Swedish Agency for Work
Environment Expertise

Safety Culture and Safety Behaviour That Reduces Risk in Military Organisations

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Foreword

Safety, safe behaviour and safety culture are vital aspects of the work environment in our workplaces. In the military, however, safety culture and safety management are particularly necessary in order to maintain a good work environment for personnel who must constantly adapt to meet new challenges – challenges that often arise in critical situations – and to keep up with rapid technological development within these organisations. In order to maintain a high level of safety that both protects personnel and materials and maintains the confidence and capacity to fulfil their mission, safety management in the military must be a continuous and dynamic process.

From this viewpoint, and to comply with the Swedish Government's work environment strategy for the period 2021–2025 – one of four priority areas of which is a safe working life in which no-one is to place their life or health at risk due to their job – the Swedish Agency for Work Environment Expertise has initiated this project. The present report is a systematic knowledge compilation of research that illuminates the nature and importance of safety culture and safety behaviour within military organisations.

The authors of the literature review are Professor Mattias Elg and Associate Professor Jason Martin of Linköping University. The authors have autonomously selected their theoretical and methodological approach and are responsible for the results and conclusions presented in the report. Professor Emerita Ann Enander of the Swedish Defence University and Associate Professor Johan Bergström of Lund University reviewed the literature review on assignment from the Agency. A reference group comprised of representatives of the Swedish Armed Forces has reviewed and commented on the content during work on the literature review.

Monica Kaltenbrunner, PhD, analyst at the Swedish Agency for Work Environment Expertise, has managed the process on behalf of the agency. The responsible communications officer was Julia Engström.

I would like to extend my sincere thanks to all those involved in preparing this literature review.

Gävle, December 2024

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Summary

Introduction

This literature review focuses on safety culture and safety behaviour within military organisations. It has been prepared as part of the Swedish Agency for Work Environment Expertise's assignment to illuminate the nature of the work environment in different industries and sectors in Sweden. It is based on existing empirical research from Sweden and other countries with similar military organisations. The knowledge compilation supports the Swedish Government's work environment strategy for the period 2021–2025, one of four priority areas of which is a safe working life in which no-one is to place their life or health at risk due to their job.

The overall purpose of this literature review is to gather relevant research concerning safety culture and safety behaviour within military work environments in Sweden and comparable countries. It is based on a rapid literature review of published research papers that summarises the current state of knowledge. It also identifies future research needs.

The work of the literature review has been guided by the following three research questions:

1. What factors in the work environment at the individual, group and organisational levels promote a strong safety culture?
2. What interventions, practices, or methods have been shown to contribute to a good safety culture or safety behaviour at the individual, group or organisational levels within military operations?
3. How do safety regulations in policies and governance documents differ from how safety behaviour is actually dealt with, and how can this gap be bridged?

Definitions:
- **Safety Culture:** According to the Swedish Work Environment Authority, safety culture is the common attitudes, values and perceptions that managers and employees have about their relationship to safety and the work environment. A good safety culture is dependent on how work is organised and led. A safety culture can be described as a stable pattern of shared, learned assumptions about safety that guide the actions of those within the organisation. This culture encompasses both visible and documented attributes and more implicit ideas and habits.
- **Safety Climate:** The safety climate can be described as a 'snapshot' of an organisation's safety culture. It reflects the mood and prevailing perceptions concerning safety in the organisation. While this is based on the underlying culture, it is more specific and therefore easier to measure. The safety climate reflects how staff perceive common values and views about safety at a specific point in time.
- **Safety Behavior:** Safety behaviour is crucial to the organisation's safety performance. Safety behaviour can be divided into regulatory compliance (behaving in accordance with safety rules) and participation in the safety culture (behaving in a way that contributes to a safe work environment for all, not just the individual).

Method

The literature review has been limited to military organisations within NATO, plus Australia and Israel. Only papers published in peer-reviewed journals and empirical papers featuring qualitative and quantitative studies have been included. Grey literature, such as reports from commissions of inquiry, has been included as a supplement.

The literature review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) reporting guidelines to ensure that results are reported in a transparent and structured manner. Searches were conducted based on the Population, Exposure, Outcome (PEO) framework to define inclusion and exclusion criteria. *Population* is defined as military personnel in hazardous environments, *exposure* covers the factors that affect the safety culture and safety behaviour, and *outcome* focuses on incidents and accidents. Searches were conducted in the databases Scopus, Web of Science and PsycInfo.

An initial assessment of relevance was made based on the titles and summaries of 1,808 papers, 1,418 of which were subsequently excluded. The remaining papers were then subjected to full text analysis, which resulted in 35 papers being selected for a quality review. Papers of high or medium quality were chosen for inclusion in the analysis. A total of 28 papers were included in the final analysis. Processing was performed using Zotero reference management software and the Rayyan systematic review management platform.

Results

Research question 1: *What factors in the work environment at the individual, group and organisational levels promote a strong safety culture?*

Individual level

- *Experience as a key factor:* Personal experience and length of service strengthen safety awareness and promote a culture in which mistakes are viewed as learning experiences, especially through debriefing and sharing experience.
- *Psychological strain:* Chronic psychological stress can have a negative impact on the safety climate. Balancing the demands of the job with resources can however mitigate the impact of stress and support compliance with safety regulations.
- *Individual variation:* Personal characteristics, such as risk tolerance, age, and gender, influence safety behaviors. Younger individuals and men tend to have a more skeptical view of safety, while experience and older age reduce risk-taking behavior.
- *Employment conditions and safety:* When employers fulfill the psychological contract with employees, compliance with safety regulations increases, and staff are more likely to remain in service, contributing to a stable and safe work environment.

Group level

- *Group dynamics and communication:* A transformational leadership style that promotes open communication and camaraderie within the group strengthens the safety climate. This climate fosters conditions for employees to share safety-related information and lessons, leading to safer behaviors.

Organizational level

- *Safety climate:* A positive safety climate supported by management's commitment, clear safety communication, continuous monitoring, relevant training efforts, and reward systems for safe behavior creates a safer workplace. Feedback to employees reinforces safety awareness and supports compliance with safety standards.

Research question 2: *What interventions, practices, or methods have been shown to contribute to a good safety culture or safety behavior at the individual, group, or organizational levels within military operations?*

Individual level

- *Training and education:* Specific training develops mental and physical readiness to handle risks. Education not only enhances individual skills but also strengthens the overall safety culture.
- *Technical monitoring:* Advanced monitoring systems, such as driver assistance systems, can help reduce accident risk by directly influencing driver behavior and providing insights for learning in follow-up sessions.
- *Feedback:* Feedback can be an effective approach to enhancing safety by providing military personnel with immediate insights into their behavior and enabling necessary adjustments. A systematic feedback structure reinforces safety behaviors under challenging conditions and reduces the risk of psychological pressure leading to safety lapses.

Group Level

- *Learning from mistakes:* A culture where mistakes are used as learning opportunities without blame promotes safety. The group's attitudes are shaped in an environment that emphasizes transparency and honesty, facilitating openness to share mistakes and experiences.

Organizational Level

- *Organizing for learning:* A culture that enables structured debriefing processes and experi-ence-sharing enhances safety by creating an open and learning-oriented environment. An organization with built-in social redundancy, where roles and responsibilities overlap, provides a robust safety system and facilitates quick adaptation to changes.
- *Safety monitoring system:* Effective measurement tools and reporting systems contribute to continuous improvement of the safety culture by providing management with quick access to data, allowing for timely and effective decisions to maintain and improve the safety climate.

- *HRO:* High Reliability Organizations (HROs) are organizations that effectively maintain high safety standards in complex and high-risk environments by adhering to five principles. These include a constant awareness of risks (preoccupation with failure), a reluctance to simplify, respect for operational knowledge (sensitivity to operations), a commitment to resilience and deference to expertise in critical situations. By integrating these values, HROs build a culture of continuous learning and improvement, strengthening their ability to manage risks safely.

Research question 3: *How do safety regulations in policies and directives differ from the actual handling of safety behaviors, and how can this gap be bridged?*
- *Compliance and safety climate:* A safety climate that supports compliance without requiring excessive adherence creates more sustainable safety behavior. Flexibility for rule-breaking should be allowed if strict rule adherence would pose a risk to safety, creating a balance between regulation and decision-making freedom.
- *Reporting culture and learning:* A culture that emphasizes learning and open reporting, without blame, strengthens safety. In a just culture, where mistakes are seen as learning opportunities rather than sources of punishment, psychological safety is promoted, encouraging individuals to report and learn from mistakes.

The included studies were also reviewed from a gender perspective, revealing that male first authors dominate, with only 18% having female first authors. This raises questions about the representation of female perspectives in research on safety culture and safety behavior in military contexts. The gender distribution among study participants is reported in a smaller proportion of the articles, and where it is included, it is most often used merely as a control variable without deeper analysis. Gender aspects are addressed only marginally in 32% (9 out of 28 articles) of the studies, with few examples of in-depth analysis. This indicates an overall lack of discussion on gender in these studies.

Discussion

The discussion in this report highlights several factors with strong links to the work environment that influence safety culture and safety behaviour at individual, group and organisational level within military organisations.

The role and limitations of safety climate
The safety climate receives significant attention in national and international research as a metric for safety culture and a safe work environment. However, there are risks associated with relying on safety climate surveys to measure the quality and safety of the work environment, as they often fail to capture the complexity of factors such as authority, group dynamics and psychological safety. While climate measurements may provide an overall picture, there is a risk that they will conceal real work environment challenges and safety issues.

Structural and individual factors
Safety management and the work environment are affected by both structural conditions and the actions of individuals. Structures such as historical and organisational norms are the foundations of safety and the work environment, but they can also be restrictive if they do not provide flexibility and room for manoeuvre. The individual plays an important role, as their actions maintain or alter the safety climate and work environment. Their actions can contribute to a dynamic work environment in which safety and improvement go hand in hand, if they feel psychologically safe and supported.

The importance of leadership to safety
Leadership is highlighted as a crucial factor for achieving a good working environment and safety culture. This is true of both transactional and transformative leadership. Transactional leadership provides stability and predictability in the work environment, while transformative leadership encourages learning and adaptability.

Integrating safety management into day-to-day operations and providing space for reflection are important factors
In the military, effective safety management and a good work environment require the integration of safety issues into day-to-day operations. Room for reflection is also required, such as debriefing and follow-up measures. The combination of practical application and pauses for reflection creates an adaptive and resilient work environment in which learning and safety can be continuously improved to meet new challenges.

Differentiating between policy and practice
When faced with complex and unpredictable situations, it is often difficult to rigidly comply with formal safety regulations. Military organisations may need a flexible work environment that permits departures from the rules when this is necessary to perform duties in a safe and effective manner. A culture that emphasises learning, psychological safety and restorative justice contributes to a work environment in which safety is a priority, without strict adherence to the rules hindering adaption to reality.

Sex and gender aspects
The general lack of sex and gender perspectives in the literature review is an identified problem. If these perspectives are not considered, important factors that influence the actions of individuals in high-risk situations may be overlooked. There is also a risk that research will miss significant differences in safety behaviour between women and men. An inclusive perspective may lead to a more nuanced understanding of the dynamics of work environments and safety cultures.

Methodological challenges and gaps in research
There is a shortage of studies conducted under realistic operational conditions, meaning that certain aspects of the work environment, safety culture and safety behaviour have not been adequately explored. The discussion emphasises the need for longitudinal and system-oriented studies to understand causality over time, particularly in relation to leadership, the work environment and safety behaviour.

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1. Introduction

This literature review focuses on safety culture and safety behaviour within military organisations. It has been prepared as part of the Swedish Agency for Work Environment Expertise's assignment to illuminate the nature of the work environment in different industries and sectors in Sweden. It is based on existing empirical research from Sweden and other countries with similar military organisations. The literature review supports the Swedish Government's work environment strategy for the period 2021–2025, one of four priority areas of which is a safe working life in which no-one is to place their life or health at risk due to their job.

Background

Today, in a world marked by escalating crises and significant deterioration in the global security landscape, good safety culture and safety behaviour within military organisations are crucial to managing risks and achieving a good level of safety and a good work environment. These aspects are key to the capacity for and credibility of risk-prevention in military operations.

In many respects, the Swedish Armed Forces have a well-established safety structure that covers organisation, processes and documentation (for example, safety regulations) that is intended to achieve good safety behaviour. That said, the Swedish Armed Forces are in a period of transition as a fit-for-purpose operational defence is being established. In such a defence, focus on work environment aspects such as safety culture and safety behaviour become even more important, especially given Sweden's accession to NATO. Increased internationalisation and collaboration involve the creation of new points of contact and the development of interactions between military units. The various units or partners may have very different views about what constitutes good safety culture and good safety behaviour, thus increasing the risk of potential safety risks. This means that further efforts are needed to develop and maintain a fit-for-purpose common safety culture. The expansion of training exercises in peacetime and increasingly complex manoeuvres and missions in crises, conflict, and wartime places greater demands on the Swedish Armed Forces to conduct operations as safely as possible. Ciucă et al. (1) underline the importance of integrating the safety culture into military training and operations. A holistic view of safety is crucial in the face of today's complex threat scenarios, and this view must encompass the entire organisation both in peacetime and in crises and conflict situations. As such, it is vital to understand what safety culture is in a military context and how it can contribute to good safety behaviour that promotes a safe work environment.

Purpose and research questions

Against the background described above, the overall purpose of this literature review is to gather relevant research concerning safety culture and safety behaviour within military work environments in Sweden and comparable countries. The results are based on a rapid literature review method of published research papers that summarises the current state of knowledge.

The work of compiling knowledge has been guided by the following three research questions:

1. What factors in the work environment at the individual, group and organisational levels promote a strong safety culture?
2. What interventions, practices, or methods have been shown to contribute to a good safety culture or safety behaviour at the individual, group or organisational levels within military operations?
3. How do safety regulations in policies and governance documents differ from how safety behaviour is actually dealt with, and how can this gap be bridged?

