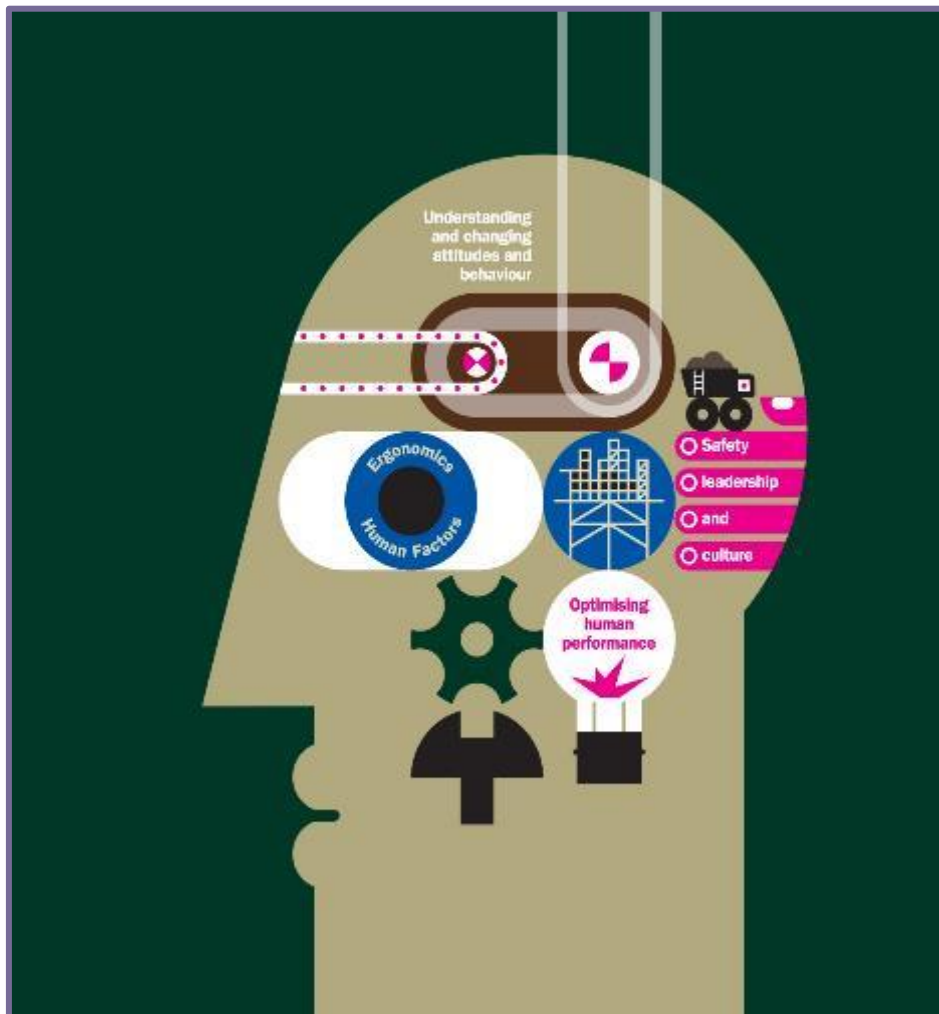
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