To begin with, it must be acknowledged that health and safety in a civilian context cannot simply be translated into a military context. Soldiers and sailors in uniform are trained to effectively deal with danger and the presence of death – to do their jobs in situations that are avoided at all costs in civilian life. Everyone in uniform lives with what Keegan (2, p, 199) calls "the knowable possibility of disaster".

Safety culture, safety climate and safety behaviour

The Swedish Work Environment Authority (3) defines the term *safety culture* as the common attitudes, values and perceptions that managers and employees have about their relationship to safety and the work environment. Moreover, the Swedish Work Environment Authority underlines that a good safety culture is dependent on how work is organised and led. Safety culture may be comprised of visible and explicit attributes, such as guidelines or other policy documents. Its attributes may also be implicit and invisible, such as unspoken ideas, habits or patterns of behaviour. The explicit elements of safety culture inform people in the organisation and are expressed, reproduced and communicated in various ways, both real and symbolic (3–18).

The term *safety climate* (9,13,19–25) can be defined as the current mood and prevailing perceptions of the safety culture within the organisation. Neal and Griffin (21) argue that an organisation's safety climate is a kind of snapshot of how employees perceive the meaning, values and perceptions concerning safety within the organisation at any given point in time. So, the climate is based on the culture but is easier to understand and describe in more concrete terms, and thus easier to measure. However, the safety climate may also contain variations and interpretations of more deep-lying and stable perceptions of safety in the organisation.

The safety performance of the organisation is dependent on safety behaviour within the organisation. The term *safety behaviour* refers to the behaviour and actions of individuals that promote and maintain a safe work environment. It encompasses conscious, regular actions that reduce the risk of accidents and injuries. In the work environment, this is often a matter of following safety procedures, reporting risks, using personal protective equipment and behaving responsibly in high-risk situations. According to Griffin and Neal (21, 26), there are two main categories of safety behaviour in the workplace: safety compliance and safety participation. Safety compliance involves following specific rules, guidelines and procedures, such as performing risk assessments or complying with work environment regulations. Safety participation involves voluntary actions that go beyond basic requirements, such as informing colleagues about potential hazards, helping to improve safety measures or active participation in safety training.

2. Method

This chapter describes the method used to prepare the literature review. The description is chronological, making the key components and analytical steps simple to follow. A literature review must adhere to certain principles and live up to demands for relevant content, thoroughness and objectivity. To this end, this knowledge compilation is largely based on the processes and methods described by Booth et al. (27). Figure 1 is a flowchart showing the stages of the process.
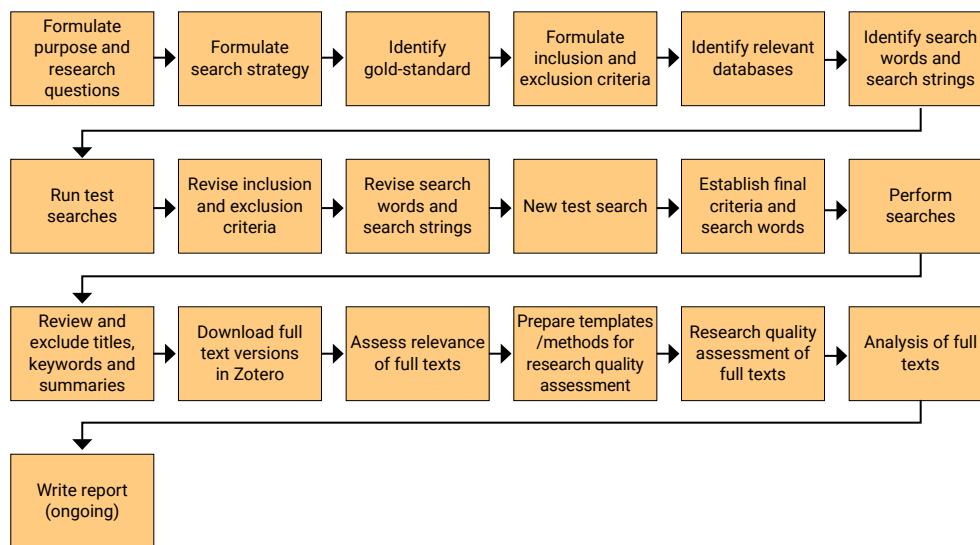

Figure 1. Flowchart showing the process of the literature review

Limitations and criteria for inclusion and exclusion

The literature review focuses on military organisations where safety measures are critical to protecting both military personnel and civilians. The reviewed papers were carried out in NATO member countries and Australia and Israel, which both have a 'Western perspective' on the military and how it is organised, trained and deployed, and are thus relevant in a Swedish context. The review has mainly covered scholarly research papers published in reputable, peer-reviewed international journals. In the introduction, results and discussion sections, the literature review has been supplemented with scoping reviews, meta-analyses, conceptual papers, reports, investigations and books, which for the purposes of this report are designated as grey literature. Another general choice was that searches would not be restricted to a specific period of time.

Only empirical papers have been included in the results section of the literature review. This choice is mainly justified by the fact that papers based on empirical studies provide concrete evidence of the studied phenomenon and underlying relationships. Research papers featuring studies that use both qualitative and

quantitative data have been considered for inclusion. To summarise, the choice to focus on the results of empirical papers is justified because it ensures that the conclusions of the literature review are based on the most robust and reliable evidence available.

Literature search and databases

The identification of literature and searches in databases were performed with the support of the University Library at Mid Sweden University. The first stage included identifying 'gold-standard' papers that could serve as a point of reference for drawing up inclusion and exclusion criteria. These criteria, as well as search words and search strings, were adjusted in an iterative process using test searches to improve search precision.

Searches were conducted based on the Population, Exposure, Outcome (PEO) framework (cf., for example, Khan et al., 28) to define inclusion and exclusion criteria and to structure and define the research questions. For the purposes of this study, population is defined as military personnel in high-risk environments, while exposure is the factors to which military personnel are exposed that may influence the safety culture and safety behaviour in their organisations, for example:

- interventions such as specific training programmes or leadership strategies;
- working methods such as technical supervision or procedural adaptations;
- organisational factors such as changes to policies or organisational culture;
- environmental factors such as the conditions under which personnel conduct high-risk operations, or operate under psychological strain; and
- group dynamics and team communication.

By studying the impact of these factors on safety, effective means of promoting a strong safety culture within military organisations may be identified. Outcome refers to the impact of safety culture and safety behaviour on the number of incidents and accidents. This includes how improving the safety culture and changing behaviour can lead to fewer incidents and accidents. Being able to measure actual safety outcomes – such as changes in the number of incidents and accidents – is key to evaluating the effectiveness of interventions, working methods and organisational changes.

Published papers were assessed for inclusion in three stages based on the PEO framework and the established criteria. First, the relevance of the titles of the papers were assessed, after the abstracts of that were considered as relevant were reviewed. The full text of papers that fulfilled the inclusion criteria was then downloaded. Next, a search in three databases followed: Scopus, Web of Science and PsycInfo. The search strings are presented in table form in Appendix 4. Once the systematic search was complete, the full papers were uploaded to the reference management software Zotero to assess the relevance of the full text. For a comprehensive account of the included papers, please see Appendix 1. The total number of excluded papers is reported in Appendix 2.

Table 1. Criteria for the inclusion and exclusion of papers based on PEO

PEO	Include	Exclude
Population	Papers focused on military personnel conducting high-risk operations, with the emphasis on: • individuals directly involved in combat; • individuals in combat-adjacent roles (for example, medics, combat engineers and logistics personnel); • personnel stationed in a warzone or conflict zone but not directly or indirectly involved in combat; and • personnel undergoing training.	Papers focused on military personnel not involved in high-risk operations. Post-service exposure papers. Papers focused on prisoners of war. Papers not focused on NATO member countries, Sweden and/or Ukraine.
Exposure	Papers dealing with safety culture/safety behaviour linked to: • interventions • working methods • organisational factors • environmental conditions • group dynamics and communication	Papers focused on military organisations in contexts where normal risks and hazards to life and health do not apply. Papers that include behavioural and/or cultural factors linked to high-risk military operations.
Outcome	• Safety culture • Safety behaviour • Actual safety outcomes, such as fewer incidents and accidents.	Papers not focused on risks to life and health, such as papers that deal solely with: • material damage or losses; • environmental impact; • economic losses; or • the consequences of paused or halted activities.

The review process

The review process was conducted by both authors. First, the titles, keywords and summaries of the 1,808 papers identified as potentially relevant were reviewed. This round resulted in the exclusion of 1,418 papers lacking relevance based on the PEO criteria and research questions. Duplicates were then removed, resulting in the exclusion of a further 86 papers. In the next stage, a matrix was created with the remaining 304 papers, which were subjected to a full-text screening to establish relevance (see Figure 2). At this stage, a further 269 papers were excluded as they did not meet the PEO criteria.[1] Three papers were chosen for inclusion after a manual search. The result of this meticulous selection process was that 35 papers were deemed to meet the PEO criteria. These were then subjected to a quality assessment. The search and review process is illustrated in the flowchart in Figure 2.

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1 Of these papers, 15 were however deemed relevant for inclusion in the report's introduction and discussion section.

The systematic search process was completed with a manual search of reference lists in relevant papers by the authors. A search was also conducted based on the subject area in the DiVA portal to identify potentially relevant papers, reports and investigations that may have been missed when searching the other databases. Manual searches were conducted to ensure a comprehensive and inclusive literature review. An account of journals, databases and publication trends can be found in Appendix 2.

Quality assessment of the 35 papers selected as relevant to the literature review was performed in two stages. First, an individual review was conducted and then a joint weighing up of assessments and decisions. Two different assessment protocols were used: one for papers based on qualitative research (see Appendix 5) and one for papers based on quantitative research (se Appendix 6).

The research quality assessment of qualitative papers was based on the checklist developed by the Swedish Agency for Health Technology Assessment and Assessment of Social Services (SBU) (29). The SBU checklist consists of five quality criteria: purpose, selection, data collection, analysis and results. For each of these quality criteria, there are questions that must be answered to assess quality. For example, under data collection are the questions: "What methods were used to collect data?" and "Are there serious flaws in the data collection that may affect reliability?" The questions are answered "Yes", "No" or "Unclear". There is also space to write a comment (see Appendix 5). After a balanced assessment, the quality of the paper in question is rated as high, medium or low. Papers rated as high or medium quality were selected for inclusion. Six out of ten of the selected qualitative papers were rated as being of high or medium quality.

To assess the research quality in papers based quantitative research, the authors developed a checklist based on Tompa (30, 31). The checklist consisted of eight questions based on specific quality criteria. Each question was answered on a scale of 1 to 5. As an example, one of the questions was: "To what extent is the statistical method suitable based on the research question and study design?" (see Appendix 6). Only papers with an overall rating of high or medium quality were selected for inclusion. Of a total of 25 papers based on quantitative research, 22 were rated as being of high or medium quality. The deficiencies that resulted in papers being excluded were mainly related to selection, data collection and analysis. So, after quality assessment, a total of 28 paper were selected for inclusion in the results of the literature review.

These papers were then uploaded to the online reference management tool Zotero and processed on the Rayyan systematic review management platform. Rayyan is a specialist online tool designed to help researchers save time during systematic reviews and literature reviews. Rayyan's strength lies in its ability to facilitate independent reviews of papers while at the same time making for easier collaboration between reviewers. This function was particularly valuable as it guaranteed that the review process could be implemented both jointly and individually, without compromising the integrity or quality of the work.
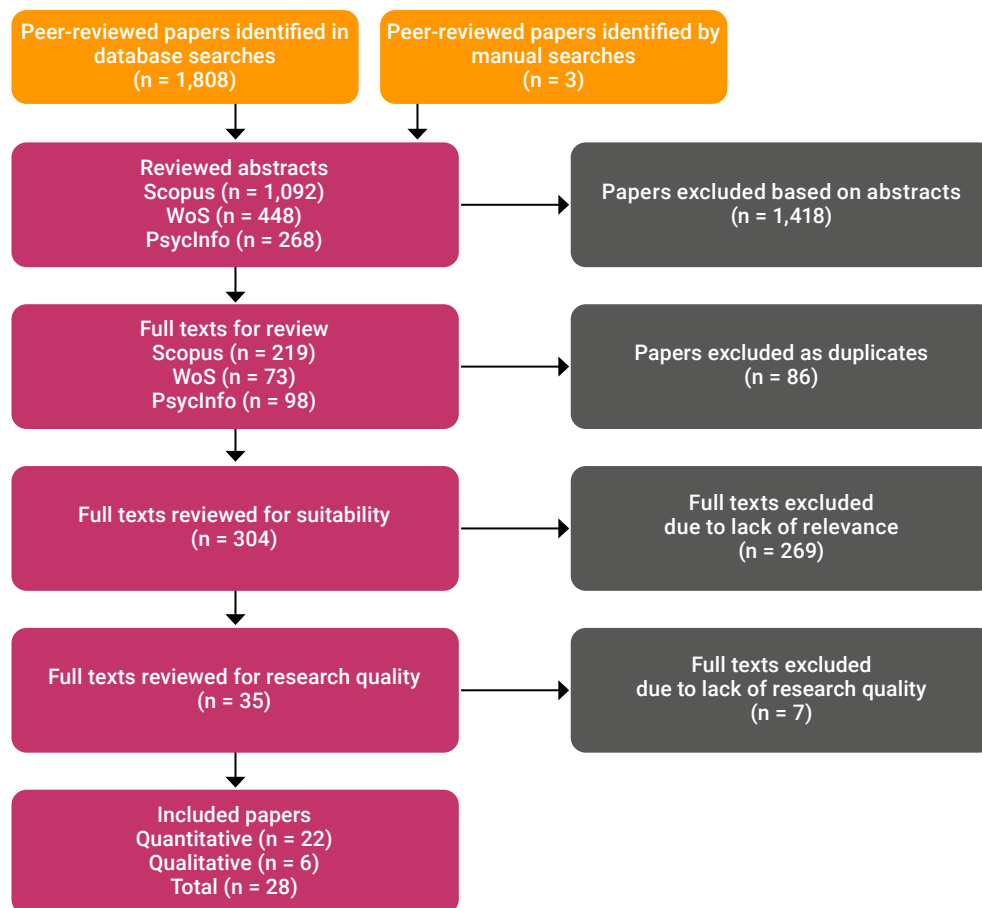
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┌─────────────────────────────┐  ┌─────────────────────────────┐
│ Peer-reviewed papers        │  │ Peer-reviewed papers        │
│ identified in database      │  │ identified by manual        │
│ searches (n = 1,808)        │  │ searches (n = 3)            │
└─────────────────────────────┘  └─────────────────────────────┘
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Reviewed abstracts
Scopus (n = 1,092)
WoS (n = 448)
PsycInfo (n = 268)

Papers excluded based on abstracts
(n = 1,418)

Full texts for review
Scopus (n = 219)
WoS (n = 73)
PsycInfo (n = 98)

Papers excluded as duplicates
(n = 86)

Full texts reviewed for suitability
(n = 304)

Full texts excluded
due to lack of relevance
(n = 269)

Full texts reviewed for research quality
(n = 35)

Full texts excluded
due to lack of research quality
(n = 7)

Included papers
Quantitative (n = 22)
Qualitative (n = 6)
Total (n = 28)

Figure 2. Flowchart of searches during the various stages of the selection process

Processing and analysis

Once research quality was assessed, the remaining 28 papers were full-text analysed. The analysis was performed in three iterative steps: 1) create an overall picture, 2) code the material, and 3) interpretation. In the first analytical step, the authors sought to create an overall picture by individually reading the selected papers (n = 28) and inductively analysing the main themes and results of each study. With the aid of the matrix, papers were thematically clustered using a common mind map, thus creating a shared overall picture of the material.

In the second analytical step, an in-depth analysis was performed by individually coding the content of the papers to generally and specifically capture what each paper was about. Individual coding was followed by a joint analysis during which the authors discussed each paper to verify and harmonise coding. This step also involved further iterations of step 1 to verify and refine the results of the overall analysis. One vital component of step 2 of the analytical process was to thematise, sort and describe the key messages and knowledge contributions of each paper, The outcome of the second analytical step was a more detailed matrix that could be used as a tool in step 3, interpretation.

In the third analytical step, a synthesis of step 1 and parts of step 2 was created using a joint interpretive approach. As a result of this analytical process, using the detailed matrix the authors were able to categorise the papers based on overarching and adjacent themes. This facilitated a more structured clustering and cross-comparison of the content of the papers. The third analytical step also involved further iterations of both step 1 and step 2 to verify and refine the results of these analytical steps. Categories that emerged from the analysis included "Experience as a key safety factor" and "Measuring safety", illustrating the breadth of subjects covered. A total of 19 different categories were defined. These were then clustered in five overall areas that both represent the main results of the literature review and reflect the complex nature of the subject area being studied.

3. Results

Factors that promote a strong safety culture

Under this heading, research question 1 is addressed: What factors in the work environment at the individual, group and organisational levels promote a strong safety culture? The factors are presented at individual, group and organisational level.

Individual level

Experience as a key factor
Desai et al. (32) demonstrate that previous experience of minor or intermediately severe accidents has a positive impact on perceptions of the safety climate within the work unit. In other words, such events can reinforce safety consciousness. Furthermore, Firing et al. (33) describe how military pilots share experiences through systematic debriefings. One conclusion is that – by sharing stories about previous mistakes and even encouraging an attitude of embracing mistakes – experienced professionals play an especially important role in normalising mistakes in order to promote good safety behaviour.

Psychological Strain
Fogarty (34, 35) underlines the negative impact of psychological factors on the safety climate at both individual and organisational level. This particularly applies to the psychological strain and effects of long-term fatigue, something that has been shown to be a risk factor when flying unmanned aerial vehicles (UAVs), when operator fatigue can present significant safety risks. Rosenbloom (36) also highlights the negative impact of fatigue, this time on driver safety in a study of military truck drivers in the Israel Defense Forces (IDF). The risks can however be mitigated by previous personal experience and in-vehicle data recorders to monitor driver behaviour, and by providing opportunities for feedback.

The principles for high reliability organisations (HROs)[2] have been shown to mitigate psychological strain and to be useful in improving safety behaviour under challenging circumstances (Steen et al. 37).

Another perspective on how phycological strain affects safety behaviour at individual level is provided by the job demands-resources model (38). According to Fogarty et al. (38, 39), while psychological strain affects safety outcomes in terms of the number of errors, this can be mitigated by balancing the demands of the job with available resources, thus contributing to increased regulatory compliance and improved safety behaviour. So, an organisation that matches

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2   A high reliability organisation (HRO) is an organisation that has succeeded in maintaining a high level of safety and consistently avoided serious accidents in a complex, high-risk environment. HROs adhere to five key principles that help them to manage risk and build a strong safety culture (37): preoccupation with failure, reluctance to simplify, sensitivity to operations, commitment to resilience and deference to expertise (36).

the demands of an individual's duties with adequate resources to perform them promotes good safety behaviour, which in turn improves safety.

Individual variation
In a study of the propensity of Swedish military personal to take risks, Börjesson et al. (40) examine how demographic variables, personality traits and views on safety affect the individual's inclination to take risks. The study finds that risk propensity and negative safety values, including scepticism about safety measures and a sense of personal invincibility, decrease with age. Hence younger military personnel are more likely to take risks and have a negative attitude to safety measures. Men demonstrated a more sceptical view of safety measures and a higher risk propensity than women. Lack of deliberation, reflecting an inability to think ahead and foresee consequences, was positively related to risk propensity; soldiers and officers with a tendency towards this kind of impulsivity also had a more positive attitude to danger-seeking. Safety scepticism – i.e., a sceptical view of safety measures and an unwillingness to take precautionary measures – was linked to higher risk propensity and a greater sense of personal invincibility. A fatalistic attitude to safety, based on the belief that accidents are unavoidable and happen by fate or chance, was also related to variations in safety behaviour but was not as prominent as safety scepticism. In an earlier study, Börjesson et al. (19) also identify thrill-seeking and calculated risk-taking as factors that contribute to risk propensity. This was particularly true when risk-taking was considered necessary.

In a diary study of naval cadets, Kjellevold Olsen et al. (41) underline that an individual's disposition to form good safety behaviour can be predicted based on their personal characteristics. The study examines the impact of leadership on day-to-day operations aboard a naval vessel, finding that the personality traits of leaders are a significant factor in the leadership style they choose, and thus on safety behaviour within the organisation. This raises the question of whether – and if so, in what ways – personality tests might be used to predict which safety behaviour an individual is likely to present (41).

Links between employment relationship and safety
By integrating the five principles, an HRO can build a culture of continuous learning and improvement, strengthening its capacity to safely manage risks.

A study by Kraak et al. (42) focuses on the correlation between an employee's perceptions of their employment relationship and their safety behaviour. The study examines turnover intentions and safety compliance behaviour among 1,593 members of an air force in a European NATO member country to offer insights into how these intentions and behaviour are affected by the fulfilment of the psychological contract between the employee and employer, i.e., the unwritten, intangible agreement describing their informal commitments to and expectations of one another. The study finds that when employers live up to or even exceed their commitments to their employees, turnover intention decreases and compliance with safety regulations increases.

This research illuminates one critical factor that also connects to the

organisational level: in the military, successful human resources management is vital. By understanding and meeting the expectations of employees, organisations can not only improve safety behaviour but also reduce staff turnover. In their study, Kraak et al. (42) thus offer valuable insight into how to develop safer and more stable workplaces.

Leadership and the safety climate
Unsurprisingly, the research shows that leadership is critical to safety management. The nature of the relationship between leadership and the safety climate depends on one's perspective. On the one hand, there are papers that contend that the safety climate influences leadership and the relationship between leaders and employees (43, 44), i.e., that leadership is subordinate to the safety climate when i comes to achieving safety in the organisation. On the other, there are papers demonstrating how leadership influences the safety climate (45–47), more directly affecting safety behaviour and outcome in the form of actual safety.

Leadership styles, particularly transactional and transformative leadership, are prominent in several papers (44,45,47). Transactional leadership implies a more controlling, by-the-book leadership focused on rewarding performance and correcting deviations. Transformative leadership, on the other hand, is visionary and strives to inspire and engage employees to achieve change and development (48). These leadership styles are often studied separately and are sometimes seen as opposites, see, for example, Zohar and Tenne-Gazit (47). While transformative leadership dominates, there are also papers highlighting the importance of employing a transactional leadership style (44). Martínez-Córcoles and Stephanou (44) have studied so-called "active management by exception" (p. 96), one of the more controlling subcategories of transactional leadership in which the leader actively seeks out errors or deviations to reprimand and rectify. According to the study, this style of leadership can promote safety behaviour, as it leads to fewer safety errors. This may seem counterintuitive, as leadership research overwhelmingly highlights transformative leadership as being more effective. This type of active fault seeking and reprimanding may however actually stimulate the individual to imitate this behaviour with regard to both them and others, which may sharpen focus on safety and reduce the number of errors (44). Unsurprisingly, context and situation are described as crucial to which leadership style proves to be most effective.

Passive avoidant 'non-leadership' is highlighted in several papers as the least appropriate leadership style for promoting good safety behaviour and good safety (41, 44, 45). Kjellevold Olsen et al. demonstrate that non-leadership in a military context can even lead to more errors and breaches of safety compliance (41).

Börjesson et al. (19) have studied how individual characteristics, leadership and group cohesion affect attitudes to risk and safety among Swedish conscripts during military training. One finding was that leadership focused on safety and promoting necessary risk-taking plays a critical role in shaping healthy attitudes to both safety and risk-taking. This balanced leadership is vital to creating an environment in which soldiers and officers are not only safety-conscious but also willing to take calculated risks when necessary.

Group level

Group dynamic

Zohar and Tenne-Gazit (47) illuminate how group dynamics and group communication achieve a good safety climate and thus improve safety behaviour. Their study focuses on how transformative leadership and group interaction create the conditions for strengthening the safety climate within organisations. They demonstrate that transformative leadership influences both communication and the frequency of interactions within the group, which in turn reinforces the group's overall climate. The authors (47) underline the need for leaders in military organisations to understand their influence, not only on individual members but also on the quality of group communication. Promoting bonds of friendship within the team may however be just as important as leading communication itself within the group.

Organisational level

Safety climate

The safety climate can be viewed as a measurement of the organisation's overall attitude to safety, such as how policies and procedures affect the behaviour and attitudes of employees. Papers of safety climate cover areas such as working with explosive ordinance in the Australian Defence Force (Fogarty et al., 39) and the safety climate in the US Navy (Lai et al., 49), the latter focusing on developing a safety climate index (SCI) for over 100 vessels. Martínez-Córcoles and Stephanou (44) have also studied correlations between active transactional leadership, safety climate and safety performance in special forces. Luria (45, 50) has studied the relationship between safety climate, leadership and trust in the Israel Defense Forces (IDF). These various papers highlight the importance of leadership and trust to promoting a good safety climate and safety behaviour in the military. The papers reveal that a good safety climate in a military organisation has a tangible effect on individual safety behaviour and can reduce the number of incidents and accidents.

So, the safety climate can be viewed as a measurement of the organisation's overall attitude to safety, such as how policies and procedures affect the behaviour and attitudes of employees. This can be broken down into specific aspects. Table 4 shows several aspects highlighted in the papers that are considered key to understanding and developing a positive safety climate. One point of departure is that a deeper understanding of these factors allows an organisation to take specific steps to improve its safety climate, contributing to a work environment that is safer for everyone.[3]

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3   Most studies of the safety climate rely on surveys. The concept of the safety climate is built up from a set of factors that in turn consist of a number of component parts. Schüler and Vega Matusczcyk (23) provide an example of this when measuring factors related to management support for safety performance based on six different statements (for example: "Management always provides relevant information to ensure compliance with safety laws and regulations"). A balanced picture of the safety climate is then obtained by combining results from the various factors. The basic principle is that a higher estimation of the factors leads to a better safety climate.

Table 4. Factors at organisational level that are indicative of a work environment with a good safety climate

Factor	Brief explanation	Example references
Management's commitment to safety	Shows management's commitment to and initiatives to promote a high standard of safety.	(32, 49)
Safety communication	Covers how information about safety practices and procedures are communicate within the organisation.	(43, 44)
Safety monitoring	Relates to monitoring by and support from managers and supervisors to maintain safety standards.	(34, 35, 51)
Standards and suitability of training	Illuminates the relevance and effectiveness of safety training given to personnel.	(32, 52)
Reward systems	Includes systems to reward safe behaviour and safety compliance within the organisation.	(32)
Feedback on the results of safety management	How regularly and constructively the organisation evaluates and provides feedback on the results and impact of safety management.	(34, 35)
Safety consciousness	The degree of awareness and understanding of safety risks and preventive measures among personnel.	(44, 49)

While there are core aspects of the safety climate that recur in the papers (see Table 4), there are also variations in how the researchers view them. In other words, there is no uniform definition of the term safety climate. A list of factors that are indicative of a good safety climate can be found in individual papers. These are presented in Table 5.

Table 5. Factors at organisational level that are indicative of a good safety climate

Faktor	Brief explanation	References
Adequate resources	Relates to whether the organisation allocates adequate resources to support safety work.	(35)
The effect of social status on safety behaviour	How safety behaviour is influenced by an individual's social standing within the organisation.	(43)
Training on equipment and materials	Specific training on the use and handling of equipment and materials to increase safety.	(52)
Unit ethics	Moral and ethical guidelines that influence the unit's decisions and behaviour concerning safety.	(23)
Management prioritising physical fitness	The value and priority management places on physical fitness as a component of safety work.	(23)
Proactive practices (promoting learning)	Initiatives intended to promote learning and development in the field of safety.	(44)

Two of the most striking similarities between the papers in Table 5 are their emphasis on the commitment of management to safety and the importance of effective communication, both of which are highlighted by, for example, Zohar and Luria (32) and Desai et al. (43) These papers underline that unambiguous and consistent leadership is crucial to encouraging safety-consciousness and proactive behaviour among personnel.

Maintenance of materiel and equipment
Nitzschner et al. (52) study the safety climate for maintenance in the German Air Force. The authors emphasise that the maintenance of materials and equipment is key to maintaining and promoting good safety. Their research shows that well-maintained equipment is vital to operational safety and preventing incidents. They underline that a positive safety climate, in which personnel feel that their safety is a priority, includes a strict undertaking to regularly and thoroughly inspect and maintain all equipment. One interesting aspect of the study is that a systematic approach to maintenance not only improves physical safety but also contributes to creating a culture in which safety is viewed as integral to the organisation's day-to-day operations. By ensuring that equipment is in tiptop condition, one can effectively reduce the risk of incidents and accidents, which in turn means that it is integrated into the safety climate in the organisation.

Conditions for creating good safety in UAV operations
Steen et al. (37) contribute much-needed knowledge of a field in which it is generally lacking, namely regulations and procedures for operations involving unmanned aerial vehicles (UAVs). According to the authors, to manage the risks associated with UAV operations, the organisation must be committed to and apply the principles of high-reliability organisations (HROs). An HRO

is an organisation that has succeeded in maintaining a high level of safety and consistently avoided serious accidents in a complex, high-risk environment.

While UAVs offer considerable operational advantages in surveillance, reconnaissance and combat missions, they come with their own set of risks and challenges. These include technical malfunction, human error and issues related to communication and coordination between different actors, such as UAV operators, ground crews and air traffic controllers. It is particularly important to remain vigilant for potential risks, even when everything appears to be working well. This is a matter of avoiding simplistic interpretations of complex situations, being sensitive to operational conditions and promoting organisational resilience and deferring to expertise.

Steen et al. (37) also highlight the importance of managing fatigue and exhaustion among UAV pilots, something that poses significant safety risks. This problem is due to a lack of regulation concerning rest times, which increases the risk of incidents and accidents. Addressing these challenges demands improved reporting procedures based on the conditions in which UAV operators work, as well as effective communication between all involved to maintain situational awareness. The authors also identify the importance of having a system in place that encourages and facilitates the reporting of safety-related incidents and accidents. This facilitates learning from mistakes, gradually improving safety. The study also highlights the need to deal with the operational complexity and uncertainty of UAV operations. This demands a balance between complying with existing rules and protocols and adapting to continuously changing circumstances.

Steen et al. also underline the need for continuous evaluation and improved safety practices within military UAV operations. This includes developing robust reporting systems, managing fatigue and exhaustion among personnel, improving channels of communication and coordination, and building an organisational culture that prioritises safety and resilience. By addressing specific needs and challenges, UAV operations can be safer and more effective, which in turn serves their missions and objectives (37).

Interventions, practices and methods that can contribute to a good safety culture or safety behaviour

Under this heading, research question 2 is addressed: *What interventions, practices, or methods have been shown to contribute to a good safety culture or safety behaviour at the individual, group, or organisational levels within military operations?*
The factors are presented at individual, group and organisational level.

Individual level
Training

Papers by Schüler and Vega Matuszczyk (23), Nitzschner et al. (52) and Fraher et al. (53) highlight that a strong link between completing core assignments in

realistic training exercises and applying safety behaviour is crucial to building and maintaining a good safety climate within military organisations. Research shows that training programmes specifically designed with strong links between realistic exercises and safety behaviour directly contribute to shaping safety culture, reducing risks and promoting safety compliance at all organisational levels.

One training programme in which safety aspects are emphasised is the US Navy's Basic Underwater Demolition/SEAL (BUD/S) school. Th US Navy's Sea, Air, and Land (SEAL) teams are basically combat divers who conduct small-unit special operation missions. One element of BUD/S is Hell Week, during which SEAL candidates are tested to the limit over five and a half days with minimal sleep and rest. Fraher et al. (53) have studied how, through meticulously planned training, SEAL candidates develop the capacity for mindfulness as a means for dealing with high-risk military operations. This study illuminates the mental strength and ability to remain composed under pressure that is crucial to dealing with the extremely demanding missions that this category of military personnel undertake. Vega Matuszczyk (23) follows a similar line of reasoning, emphasising the connection between physical training and safety climate.

So, training can be viewed as not only a means to improving individual abilities but also as fundamental to building a strong safety culture and mental readiness. The combination of physical and mental preparation is crucial to effectively managing risks and promoting a safety culture that protects personnel and ensures the success of the mission. Research also supports the contention that training plays a key role in shaping the ability of the individual and group to react quickly and mindfully to demanding situations, something that is key to safety-consciousness.

Technical monitoring
Monitoring activities has been identified as a key factor for increasing safety in several papers (33, 54, 55). These studies highlight how monitoring can influence everything from behaviour to organisational learning processes and decision-making patterns in sectors that demand a high level of trust.

Shmueli et al. (55) examine driving safety among Israeli military physicians in combat units, finding that traffic accidents were rare despite reports of dozing off while driving. The study uses a combination of self-reported data and objective measurements from an advanced driver assistance system (ADAS) to identify risky behaviour related to lack of sleep and work-related stress. The results suggest that technical monitoring systems may play an important role not only by directly influencing driver behaviour (as they are aware that they are being monitored), but also as a learning tool. Thanks to these systems, during debriefings the drivers can be given feedback on how fatigue affects their driving, and how the risk of accidents can be reduced. Similar results emerge in a study by Rosenbloom (36), in which safe driving (in the form of few accidents) is explained by the professional competence (mainly experience) of the drivers, their awareness of being monitored, and systematic safety efforts, mainly in the form of daily feedback from a superior.

Group level

Learning by acknowledging mistakes

Fraher et al. (53) adopt a group perspective on learning from and dealing with mistakes and errors. Their study focuses on operations and training in the US Navy SEALS. SEALS work in small teams to undertake specialist missions under demanding conditions in which minor errors can have major consequences.

In the study, the authors underline the importance of having systems at group level that are designed for learning in all parts. Errors and mistakes, whether during training or operations, are highlighted as learning opportunities rather than cause to apportion blame and punishment. In their study, Fraher et al. (53) offer examples of how a safety culture can be developed that is fully focused on the team as a collective always safely and effectively completing its mission. This in turn helps to shape a non-judgemental attitude when mistakes are made and helps the team to learn from these mistakes at a group level, so they can be avoided next time. In such a culture, errors and mistakes are acknowledged, as everyone is determined to avoid mistakes in critical situations. Similarly to the earlier examples from the air force (cf., for example, Firing et al., 33), pride and blame are therefore played down in favour of full focus on transparency and honesty, facilitating a supportive culture of learning (53).

Organisational level

Organisation for learning

Research demonstrates that learning is a key component of safety culture and how safety behaviour is shaped and developed (cf., for example, 33, 56, 57). The coordination of complex military systems during missions demands an established structure and a culture of learning in both peacetime and wartime. Firing et al. (33) emphasise the importance of creating structures, processes and a culture supportive of freely sharing knowledge and experience to promote good safety behaviour. There are however disparities between branches of the military and air forces appear to have developed more sophisticated and ingrained forms of organisational learning.

Firing et al. have explored debriefing as a learning tool during regular training in a fighter squadron. They identify four narratives that affect willingness to share mistakes:

- Mastery Culture – Embracing to Share Mistakes
- Safety Culture – Embarrassing to Hide Mistakes
- Performance Culture – Embarrassing to Share Mistakes
- Cloaking Culture – Negotiating Whether to Share or Hide Mistakes

The authors' conclusion is that an open debriefing process is key to creating a culture that encourages learning from mistakes. An ingrained and systematic debriefing culture thus contributes to openness and learning, as well as reducing the risk of experience and knowledge being hidden (60).

Organisation for monitoring decision-making – social redundancy
Roberts, Stout and Halpern (54) study decision dynamics on aircraft carriers, where decisions 'wander' in search of the right expertise; concerning take-off and landing, for example. Their research shows that a flexible structure is crucial to rapidly adapting to change. An organisation is collectively shaped through monitoring and overlapping roles to improve safety (see also Hutchins, 58). This is sometimes called social redundancy[4], i.e., building in multiple layers of support systems and safety nets to ensure that individuals and groups receive the help and support they need, even if one or more systems fail. The study does however highlight the potential danger of overreliance on this type of redundancy, as the components of the system are often not as independent as one might think. This argument is also supported by Bakx and Nyce (61).

Safety monitoring system
Measuring, following up and disseminating experiences of safety behaviour can be crucial to reducing risks. Papers by Lai et al. (49) and Catino and Patriotta (57) offer insights into how organisations can develop and improve their safety culture by learning from mistakes and applying scientific measurement methods to assess their safety climate.

Lai et al. (49) explore the development of a safety climate index (SCI) in the United States Navy. Their study reveals that it is possible to create a good measurement tool by asking fewer questions in a survey, without losing the ability to obtain a reliable assessment of safety onboard a vessel. By comparing SCI outcomes with real safety issues experienced onboard, the researchers saw that a higher SCI is associated with fewer reported incidents and accidents. Lai et al. (49) emphasise the importance of having a tool that can quickly provide reliable data, so that leaders can effectively make decisions that improve the safety climate.

Measuring the safety climate is however a challenge, as such instruments measure different aspects of the concept, which is by nature multidimensional. Certain instruments are used to understand how the safety climate connects to the psychological aspects of a complex military environment; for example, the instrument developed specifically for this purpose by Zohar and Luria (52). For their part, Hofmann et al. (34) have developed the Aviation Safety Climate Scale for the German Air Force. The fact that different instruments measure different aspects underline the importance of adapting safety climate measurements to specific contexts and needs. It also shows how the safety climate can be influenced by the unique characteristics of a specific work environment, hence the need to customise measurement instruments.

Several papers contribute their own unique perspectives to expand the understanding of the safety climate. Schüler and Vega Matuszczyk (23)

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4   Social redundancy is the equivalent of redundancy built into technical systems, i.e., intentionally duplicating functions or components so that a component or subsystem failure will not bring down the entire system (cf., for example, Snook, 59; Sagan, 60). One example of redundancy in a military context is fitting multiple navigation systems to aircraft, combat vehicles and ships; if a satellite-based GPS system fails, for example, there is usually an inertial navigation system to take over.

present the Military Safety Climate Questionnaire (MSCQ) and Nordic Occupational Safety Climate Questionnaire (NOSACQ-50), both of which are multidimensional instruments that provide a clear picture of the various aspects of the safety climate. This breadth of measurements makes it possible to obtain a more nuanced image of the safety culture.

Catino and Patriotta (57) focus on learning from mistakes in the Italian Air Force, emphasising the significance of cognition and emotions to the development of a safety culture. By analysing incidents in which mistakes were made, they explore how individuals and organisations process and learn from these experiences to prevent future incidents. Their work demonstrates that an open, supportive culture in which mistakes are viewed as learning opportunities is crucial to building a robust safety climate. This attitude facilitates a deeper understanding of the underlying causes of mistakes and encourages the sharing of knowledge and experience within the organisation.

While Lai et al. (49) are focused on developing quantitative measurement tools for assessing and tracking the safety climate, Catino and Patriotta (57) are more interested in the qualitative value of understanding and processing the cognitive and emotional aspects of learning from mistakes. Between them, they provide a comprehensive picture of how the safety climate in military organisations can be improved by measuring, following up and disseminating experiences of safety behaviour.

The gap between theory and reality

Under this heading, research question 3 is addressed: *How do safety regulations in policies and governance documents differ from how safety behaviour is actually dealt with, and how can this gap be bridged?*

Operational compliance

In Russell et al. (62), operational compliance is one part of a three-factor measure of safety climate. Fogarty et al. (39) demonstrate that the safety climate affects the degree of operational compliance in safety behaviour, which in turn has a direct impact on how many safety errors and safety breaches occur. While operational compliance is underlined as something worth striving for, the key is to create a safety culture that encourages safety compliance rather than a safety culture that demands operational compliance.

Roberts et al. (54) describe how organisations on two US Navy aircraft carriers resolve the dilemma of extreme counterproductive compliance, i.e., when it becomes more dangerous to follow the rules than to break them. The solution is to allow rule-breaking when strict compliance would endanger safety. The authors describe the organisation of an aircraft carrier as so complex that the system must be designed to eradicate error. This is primarily achieved through careful monitoring of activities within the system, while at the same time giving personnel decision-making latitude, personal accountability and adequate competence, regardless of rank or duties.

Roberts et al. (54) also demonstrate that decision-making that rests on this paradox of strict control and relative freedom is required in complex HROs that perform many simultaneous integrated activities balanced on the edge of risk-taking. The study highlights the conflict between the need to implement and maintain safety management systems and the autonomy and room for manoeuvre necessary for individuals to make the right decisions when confronted with the unexpected. The study offers a solution to this dilemma using an aircraft carrier as an example (54).

Learning and sociocultural aspects

Adopting an organisational perspective on learning, Catino and Patriotta (57) emphasise the importance of developing an error reporting system that not only functions as a formal case management system but is also designed to actively contribute to professional learning within the organisation. By disseminating experiences in multiple channels, one contributes to learning processes and improves safety. One example of this is the continuous stream of detailed information on incidents and accidents in the regular publication distributed to Italian Air Force pilots.

Catino and Patriotta (57) argue that the active promotion of good safety behaviour demands a safety culture in which all planning and decisions are based on Murphy's Law, i.e., that anything that can go wrong will go wrong, unless one takes precautions to prevent it. Catino and Patriotta (57) also contend that a further step in promoting safety behaviour is to make the safety culture explicit and living. The authors study safety among pilots in the Italian Air Force, highlighting how values are communicated and internalised by expressing them as maxims and principles. One key value in this type of safety culture is to actively avoid apportioning blame. According to the authors, a blame culture appears to present a significant impediment to organisational learning, creating a culture of silence that they argue is devastating to safety and development. Luria (50) demonstrates that safety management based on a good safety climate promotes trust in the organisation. Trust is also crucial to achieving psychological safety (57), one of the most important preconditions for a culture of learning.

Boskeljon-Horst et al. (56) also underline the important role psychological safety plays in avoiding blame culture and promoting learning. The authors show that a restorative, rather than retributive, just culture supports and promotes learning, and that a restorative just culture demands that leaders demonstrate moral courage. This benefits the safety culture and promotes learning above punishment.

However, according to Boskeljon-Horst et al. (56), this kind of restorative just culture does not necessarily come naturally when exercising leadership in a military context. The authors note that these two opposing approaches to a just culture, retributive and restorative, can either inhibit or assist learning from mistakes and incidents. The former is based on the idea that the correct response to an event that has caused harm or damage is retribution, as long as the consequences are proportionate. So, pain is answered with pain, according

to a classical retributive view of punishment. A restorative just culture, on the other hand, seeks to heal the damage that has been done, including repairing relationships between those involved. While both forms of just culture demand accountability, they do so in different ways: one through punishment and the other through redemption and learning. One conclusion of the study is that it can be difficult to learn from mistakes in an organisation dominated by a retributive just culture. The authors contend that military leadership has traditionally been retributive, with no ambition to foster a restorative just culture. They are also critical of hybrid forms of just culture, such as responding restoratively in a retributive context. There is only one way to promote learning, and thus good safety behaviour: one must have a safety culture based solely on restorative just culture. Otherwise, there is a risk of inhibiting or even preventing learning aimed at attaining a higher level of safety (56).

Steen et al. (37) also address the phenomenon of just culture in their study of military UAV operations, arguing that the safety management of such operations should be based on a just culture that above all focuses on how to learn from previous mistakes, rather than assigning blame or punishment. Here, it should be noted that there is obviously a place for reprimand in a restorative just culture as a means of creating learning and promoting safety. From this viewpoint, a certain amount of blame may also occasionally be considered just. Someone who places, or may place, themselves or others at unnecessary risk must always face the consequences as a stage in the learning process, and in the interests of group development. This usually involves an element of blame.

The correlation between culture and safety behaviour in military organisations finds further support in Soeters and Boer's study of culture and flight safety in military aviation (63), in which they explore the impact of national culture on flight safety in 14 NATO air forces by comparing total losses per 10,000 flying hours to national cultural scores. Their results show that higher levels of individualism are associated with fewer accidents, as personnel in more individualistic cultures tend to make autonomous decisions based on professional rather than organisational judgement.

This promotes learning as individuals draw conclusions from their own experiences and adapt their behaviour accordingly. The risk of accidents is higher in cultures that prize rules and procedures and individuals are uncertain when faced with the unknown. The avoidance of uncertainty leads to more accidents, as well as fewer opportunities to learn from unfamiliar situations. The study also shows that greater power distance may increase the number of accidents. This is because subordinates in cultures with high power distance are less inclined to question the decisions of their superiors, something that can cause critical errors and inhibit organisational learning.

Reports, investigations and other literature

Factors that promote a strong safety culture

Two examples of factors that may have an impact on safety are found in the Swedish Accident Investigation Authority's reports on two crashes involving the AS 332 Super Puma air-sea rescue helicopter, one at Rörö in November 2003 and the other at Lindö in November 2005 (64). The Rörö accident resulted in the tragic deaths of six of the seven crew members. Both reports place some of the blame for the crashes on collaboration issues due to the different organisational backgrounds of the pilot and copilot. The report on the Lindö accident (64) describes a lack of consensus between the pilots concerning operational behaviour since they had different bases of operation and had not trained together. Furthermore, investigators call attention to cultural differences within the helicopter fleet, with culture clashes and even contradictions between the military branches contributing to personnel having different perceptions of operational activities. The report on the Rörö accident (65) also highlights misunderstandings and terminological confusion within the organisation as contributory factors. The investigators describe an organisation in which misunderstandings between crew members could, at least in part, be attributed to their backgrounds in different branches of the military with different operating systems.

An international example of how safety culture and safety climate can have a negative impact on safety is provided by the Nimrod Review, an independent review into the broader issues surrounding the loss of an RAF Nimrod MR2 aircraft in Afghanistan in 2006 (Haddon-Cave, 66). Both Haddon-Cave (66) and Cockram (67) mention that the structure of the organisation failed to create the conditions for a positive, just and learning-oriented reporting culture, a situation that contributed to the crash.

These accident investigations provide examples of how structural conditions and the preconditions for safety can negatively impact actual safety. In the report on the Lindö accident, for example, reorganisations were described as characterised by stopgap solutions, a poor work environment, lack of time, high workloads and a shortage of resources, all of which had a negative impact on safety. The Nimrod crash (66, 67) is another example of how organisational shortcomings undermine safety. So, these examples describe how deficient structural conditions can adversely affect safety behaviour and safety. Börjesson et al. (69) also underline that the increasing complexity of assignments requires that recruitment, training and education be aimed at developing the ability of personnel to undertake flexible roles to a greater extent.

Interventions, practices and methods that can contribute to a good safety culture or safety behaviour

Since the beginning of the twenty-first century, Swedish research in the field of safety culture, safety climate and safety behaviour has largely addressed risk and risk-propensity (cf., for example, 73–78). Börjesson et al. (70), for example, highlight risk profiles as a vital component of safety evaluations. Börjesson

et al. (69) also illuminate the impact on regulatory compliance of employees' perceptions of the value placed on safety management by their employer, and how multiple, parallel safety climates may evolve depending on employees' backgrounds, education and previous experience of other organisations.

The gap between theory and reality

When it comes to safety behaviour, Nilsson et al. (73) underline that, in combat, events sometimes conspire to force officers to break the rules to complete the mission. The authors note the paradox that, under such circumstances, strict adherence to the rules may have a negative impact on safety. Both Nilsson et al. (73) and Larsson et al. (74) describe a safety culture in which breaches of regulations tend to be evaluated based on whether they lead to success. This is also reflected in the study by Börjesson and his colleagues (71); both Börjesson et al. and Larsson et al. (74) describe a phenomenon in Swedish peacekeeping forces in which conflict arises between the will to affect the mission and the desire to comply with safety regulations. Börjesson et al. (71) also describe a subsequent safety culture in which deviations from the regulations are not reported. This links to the definition of the term productive risk-taking in Börjesson et al. (72): the level of safety and operational compliance observed in training and exercises does not always apply to critical situations, when a risk-benefit analysis is likely to come to completely different conclusions.

Looking at leadership in an air force context, Larsson et al. (74) highlight the negative impact of trust in superiors on safety reporting. They describe a perception that superiors will accept an error once or perhaps twice, but not three times, making it more difficult to own up to mistakes and thereby learn from them. The authors also describe a strong collegial safety culture that, to some extent at least, compensates for the lack of reporting. The relatively high level of monitoring and follow-ups of flying activities conducted by air forces may also make it difficult to hide mistakes and errors, at least from the collective of colleagues. Leadership that encourages a positive reporting culture and the acknowledgement of mistakes also facilitates learning to improve safety in the organisation.

Börjesson et al. (69) demonstrate that learning is a prerequisite for an efficient, agile organisation that is capable of quickly transforming experience into generalisable knowledge and, eventually, applying it in practice.

Haddon-Cave (66) and Cockram (67) also highlight the importance of an organisation focusing on learning, positivism and a just reporting culture. Their conclusions are drawn from studying the crash of an RAF Nimrod, one significant underlying cause of which was an organisation lacking such a focus. A committed safety culture comprises a reporting culture, a just culture, a flexible culture, a learning culture, and a questioning culture. To build such a culture, one should create conditions that permit and encourage continuous critique of operational processes, and avoid blindly and uncritically following procedures (67, 66).

Sex and gender aspects

Various aspects of gender balance in the papers

A large majority of the papers have multiple authors. A minority of author groups include female authors (for example, Fogarty, 38; Börjesson, 19). There is a significant gender imbalance in the most important category about the acquisition of research qualifications, first author: only 18 per cent of the papers (5 of 28) have a female first author. The dominance of male first authors raises questions about whether the female perspective is really represented in international research in the field of safety culture and safety behaviour in military organisations. About the gender balance of participants in the papers, only 21 per cent of the papers (6 of 28) contain information on gender balance and/or gender differences among participants. In most cases, reporting of gender balance and/or gender differences is entirely lacking and, where there is information, it is generally only as a control variable.

Discussion and analysis of gender aspects in the papers

Developed reasoning about sex and gender aspects appears to varying degrees in 32 per cent of the papers (9 of 28). The variation is however great. In a few cases, there is more developed analysis of how gender differences influence the results of each study. In Börjesson et al. (19) and Börjesson et al. (40), for example, sex is one key variable, particularly when highlighting and discussing the relative propensity of male and female participants to take risks. In the method section of their paper, Hofmann et al. (75) describe gender as insignificant to the key outcome variables of the study: safety climate, leader–member exchange, safety citizenship role definitions, and safety citizenship behaviours. Shmueli et al. (55) and Kraak et al. (42) also demonstrate that gender has no significant impact on outcome variables in their studies. Sex is a background variable in Schüler and Vega Matuszcyk (23). The paper explains that the participants selected for the study reflect the gender balance of the Swedish Armed Forces as a whole.

The results show that more developed and problematised reasoning about the gender balance of participants in the studies, and/or how sex and gender aspects influence their results, is notable by its absence. For example, while Soeters and Boer (63) mention gendered roles in passing as a potential factor, no deeper analysis is performed. In a few examples, the authors of papers reflect that their male-dominated selection makes it difficult to draw any general conclusions (cf., for example, Firing et al., 76; Kjellevold Olsen et al., 41), which at least implies an awareness that a lack of perspective may skew their conclusions.

Summary of results

Research question 1: *What factors in the work environment at the individual, group and organisational levels promote a strong safety culture?*

Individual level

- *Experience as a key factor:* Personal experience and length of service strengthen safety-consciousness and promote a culture in which mistakes are viewed as learning experiences, especially through debriefing and sharing experience in a professional context.
- *Psychological strain:* Chronic psychological stress can have a negative impact on the safety climate. Balancing the demands of the job with resources can however mitigate the impact of stress and support compliance with safety regulations.
- *Individual variation:* Personal characteristics such as risk appetite, age and sex affect safety behaviour. Young people and men tend to take a more sceptical view of safety, while experience and age reduce the appetite for risk.
- *Links between employment relationship and safety:* When an employer fulfils its psychological contract with its employees, compliance with safety regulations increases, as does the desire to remain in the service, contributing to a stable and safe work environment.

Group level

- *Group dynamic and communication:* A transformative leadership style that promotes communication and bonds of friendship within the group reinforces the safety climate, creating the conditions for personnel to share safety-related information and lessons, which in turn improves safety behaviour.

Organisational level

- *Safety climate:* A positive safety climate creates a safer workplace. Creating and maintaining a positive safety climate demands commitment from management, clear communication regarding safety, continuous monitoring, relevant training initiatives and a reward system. Feedback to personnel increases safety awareness and promotes compliance with safety standards.

Research question 2: *What interventions, practices, or methods have been shown to contribute to a good safety culture or safety behaviour at the individual, group, or organisational levels within military operations?*

Individual level

- *Training:* Relevant training develops mental and physical preparedness to deal with risks. Training not only develops individual capabilities, it also strengthen the safety culture in general.

- *Technical monitoring:* Advanced monitoring systems, such as advanced driver-assistance systems, can help to reduce the risk of accidents, by both directly influencing driver behaviour and offering insights for learning in performance reviews.

- *Feedback:* Feedback can be an effective means of improving safety, giving military personnel opportunities to gain immediate insights into their own behaviour and adjust accordingly. A structure for systematic feedback strengthens behavioural safety under stress and reduces the risk that psychological pressure will lead to safety breaches.

Group level

- *Learning by acknowledging mistakes:* A culture in which mistakes are opportunities for learning rather than for apportioning blame promotes safety. The group's attitude is shaped in an environment that emphasises transparency and honesty, opening the way to sharing mistakes and experiences.

Organisational level

- *Organisation for learning:* A culture that facilitates structured debriefing processes and experience-sharing reinforces safety by creating an open learning environment. An organisation in which roles and responsibilities overlap provides a robust safety system and facilitates rapid adaption to change.

- *Safety monitoring system:* Effective measurement instruments and reporting systems contribute to the continuous improvement of the safety culture by providing management with quick access to data, facilitating rapid and effective decision-making to maintain and improve the safety climate.

- *HRO principles:* A high reliability organisation (HRO) is an organisation that has succeeded in maintaining a high level of safety in a complex, high-risk environment by following five principles: preoccupation with failure, reluctance to simplify, sensitivity to operations, commitment to resilience, and deference to expertise. By integrating these principles, an HRO can build a culture of continuous learning and improvement, strengthening its capacity to safely manage risks.

Research question 3: *How do safety regulations in policies and governance documents differ from how safety behaviour is actually dealt with, and how can this gap be bridged?*

Operational compliance

- Operational compliance and the safety climate: A safety climate that encourages regulatory compliance without excessively demanding it creates more sustainable safety behaviour. Some rule-breaking flexibility should be permitted if strict adherence to the rules poses a safety risk. This creates a balance between regulation and decision-making latitude.

Learning and sociocultural aspects

- Reporting culture and learning: A culture that emphasises learning and open reporting, without apportioning blame, is a safer culture. A just culture in which mistakes are viewed as learning opportunities rather than cause for punishment promotes psychological safety and an awareness of safety that encourages individuals to report and learn from mistakes.

Gender aspects

Male authors dominate the papers reviewed here. Only 18 per cent of papers have a female first author, raising questions about the extent to which a female perspective is represented in research into safety culture and behavioural safety in military organisations. The gender balance among participants is reported in a small percentage of the papers and, when it is, it is usually used solely as a control variable without deeper analysis. Gender aspects are only marginally highlighted in 32 per cent of the papers with, for example, an in-depth analysis, indicating that any discussion of gender is generally missing from these papers.

4. Discussion of results

Factors in the work environment at the individual, group and organisational levels that promote a strong safety culture

The importance of the safety climate to safety
As the measurable expression of safety culture, safety climate is highly prominent in both national (22, 23) and international research (25, 39, 52). However, there may be reason to problematise safety climate surveys and how they are used. Guldemund (17), Silbey (18) and Antonsen (15) all question the wisdom of unreflectingly using these instruments in practice in organisations without adequate knowledge of the complex web of factors that influence safety, or the way in which the safety culture might influence safety behaviour within the organisation. Safety climate surveys do not capture critical safety mechanisms such as authority, obedience or group dynamics. Antonsen (16) adresses issues of power and conflict in organisations and their relationships to safety culture, noting that having conflicting views on safety can promote learning that helps to increase safety. Relying solely on safety climate surveys to determine an organisation's ability to promote good safety may present a one-dimensional, oversimplified picture. Another study by Antonsen (15) reveals that a high result in a safety climate survey can be misleading and give a false impression of the organisation as safer than it is, which can lead to real safety issues not being identified and addressed. This shows that it is far from easy to measure, interpret and draw conclusions from surveys such as the Nordic Safety Climate Questionnaire (23, 77). So, to truly understand how safety behaviour is shaped, short-term and cross-sectional safety climate surveys should be supplemented with other data and other methods, preferably with a long-term perspective. This will provide a more comprehensive and deeper understanding of how good safety behaviour is encouraged and how a high level of safety can be developed (cf., for example, Antonsen, 15, 16; Guldenmund, 17; Silbey, 18).

Structural conditions and the influence of the individual on safety management
Both structural and individual factors help to create and maintain safety (cf., for example, Snook, 59). Given that we are born into social and cultural structures (cf., for example, Archer, 78), it is reasonable to assume that the safety climate in the military is deeply rooted in this historical, social and organisational framework. Perrow (79) argues that the complexity of the structures that constitute, for example, military organisations, is fundamental to defining what are considered safe behaviour, procedures and policies. These structures are the foundation of safety management, where values, norms and expectations are shared collectively. At the same time, Archer (78) argues that individuals too play an important role within these structures that is crucial to reproducing – i.e., behaving in a manner that maintains existing attitudes and practices – or changing the safety climate. The results reproduced in this literature review show that trust is one important prerequisite for unleashing the power of the individual; trust begets psychological safety and what Amy Edmonson calls the "fearless organisation" (80).

Developing an effective safety culture demands a balance between stable, predictable structures and individual room for manoeuvre (cf., for example, Dekker, 81). This may mean having clearly defined safety norms alongside the flexibility for individual contributions and adaptions. By investing in training, supporting open dialogue, encouraging critical thinking and acknowledging mistakes, military organisations can create an environment in which structures and individuals interact to improve safety (56). This shows that a good safety culture and safety behaviour – which in turn contribute to a good work environment – are created at various levels of the organisation, and that all levels must be involved and active. The literature review reveals several good examples of how to find the necessary balance between stability and flexibility to achieve good safety management, in the air force in particular but also in special forces organisations, both generally and internationally (56, 57, 59).

Leadership and management for safety
Many of the papers in this literature review highlight leadership, leadership style and management as key factors in achieving a safe military organisation (43–47). Bass and Riggio (82) and Yukl (83) argue that it can be both difficult and meaningless to differentiate between leadership and management in the everyday application of the terms. According to Antonakis (84), good leadership requires a stable and rational management structure based on honouring obligations and commitments. Bass et al. (85) describe this as the transactional component of leadership. According to Antonakis (84), transactional leadership can provide a solid foundation. However, improving results demands a leadership style that goes beyond the purely transactional. This view is reflected in the results of several papers that highlight the necessity of both transactional and transformative leadership styles to creating a strong safety culture and good safety behaviour (45–47). The results in the literature review indicate that there may be complex causal relationships between transactional and transformative leadership in terms of how they influence safety culture and safety behaviour, see Zohar and Tenne-Gazit (47) for example.

Interventions, practices and methods that can contribute to a good safety culture or safety behaviour

Safety management in day-to-day operations: Integration and reflection
The research described in this literature review highlights two complementary working methods designed to ensure and develop safety: integration into day-to-day military operations (50, 54, 55) and a more spontaneous approach (36, 56, 76). In other words, safety management needs to be viewed as a natural element of daily operations, integrated into activities, processes and decision-making.

Several papers also note that more forward-looking safety management with structures and processes that allow personnel to regularly reflect on and learn from their experiences promotes safety through continuous learning and improved procedures and attitudes. In practice, this can be achieved through debriefings and follow-up measures (55–57).

A combination of these two approaches – integrating the practical application of safety measures into day-to-day operations while providing space for reflection and learning – can strengthen the ability to adapt to and deal proactively with safety challenges. This is not to ignore the fact that the dynamic nature of warfare may involve significant changes to safety assessments depending on the mission, situation and choice of means and methods.

Train as you fight and safety management
The reality of the demands that war and combat impose in terms of the risk-taking and safety-consciousness required to win the battle is described above. One fundamental principle of military training is train as you fight – to train under the most realistic conditions possible to prepare soldiers and sailors for the risks and challenges they will face on the battlefield (53). This principle underlines that training must not only simulate the physical and tactical environments of warfare but also interweave the cognitive and emotional strain that personnel will face. In this approach, the combination of risk-taking with safety-consciousness must be an integrated and natural element of the training process, as realistic preparation demands an understanding and assessment of, and the ability to deal with, the risks involved in real combat situations.

Training linked to safety management
While training clearly plays a key role in strengthening safety culture and safety behaviour (23), the design of training activities is vital to achieving a good result. Fraher et al. offer an example of how success can be achieved in their study of the US Navy's BUD/S programme (53), demonstrating that SEALs are fully prepared for the challenges and risks they will encounter in the field while maintaining the highest possible safety standards. One risk associated with training and exercises is that they may focus solely on winning, meaning that important safety aspects may be overlooked, which may present a danger, see for example Schüler (77).

The gap between theory and reality

The literature review reveals a disconnect between formal safety regulations in policies and governance documents and how safety behaviour is actually dealt with in practice. While these regulations are designed to ensure a safe work environment, they are difficult to apply strictly in complex and unpredictable situations. This may force personnel to break the rules to affect their mission, as noted by Roberts et al. (54).

Overall, the papers included in the literature review suggest that developing a safety culture that promotes flexibility, learning and open communication is crucial to bridging the gap between policy and practice. Roberts et al. (54) illustrate this point by describing how US Navy aircraft carriers manage the risk that excessive operational compliance will prove counterproductive to safety by permitting deviation from the rules when strict compliance may compromise safety. The solution is to combine a high level of monitoring with individual

discretion and accountability, giving personnel the ability to make informed decisions when faced with the unexpected. Decision-making that rests on this paradox of strict control and relative freedom is required in complex systems that perform many simultaneous integrated activities balanced on the edge of risk-taking (54).

The knowledge compilation also reveals that developing a learning culture is crucial to bridging the gap between safety regulations and how safety behaviour is actually dealt with. Catino and Patriotta (57) emphasise the importance of having a reporting system that not only processes formal cases but also contributes to professional learning by disseminating experiences in multiple channels. They argue that a safety culture should be based on Murphy's Law – anything that can go wrong, will go wrong – and the need to actively work preventively.

Another important aspect that emerges from the literature is the importance of resisting a blame culture. Boskeljon-Horst et al. (56) show that a blame culture can inhibit learning by creating an environment in which employees are afraid to report mistakes. To promote good safety behaviour, they recommend a restorative just culture that supports and encourages learning. This demands that leaders within the organisation have the moral courage to focus less on punishment and instead emphasise the importance of learning from mistakes. The authors caution against a hybrid form of just culture that combines the retributive with the restorative; only a fully restorative just culture will promote learning (56).

The literature review underlines that developing psychological safety is crucial to promoting a learning culture. Luria (50) demonstrates that safety management based on a good safety climate promotes trust in the organisation.

In summary, the literature review reveals that, to effectively bridge the gap between safety regulations and actual safety behaviour, organisations should do the following:

- *Allow flexibility in operational compliance*: Allow personnel to deviate from the rules when necessary to maintain safety and give them the latitude to make informed decisions when faced with complex scenarios.

- *Promote a learning culture*: Implement reporting systems that encourage openness and learning, thus ensuring that mistakes are viewed as learning opportunities rather than reason for reprimand.

- *Develop psychological safety:* Create a work environment in which personnel can feel secure in reporting mistakes and expressing concerns without fear of negative consequences, something that is key to continuous learning and improved safety.

- *Adaptive leadership:* Leaders should actively promote a restorative just climate and support a culture in which learning and safety are prioritised over strict operational compliance.

Combat puts demands on safety

Warfare is by nature in constant flux and often driven primarily by technological advances. Once successful strategies can therefore quickly become redundant. One way to develop and improve safety is by consciously taking risks to constantly investigate how safety can be achieved (cf., for example, Wildavsky, 86), with the emphasis on adaptability, renewal and constantly exploring and balancing risks.

Sex and gender aspects

The results reveal a striking lack of gender mainstreaming in research into safety culture and safety behaviour in military organisations, which generally tends to be gender neutral (for example, Fogarty, 38; Zohar & Tenne-Gazit, 47; Catino & Patriotta, 57), rendering sex and gender invisible. Where data is gender disaggregated, it is mostly only as a control variable, although there are exceptions such as Börjesson et al. (40). In what is traditionally a male-dominated military context, it is argued that these factors are highly significant. If sex and gender perspectives are not considered, there is a risk that research into safety culture and safety behaviour in military organisations will overlook significant differences in safety behaviour between women and men, as well as how gender norms influence the actions of individuals in high-risk situations. An inclusive perspective should be able to contribute a more nuanced understanding of the dynamics of safety culture and make it possible to adapt strategies to improve safety for everyone in the military.

Methodological challenges to studying safety in a military context

Studying safety under fire

The results reveal a significant shortage of papers of safety culture and safety behaviour under fire. It should be noted at the outset that different branches of the military have different conditions in this regard (59). Even in peacetime, navies and, to an even greater extent, air forces operate in an environment and under conditions that do not differ significantly from missions during wartime or conflict. Even under 'normal' peacetime conditions, these environments are relatively high-risk. The day-to-day routine of military units not involved in manoeuvres, wargames or combat usually revolves around training and guard duty. The selected papers of army units include both conscripts and professional soldiers. This differs somewhat from the other branches: studies of navy operations mainly focus on serving sailors or cadets (mainly during exercises or training), while studies of air operations focus mainly on flight crew serving in the air force. There is grey area between exercises/training and combat in studies of air forces. This may partly explain the relative differences between air force, navy and army in both the number of papers and their contexts and focus.

In his doctoral thesis, Schüler (77) notes that, in an environment characterised by training and exercises, there is a risk that safety will be perceived as an extraneous burden imposed on normal operations. Schüler argues that in such environments safety and, above all, the need to develop safety through learning, may not be integrated as a natural part of the planning and implementation of combat. According to Schüler, it is not entirely clear whether this approach is applicable to the reality in which the knowledge is intended to be applied. There is a risk that training and exercises fail to reflect the reality that the military is subjected to. For example, it may mean a narrow focus on safety as it applies in peacetime, with the risk of losing sight of what is important in actual combat when one must take the necessary risks to win the battle or war (77).

The absence of papers situated in a war or conflict environment suggests that safety culture, safety climate and safety behaviour have not been adequately studied in environments with deployed units engaged in action. It is possible that, in part, shortcomings in the data in this literature review can be explained by the choice of terminology and the parlance used in these environments; perhaps including the terms risk and risk-taking would have provided a different result. Researchers clearly face a challenge when it comes to studying safety in this type of environment, not least methodologically but also given the obvious risk to personal safety. Another factor is the rapid technological and tactical development that further complicates battlefield safety and safety behaviour on the battlefield. For example, in a relatively short time, drones have made the battlefield transparent in a manner approaching a paradigm shift for ground warfare. A skilled pilot operating a modern drone can even navigate in dense forest, hence all movements close to the frontline must be presumed to be under surveillance by drones resulting in particular demands on safety and safety behaviour.

5. The state of research and identified knowledge gaps

The literature review indicates shortcomings in the state of research into the concepts of safety culture, safety climate and safety behaviour. Cutting-edge research in the field is mainly limited to the United States, Israel and, to some extent, Australia. Meanwhile, a western and northern European perspective on these phenomena is largely lacking. Existing papers suggest several knowledge gaps that need to be addressed. The results of the searches conducted in preparation for literature review revealed few papers that explore safety culture and safety behaviour in a specifically Swedish military context.

Another tendency in the papers selected for the literature review is that papers focused on the individual and organisational levels are relatively well represented. There are, however, fewer papers focused on the group or team level, or other comparable organisational units. A group/team perspective is important in a military context, hence future research needs to focus on this perspective.

Another noticeable trend is the dominance of cross-sectional studies. There are relatively few papers that look at causality over time, such as how leadership and safety culture influence safety behaviour in practice. So, more longitudinal studies are needed, but also studies focused on the relationship between causal factors and outcomes in the form of good safety behaviour, as well as studies with a holistic system perspective.

There is also a lack of papers exploring safety challenges and trials in military organisations that conduct operations with other systems, such as other types of armament, other branches of the military, or other nations within the framework of NATO. It may, however, prove challenging to conduct exercises involving different organisations, as they have different conditions and training needs. For example, a high reliability organisation characterised by repetitive, routine operations (54) has different training and exercise needs than a critical action organisation (87) that engages in extreme events such as armed conflict, with the concomitant higher risk of errors or deviations.

Furthermore, the results reveal a lack of research into strategic and military policy decisions and the impact these have on safety, hence this relationship could not be explored in depth. It is possible that this is the result of a methodological flaw in the choice of search strings. This lack of research does however reveal a shortage of studies into how policymakers influence safety culture and safety behaviour. It is therefore important that future research focuses on filling this knowledge gap by, for example, integrating multidisciplinary perspectives and analysing in-depth case studies.

This literature review also highlights the learning perspective as a key factor linked to safety culture and safety behaviour. However, the results show that relatively few studies have specifically adopted a learning perspective on military organisations, much less military organisations in combat. One approach to future studies would therefore be to take a closer and more specific look at learning processes in military organisations and what shapes effective learning processes that encourage good safety behaviour in both peacetime and wartime.

Finally, future studies need to highlight a sex and gender perspective. The results reveal a significant lack of gender theory in this research field, creating a knowledge gap caused by the dearth of studies that clearly adopt a problematised, developmental perspective on sex and gender. Sex and gender aspects should have a natural place in the research field when it comes to building knowledge about safety culture and safety behaviour.

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7. Appendices

1. Included studies

Table 6. Studies included in the results

Title	Year	Authors	Journal	Country	Purpose, partici-pants, period	Method and material	Main results
A demands–resources view of safety climate in military aviation	2018	Fogarty, G.J., Cooper, R., & McMahon, S.	*Aviation Psychology and Applied Human Factors*	Australia	Army, EOD team	Quantitative, survey n = 272	Development of a measurement instrument in a military UXO organisation.
Bifactor modeling as-sessment of a safety climate index using item response theory.	2023	Lai, K., Jameson, J.T., Biggs, A.T., Roma, P.G., & Russell, D.W.	*Safety Science*	USA	Navy, ships crews	Quantitative, survey n = 11,295	New scales, Afloat Safety Climate Assess-ment Survey (ASCAS), three factors for safety culture.
Climate as a moderator of the relationship be-tween leader-member exchange and content specific citizenship: Safety climate as an exemplar	2003	Hofmann, D.A., Morgeson, F.P. & Gerras, S.J.	*Journal of Applied Psychology*	USA	Army, transport unit	Quantitative, survey n = 127	Quality of LMX can be linked to safety climate to improve safety (interaction effect).
Climate as a Social-Cognitive Construction of Supervisory Safety Practices: Scripts as Proxy of Behavior Patterns.	2004	Zohar, D., &Luria, G.	*Journal of Applied Psychology*	Israel	Army, platoon	Quantitative, survey n = 2,024	Linking management and leadership to safety climate.
Climate strength – How leaders form consensus.	2008	Luria, G.	*Leadership Quarterly*	Israel	Army, brigade	Quantitative, survey n = 2,524	Explore the impact of trust on the umber of injuries and safety climate.
Culture and Flight Safety in Military Aviation.	2000	Soeters, J.L., & Boer, P.C.	*The International Journal of Aviation Psychology*	NATO	Air force, flight crew	Quantitative, accident and incident data	How dimensions of national cultu-re (Hofstede) are reflected in number of incidents and accidents.
Decision Dynamics in Two High Reliability Military Organizations	1994	Roberts, K.H., Stout, S.K., & Halpern, J.J.	*Management Science*	(14 NATO countries)	Navy, aircraft car-riers	Meta-study based on empirical quantitative and qualitative metadata.	How accountability affects decision quality to achieve safety – Skin in the game.
Development and testing of a tool to measure the organizational safety climate aboard US Navy ships.	2022	Russell, D.W., Russell, C.A. & Lei, Z.	*Journal of Safety Research*	USA	Navy, ships crews	Quantitative, survey n = 4,042	New scales, Afloat Safety Climate Assess-ment Survey (ASCAS), three factors for safety culture.
Development and Valida-tion of a Safety Climate Scale for the German Armed Forces.	2022	Nitzschner, M.M., Reeb, C., & Erley, O.	*Psychological Test Adaptation and Development*	USA	Air force, flight crew	Quantitative, survey n = 989	Validation of ASCAS, sociotechnical perspective on safety climate.

Title	Year	Authors	Journal	Country	Purpose, participants, period	Method and material	Main results
Driving safety among Israeli military physicians in combat units.	2006	Shmueli, O., Zabarsky Shasha, G. & Rosenbloom, T.	*Traffic Injury Prevention*	Germany	Army, lorry drivers	Quantitative, survey n = 64	Despite measured high-risk behaviour, there are few accidents, demonstrating a high safety climate.
Job burnout, effort-reward imbalance and time pressure as predictors of safety among military truck drivers.	2022	Rosenbloom, T.	*Journal of Transport and Health*	Israel	Army, lorry drivers	Quantitative, survey n = 56	Stress does not automatically lead to poor safety behaviour (traffic and drivers).
Learning from Errors: Cognition, Emotions and Safety Culture in the Italian Air Force.	2013	Catino, M., & Patriotta, G.	*Organization Studies*	Italy	Air force, flight crew (pilots)	Qualitative, interviews and observations	How debriefing works as a method/tool for organisational learning and strong safety culture. "Knowledge hiding" as a concept
Learning from the complexities of fostering a restorative just culture in practice within the Royal Netherlands Air Force.	2023	Boskeljon-Horst, L., Snoek, A., & van Baarle, E.	*Safety Science*	Netherlands	Air force, flight crew (pilots)	Qualitative, focus group and interviews	Retributive vs. restorative just culture. Just culture as a foundation for good safety culture.
Linking active transactional leadership and safety performance in military operations.	2017	Martínez-Córcoles, M., & Stephanou, K.	*Safety Science*	Greece	Army, paratroopers	Quantitative, survey n = 181	Exploring how transactional leadership contributes to safety and safety behaviour.
Military unmanned aerial vehicle operations through the lens of a high-reliability system: Challenges and opportunities.	2023	Steen, R., Haheim-Saers, N., & Aukl, G.	*Risk Hazards & Crisis in Public Policy*	Norway	Army, UAV unit	Qualitative, interviews and document studies	Using the principles of HROs to organise with the focus on new UAV technologies.
Working on Actions in Performance. Discovering how US Navy SEALs build capacity for mindfulness in High-Reliability Organizations (HROs)	2017	Fraher, A.L., Branicki, L.J., & Grint, K.	*Academy of Management Discoveries*	USA	Navy, special forces	Qualitative, longitudinal, interviews and vide recordings	"Mindfulness in action" and attitudes to errors as a safety mechanism.
Multi-Domain instrument for safety Climate: Military safety climate questionnaire (MSCQ) and NOSACQ-50	2022	Schüler, M., & Vega Matuszczyk, J.	*Safety Science*	Sweden	Professional personnel in all branches of the military	Quantitative, survey, experiment n = 956 + 377	New scales (MSCQ & NOSACQ-50) with seven different dimensions of safety climate.
Organizational Learning Through Debriefing: The Process of Sharing and Hiding Knowledge.	2020	Firing, K., Owesen, V., & Moen, F.	*Scandinavian Journal of Military Studies*	Norway	Air force, flight crew (pilots)	Qualitative, interviews and observations	Studying links between learning and safety culture. Links to cognitive and emotional factors.
Passive avoidant leadership and safety non-compliance: A 30 days diary study among Naval cadets.	2021	Kjellevold Olsen, O; Hetland, J., Berge Matthiesen, S., Løvik Hoprekstad, Ø., Espevik, R., & Bakker, A.B.	*Safety Science*	Norway	Navy, officer training	Quantitative, survey + diary n = 78	The impact of day-to-day operational leadership on safety when passive leadership is a hazard.
Psychological strain mediates the impact of safety climate on maintenance errors.	2005	Fogarty, G.J.	*International Journal of Applied Aviation Studies*	Australia	Army, helicopter maintenance	Quantitative, survey n = 146	Examples of how stress mediates/affects safety climate and results in multiple cases.

Title	Year	Authors	Journal	Country	Purpose, participants, period	Method and material	Main results
Risk and Safety Attitudes Among Conscripts During Compulsory Military Training	2011	Börjesson, M., Österberg, J., & Enander, A.	*Military Psychology*	Sweden	Army, conscripts from a training/logistics regiment	Quantitative, longitudinal, survey n = 389	Balanced, safety-oriented leadership has a positive impact on safety behaviour. Risk-oriented leadership increases risk-taking.
Risk propensity within the military: a study of Swedish officers and soldiers	2015	Börjesson, M., Österberg, J., & Enander, A.	*Journal of Risk Research*	Sweden	Army, conscripts and officers from a training/logistics regiment in the Nordic Battle Group (NBG)	Quantitative, survey Two groups: n = 131, n = 38.	Propensity to take risks declines with age, and the difference between women and men. Recklessness, reflecting an inability to think ahead and anticipate consequences, was positively related to risk-taking.
Safety climate in defence explosive ordnance: Survey development and model testing	2017	Fogarty, G.J., Murphy, P.J., & Perera, H.N.	*Safety Science*	USA	Flight crew in all branches of the military	Quantitative, survey n = 28,000	Job-demand-resource framework linked to how to define safety climate
The relationship between safety climate and recent accidents: Behavioral learning and cognitive attributions	2006	Desai, V.M., Roberts, K.H., & Ciavarelli, A.P.	*Human Factors*	USA	Navy, flight crew	Quantitative, survey n = 6,361	One perspective on how previous experience affects the safety climate.
The role of organizational and individual variables in aircraft maintenance performance	2004	Fogarty, G.J.	*International Journal of Applied Aviation Studies*	Australia	Army, helicopter maintenance	Quantitative, survey n = 240	Explores the influence of psychological factors and health. Defines the terms *safety climate* and *safety culture*.
The social aspects of safety management: Trust and safety climate	2010	Luria, G.	*Accident Analysis and Prevention*	Israel	Army, brigade	Quantitative, survey n = 2,389	Model for the impact of leadership style and social interaction on safety climate.
Transformational Leadership and Group Interaction as Climate Antecedents: A Social Network Analysis.	2008	Zohar, D., & Tenne-Gazit, O.	*Journal of Applied Psychology*	Israel	Army, infantry unit	Quantitative, survey n = 1,328	Transformational leadership improves safety behaviour.
Turnover intentions and safety compliance in the military: A psychological contract perspective	2023	Kraak, J.M., Griep, Y., Barbaroux, P., & Lakshman, C.	*Business Research Quarterly*	Europe	A study of the relationship between the psychological contract, turnover intentions and safety compliance in the air force, both aircrew and groundcrew.	Quantitative, survey n = 1,593	The fulfilment of the psychological contract (six dimensions) by the organisation is positively associated with safety compliance.

2. Excluded full texts and the reasons for exclusion

Table 7. Summary of full texts excluded from the literature review results section, the reason for exclusion and examples of excluded papers.

Excluded	Number of studies	Reasons for exclusion (based on PEO criteria)	Number	Examples of excluded full texts
Excluded based on title or abstract	1 418			
Excluded on the grounds of duplication	86			
Excluded on the grounds of relevance	269	Wrong organisational context	151	Stucky, C. H., De Jong, M. J., & Kabo, F. W. (2020). Military Surgical Team Communication: Implications for Safety, *Military Medicine, 185*(3), pp.448–456.
		Wrong focus (not focused on risks to life and health)	77	Hunt, D. (2023). The risk of risk assessments: Investigating dangerous workshop biases through a socio-technical systems model, *Safe-ty Science*, https://doi.org/10.1016/j.ssci.2022.105918.
		Wrong country/geographical area	23	Jung, H., Lee, S., & Sohn, Y. W. (2015). The influence of safety-specific transformational leadership on the safety behaviors, *Korean Journal of Industrial and Organizational Psy-chology, 28*(2), pp.249–273.
		Konceptuella eller Conceptual or literature review (no empirical basis)	18	Bakx, G., & Nyce, J. (2017). Risk and safety in large-scale sociotechnological (military) sys-tems: a literature review, *Journal of Risk Re-search, 20*(4), pp.463–481.
Excluded on the grounds of poor quality	7		7	Porte, T. L., & Consoloni, P. (1998). Theoretical and operational challenges of "high-reliability organizations": Air-traffic control and aircraft carriers, *International Journal of Public Administration, 21*(6-8), pp.847–852.
Total number excluded	1780			

3. Overview of journals, databases and publication trends

The publication frequency in various journals as well as the contribution of databases to the selection and also publication trends over time have been studied in order to identify important publications and main actors in these fields of research. The literature review provides a broad picture of where and how research on safety issues has been shaped over recent decades. The following charts and tables provide a detailed overview of this data analysis and the insights that have been drawn from the compiled literature.
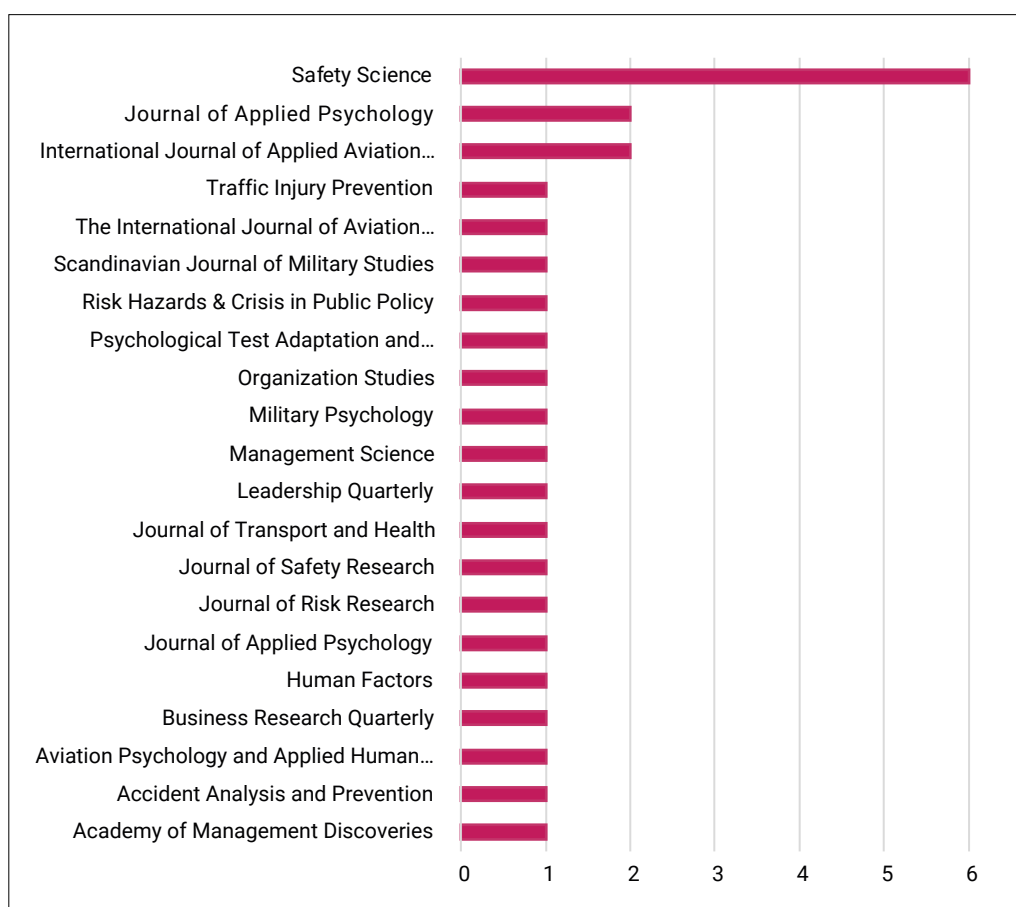

Figure 3. Distribution of selected papers across journals

One thing that emerges clearly from the systematic literature review is that the research is dispersed across a wide range of journals. The histogram in figure 3 illustrates the distribution of the scholarly papers in the final selection, sorted by number of publications per journal. *Safety Science* is the most frequently cited journal, reflecting its significance and relevance within the field. Next on the list are the *International Journal of Applied Aviation Studies* and *Journal of Safety Research*, both of which contribute key insights to the discussion of safety culture in the work environment.

Not only do the data show which journal is most influential within the field, they also give some indication of the breadth of the research being conducted. The diversity of journals represented here confirms that the literature review covers many different fields in the available literature. The histogram offers a snapshot of the publications that form the cornerstones of the research synthesis and are thus an important part of the data in the literature review.
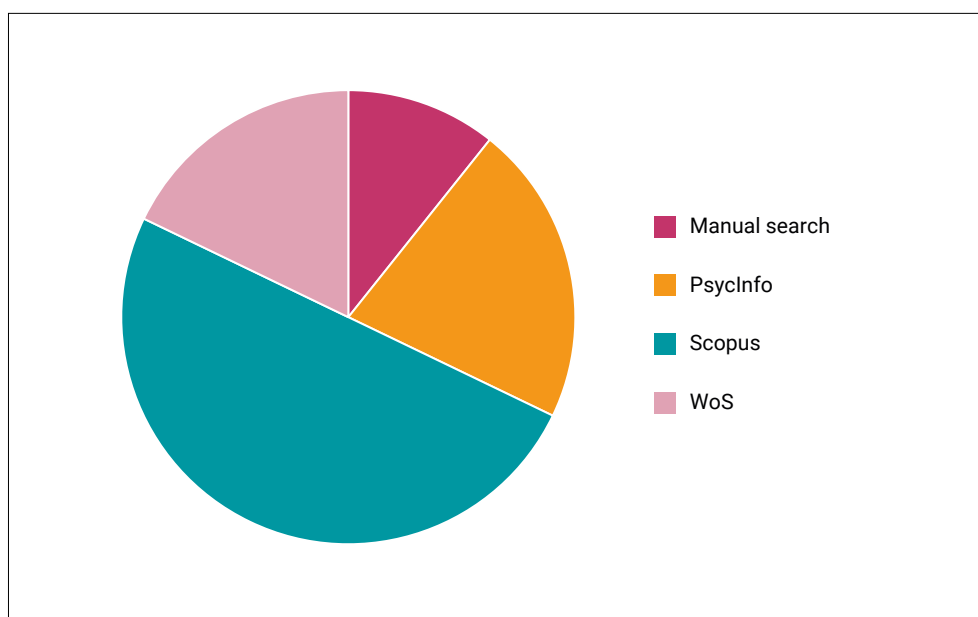
Figure 4. Distribution of selected papers across databases

The pie chart shows the distribution of the origin of the papers in the systematic literature review across three databases, as well the manual search, see figure 4. Scopus contributed the largest number of papers, with 14 references. PsycInfo contributed six papers, while WoS contributed five. The manual search returned three papers. Although Scopus returned the largest volume of papers, it is the combined insight gained from all three databases that provides a comprehensive and multifaceted view of the current research landscape and strengthens the systematic review in terms of quality and breadth.

Figure 5. Year of publication of selected papers

Figure 5 shows a notable trend. According to the diagram, the data range from 1994 to 2023. While there are annual variations, the diagram shows a weak upward tendency in the number of publications, with a significant increase over recent years. This gradual increase in the volume of literature may indicate growing interest in research in the field of safety, The most prominent rise was during 2023, possibly reflecting a response to current global challenges. This underlines the importance of continued research and development in the field.

Table 8. Distribution of journals based on main methodology and each paper's geographical focus/object of study

Country	Qualitative	Quantitative	Total per country
Australia		3	**3**
Europe		1	**1**
Greece		1	**1**
Israel		6	**6**
Italy	1		**1**
Netherlands	1		**1**
NATO (14 countries)		1	1
Norway	2	1	**3**
Sweden		3	**3**
Germany		1	**1**
USA	2	5	7
Total	**6**	**22**	**28**

TTable 8 presents an overview of qualitative and quantitative research by country and/or geographical focus for each paper included in the results section of the report. The United States is covered by most papers, seven in total with two qualitative studies and five quantitative. In second place is Israel, with a total of six quantitative papers, followed by Australia, Sweden and Norway, each with three papers. This geographical distribution of research offers some insight into which regions are contributing to the global knowledge base on safety in the military.

4. List of search strings

Table 9. List of search strings, databases and number of papers

Date of search	Database	Field	Search string	Articles
20230829	Scopus (step 1)	Title, summary and keywords	(TITLE-ABS-KEY (military OR "armed forces" OR navy OR army OR "air force") AND TITLE-ABS-KEY ("safety climate" OR "Safety culture" OR "safety behav*" OR "safety leadership" OR "high reliability" OR "safety performance" OR ("socio tech*" AND safety)))	n= 1 092
07.09.2023	Scopus (step 2)	Title, summary and keywords	(TITLE-ABS-KEY (military OR "armed forces" OR navy OR army OR "Air force") AND TITLE-ABS-KEY ("Safety climate" OR "Safety culture" OR "safety behav*" OR "safety leadership" OR "high reliability" OR "safety performance" OR ("socio tech*" AND safety))) AND (EXCLUDE (SUBJAREA,"MATH") OR EXCLUDE (SUBJAREA,"PHYS") OR EXCLUDE (SUBJAREA,"MATE") OR EXCLUDE (SUBJAREA,"ENER") OR EXCLUDE (SUBJAREA,"EART") OR EXCLUDE (SUBJAREA,"CHEM") OR EXCLUDE (SUBJAREA,"ENVI") OR EXCLUDE (SUBJAREA,"CENG") OR EXCLUDE (SUBJAREA,"ECON") OR EXCLUDE (SUBJAREA,"BIOC") OR EXCLUDE (SUBJAREA,"AGRI") OR EXCLUDE (SUBJAREA,"VETE") OR EXCLUDE (SUBJAREA,"PHAR") OR EXCLUDE (SUBJAREA,"IMMU") OR EXCLUDE (SUBJAREA,"DENT") OR EXCLUDE (SUBJAREA,"COMP")) AND (EXCLUDE (DOCTYPE,"cp") OR EXCLUDE (DOCTYPE,"cr") OR EXCLUDE (DOCTYPE,"no")) AND (EXCLUDE (LANGUAGE,"Chinese") OR EXCLUDE (LANGUAGE,"Undefined") OR EXCLUDE (LANGUAGE,"Persian") OR EXCLUDE (LANGUAGE,"Korean") OR EXCLUDE (LANGUAGE,"German") OR EXCLUDE (LANGUAGE,"French") OR EXCLUDE (LANGUAGE,"Turkish") OR EXCLUDE (LANGUAGE,"Russian") OR EXCLUDE (LANGUAGE,"Polish")) AND (EXCLUDE (AFFILCOUNTRY,"China") OR EXCLUDE (AFFILCOUNTRY,"South Korea") OR EXCLUDE (AFFILCOUNTRY,"Saudi Arabia") OR EXCLUDE (AFFILCOUNTRY,"Pakistan") OR EXCLUDE (AFFILCOUNTRY,"South Africa") OR EXCLUDE (AFFILCOUNTRY,"Singapore") OR EXCLUDE (AFFILCOUNTRY,"Serbia") OR EXCLUDE (AFFILCOUNTRY,"Malaysia") OR EXCLUDE (AFFILCOUNTRY,"Iran") OR EXCLUDE (AFFILCOUNTRY,"Thailand") OR EXCLUDE	n= 219
27.10.2023	WoS (step 1)	Title, summary and keywords	TS=(military OR "armed forces" OR navy OR army OR "Air force")) AND TS=("Safety climate" OR "Safety culture" OR "safety behav*" OR "safety leadership" OR "high reliability" OR "safety performance" OR ("socio tech*" AND safety)	n= 448

Date of search	Database	Field	Search string	Articles
	WoS (step 2)	Title, summary och keywords	TS=(military OR "armed forces" OR navy OR army OR "Air force")) AND TS=("Safety climate" OR "Safety culture" OR "safety behav*" OR "safety leadership" OR "high reliability" OR "safety performance" OR ("socio tech*" AND safety)) and Article or Review Article or Editorial Material (Document Types) and Proceeding Paper (Exclude – Document Types) and Management or Psychology Applied or Engineering Industrial or Engineering Aerospace or Operations Research Management Science or Ergonomics or Health Care Sciences Services or Health Policy Services or Psychology Multidisciplinary or Psychology Clinical or Social Sciences Interdisciplinary or Multidisciplinary Sciences or Behavioral Sciences or Psychology or Social Work or Public Administration or Psychology Social (Web of Science Categories) and English (Languages) and USA or ENGLAND or NETHERLANDS or ISRAEL or ITALY or AUSTRALIA or SWEDEN or FRANCE or NORWAY or CANADA or IRELAND or TURKEY or BELGIUM or CZECH REPUBLIC or ESTONIA or SCOTLAND or SPAIN or SWITZERLAND (Countries/Regions)	n= 73
	PsycInfo (step 1)	Title, summary, keywords & full text.	TX ((military or "armed forces" or navy or army or "air force")) AND TX ("safety culture" or "safety climate" or "safety behav*" or "safety leadership" or "high reliability" or "safety performance") OR TX ("socio tech*" and safety)	n= 268
	PsycInfo (step 2)	Title, summary, keywords & full text.	TX ((military or "armed forces" or navy or army or "air force")) AND TX ("safety culture" or "safety climate" or "safety behav*" or "safety leadership" or "high reliability" or "safety performance") OR TX ("socio tech*" and safety) Limiters - Peer Reviewed Expanders - Apply equivalent subjects Narrow by Classification: - personality traits & processes Narrow by Classification: - group & interpersonal processes Narrow by Classification: - social processes & social issues Narrow by Classification: - professional education & training Narrow by Classification: - social psychology Narrow by Classification: - clinical psychological testing Narrow by Classification: - tests & testing Narrow by Classification: - organizational behavior Narrow by Classification: - management & management training Narrow by Classification: - organizational psychology & human resources Narrow by Classification: - human factors engineering Narrow by Classification: - working conditions & industrial safety Narrow by Classification: - military psychology Narrow by Language: - english Search modes - Boolean/Phrase	n= 98

c

5. Checklist for research quality assessment of qualitative papers

Checklist for assessing papers with qualitative methodology

Authors:

Year of publication:

Title:

Overall assessment of methodological shortcomings		
Insignificant or minor		Comments:
Moderate		
Major shortcomings		

1. Concurrence between philosophical approach/theory and selection and methodology in the study			
What theory or philosophical approach did the authors begin from?			
	Yes	No	Unclear
Are the purpose and research questions related to the theory/philosophical approach?			
Comments:			

2. Participants			
How was the selection made?			
	Yes	No	Unclear
Is the selection suitable for answering the question?			
Is the recruitment method suitable and appropriately implemented?			
Are there serious flaws that may affect reliability?			
Comments:			

3. Data collection			
What methods are used in data collection?			
	Yes	No	Unclear
Are there significant flaws in data collection that may affect reliability?			
Comments:			

4. Analysis			
What analytical methods are used?			
	Yes	No	Unclear
Is the chosen analytical method suitable and appropriately implemented?			
Were the researchers reflexive when interpreting the data?			
Was their interpretation validated?			
Comments:			

5. The researcher			
What are the researchers backgrounds and expertise?			
	Yes	No	Unclear
Do the researchers have any relationship with the study participants that may affect data collection?			
Have the researchers addressed their preconceptions in an acceptable manner?			
Were the researchers independent in terms of funding or other preconditions that might affect the analysis?			
Are there serious flaws that may affect reliability?			
Comments:			

6. Checklist for research quality assessment of quantitative papers

Checklist for assessing papers with quantitative methodology

Authors:

Year of publication:

Title:

Overall assessment of methodological shortcomings		
Insignificant or minor		Comments:
Moderate		
Major shortcomings		

Quality criterion	Evaluation on a scale of 1−5 + comments
To what extent is the relationship between independent and dependent variables theoretically reasonable?	
To what extent is the study population adequately defined, measured and described?	
To what extent is the statistical method suitable based on the research question and study design?	
To what extent is the relationship between independent and dependent variables empirically correct (time & space)?	
To what extent does the study adjust/check for other possible explanations?	
To what extent are the results correctly interpreted?	
To what extent is the validity of measurements of the studied phenomenon ensured? • Are the items related in each construct *(construct validity)*? • Are all relevant parts/constructs of the phenomenon measured *(content validity)*?	
ITo what degree can the results be generalised *(external validity)*?	

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